Status Survey and Conservation Action Plan

Bears

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IUCN/SSC Polar Bear Specialist Group

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Contents

Foreword

The bears are one of the most diverse groups of large mammals. Bears are well-known and have a positive image for much of the public. They occupy an extremely wide range of habitats including lowland tropical rain forest along the equator, both coniferous and deciduous forests, prairie grasslands, desert steppe, coastal rainforest, arctic tundra, and alpine talus slopes. They are opportunistic omnivores whose diet varies from plant foliage, roots, and fruits; insect adults, larvae, and eggs; animal matter from carrion; animal matter from predation; and fish. Their dentition and digestive system reflects this varied diet.

The eight bear species currently exist in more than 60 countries on four continents. Unfortunately, bear numbers and range are declining in most areas of their range. Some species have been reduced in numbers by 50% or more in the past 100 years. Many populations are fragmented and thus more vulnerable, and human activity continues to intrude into bear habitat. The time for conservation action is growing short for many species and it is likely that in the next 20 years, many isolated bear populations will go extinct forever.

Bears are a key indicator of ecosystem health wherever they are found. As such, bears can be a key focus for ecosystem conservation. Conservation of bears and the maintenance of the habitat they need to survive will conserve habitat and space needed for many other species. Conservation of bears also conserves resources needed by local communities such as watersheds, wildlife, and the local culture that in many cases includes bears in legends and stories.

Bears are declining in many areas due to a lack of awareness of their precarious status and limited knowledge about what can and must be done to conserve them. This is particularly acute in developing countries in Asia. Outside of bears in Japan and some parts of India and Nepal, and the giant panda in China, there is virtually nothing known about the bears in the wild in Asia. Asia is the place where the Asiatic black bear, sloth bear, sun bear, and some populations of brown bear face an uncertain future. Increasing fragmentation of populations combined with ongoing habitat loss and unregulated killing often for sale of parts threaten these Asian bears.

The purpose of this status report and conservation action plan is to highlight what we know and what we don't know about all the bears of the world. We have tried to make suggestions on how to successfully implement conservation programs for bears and their habitat. Hopefully this report can be a resource for governments, conservation organizations, land managers, and students to focus conservation efforts and to serve as a benchmark about the current status of bear conservation.

The production of this Action Plan began in the early 1990s. Inevitably, some of the information will have become dated by the time of publication. However, we consider it important not to delay publication by seeking updates at this stage. We would ask the readers to consider this publication as one step in the continuous process of action planning for bears, recognizing that new information is constantly becoming available. It is not meant to be an end to the story of bear conservation, but a beginning.

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Thanks are due to Dr. George Rabb who had the vision to support the production of this document and whose support started the whole project rolling. Whitney Tilt and Amos Eno of the National Fish and Wildlife Foundation were very supportive and made commitments that allowed us to complete this task. Alison Wilson and Elise Blackburn worked tirelessly editing and proof reading, and checking tables, figures, and citations. Mariano Giminez-Dixon at IUCN was a constant supporter of this project and helped in many ways. Thanks are also due to the International Association for Bear Research and Management, the professional organization of bear biologists, and its past president Dr. Sterling Miller for support and encouragement throughout this process.

Recognition and special thanks are due to the editorial efforts of Kristy Pelletier, Kana Moll, and Joe Moll who carried the burden of so many details in such a complex and long-term project. Their skill and dedication at organizing such a large amount of diverse information from so many people is sincerely appreciated and this project would not have been completed without them. They spent many hours at the computer reading manuscripts, checking details, and contacting authors.

Given the scope of this document, it is recognized that some errors exist, and I take full responsibility for them. In some cases, there was disagreement between authors or discrepancies in the text. Judgment was used to make decisions in these cases, and I accept responsibility for such decisions.

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Executive Summary

This status survey and conservation action plan describes the status and conservation needs of the eight bear species of the world. These species currently live in more than 65 countries/autonomous regions in four continents. They are a diverse group of large mammals living in a variety of habitats from tropical rainforests to arctic ice. Bears are the umbrella species in most of the ecosystems they inhabit. The conservation of bears and their habitats will preserve the most biodiversity in these areas and focus management efforts on preserving watershed resources that also sustain human populations.

Conservation efforts for bears in North America and Western Europe are much more intensive and coordinated than in Asia or Latin America where research and management are minimal or nonexistent. The exception to this in Asia is the intensive conservation of the giant panda in China. The greatest threats to bears exist in Asia, the Middle East, and parts of South America (Table 1).

All bear species have declined in numbers and distribution due to the impacts of human activities. Major activities that impact bears are habitat alteration and destruction resulting from forest conversion to agriculture, human settlement in bear habitat, and excessive forest harvest. Unregulated killing of bears for sport, sale of their parts in medicinal products, protection of crops or livestock, and fear of these powerful animals has led to their decline.

Asian bears face a particularly destructive combination of all these threats as well as a critical lack of knowledge about their status, distribution, and requirements for survival. Many bear populations in these areas will disappear before they are ever documented.

Bear populations at greatest risk include Asiatic black bear populations in Baluchistan, Taiwan, and many areas of Southeast Asia; many small isolated sloth bear populations throughout their range; sun bear populations throughout their range; brown bear populations in Mongolia, Tibet, France, Spain, and Italy; all giant panda populations; and the spectacled bear populations in Venezuela, Columbia, and the desert populations in Peru.

Priority actions for bear conservation include:

- Initiate surveys of status and distribution for Asian bears; particularly sun bears and Asiatic black bears in Southeast Asia and southwest Asia, and brown bears in the Middle East and southern Asia.
- Develop cooperative projects to work with select countries in the range of sun bears, Asiatic black bears, spectacled bears, and Asian brown bears to establish local managers with knowledge of and experience with bears and to develop management plans. This is particularly important in countries with unknown bear populations like Indonesia, Malaysia, Thailand, Laos, Vietnam, Myanmar, and Venezuela and in countries with significant bear populations where more effort is needed such as China, Far East Russia, Ecuador, Bolivia, and Peru.
- Enhance cross-border management efforts as many of the best remaining populations and habitats exist across international borders such as Peru-Bolivia-Ecuador, Columbia-Venezuela, Laos-Vietnam, and Greece-Bulgaria-Macedonia-Albania, and France-Spain.
- Support research projects to develop basic knowledge of habitat requirements, population status and survey methods, and mortality management to serve as the biological basis for management plans.
- Document the impacts of illegal trade in bears in Asian countries and select study areas to document these impacts on representative populations of Asiatic black bears in China and in places in Southeast Asia such as in Laos or Vietnam.

Table 1. Bear species at greatest risk.

Species	Distribution areas	Status	Threats	Conservaton efforts
Giant panda	China	Endangered	Small numbers; fragmented populations	Intensive
Asiatic black bear	Asia	Threatened to Endangered	Highly fragmented; virtually unknown in the wild; ongoing killing for parts trade	None
Sun bear	Southeast Asia	Threatened or Endangered but basically unknown	Highly fragmented; unknown in the wild; habitat conversion	None
Sloth bear	Indian subcontinent	Threatened	Highly fragmented; intensive human pressures	Few
Spectacled bear	South America	Threatened	Habitat loss; illegal hunting; lack of sustainable resource use by local people	Few

- Link bears to ecosystem health and human community prosperity in countries within the range of each species with projects that focus on the needs of bears, humans and their shared resources.
- Study the relationship of forest harvest to sun bear and spectacled bear food habits and habitat use in tropical forests where harvest pressure is high and where the impacts of harvest are unknown.
- Work with local wildlife managers to develop sound research programs, population survey techniques, and sustainable harvest plans in eastern European countries such as Romania and Bulgaria.

This action plan attempts to summarize a vast amount of information. It details much of what we know about bears, but the gaps clearly show what we do not know and where we need to place our conservation efforts in the future if we are to stop the decline of bear populations worldwide.

Summary of the Status of Bear Species by Distribution

Christopher Servheen

Summary of the status of bear species by distribution.

Species	IUCN Red List Category	CITES listing	Country	Population status	Species account (p.)
Giant panda ***Ailuropoda melanoleuca***	**EN(B1+2c,C2a)**	**Appendix I**			241
			China	Small, endangered	
Sun bear ***Helarctos malayanus***	**DD**	**Appendix I**			219
			Myanmar	Unknown	
			Thailand	Unknown	
			Laos	Unknown	223
			Vietnam	Unknown	216
			China	Unknown	
			Cambodia	Unknown	
			Malaysia	Widespread but unknown	
			Indonesia	Widespread but unknown	
Sloth bear ***Melursus ursinus***	**VU(A2cd,C1+2a)**	**Appendix I**			225
			India	Isolated populations, decreasing?	229
			Sri Lanka	Decreasing?	
			Nepal	Stable?	236
			Bhutan	Unknown	
			Bangladesh	Unknown, Extinct?	
Spectacled bear ***Tremarctos ornatus***	**VU(A2bc)**	**Appendix I**			157
			Columbia	Small, threatened	168
			Venezuela	Small, threatened	193
			Ecuador	Decreasing	179
			Perú	Decreasing	182
			Bolivia	Decreasing	164
American black bear ***Ursus americanus***	**LR(lc)**	**Appendix II**			144
			Canada	Stable	147
			United States	Stable to decreasing	151
			Mexico	Stable	155
Brown bear ***Ursus arctos***	**LR(lc)**	**Appendix II**			39–143
			Norway	Very small, threatened	86
			Sweden	Increasing	111
			Finland	Stable	63
			Estonia	Stable	
			Belarus	Unknown	
			Latvia	Very small, threatened	
			European Russia	Increasing?	136
			Romania	Large numbers, decreasing	93
			Ukraine	Decreasing	
			Slovakia	Increasing	96
			Poland	Stable	89
			Czech Republic	Very small, threatened	
			Bosnia and Hercegovina	Decreasing	113

Summary of the status of bear species by distribution ... continued.

Species	IUCN Red List Category	CITES listing	Country	Population Status	Species Account (p.)
Brown bear ... continued			Yugoslav Federation	Decreasing	118
			Croatia	Stable	115
			Slovenia	Stable	119
			Greece	Very small, threatened	72
			Macedonia	Very small, threatened	118
			Albania	Stable?	
			Austria	Very small, threatened	56
			Italy	Very small, threatened	81,84
			Bulgaria	Decreasing	59
			Spain	Very small, threatened	100
			France	Very small, endangered	67
			Turkey	Unknown	
			Georgia	Unknown	
			Azerbajhan	Unknown	
			Syria	Unknown	
			Iraq	Unknown	
			Iran	Small?	
			Turkmenistan	Unknown	
			Kazakhstan	Unknown	
			Uzbekistan	Unknown	
			Tajikistan	Unknown	
			Kyrgyzstan	Unknown	
			Afghanistan	Unknown	
			Pakistan	Very small, endangered	
			India	Small, threatened	125
		Appendix I	China	Fragmented, threatened	123
		Appendix I	Mongolia	Very small, endangered	131
			Central/eastern Russia	Stable to decreasing	136
			Japan	Stable?	128
			United States	Stable to increasing	40,40
			Canada	Stable?	46
Polar bear ***Ursus maritimus***	**LR(cd)**	**Appendix II**			255
			Canada	Stable	
			Norway	Stable	
			Greenland	Stable	
			Russia	Stable	
			United States	Stable	
Asiatic black bear ***Ursus thibetanus***	**VU(A1cd)**	**Appendix I**			199
			Far East Russia	Decreasing	211
			China	Decreasing to stable?	200
			Japan	Decreasing	207
			South Korea	Extinct?	
			North Korea	Unknown, extinct?	
			Taiwan	Very small, endangered	213
			Vietnam	Unknown	216
			Laos	Unknown	
			Cambodia	Unknown	
			Thailand	Unknown	
			Myanmar	Unknown	
			Malaysia	Unknown	
			Bangladesh	Unknown	
			India	Decreasing?	202
			Nepal	Unknown	
			Bhutan	Unknown	
	CR (B1+2abc,C2a)		Pakistan	Very small, endangered	
	CR (B1+2abc,C2a)		Iran	Very small, endangered	

Chapter 1

Introduction

Stephen Herrero

People are fascinated by bears. The giant panda (*Ailuropoda melanoleuca*) exemplifies this attraction. Known the world over as an image of China, the giant panda has been adopted as the animal symbol to represent the World Wide Fund for Nature (WWF). It is also a source of fascination and joy for the many millions of people who have made trips to the few zoos fortunate enough to display them. Yet despite the undisputed value of pandas, their wild populations are threatened with the possibility of extinction. The species exists in six separate mountain ranges in China, which together have 23 population fragments, and in total number only about 1,000 individuals (Schaller *et al.* 1985; Reid this volume). Giant pandas compete with increasing numbers of Chinese for the basic resource pandas need for survival – wild land and its production of bamboo. The panda's situation is a textbook study of fragmented populations and minimum viability – the same factors influencing the future of many other bear species worldwide.

There are eight species of bears in the world (Waits *et al.* this volume). Wherever they are found they occupy a special place in human culture. Throughout the world, people see bears as having human-like characteristics. Bears walk for short distances on their hind legs, planting their feet flat on the ground. When shot and skinned they look shockingly human-like. They have few young and look after them with focused care reminiscent of human mothers. Bears are curious, and extremely playful when young. Above all, bears are seen as having power. Power means physical strength, combined with spiritual influence. Numerous human cultures around the world symbolically or physically try to incorporate the power of bears into their people. This is done by worshipping bears, eating various parts of bears, wearing their claws or skins as ornaments, taming or displaying bears, photographing them, and even by doing research on them. Throughout temperate zones, the bear is a symbol of vitality and magic to aboriginal peoples because of its ability to apparently enter the earth each fall and be "buried" (hibernation), and to be reborn each spring after its winter internment. The bear image also has unique power to evoke love and warmth through the hundreds of thousands of teddy bears sold each year.

The nature of bears

Biologically, bears are large-bodied members of the mammalian order Carnivora, family Ursidae. They evolved from smaller, tree-climbing, predatory ancestors (Miacids) about 25 million years ago. Today, only the polar bear (*Ursus maritimus*) is primarily carnivorous and predatory. The polar bear is also the largest bodied of the modern bear species and the largest non-aquatic carnivore in the world. Adult males may weigh from about 350 to over 650kg. (Stirling 1988).

Most modern bears, including the brown or grizzly* bear (*U. arctos*), the American and Asiatic black bear (*U. americanus*, *U. thibetanus*), the sun (honey) bear (*Helarctos malayanus*), and the spectacled bear (*Tremarctos ornatus*), are dietary generalists, ingesting a variety of concentrated energy sources such as fruits, nuts, insects, fish, carrion, and mammals. Mammals such as moose (*Alces alces*) and caribou (*Rangifer tarandus*) are usually only killed when they are easy to catch, such as when crippled or newly born. Nutritious, and easy to digest green vegetation is also eaten, especially when more concentrated energy sources are unavailable. In temperate and arctic portions of the northern hemisphere, most bear species hibernate when food isn't readily available. Hibernation may last for up to seven months, without the bear eating, drinking, defecating, urinating, or significantly losing bone mass (Nelson 1973; Floyd and Nelson 1990). Birth and suckling may occur during hibernation.

Other bear species have more specialized diets. The predacious polar bear has been mentioned. The giant panda feeds almost exclusively on bamboo. This is available throughout the year, hence the giant panda doesn't hibernate. The sloth bear (*Melursus ursinus*) is a somewhat specialized feeder on insect aggregations, but it also eats fruits, honey, and green plants. It has lost the first pair of inner incisor teeth thus creating a channel through which it sucks insect aggregations.

Bears are found from the high arctic (polar bears) to lowland tropical forest (sun bears) (Figure 1.1). Today bears exist on all continents except Australia, Antarctica, and Africa. There are significantly more bears in the northern than in the southern hemisphere. The spectacled

* Brown bears are called grizzly bears throughout the lower 48 States of the USA and over most of Alaska. In this volume brown bears are referred to as such except in the chapter on the USA where they are referred to as grizzly bears.

Figure 1.1. General distribution of bear species throughout the world.

bear of South America is the only bear found predominantly in the southern hemisphere.

Individual polar or brown bears may range over thousands of square kilometres; brown bears occasionally concentrate in food rich areas such as salmon streams. At McNeil River Falls, Alaska, a world-famous site for viewing brown bears, over 120 bears may occasionally be found within about 3.2km of the Falls (Walker 1993). Most bear populations are much less dense and do not congregate to this extent. Bear populations usually require large areas of land to survive. They typically compete directly with people for resources such as space, food, security cover, and even life itself. Several bear species will also kill or injure livestock, raid beehives, damage agricultural or forestry crops, or otherwise directly compete with people.

Some bear species are occasionally dangerous to people (Herrero 1985). These include the brown bear and the polar bear. Other species, such as the American and Asiatic black bear, and the sloth bear will more rarely attack people. All other bear species have the strength to inflict serious injury to people, but they seldom do. The potential danger of bears to people has led to human emotions ranging from fear and hatred, to respect and admiration.

Bears are reproductively conservative. As mentioned, they have few young and the female looks after the young carefully. Because of low reproductive rates, bear populations recover slowly, if at all, from mortality rates that exceed recruitment.

Most bear populations outside of North America (and some there) are in serious decline. People with firearms can readily kill bears. The bulldozer and the chainsaw remove their habitat. But bear hunting can be managed to maintain biodiversity, some bear populations can be fully protected, and habitat both outside and inside reserves can be managed for bears, other wildlife, and people. The support of many people, locally, nationally, and internationally will be required to achieve the goal of bear and nature conservation.

Why conserve bears?

In the northern hemisphere, where most bears are found, humankind has, for many thousands of years, sought power and significance through bear worship and other types of relationships with bears (Hallowell 1926; Shepard and Sanders 1985; Rockwell 1991). For thousands of years bear hunters and the bear hunt itself were sacred. Wearing and owning a necklace of grizzly bear claws conferred power to a Blackfoot Indian family living on the plains of North America (Ewers 1958). The Cree Indians of Canada's boreal forest region killed and ate American black bears. The flesh was eaten communally, each bone was saved, and the collection of bones ceremonially returned to the earth (Rockwell 1991). The Ainu, the indigenous people of Hokkaido Island, Japan, had an elaborate ceremony in which they would capture and raise a brown bear cub for a year, suckling it to a human mother. Then the cub was ritually sacrificed and shared by the tribe (Shepard and Sanders 1985). Amongst indigenous peoples that hunted or kept bears for sacrifice, care was almost always taken to propitiate the spirit of the bear so that bear ancestors and spirits would not take revenge. The bear has long been a powerful figure in the spirit world of indigenous people.

This has also been true among Western European peoples. Some of their earliest tales of power and influence involve bears. Among Germanic peoples of northern Europe there was a particularly fierce class of warriors called berserks (ber=bear and serk=skin) (Rockwell 1991). Berserks are said to "have fought without armour, sometimes naked or wearing only a bearskin" (Rockwell 1991). The term is still with us today, berserk meaning "wild and out of control", fearsome traits for a warrior. The Beowulf legend is but one version of an archetypal story of a bear impregnating a woman who gives birth to a supernatural bear son (Rockwell 1991). Bears are now gone from much of their former range in the western world, yet their name lives on in cities such as Bern (bear), Switzerland, and a grizzly bear is displayed on the California state flag. Both in Switzerland and California, the bear species which is symbolically represented, the brown bear, no longer survives. Only its spirit lives.

Is symbolic representation of bears enough? We think not, but maintaining bear populations and the habitat they depend upon is difficult. Conservation ultimately depends upon how much people value bears and nature. In France only a handful of bears survive (Camarra this volume). Human activities so occupy France's landscape that there seems to be no room for bears. In other parts of western Europe, attempts are being made to reintroduce brown bears, but finding space for bears isn't easy. Where bears exist in small, remnant populations, as in Parco Nazionale d'Abruzzo, Italy (Zunino and Herrero 1972; Boscagli this volume) or in the Cantabrian Mountains in northern Spain (Clevenger and Purroy this volume), major conservation programs are the reason for bear survival.

In the Cabinet-Yaak ranges of northern Idaho, brown bears have diminished to the point that population augmentation is now being attempted (Servheen pers. comm.). In places such as these, and in many other places throughout the world, people are working to conserve bears because of the power of the bear, the deep roots that join humankind and bears. Bears are symbols of the strength of untamed nature. For anyone who values wilderness, the brown bear is a vital component of much of the last real wilderness left in the northern circumpolar regions of the world. Naturalists, hunters, photographers, people close to the land, and tourists can all potentially benefit from association with nature, through bears.

To protect and manage bear habitat requires social, political, economic, and biological stability. It also requires core reserves (protected areas) large enough to maintain viable bear populations. Development will occur in surrounding areas (buffer zones), but to maintain bear populations, development must be sustainable, not degrading the natural environment on which both humans and bears depend. The benefits of development must be reasonably equitable, at least to the point of socio-political stability.

The implications and value of bear conservation, and related sustainable development are far more extensive and desirable than might at first be imagined. Bear conservation inevitably helps to conserve healthy watersheds and natural ecosystems, and hence species diversity. For example, Peyton (this volume) estimates that by preserving spectacled bears in their varied range of habitation in South America (from high paramo alpine meadows to mid-elevation cloud forest) would also conserve 40% of all species present along this elevation gradient.

An example of how spectacled bear conservation can help to maintain natural ecosystems and biodiversity, and also contribute to sustainable development, is provided by La Planada Nature Reserve – Awa Indigenous Reserve. This 3,500km^2 protected area is home to spectacled bears, about 1,200 Awa Indians, and non-indigenous Colombians (Orejuela this volume). This reserve is located in one of the most biologically diverse areas on earth. Reserve managers are attempting to protect spectacled bear habitat, and to assist the Awa Indians and other inhabitants with sustainable development. As with all examples of bear conservation, this one is complexly interwoven with human affairs represented by several jurisdictions.

Bears can pay their way if given a chance. In the Arctic region of Canada, polar bear populations are managed for conservation and sustained yield hunting. Harvesting permits are based on population surveys. The permits go to indigenous peoples and they in turn often sell guided hunts. Economic benefits are considerable (Stirling 1988). In other places, bears attract tourists who will spend significantly to see, hear about, learn about, or even just stay for awhile in areas where bears are found. In some areas such as McNeil River Falls, Alaska, the Khutzeymateen and Kateen rivers of British Columbia, or Yellowstone National Park, Montana, tourists and photographers come from all over the world to experience brown bears. Such photographs appear in and help sell many books and calendars. Good interpreters can share the power of bears with visitors even if the bears in a given area are hard to see. In 1990, the Minnesota Museum of Science launched a major travelling exhibit on bears. It has been continuously exhibited in cities throughout North America, and is booked through the year 2000.

In North America, Europe, and Asia one value attributed to brown bears is that of highly prized trophy animal generating significant direct revenue. In North America, after a century of serious declines, many hunted brown bear populations are now managed for sustainability (Miller and Schoen this volume).

The scientific and medical values of bears are also considerable. Bears may hold the key to understanding several health problems that affect humans. Osteoporosis (bone loss) in humans occurs during periods of physical inactivity such as when bed ridden, or during space travel. Bears are the only known animals that can maintain bone mass during long periods of physical inactivity (Floyd and Nelson 1990), a physiological adaptation to hibernation. Brown bears, and American and Asiatic black bears may go for up to seven months without eating, drinking, urinating, or defecating. Understanding the mechanisms behind this extreme form of dormancy may help astronauts prepare for space travel, and has helped doctors treat patients with kidney disease.

In much of east Asia dried bear gallbladders (the bile salts) are widely used to treat a variety of human ailments, but especially for serious conditions such as liver cancer and cirrhosis of the liver (Mills 1995). There is tremendous value and demand in east Asia for bear bile. Mills (1995) surveyed doctors in S. Korea and found that they would pay US$1,000 to US$18,750 for a gall bladder guaranteed to be from a wild bear. This medical demand for wild bear bile places awesome pressure on wild bear populations in most areas of east Asia (Mills and Servheen 1991). It has repercussions worldwide for illegal trade and poaching, although the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) has proven to be reasonably effective in controlling illegal trade (Rose and Gaski 1995).

The medicinal value of bear bile has also led to wild bears being brought into captivity and "milked" for their bile by using permanently attached catheters. In China, as of 1992, 6–8,000 bears, mainly Asiatic black bears, were kept in "ranching" operations (Jizhen this volume). Mills (1995) reported that as of 1994, 10,000 or more bears were being kept on bile farms. There has been serious attempt by the Chinese government to prevent wild bears being brought into such operations, and to make the "farms" dependent upon captive breeding (Jizhen this volume). The unique active ingredient of bear bile, ursodeoxycholic acid, has been synthesized and is widely sold in countries such as S. Korea and Japan (Mills and Servheen 1991). However, most people who use dried bear bile believe the wild substance to be the most effective. The complex socio-medical issues associated with bear gall bladders must be understood as part of the basis for progressing on bear conservation programs in Asia.

In identifying the various values that bears have for people, we should not forget their basic existence value. Bears are unique creatures with whom we share the earth. For some people this is enough justification for bear conservation. However, to maintain bears we must also maintain the natural ecosystems that are their habitat.

These ecosystems also provide clean water, air, and genetic resources – the basic resources people need to survive. The affairs of bears and human survival may be more intertwined than most people believe.

Status Survey and Conservation Action Plan for Bears

Preparation of this Action Plan has been a considerable task. The plan has had to address the status and conservation of eight species of bears found in 62 countries. In each country we have attempted to involve various stakeholders who either have legal responsibility for managing bears, or who were willing to assume some responsibility for the future of bears and the habitat they need to survive. We, the editors of the action plan, are indebted to the many contributors who donated their time and expertise.

Most of this Action Plan is a series of species by species, country by country reports, essential for understanding the status and needs of bear conservation in various places. In preparing this large amount of information we asked the authors to follow a common format where possible. The reader can therefore expect, in order and when available, information regarding: historic range and current distribution of the bear species; the current status of bear populations in the country; the legal status of bears; threats to bear populations and habitat; management of bears; human-bear interactions; public education needs; and conservation action recommendations (possibly including costs of various proposals). Additional information on the status of various bear species throughout the world can be found in Servheen (1990).

This Action Plan reveals a litany of bear population declines and habitat destruction, in every case because of human activities. The patterns and outcomes are somewhat archetypal. When people move into an area they settle the most agriculturally productive lands first. Soon the most sensitive bear species are more or less excluded. Examples would be the exclusion of brown bears from the prime agricultural areas of Europe or California. Bears then either are extirpated, or relegated to more marginal quality lands, often mountainous areas. But human pressure continues even in these marginal lands. The outcome of this scenario is not predetermined, however. Bears may be extirpated, as was the case for grizzly bears in most of the contiguous United States, or they may survive. This action plan is a guidebook for co-existence between bears and people.

Throughout the world, three major factors drive the loss or decline of bear populations. The first major factor is human-induced mortality. There are few places in the world where bears now die other than by being killed by human beings. For example, Gunson (1995) reviewed 798 recorded brown bear mortalities in Alberta. Of these mortalities 795 were directly human-caused, most of these by legal hunting. Only three natural mortalities were recorded. Even grizzly bears that live in national parks in the contiguous United States seldom die from causes other than being shot (Mattson *et al.* 1995). The fundamental element for maintaining bears in any area is to control human-induced mortality (Mattson *et al.* in press).

The second major factor influencing bear populations is habitat loss. For example, in Norway, sheep and agriculture now occupy most of what was once brown bear habitat (Sorenson this volume). In the contiguous United States the grizzly bear only occupies 2% of its former habitat (Servheen pers. comm.), the rest has been developed so extensively for human uses that grizzly bears no longer survive. Of course habitat loss interacts with mortality, and if severe enough the outcome is bear extirpation. But landscape use can be planned with bears' habitat needs in mind. The Yellowstone Ecosystem wasn't planned this way originally; however, since 1975 when the grizzly bear was declared a threatened species in the contiguous United States, regional planning has been directed toward managing grizzly bear mortality and maintaining habitat (USFWS 1993). Since the early 1980s many of the new trails built in occupied brown bear habitat in Alberta and British Columbia have been designed to control habitat impacts and also to decrease chances of bear encounters with people (Herrero *et al.* 1986; McCrory *et al.* 1989).

The third factor influencing bear populations is habitat fragmentation. The range map for pandas, 1800–1993 (Reid this volume), is a classic example of habitat loss and fragmentation, and declining populations. The six panda sub-populations remaining are not currently connected to one another. No one knows the viability of these populations, although none appear to be large enough to meet current criteria for long-term viability (Waits *et al.* this volume). A parallel situation exists in the contiguous United States where, coincidentally there are also six, fragmented sub-populations of grizzly bears remaining (Servheen 1990). Landscape level planning needs to take in account potential bear habitat fragmentation and its implications regarding viable populations.

Consideration of the various papers in this volume suggests that bears will do best where a major piece of habitat is protected as a "core" reserve. Yellowstone and Glacier NPs serve this function for grizzly bears in the contiguous United States, as do the contiguous Rocky Mountain national parks in Canada (Banff, Kootenay, Jasper, and Yoho). But in each of these cases, and in most others, the size of the protected core does not appear to be large enough to maintain a long-term viable population of grizzly bears (Newmark 1985). Important grizzly bear habitat in surrounding areas needs to be identified, protected, and bear access needs to be provided for via travel corridors (linkage zones). These larger landscapes, including both protected cores and surrounding habitat, are necessary because of the large home ranges of grizzly bears and the large area needed to maintain viable populations. The protected area model developed by Noss and Cooperrider (1994) is a useful framework for designing reserves to protect bears and other large, mobile species, as well as the natural ecosystems upon which the species depend.

Because grizzly bears in the Yellowstone, and Canadian Rocky Mountain parks are so wide-ranging, they enter different management jurisdictions. Knight (pers. comm.) found that the average grizzly bear in the Yellowstone Ecosystem entered 4.2 different management jurisdictions in a year. These included national park lands, forest service lands, county owned lands, and others. In each of these jurisdictions conditions have to be favorable for grizzly bears if they are to survive. The Interagency Grizzly Bear Management Team evolved to serve the need of coordinating management across the various jurisdictions. (USFWS 1993). In the regions surrounding the Rocky Mountain Parks of Canada a similar but less formal Interagency-Multi stakeholder Grizzly Bear Steering Committee has evolved (Herrero 1995). However they are structured, such groups representing the interests of various human groups, as well as the interests of bears, will be essential elements for bears to survive in developing landscapes. Other useful planning tools in this regard are the concepts of ecosystem management (Grumbine 1994), cumulative environmental impact assessment (Weaver *et al.* 1986; USDAFS 1990), and adaptive management (Walters 1986).

However difficult it may be to manage bear mortality, habitat loss and fragmentation, and interagency differences, it is far less difficult than attempting to reintroduce bear species into areas that have become dominated by human affairs. The slow progress in implementing proposed brown bear reintroductions in western Europe, or grizzly bear reintroduction into unoccupied habitat in the contiguous United States, are clear examples of this principle.

In addition to country/species reports, this Action Plan contains three general sections. The section on bear molecular genetics contributes a clear view regarding why we consider there to be eight species of bears (Waits *et al.* this volume). This section also highlights the fact that many of the existing sub-species of bears, based on morphometrics, may not be valid taxonomic units. Bear molecular genetics has also been used to develop a bear population estimation technique based on DNA analysis of hair samples collected from unmarked individuals (Woods *et al.* 1996). Also discussed in the molecular genetics section are new forensic techniques based on samples of hair or blood that allow for identification of species, geographic origin, sex, and individuals. These techniques should prove invaluable in cases involving poaching.

Servheen (this volume) addresses the population and habitat research needs for bear conservation. Servheen argues that scientific data should be an important element for making management decisions related to bears. He recognizes that money will usually not be available for radio-collaring and long-term studies using marked individual bears. He points out the value of monitoring the minimum number of reproductive females and their distribution, and the need to monitor mortality for this and other age/sex classes. Servheen also emphasizes the value of integrated mapping of vegetation, bear distribution, human uses of the management area, and various habitat parameters such as quality, use, loss, fragmentation and alienation. This mapping approach, especially if developed in a Geographic Information System (GIS), allows for visual representation of bear management variables at various scales. Such maps can be used to communicate essential information about bears to a broad public. There is no simple formula for implementing any section of this action plan; however, respect for and working with local peoples, bottom up and top down planning combined, interagency-multi stakeholder processes, education, and supportive human values are all key dimensions. Plans are easier to make than to implement.

The third general section addresses the question of trade in bears and bear parts. While trade in live bears does not appear to be a serious issue, the demand for bear parts for traditional East Asian medicine is impacting many bear populations, not only of those species that inhabit the countries where bear parts are in demand but further afield in the Russian Far East and elsewhere.

We, the various members of the IUCN/SSC Bear Specialist Group and the IUCN/SSC Polar Bear Specialist Group have prepared this Action Plan out of our concern for bears and the natural environments that support both them and us. We hope that you, our readers, not only share our concerns, but will also find new inspiration and ideas that will lead toward long-term co-existence of bears, people, and nature.

Personal communications

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Chapter 2

An Overview of Bear Conservation Planning and Implementation

Bernard Peyton, Christopher Servheen, and Stephen Herrero

Introduction

One of the most significant threats to successful conservation planning is lack of an organized approach. Poor organization and the inability to implement conservation in a timely fashion is as great a threat to bears as human actions that fragment and destroy bear populations and their habitat. In this chapter we provide procedures for designing and implementing conservation plans to benefit bears and people. These procedures are intended to empower natural resource managers to act, particularly in the developing parts of the world where knowledge about bears and resources to implement conservation action are most needed. Lack of knowledge contributes to uncertainty about the correct action to take, and lack of capital and trained human resources increases probability of inefficient actions. Below we present ways to organize conservation programs, improve the use of existing resources, and comment on management strategies that need more attention.

The process of planning and implementation is a social activity that relies on organizational expertise and political support as well as the scientific facts about bears. Our outline for effective conservation programs for bears is: 1) identifying threats and other issues affecting each bear population of interest; 2) prioritizing these threats/issues; 3) developing methods and criteria to select projects and institutions that address threats/issues; 4) assigning responsibilities to individuals and organizations best suited to implement actions; 5) establishing a time frame for implementation; 6) allocating human and capital resources efficiently; and 7) modifying actions to have expected progress in established time frames according to the recommendations of monitoring and evaluation. Political support is vital for each of these 7 steps, which we discuss below.

Planning and implementation of successful conservation action is fundamentally a problem-solving art requiring political support. Biological information, which is assumed to be objective, is a major influence on the development of the action planning process, but is not the sole determinant of whether individuals or groups will support policies to conserve bear populations. Those decisions are based upon cultural beliefs, values, economics, threats (either real or perceived as a result of the action), and political considerations (Mattson *et al.* 1996 and references therein). This is especially true in, but not restricted to, rural areas where public understanding of scientific concepts and methods of inquiry is limited. In such areas, the growing demands of people for the same resources bears need to survive (e.g., space, water, food, shelter, and travel corridors) forces wildlife managers to simultaneously consider the needs of both people and bears. Managers strike a balance between these conflicting demands, and at the same time have a feeling about what can prevent that balance from being attained. This problem is becoming increasingly difficult to solve in favor of preserving bear populations. The smaller and more insular bear populations become, the more the ecological needs of bears dictate the decisions managers must make if bear populations are to persist.

In this chapter we treat both the narrow scientific and broader holistic aspects of problem solving. The strength of one aspect is the weakness of the other. Whereas the scientific approach yields technical definitions and fixes to problems, the holistic perspective comprehends and anticipates what can prevent technical fixes from being successful. Michael Thompson and Michael Warburton (1992) summed up this redundancy as follows:

"To understand just the fixes is to risk some nasty surprises once you start implementing them: to understand just the obstacles is to risk never getting to the point of implementing anything. The challenge, therefore is not to choose one or the other but to usefully combine these two modes of understanding."

Although our focus is bears and the people who live with them, the principles we mention are applicable to the implementation of plans in any field. Our remarks are addressed primarily to government resource managers, but not limited to them. We leave it to our readers to select the parts of this chapter that pertain to their situations.

Planning

Planning is the process of determining the recipient(s) and sequence of events to implement actions. This process is guided by the mission of an organization that does a thorough inventory of what is known about a problem and its own capacity to address it (Figure 2.1, Table 2.1).

Table 2.1. Knowledge and associated steps that are taken to plan and implement programs that benefit bears (after Servheen 1997, Little 1994).

Knowledge Category	Purpose
BIOLOGICAL/ENVIRONMENTAL	
Bears: (Table 2.2) **Humans:** population growth and distribution, activities (e.g., road building, settlements, crops, grazing, timber harvest, mining, hunting, etc.), effects on bears (mortalities, changes in behavior, etc.), and bear use of habitat (access, habitat fragmentation and loss, etc.). **Ecological/environmental matrix:** local scale (fire, rainfall, temperature, soil erosion, plant phenology, pests, etc.), global scale (pollution, El Niño effect, global warming, etc.).	Identify threats to bears, prioritize threats, and determine location of the most vulnerable point for each threat. Determine what is necessary to address each threat and the criteria on which to judge success Monitor management action.
SOCIO-POLITICAL INSTITUTIONS	
Power and authority over resource use: ability to enforce policies and regulate resource use, ability to encourage cooperation with other groups, public attitudes towards institutions with authority. **Internal capacity:** structure (vertical and horizontal, compatibility with program tasks, etc.), knowledge and ability to incorporate learning, commitment to policies, etc.	Determine who will be responsible for implementing project tasks. Set timetable to address each threat based on institutional capacity.
LEGAL/ECONOMIC	
Basis for sustained resource use: land and resource ownership patterns, usufruct rights, etc. **Access to capital and education/training**, **Labor availability and employment** (formal and informal), **Market issues:** including those that influence the trade in bear parts, perceptions of threats to livelihood, etc.	Understand incentives needed to create stewardship for bears and compensate losses from desired changes in human activity. Set timetable: based on external factors.
VALUATIONAL	
Cultural and spiritual beliefs, **Public attitudes** towards bears and other elements of the natural world, **Understanding of concepts**: conservation, biodiversity, sustained resource use, etc.	Build programs on existing beliefs, and thus strengthen acceptance of project goals.

This management information is then converted to goals, objectives, and specific strategies to address problems. The primary objective of planning is to maximize the efficient allocation of scarce resources to their highest priority needs. Inadequate planning is a primary cause for failures to achieve conservation objectives. Planning consists of three steps when used to conserve bear populations: identifying threats (part of management information), prioritizing threats (goals), and determining what is needed to address each threat (objectives and specific strategies) (Servheen 1997).

Identifying threats

The initial aspect of planning bear projects is to clearly define threats to bear populations. How threats are defined and understood affects every subsequent event in plan implementation. We suggest categorizing threats by type. Most bear populations are threatened by human-caused mortality, habitat fragmentation, habitat loss, and lack of public or political support (Servheen 1997). Planners should then detail the kind and amount of information needed to precipitate, justify, and rationalize actions that address threats (Mattson, D., U.S.G.S. Forest and Rangeland Ecosystem Science Center, Moscow, Idaho, pers. comm. November 1997).

Threats should be defined comprehensively, not just with biological or technical terms (Schön 1983). To do so planners must have information about people who cause bear mortalities and compete with bears for resources. This requires identifying key participants, clarifying perspectives, describing their relations and strategies, and identifying outcomes that are relevant to them (Mattson, D., U.S.G.S. Forest and Rangeland Ecosystem Science Center, Moscow, Idaho, pers. comm. November 1997). The way people behave is strongly influenced by how they perceive the costs and benefits associated with protecting bears and bear habitat. Therefore threat definitions should include the socio-political, legal and economic, and valuational forces that modify human behavior (Table 2.1). Specialists in these areas and opinion surveyors may be needed to reveal what the public thinks about issues and how they might react to a management decision. At a minimum planners should understand how land and other resources are owned and/or leased, what legitimizes the power of authorities over their constituents, and the decision-making processes that govern resource use (Servheen 1997). Inclusion of the non-biological information in the definition of threats enables planners to draft steps needed to achieve the desired future state of a bear population and/or decide whether the threat is worth solving. The extent people both inside and outside the planning organization share the same definition of threats to bears greatly affects the success of plan implementation (Clark *et al.* 1996).

Management information should be as accurate as possible given constraints of time, relevance, and cost. Information that is too late to be useful can have as much negative affect on management as biased information. Planners should develop strategies for identifying bias and managing uncertainties and risk associated with information. Rapidly conducted surveys are cost effective but often provide biased results. This is particularly true in remote communities where residents are reluctant to reveal information such as their hunting practices until sufficient trust has been established. Rapid surveys rarely reveal sufficient data on local knowledge, land tenure, seasonal patterns of resource use and labor, the degree authorities can enforce regulations, political conflicts, and the history of these conflicts and uses over time. These issues influence how rural residents act towards bears.

Finally, a longer-term investigation is often necessary to phrase survey questions correctly. For example, one of us (Peyton unpubl. data) spent several months in the Peruvian coastal desert looking for what locals described as an "ant-eating bear. Had Peyton realized that local residents use the word "bear" to describe both spectacled bears (*Tremarctos ornatus*) and northern tamanduas (*Tamandua mexicana*), he might have asked his guides if this ant-eating bear had a long tongue!

Prioritizing threats

The ability to prioritize threats leads to efficient use of resources and emphasis on actions that are immediately required to preserve bear populations. Not doing so is most devastating to small bear populations where time to correct a problem is short. Project planners/managers need to develop strategies for ranking threats and their organization's ability to address them in a timely manner. They also need legal and social norms that provide them with the authority to make decisions that enhance bear conservation (Servheen 1997). The results of that authority can include conserving resources for long-term human benefits (e.g. road closure to protect critical habitat, reduced timber sales) and promoting changes in government organizational structure to improve its ability to address threats.

In developing parts of the world (notably in the tropics), lack of basic information about bear ecology inhibits managers' abilities to prioritize threats or choose among alternative strategies to correct them. This is somewhat offset by a limited number of stakeholders that need to be coordinated under the centralized governments of developing nations. Wildlife managers in developed countries generally have the opposite problem: more management information, but a large number of stakeholders and many structures of authority that require coordination. Managers faced with either prospect may be reluctant to take aggressive action against threats. Some specialists act with deficient information because they know bear populations will continue to decline if they do nothing. Others need a prescribed set of actions that address the critical issues of most bear populations before they start. We suggest the right way to proceed is somewhere between these two positions and explain our reasoning in the next section.

Determining what is needed to address threats

Rational/scientific approach

Once threats have been prioritized, planners must determine what needs to be done to reduce or eliminate them. A rational/scientific approach is to determine a desired future condition for the factors that were found to threaten a bear population's survival (Servheen 1997). These become goals for specific programs. Goals for most of the world's bear populations are to minimize human caused mortalities of bears, maintain habitat, maintain linkages between habitats and populations, and increase public knowledge and support for bear conservation (Servheen 1997). After considering bear and human needs and their simultaneous impacts on each other, planners will often draft several programs, one or more of which will be selected to address the priority threats. These programs identify the recipient of the action (e.g., bear population, human group, locations, etc.), what is to be done (objectives / specific strategies), and the criteria to be used to measure the project's success. The agency/group then chooses projects among these alternatives taking into consideration its own capacity to implement them, and the threats and opportunities that are present outside the agency.

Holistic/artistic approach

The rational/scientific planning approach often does not work because it assumes managers can control enough of the internal and external environment projects operate in. Lack of administrative support, poor organizational structure, and resistance to learning are common internal ills that impede project implementation. Internal problems magnify the effects of external problems that even the most intuitive planners find hard to make contingencies for (e.g., political turmoil, natural disasters, staple resource shortages, and insufficient scientific evidence to counter unforseen opposition to project goals). In its place managers must have faith and latitude to make creative adjustments to project implementation given the problems they encounter. They must receive timely feedback on the performance of the project and its participants, and modify both as needed. There is always the chance that people will start projects that events outside their control will subjugate. However, Albert Hirschman (1967) says it is also likely people avoid starting projects that would succeed given the creative solutions that would bloom under a crisis. Both errors in judgement stem from inadequate information. Therefore planners should be preoccupied with a much broader definition of problems, and how organizations gain knowledge and learn from errors (Bryant and White 1982). We call this a holistic/artistic approach. The rest of this section details the kinds of knowledge and learning that can reduce the impact of irrational events or create new opportunities for bear projects to succeed.

Actions for bears

In much of the world so little is known about bears that the highest priorities are to gather basic information on them (Table 2.2 and Servheen 1990, page 27). Several facts are worth noting. First, population demographics and trend data are not necessary to implement conservation measures. Although managers want to know this information, these data are expensive to obtain, sometimes requiring over 5 years of tracking radio-marked bears. Immediate management needs can be met with research that is less expensive and less intrusive on bears (Table 2.2). For example among the highest priorities is knowing the distribution of animals, particularly adult females.

Of the demographic data, survivorship (particularly of female bears) generally has more influence on bear population growth than fecundity, and human-caused mortality always limits growth. Mortality can be reduced by changing the frequency and lethality of encounters between bears and humans. Frequencies of encounters is

Table 2.2. Knowledge about bear populations and their biology used by an agency/group to plan, implement, and monitor programs that benefit bears (after Servheen 1994).

Research/Monitoring item	Importance[1]	Duration	Extent[2]	Cost/Impact[3]	Capture[4]
Distribution (population)	High	Annual, long-term	Entire Area	Low/Low	No
Distribution (females with cubs)	High	Annual	Entire Area	Moderate/Low	No
Mortality source, location, and causes	High	Annual	Entire Area	Low/Low	No
Human–bear conflicts	High	Annual	Entire Area	Low/Low	No
Habitat use (from sign)	High	1–3 years	Study Area	Low/Low	No
Habitat fragmentation	High	Annual	All	Moderate/Low	No
Population size and genetic viability	Moderate – High	2 or more years	Study Area	High/Low	No
Genetic relatedness	Low	1–2 years	Stratified sampling	High/Low	No
Food habits (from scats)	Moderate	Annual	Entire Area, Study Area	Moderate/Low	No
Food abundance	Moderate	Annual	Stratified sampling	Moderate/Low	No
Litter size	Low	Annual	Entire Area	Moderate/Low	No
Reproductive interval and age of first reproduction	Moderate – High	3–5 years	Study Area	High/High	Yes
Seasonal habitat use (marked animals)	High	3–5 years	Study Area	High/High	Yes
Home range size and movement patterns	Low	3–5 years	Study Area	High/High	Yes

[1] Importance is the significance of information to the immediate conservation of the population.
[2] Extent of the area in which research/monitoring should take place.
[3] Cost is the financial and human resources required to collect information. Impact is the effect on the bear population from collecting this information.
[4] Capture and radiotracking of bears necessary to obtain information.

a function of how many humans are in bear habitat, their access to it, and reasons for being there. Lethality of encounters is affected by whether humans are armed, the economic value of bears (e.g., negative value for being an agricultural pest, positive value for meat and bear parts), and other cultural factors (Mattson *et al.* 1996).

Population numbers may never be accurately known, but the assumed trend in a population can be inferred by a suite of factors including changes in the spatial distribution of animals, the degree animals occupy all high quality habitat, changes in the abundance of bear sign (including sightings) and bear parts in markets, and the frequency and locations of mortalities and agricultural depredation. Scientific techniques also exist to estimate population trend by calculating the intrinsic growth rate (λ: Hovey and McLellan in press). The technique requires extensive survivorship and reproductive data from radio marked bears.

Managers should also obtain information on the ability of the habitat to provide for the needs of bears such as the size and shape of habitat blocks, presence of corridors that link them together, the distribution and phenology (seasonality) of bear foods, the availability of denning and security cover, and the human activities that impact these features. The latter could be measured in terms of road access, distribution and density of humans, and the extent of deforestation for crops and grazing.

In a perfect world all these factors are known to wildlife managers who are thus able to identify appropriate corrective action against threats and justify their immediate implementation. When resources permit, managers can produce maps that combine human and bear activities on the same images with habitat information. These images reveal sites where the cumulative impacts of humans on bears will most likely have significant negative effects on bear populations. When prescribing solutions for these sites it is important to:

1. Be pro-active rather than reactive when deciding what to do. An example of the latter approach was the Arizona Fish and Game's decision to study its black bears (*U. americanus*) before they became hunted as a game species (LeCount, A.L., Arizona Fish and Game biologist, Phoenix, pers. comm., June 1980).
2. Be conservative when setting harvest limits or protecting bears and their habitat. This approach is mandated by the limited reproductive potential of bears and the uncertainty and imprecision of the methods managers use to assess their objectives (Miller 1990).
3. Increase the reliability of existing information by using repeatable methods that include measures of precision. Assumptions and the basis for them should be clearly stated. Every piece of information that is to be entered into a database should be cross-referenced with its source and with a level of confidence in its reliability. These steps improve the legitimacy of results.

But the world is far from perfect. Many land and wildlife managers identify sites or activities leading to habitat and bear population fragmentation without sophisticated tools. This is particularly true for tropical bear species where difficult access alone prevents gathering field information. Although much of the good information we have on bears has come from long-term research programs that involved capture and telemetry procedures, few natural resource agencies in developing countries can initiate similar efforts. However, they can do good science and conservation work. The following ideas can guide project planners/managers to make the best of incomplete knowledge about bears and human activities.

1. It is not essential to know a lot about a specific bear population to do something for it. Many of the most needed programs address non-biological issues that are the basis for the dominant threats to bears. These are the legal, social, political, and cultural pressures that determine human values and their behavior. Subtle changes in this behavioral landscape may be all that is required to reduce illegal kills, limit human activity in bear habitat, and increase stewardship for bears while long-term solutions are sought. The important thing is to act immediately, but cautiously. Information and ability to monitor bear populations can catch up to management needs as projects develop.
2. Do what is possible. Most wildlife agencies in the world do not have the resources to sustain a lengthy radio tracking effort, but do obtain data that can be used to infer trends. In areas where knowledge, access, budgets, and technology are in short supply, information for interim management needs can be obtained from yearly harvest data (Carlock *et al.* 1983), questionnaires (Bjärvall 1980; Furubayashi *et al.* 1980), interviews (Herrera *et al.* 1994) and/or examination of evidence of bear and human presence along trails or transects (Herrero *et al.* 1986; Peyton 1987).
3. Identify aspects of bear ecology that are likely to be shared species-wide and/or worldwide to help overcome the uncertainty that prevents actions from being initiated (Mace, R., Montana Fish, Wildlife, and Parks, Kalispell, Montana, pers. comm. September 1997). Management of bears worldwide is severely compromised by uncertainty over population size, hunting pressure, rates of exploitation of populations and habitat, habitat requirements, and distribution of bears in areas of low density (Hugie 1980).
4. Use all the data that is known about bears, habitat, threats, etc., and do not duplicate efforts (Horejsi, B.L., Wildlife Scientist, Speak up for Wildlife Foundation, Calgary, Alberta, pers. comm. October 1997).
5. Have conservative management if information on bears and human-caused threats to their survival is severely lacking. This same precautionary principle applies to managing small and insular bear populations.

6. Match objectives with the physical landscape. For example, setting targets for population monitoring based on annual counts of unduplicated females with cubs, their distribution, and mortality may be desirable for management (Knight *et al.* 1995; Strickland 1990), but it is not feasible in much of the tropics because of poor access and limited visibility (see Box 2.1 on monitoring).

Actions for people

Some of the most important conservation actions that benefit bear species focus on human groups. Planners should make sure government ministries and departments are informed about natural resource policies that affect bears, and to the extent possible, have the same expectations from those policies. The same should be done at the community level. Compliance with policies is a function of how much community members perceive conservation action to be in their self-interest. However, rural inhabitants do not view the following actions to reduce threats to bears to be in their self-interest: road closures, limits on development and the harvest of forest resources, village resettlement programs, restrictive hunting regulations, and increased law enforcement. Planners should consider the following strategies to make these actions work at the community level:

1. Provide communities with benefits (e.g., public education, rural development, agricultural extension, compensation for agricultural losses due to bears) in return for favorable treatment of bears and their habitat. The intended outcome of action should be the preservation of large areas for bears that simultaneously provide a sustained and long-term benefit to local people (Beecham, J., Idaho Fish and Game Dept., Boise, Idaho, pers. comm. September 1997).
2. Include flexibility in how goals and objectives are achieved. Agencies that facilitate and support rather than direct are generally more successful in forming community-based groups that preserve forest resources (Sarin 1996).
3. Actions must be realistic. Rural inhabitants in eastern Europe and North America may respond according to management goals when presented with compensation for agricultural losses due to bears, increased penalties for poaching bears, and public education programs. However these programs alone will not prevent the conversion of bear habitat to agricultural uses by people who have no other means to make a living. Therefore, planning information must include how people perceive benefits and costs, their systems of distributing them, and how they assess risk (Bryant and White 1982).
4. Match specific tasks with existing human capacity (Honadle and Vansant 1985). For example, if a project goal is to employ farmers to compensate them for lost income from cutting timber in bear habitat, it makes little sense to promote a highly technical bear project that cannot capture local labor unless training is provided.
5. Have goals that reflect what to do if your project is a success. Increasing bear populations can significantly add to problems of bear encounters with livestock, agriculture, and people. These prospects should be anticipated by planning measures to address them.
6. Include the beneficiaries of a project in the planning and operative processes from the start and give them a shared responsibility of managing the project's goods and services (Honadle and Vansant 1985; Peyton 1994). When local people are not given a meaningful role from the beginning they do not view top-driven resource management to be in their best interest (Wray and Alvarado 1996). Relevant activities at the planning stage are devising data collecting methods and ways to share project financing, determining the distribution of costs and benefits, and helping to select project alternatives (Donovan 1994). When determining these roles, be careful that scientific knowledge and methods are not compromised (Horejsi, B.L., Wildlife Scientist, Speak up for Wildlife Foundation, Calgary, Alberta, pers. comm. October 1997).
7. Preserve roles for women. Although community leadership roles are usually reserved for men, women are often the primary users of forest resources (Poffenberger 1994) and thus should participate in all phases of project development (Brown and Wycoff-Baird 1992). Ways to do this are to first research women's needs and roles, provide extension information to them, and involve them in decision-making capacities (Molnar 1992). By broadening the base of participation Friedmann (1973) says:

   "Planning is not merely concerned with the efficient instrumentation of objectives, it is also a process by which society may discover its future."
8. When defining problems and terms, planners should expect that they will not have the same meaning in the local culture. Plan to spend the time necessary for all parties to understand each other's meanings and respect the positions the terms represent.

Determining criteria

Criteria are objective statements used by planners to choose projects among alternative actions, and by managers and outside reviewers to evaluate project success. Criteria should include cost, benefit, effectiveness, uncertainty, reliability, risk, equity, and timing. By defining these criteria before projects are implemented, planners can correct potential problems before they occur.

Planners also need criteria to locate project goals in appropriate structures. Examples of these criteria include compatibility with the agency mission, organizational structure and culture, authority, leadership, incentives, access to information and power, communication mechanisms (including feedback and learning), expertise, resources (capital, human, time, technology, knowledge, infrastructure, physical assets, etc.), administrative ease, legality, and political viability. If the agency/group that initiated a project is perceived by the public to have authority, has adequate resources, and its internal organization is matched to tasks it will perform, then it is suited to implement the project. If not, planners should advise management about the deficiencies. The latter will decide whether an agency/group should change what is not adequate, collaborate with other organizations, or not perform tasks. Proceeding without this review of internal capacity is unwise. Poorly located structures can severely limit the flow of information, and the allocation of tasks and funds (Clark and Harvey 1991).

Criteria used by evaluators to measure success and performance of both bear populations and project personnel should also be considered during the planning stage. Among the potential problems of not doing so is limiting the judgement of success to biological factors and ignoring important social and economic information and values held by outsiders (Groves 1994). For example, the increase in the level of public awareness about bears can be a more important product of a project than the research results that generated that awareness. One measure for success may be the amount of time to delay the impacts of a threat that can be used to search for better alternatives (Western 1994). People are more likely to be satisfied that something was accomplished under broader criteria of success, and with the understanding that implementing policies and programs is exceedingly difficult under the best of circumstances (Pressman and Wildavsky 1984).

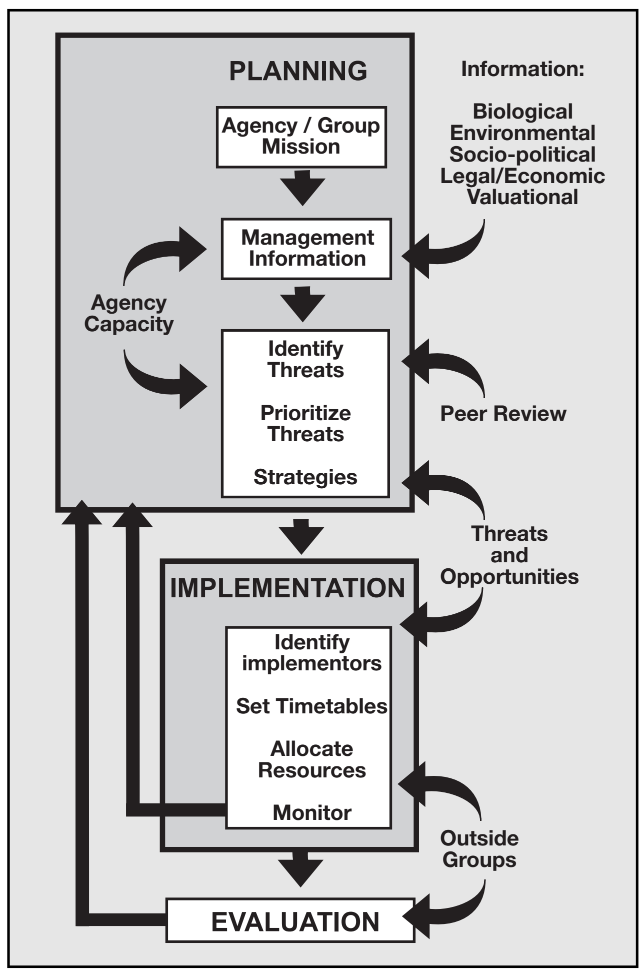
Peer review

The final word about planning is to get adequate peer review throughout the process to ensure that poorly designed plans are not authorized or implemented. This is especially important when planning invasive techniques on depleted bear populations for which acceptable risks of damage from project actions are very small to nonexistent (Miller 1990). Peers also can enlighten planners about public opposition to project goals (threats) and opportunities for collaboration and acceptance of goals. Some amount of public review during the planning stage may be mandated by law. Managers make difficult decisions about how much of the public and private sector to inform, what information to give them, and when. These reviews can consume valuable resources and result in project(s) being disrupted or canceled. Alternatively, the more ownership the public feels in the process of planning and implementing projects, the more likely they are to accept its outcome. Specialists inside and outside an organization can help managers make these decisions.

Implementation

Implementation is a process of developing and managing the achievement of sequential objectives (Honadle and Vansant 1985). It is the ability to initiate actions for objectives that move the focus of actions from their initial condition to their desired future status (Pressman and Wildavsky 1984). There are 4 basic steps involved in the process: choosing the agency/group and individuals to be responsible for executing project tasks; setting a time frame for project action; allocating resources; and monitoring progress and evaluating project outcome (Figure 2.1). We will discuss each of these components in turn.

Figure 2.1. **Planning and plan implementation procedures undertaken by an agency/group (dark gray shaded) and outside evaluators/peer groups to manage bear populations. Arrows indicate flow of information.**



Choosing project implementors

After a careful analysis of an organization's internal and external environment, which includes the recommendations of planners, project staff must decide which group(s) are the most appropriate to undertake project tasks. An optimal organization would have a clear mandate and autonomy, an ability to coordinate with all the entities involved in a project, the ability to deliver the project resources to human and bear populations. Below and in Table 2.3 we discuss the merits and problems of lodging project tasks with three of the commonly involved social groups: government agencies, communities, and non-government organizations (NGOs). Following that we discuss qualities individuals should have to be involved with projects. Project implementors are rarely chosen

Table 2.3. Characteristics of three social groups, their possible effect on planning and implementation, and how to counter negative effects.

Characteristics of social group	Possible effect on planning/ implementation procedures	Solutions to negative effects
Government Natural Resource Agencies		
1. Centralized decision making capacity. 2. Concentration of financial and trained human resources in the central office. 3. Subservience to the interests of more powerful ministries. Natural resource agencies are politically weak and understaffed compared to the ministries in charge of resource extraction, particularly in developing nations (Brandon 1996).	1. Increased ability to control implementation and prevent powerful local interests from co-opting project benefits, but can lead to tight control of information flow, unresponsiveness to change, and lack of incentives for managers at lower levels. 2. Capable of operating with "economies of scale" to replicate successful programs. More commitment to conservation goals than local government agencies but weak ability to enforce policies. Rural areas lack financial and skilled human resources where greatest needs exist. 3. Policies are ignored by other ministries leading to conflicting land uses.	1. Maintain decision-making which requires conceptual understanding and decentralize management which requires technical and people manipulating skills. Increase efforts to keep parties informed. Monitor and evaluate project performance often and incorporate this information in management practices. Provide incentives to lower level managers in return for their competence. 2. Form partnerships with other social groups who can provide resources (NGOs, international aid organizations, universities, etc.). 3. Coordinate policies between ministries.
Communities		
1. Weak institutions of authority. 2. Repositories of local knowledge on wildlife (including bears) and local systems of power. 3. Lack technical and managerial skills.	1. Inability to control resource use of community members and outsiders, and inability to represent needs to regional, national, and international groups. 2. Can provide project planners with information that otherwise would be costly to get. 3. Have limited ability to provide skilled labor, articulate views effectively with external institutions, keep records, and administer finances; all of which impedes community participation and project implementation.	1. Avoid giving management responsibilities to weak community institutions without substantial long-term efforts to improve it. Where local authority is strong, project implementors may only need to provide technical assistance and empowerment. 2. Consult community members during the planning process and employ them to monitor or evaluate the impact of project activities. 3. Provide technical and administrative training and/or design projects that use existing capacity of community members.
Private Non-Government Organizations and profit groups (lending institutions, industry, etc.)		
1. Issue focused, and non permanent. 2. Flexible organizational structure. 3. Source of resources (local information, funds, skilled labor, etc.) and administrative capabilities, but also can be influenced by donor's values and responsive to economic opportunity.	1. Can be perceived as politically neutral and thus act as a boundary spanning agent between groups. 2. Can rapidly respond to problems with innovative solutions. 3. Provide human and financial resources and administrative abilities beyond the capacity of other groups. Can analyze the cost of alternative plans during the planning process and the sustainability of project action during implementation. Can usurp local leadership and their issues; initiate unneeded projects, and pursue economic self interests.	1. Do not depend on NGO leadership as a long-term solution to problems. 2. Form cooperative relationships with private for-profit groups and use their expertise in developing and administering projects. 3. Define rules of comanagement that prevent the economic interests of private groups from hurting project outcomes (e.g., operate under memorandums of understanding that uphold the integrity of goals, and monitor and evaluate often).

solely on the basis of merit, but to the extent they are reduces the likelihood of project failure.

Government

Almost all government agencies share several attributes that make them desirable implementors. They are among the most permanent social structures and have the ultimate responsibility for sustaining resources their constituents depend upon for survival. No matter who is chosen to implement projects, governments should not abdicate that responsibility. The ways governments act include enabling, supporting, providing extension services to other groups, and the coordination and regulation of activities (Murphree 1994).

An impediment of government agencies is that bear conservation is often a low priority. This is particularly understandable in developing nations where government agencies lack funds to meet minimal demands of public welfare and political sovereignty. Scarce resources and manpower encourage governments to concentrate power at the center where these resources can be used more efficiently (Bryant and White 1982; Table 2.3). Consequently, regional wildlife agencies who lack staff and budgets to enact programs often ignore bears and rely on central authorities for decision making. Therefore, it is vital that bear projects are coordinated at top levels of government. To help convince central authorities about the importance of bear conservation and supporting regional efforts, planners and project implementors should establish the links between 1) preserving bear habitat and having watershed products on national scale, 2) having watershed products in large urban environments and maintaining national security, and 3) improving regional capacity for watershed management by its participation in projects that focus on bears. Similar arguments can be drawn for other resources such as tourism.

Governments also have efficient mechanisms to control human behavior by enacting laws that state how resources and opportunities are to be distributed. However, compliance with regulations to protect bears is inconsistent in developing nations. Primary reasons include unfair laws that prohibit rural residents from owning land and controlling resource use, and government inability to enforce regulations. Communities that lack authority to prevent outsiders from destroying local habitats are encouraged to exploit the same resources before others do. Informal agriculture replaces bear habitat in the absence of regulation. Likewise, the incidence of poaching and selling of bear parts is high in many areas. These conditions require natural resource agencies to form partnerships with organizations whose capacity exceeds their own. To do this effectively government agencies should:

1. Increase their ability to coordinate policies between government ministries, and from the center to the peripheral organizations of society. Weak coordination characterizes the government agencies of many developing nations, but is not limited to them (see Pinto 1969, pages 13–14, for a list of organizational and non-organizational handicaps of government agencies). Failure to coordinate at the top levels of government results in ministries implementing incompatible uses on the same area. An example of this was Ecuador's concession of 6,000km^2 of wilderness for oil exploitation within days after declaring Sumaco–Napo Galeras National Park in the same area (Wray and Alvarado 1996, also see Bolivia's Country Report in this volume). The Interagency Grizzly Bear Committee that coordinates the recovery of the grizzly bear in the contiguous United States is a model of interagency cooperation with some success in implementing coordinated efforts across agency boundaries (Herrero 1994).
2. Carefully determine which project functions to decentralize. Preserving bears and bear habitat requires first central and then local participation. What combination of influence is best? Government implementors should make that decision on the basis of the status of bears and their habitat, local political support (Table 2.4), the project elements, and the degree of coordination between and among agencies and the public. Strong central control is needed when bear populations are small, and local capacity to administer projects is weak. Governments that find ways to decentralize administrative functions and political authority can increase their influence with the public, and increase the information they have about bears. The danger of decentralization is resources and

Table 2.4. The political context and ways to decentralize project authority (after Bryant and White 1982).

Public influence	Attitudes of leaders at lower social levels Supportive:	Opposed:
Public organized and potentially influential	I. Greater local responsibility for project administration is possible	III. Central government should use projects to develop local capacity.
Only local elites have influence	II. Local responsibility still possible, but the central government should retain controls and help organize the public.	IV. Central government should retain the most control and use more resources than II and III to develop local capacity and organize the public.

support can be diluted to the point of losing function or being vulnerable to special interests.
3. Operate under formal memoranda of understanding that require interagency consultation. Co-management relationships between government agencies, communities, and private groups should be clearly defined at the onset of project implementation. Failure to do so results in fragmented relationships between groups which ultimately causes public confusion about regulations and the need to protect bear populations. Some of the ways agreements can be structured are mentioned below. These agreements need not have the exact same meaning for all parties, but each party should understand the meaning for other parties and respect it (Hill and Press 1994).
4. Be cautious when replicating a successful project in a new area. What works in one local area may not work as well or at all elsewhere.
5. Be an adaptive organization capable of revising project implementation according to new information (see monitoring and evaluation below, Bryant and White 1982).

Community

Long-term maintenance of bear populations depends on their stewardship by the people who have the most contact with them. It is vital that rural communities are included as partners in efforts to manage bears because most bear inhabited regions lie outside parks where local interests prevail. Not doing so encourages rural residents to identify actions to protect bears as one more restrictive land-use measure imposed on them by governments and environmental groups who they generally distrust and resent (Kellert 1994). Illegal hunting, such as that which has been the leading cause of grizzly bear mortality in the Northern Continental Divide Ecosystem from 1986–90 (Dood and Pac 1993), is a common response of rural residents who feel victimized by regulations.

Government institutions in developing parts of the world often lack knowledge about how community leadership functions and about the ecology in peripheral areas. Often they assume community leaders are not as concerned about biological goals of resource preservation as they are about ownership rights and how to distribute benefits. Consequently government agencies do not have adequate information to design or implement programs. These conditions characterize the Andean nations, parts of eastern Europe, Eurasia, the independent nations of the former USSR, the Russian Far East, China, and much of tropical Asia. Because knowledge about bears and community structures of authority require a lot of time to acquire, government and private agencies should make the best use of the knowledge present in communities.

Government agencies throughout the world are recognizing the value of building their programs on existing authority relationships, particularly where their own authority is weak. Where local authority and ability to control resource use is strong, central authorities may only need to empower them and provide technical assistance (Poffenberger 1994). A growing number of case studies support this approach. A USAID funded team from Cornell University found that poaching and other resource depleting actions were reduced in East African communities that participated extensively in the management of the wildlife on their lands (Little 1994). The rate of deforestation was reduced in India where local communities had more say in their own affairs (Poffenberger 1994). Divesting resource management from central authorities to communities is not a panacea for preventing bears and other resources from disappearing (Wells and Brandon 1992), but it should be considered part of a program where government authority is ignored or limited.

Although communities have been regulating harvest and distribution of resources for millennia (Croll and Parkin 1992), their authority to do so has deteriorated in much of the world. A combination of nonrecognition of land rights, inadequate access to capital and technical assistance, market forces, and changing cultural traditions have eroded the capacity of local leadership to control the behavior of community members or articulate community concerns to outside groups. Michael Dove (1996) summarized the problem of preserving tropical forest habitat in Borneo as follows:

"The problem is not that the forest dwellers are poor, but that they are politically weak, while the problem with regard to the forest is not that it is environmentally fragile but that it is politically marginal. In short, the problem for the forest dwellers, and the single most important determinant of their fate, is that they inhabit a resource that is coveted by groups more powerful than they, while the problem for the forest is that it is inhabited by people who are too weak to insist on its rational use. Therefore the problems stem not from an ecological imbalance, but from a political-economic imbalance – created by an association of rich resources and poor people."

Lacking also are technical and managerial skills to implement projects. Consequently, government and private sector organizations usurp these functions and consider local institutions to be unworthy partners for enforcement and resource conservation functions (Bromley 1994). Government agencies find it easier to justify extractive activities in remote areas to favor communities more centrally located and with more voting power.

In summary, government agencies can increase their influence over rural residents where they formerly had less authority, but project implementors should be prepared to provide community institutions with support and empowerment. Here are ways to achieve this:
1. Balance the risks assumed by communities for not exploiting bears or their habitat with the achievement

of meaningful benefits (Wells and Brandon 1992). In descending order, the most important of these to communities are: land and resource tenure, political and cultural autonomy (Stocks 1996), welfare, and economic development (including technical assistance, education, and training opportunities). The existence of these benefits does not guarantee project success, but their absence is why bear habitat is converted to pasture in places like the Andes (Peyton *et al.* 1994) and often why community-based conservation efforts fail (Wells and Brandon 1992).

2. Create a cooperative incentive by having the beneficiaries share not just the benefits (B) associated with projects, but also the costs (Honadle and Vansant 1985). Direct costs (DC) include loss of the use of habitat and other resources shared with bears, loss of income from killing bears (e.g., hunter guide fees, sale of bear parts, etc.), and agricultural depredation by bears. Planners should assess the opportunity costs (OC) of not exploiting a resource against that which a community would gain from exploiting it or an alternative product. These costs and benefits should be calculated for individuals to assess whether incentives are realistic to encourage people not to destroy resources (Poffenberger 1994). A formula for doing so is: $P = [(B \times Pr) - (DC + OC)]R$, where willingness to participate (P) reflects the probability (Pr) of gaining benefits minus both types of costs, all modified by the amount of risk (R) participants can afford to take (Bryant and White 1982). In general the poorer an individual is, the more they respond to reduced risk than to expected benefits.
3. Allow project participants to organize themselves according to how they define consensus and equitable participation (Messerschmidt 1992).
4. Do not isolate people from resources without creating alternative resources. Examples in spectacled bear habitat include tourism, education, alternative crops such as orchids and palm oil, and art (Peyton 1994). The consequence of doing so is to encourage violent behavior. Between 1979–84, 117 violent clashes occurred between the forestry department and villagers in the national parks and sanctuaries in India because villagers felt they had no say in the way resources were managed in protected areas (Palit 1996). David Garshelis (Minnesota Dept. of Nat. Res, Grand Rapids, Minnesota, pers. comm. June 1996) provided the following example of an alternative approach: "In Nepal, India, and some parts of southeast Asia, the central government is giving back control of land to local villages and also giving advice on how to plant and manage community forests (they also provide fast-growing seedlings). The villages have learned that if they do it right (prevent early harvest – i.e., tree poaching), they can reap tremendous benefits in terms of fodder, fuelwood, and building materials. They have also found that animals return [to these forests], so prospects for meat harvests are improved. One such place in India recently saw the return of sloth bears (*Melursus ursinus*) in a community forest."
5. Project personnel (especially those from outside the community) should be sensitive about how they are perceived by community members. For example, foresters in developing nations such as Indonesia have adopted western axioms that 1) forests should be used to produce the "greatest good for the greatest number of people", 2) scientific forestry is an efficient and rational form of resource use, 3) and promoting economic growth through forest production is an important and politically neutral role for foresters. Forest dwellers in Indonesia perceive these axioms as deliberate political acts that justify state control of forest resources and their means of extraction (Peluso 1992).
6. Listen carefully to what rural people say. Be sensitive and patient about the way you ask questions. Try to appreciate the meaning of the information in the context of the decisions people make to survive. The way projects are implemented is often perceived by local resource users to be as important as what is done.

Non-Government Organizations (NGOs)

NGOs can provide what government and community institutions lack. They and university staff are good sources of knowledge about local ecological and sociological conditions. Their knowledge of local culture helps planners to phrase project goals in terms of existing cultural traditions that teach respect so that goals can be understood. This in turn strengthens local institutions as well as the link between preserving bears and improving living standards. Governments also get assistance from NGOs and university staff to apply recently developed scientific methods and theory to projects, and communicate that application to the public.

NGOs and universities are catalysts and facilitators of projects. Their management information combined with flexible organizational structure allows them to explore innovative solutions to problems that are not forthcoming from more rigid bureaucracies (e.g., government, lending institutions, and for-profit businesses). The marketing and capital management skills of NGOs and not-for-profit groups enable them to analyze resource-use options for their sustainability (May 1992). Once problems are identified, NGOs such as the King Mahendra Trust for Nature Conservation in Nepal and Fundacion Natura in Ecuador can respond rapidly to them with human, technical, and capital resources.

Finally, the perceived neutrality of NGOs allows them to liaise between groups that do not trust each other's actions. This function is particularly useful between government and local user groups. All these qualities can encourage governments to delegate more authority to lower levels of their ministries or to divest itself of those functions through privatization. Those interested in forming partnerships with NGOs are well advised to shop around. NGOs exhibit a wide range of capabilities and some are more suited for tasks than others.

A disadvantage of NGO influence is donations can foster dependency relationships, particularly when NGOs usurp local leadership and issues. Sometimes NGOs initiate unneeded capital development projects or push goals driven by values of NGO donors and not the needs of bears or the people that live with them. In 1995 the World Society for the Protection of Animals (WSPA) reintroduced three orphaned spectacled bears into the Maquipucuna Nature Reserve in northern Ecuador. Although reintroductions may be useful vehicles to call attention to species needs, this case was guided by what was perceived to be good for the individual bears, and not the wild population. No studies were made prior to the release on the reserve's capability to provide for the needs of wild or captive bears. There was no scientific justification to augment the local bear population (Peyton *et al.* 1994). On the advice of outside peer review, WSPA has initiated a study in the nearby Cayambe-Coca Ecological Reserve to determine the needs of wild spectacled bears.

Individual participants

The challenge of managing the disparate elements of both the bear biology and human interests is best taken up by a team of people. Although teams can be of various sorts (e.g., specialist groups, research and recovery teams, biological technical committees, interagency teams, etc.), their members should know about bears, the latest theories of conservation biology, state-of-the-art research and management techniques, and have experience in implementing conservation actions. The perceived legitimacy of the team to make recommendations is dependent on the quality of information it uses, and the political influence of its members. To improve the latter, the team could include at least one person from the community affected by conservation action.

Project participants should understand and effectively address all non-biological limitations to bear survival including: political, social, and organizational obstacles (Figure 2.2). It may be necessary to include people who are not biologists. Anthropologists and religious leaders can explain why project goods and services do or do not change the behavior of those who live with bears. Likewise, economists can help reduce the impact on bear populations from illicit trade (e.g., drugs, bear parts) by using their knowledge on how markets function. Some teams should include social scientists. They understand the socio-economic characteristics of human groups who threaten bear species with habitat loss and poaching. Had social scientists been included from the inception of projects to

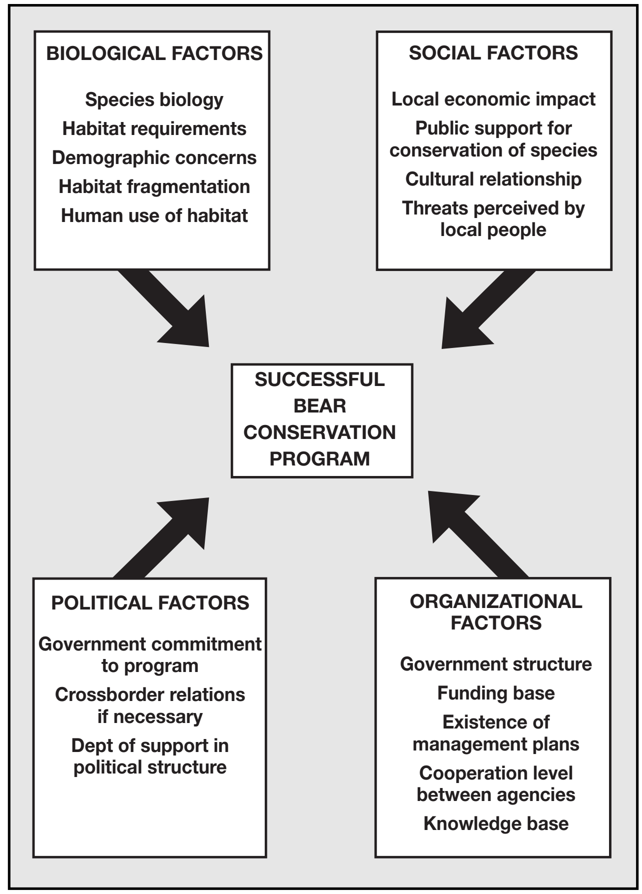


Figure 2.2. Concerns that should be addressed in an effective conservation program (Servheen 1997; adapted from Kellert and Clark 1991).

conserve the giant panda (*Ailuropoda melanoleuca*) in 1980, more conservation action would have addressed the impoverished socio-economic conditions of villagers surrounding panda reserves (Reid 1994).

Implementation is mostly a socio-political process, and less a biological one. Yet biologists traditionally are called upon to solve problems (Schaller 1992). To make it work, project managers should not only be able to organize tasks, but motivate people to accomplish them. It helps to have participants with interdisciplinary problem solving techniques, ones that build coalitions and resolve conflicts (Westrum 1994). Project leaders should be able to be self-reflective as well as focused on technical concerns. Leaders from large agencies need to be patient and supportive of their mid-level managers who often find themselves torn between conflicting demands of the public, their superiors (Bryant and White 1982), and the needs of bears.

Setting time frames

Project managers must decide when to address threats and for how long. A schedule should be developed that lists the tasks to counter each threat, who will do them, and when they are to be performed and reviewed. Efficient use of time and resources should be emphasized, particularly when dealing with small bear populations. Managers should also try to implement consistent and coordinated actions because successful conservation is a long-term effort. Inconsistent project action is a main contributor to the unreliability of the data collected about bear populations (Servheen 1994).

Actions for bears

Managers should be prepared for a long-term effort, not without risks (Yaffee 1994). Population growth rates for bears are so low that measurable changes in density are unlikely to occur during the time span of most projects (Taylor 1994) or most managers! Therefore, a decade or two might pass before the impact of a management decision may be evident.

Timing of research and monitoring projects should cover the range of annual variation in whatever is investigated (Mattson *et al.* 1996). Studies of bear habitat should include occasional catastrophic events such as bamboo die-offs and the El Niño effect that causes widespread changes in the phenology of foods eaten by giant pandas and spectacled bears. Studies to estimate the minimum number of females with cubs should last at least two reproductive cycles (e.g., six years for most brown bear populations, and four years for North American black bears) (Servheen 1994).

Actions for people

All agencies/groups should match the temporal demands of projects with their capacity. Initially, limit the number of sectors and organizations involved in a project; then expand according to needs and ability. By doing so, less time will be demanded to coordinate and resolve conflicts between bodies and more time can be focused on priority objectives.

Extra time must be allotted to projects in developing parts of the world. Here, political instability, poor communication and access to bear habitat, and cultural barriers may demand time to overcome. Project managers should avoid implementing elaborate plans within fixed time frames in these areas (Peyton 1994).

Managers should also budget time for institutional strengthening and creating ownership in conservation solutions. This rarely comes about as the result of a pure project approach and involves a lot of dialogue. Agreements such as those between governments (International Agreement on the Conservation of Polar Bears and Their Habitat, May 1973) and indigenous native groups (e.g., 1972 U.S. Marine Mammal Protection Act, 1992 Protocol of Intentions for indigenous native peoples of Alaska and Chukotka) that monitor and regulate the harvest of polar bears (*U. maritimus*) evolved over 10–15 years with many meetings achieving incremental steps toward consensus (Belikov and Boltunov 1998). Studies to determine population estimates of polar bears in Baffin Bay (supported by the Government of the Northwest Territories, University of Saskatchewan and Parks Canada) have been extended for several seasons in an expanded study area because Inuit wildlife managers thought the study was biased and missed counting animals (Douglas Clark, Nunavut District Ecologist, Parks Canada, Pangnirtung, NWT, pers. comm. October 1997). Achieving public acceptance of research results can add years to projects and should be anticipated.

Time frames for local participation should accommodate their temporal use of resources. For example, local acceptance of project goals would be compromised by planning an activity that would take away labor needed to harvest food crops.

Finally, the time frame for agreements and their extensions between state agencies/NGOs and community groups who form management partnerships should be clearly defined. Not doing so increases the fear of community members that their contribution of labor and lost opportunities will be unrewarded when an agency/organization revokes the agreement prematurely (Poffenberger and Singh 1996).

Allocating human and capital resources

Project managers should use personnel and capital expenditures in the most efficient and useful capacities they can (Servheen 1997). The best money-saving strategy is to act early. By doing so, costs are reduced and more options are kept open (see Thompson and McCurdy (1995) for a discussion on the merits of proactive vs. reactive management). Recently, there has been an increase in the number of ballot initiatives in the United States that allow voters instead of state agencies to decide issues such as whether to outlaw the use of dogs and bait when hunting black bears. A proposal to ban these practices failed in Michigan because private (Citizens for Professional Wildlife Management) and public groups anticipated the referendum by several years. They used the time to garner more money than the opposition and reserve television time. Inability to educate the public early enough resulted in a similar measures passing in Oregon and Washington.

Another cost-saving strategy is to avoid creating redundant infrastructure by building projects on pre-existing institutions and leadership (Honadle and Vansant 1985). Organizations can form collaborative partnerships with entities that have what they lack. For example, bear habitat in Colombia is managed cooperatively by government agencies, national development agencies, regional utility corporations, private organizations, and indigenous people (see Colombia's country report). Although administrative costs are reduced by limiting the number of participants, these costs generally are less than what is required to create institutions. The same principle is true for creating capable leadership. Training is reduced and continuity is increased by incorporating planners as program executors (Peyton 1994).

Emphasis on reducing labor (e.g., efficiency) sometimes does not increase accuracy or public support for projects. For example, the Peruvian government's technique for censusing vicuña in Pampa Galeras that employed 30–50 peasants during the 1970s was cheaper and more accurate than an aerial strip-census. It also accomplished the objective of providing jobs to community members in return for their stewardship of vicuña, which aerial methods did not do (Norton-Griffiths and Torres 1980; Western 1982).

Government resource agencies that form partnerships with communities should try not to let conflicts between them destroy local leadership. If possible, government agencies should work with homogeneous groups of people who share similar socio-economic status and use of forest resources. Members of heterogeneous groups are more likely to disagree with each other and with management and thus consume more project resources. Another strategy for project implementors to maintain public support is to base their benefit distribution method on prior rights, important needs, and existing labor systems (Sarin 1996). By doing so community groups are less likely to feel benefits are distributed unfairly, or if they do, they will blame their own systems and not the government's. Similarly, the quality within government agencies can be improved by implementing policies of staff promotion based primarily on merit and not just seniority or political affiliation (Palit 1996).

Monitoring/evaluating

How do project leaders know that their actions are having the desired impact on bear and human populations? How do project leaders maintain their objectives and the legitimacy of their mandate in light of changing internal and external environments? The answer is through an open management style that incorporates periodic monitoring and evaluation (e.g., adaptive management). In this section, general procedures of monitoring and evaluation are described followed by what is required to monitor bear populations.

General procedures

Monitoring is an internal activity performed while the project is ongoing and often after it ends (e.g., monitoring effects of mitigation, dump closures, new ways for handling nuisace bears). Its purpose is to measure the progress of project implementation according to the expectations of planning and to reconcile differences (Brewer and deLeon 1983). It is done formally by people who are not involved in the daily execution of a project and both formally and informally by project leaders. They compare actual performance of bear populations and project participants with their intended performance. They determine whether expenditures are in line with budgets, and whether incentives are appropriate to motivate project personnel to do their tasks. Project implementors use this information immediately to modify the way programs are managed to achieve desired outcomes.

Monitoring has other useful functions. The activity can maintain bonds between collaborating partners by periodically reviewing reciprocal rights and responsibilities. This is especially critical between partners with a history of distrust in each other such as central government agencies and community institutions (Murphree 1994). Information from monitoring, when combined with outreach efforts, can also help convince a reluctant public to change their behavior in ways that benefit an ailing bear population.

Evaluation is an external activity. If done before project termination, it estimates what the project's eventual impact will be. After termination, evaluation documents what happened and why it happened. Because project plans are hypotheses about what a series of actions will accomplish, evaluation determines if links between plans and intended outcomes exist (Bryant and White 1982). Evaluation is best done by knowledgeable reviewers who have no personal stake in the project or in their judgments (Casley and Kumar 1987). They determine which factors were responsible for the outcome of the project due to the way it is implemented. Included in their analysis are the monitoring data and assessments of the relevance of program actions, the performance of individuals, and the efficiency of project resource use. With these tools, management can adapt policies to the information these processes generate and take corrective action. The following should be considered to implement appropriate monitoring and evaluating activities:

1. Monitor outcomes of bear projects by several independent methods that, when possible, minimally disturb bears (Servheen 1997 and below).
2. Invest a significant part of the project resources in monitoring and evaluating. Project leaders in developing countries, where the need for institution building is high, should consider spending half the budget on the administrative aspects that include these procedures (Orejuela, J., Fundación para la Educación Superior, Cali, Colombia, pers. comm. June 1990).
3. Maintain the independence of monitoring and evaluating committees. Members of these bodies should not be beholden to any one financial sponsor or its

political views. Hire local as well as outside independent groups to conduct these activities. The emphasis should be on the ability of these people to maintain clear views of the program's overall goals. Middle level managers who are not listened to by their superiors or who would pay a political price for expressing ideas can use evaluators to do that job for them.

4. Monitor and evaluate often and consistently (usually annually), not only when a problem occurs. Inconsistent effort results in information not being available when it is needed.
5. Research the adoption of policies by institutions long after the service delivery part of the project ends. The real contribution of a project occurs after it ends and is more important than the project itself. Planners and project implementors should emphasize sustained action, not just immediate action. The question to be asked is: what has been inherited from the project? Are permanent aspects of service delivery being institutionalized by the government? Can financial and administrative inputs be undertaken locally? Are there links between staff action and local action? Is there local ownership of the goals of the program so that outside pressure is no longer necessary to sustain the effort?
6. Evaluate what has been learned from transforming policies to implemented action. Learning does more than account for the differences between project outcome and initial conditions. Learning includes redefining goals and objectives in light of monitoring data, identifying faulty assumptions, and reshaping policy design. Changes in personnel roles, communication, and organizational structure may be required as a result of learning. Organizations that embrace learning view implementors, monitors, and evaluators as sources of new information and view implementation as an exploratory behavior, rather than a subservient task (Pressman and Wildavsky 1984).
7. Publish the findings of the monitoring and evaluating activity in readily obtainable sources. Mention how to replicate the project in comparable areas (Bryant and White 1982).

Monitoring to improve bear populations

Managers commonly monitor three things to determine how bears respond to threats and project actions: population parameters of bears, habitat quality and access bears have to it, and human impacts on bears and habitat. Good responses include increased number of bears, increased bear distribution, increased recruitment, reduced bear mortality, and reduced bear–human conflicts. Projects with these results usually do not require modification, unless these improvements happen in concert with increased public resentment towards bears. Before discussing these subjects in turn, we emphasize that preventing excessive bear mortality has become as important as preventing habitat destruction/alteration. Managers increasingly confront two situations: habitat that no longer supports bears because it lacked security, and fewer areas large enough for bears to live in. Monitoring data has the most potential to accurately show trends for these and other threats to bears.

Gathering accurate monitoring information about bear populations is difficult. Despite their large size, bears are elusive and secretive. They occupy large landscapes that discourage human access. Their low population density inhibits researchers from studying enough bears to estimate their recruitment and survival accurately. Within species and areas, bears exhibit a variety of survival strategies making it hard for experts to predict the performance of the population, or to apply knowledge about bears in one area to another (see Lindzey *et al.* 1986, Rogers 1987, Schwartz and Franzmann 1991, and Noyce and Garshelis 1994). Bears are also hunted and members of different sex/age classes are not equally vulnerable to hunters (Bunnell and Tait 1980). Where controls of hunting are lax, the incident of unreported kills can be three or more times that which is reported (Servheen 1994). These factors in combination create a lot of uncertainty about the true status of bear populations. Project managers can increase the credibility of their actions by:

1. Clearly specifying sources of risk and uncertainty in monitoring methods and scientific data. The greater the uncertainty the more conservative standards must be set for success [e.g., initially set a limit of allowing no more than 1% total human-caused mortality to a threatened grizzly bear population (calculated as a three year running average) and then revising limits according to the results of monitoring data (see Mattson *et al.* 1996)].
2. Applying consistent monitoring of bear populations and habitat quality at least annually. It is more important that monitoring occur regularly with comparable results between monitoring periods, than infrequently and with variable precision (Servheen 1994). Project implementors should not modify methods in ways that prevent data from being comparable between monitoring periods.
3. Reducing logistics associated with monitoring. The methods used should not be so expensive or dependent on external factors that their application on a consistent basis is jeopardized (Servheen 1994). For example, accurate aerial census of brown bears in Kamchatka (Russia) is dependent on being airborne with good visibility during a short 1–2 week period when most bears leave their dens and travel to feeding sites at lower elevations. Poor weather conditions (e.g., storms and soft snow that prevent take-off), and lack of appropriate aircraft, fuel, and funds prevent researchers from being airborne during the critical time period or seeing bears when in the air (Revenko 1997).

4. Increasing the accuracy of monitoring data by: a) using several independent methods and observing the degree different methods support the same conclusion about the status of population(s), b) minimizing changes in project personnel (McLaughlin *et al.* 1990), and c) minimizing the number of assumptions for monitoring methods to increase their accuracy (Servheen 1994). Studies can determine when assumptions are met. In the previous example, researchers assumed they missed seeing brown bears in Kamchatka, but they did not study the relationship between visibility of bears, weather conditions, and the habitat bears occupied. These measures are especially important when monitoring small populations of bears. As a bear population declines in number, imprecision generally increases because valid samples are harder to obtain (Servheen 1994).
5. Using the most unobtrusive methods possible to achieve desired ends (see Box 2.1). Examples of intrusive methods include annual capture programs, and repeated low-level flights or intrusions of researchers into bear habitat. Bait luring with unnatural baits placed near human settlements and/or for long time periods can increase bear vulnerability and should be avoided.

In addition to bear population statistics, monitors want to know the ability of habitat to provide bears with space, food, and security, and how human activities affect the availability and accessibility of habitat resources to bears (Servheen 1994). These subjects can best be approached in a prioritized fashion. First maintain accurate records on changes in the size, shape, and distribution of habitat units known to support bears. Monitors combine this information with human use patterns and the locations of bear mortalities to identify sites that need management attention. Few areas outside some parts of northern North America and Russia are considered sufficiently large to maintain viable bear populations without fairly intensive management. Timely information on threats to habitat (e.g., linkage zones, dispersal corridors, denning sites, seasonal use zones, etc.) is critical to prevent its loss. Once the size of an area falls below that which would support approximately 300 individuals, managers must minimize all human causes of mortality (Servheen 1994). Populations below 100 individuals may require augmentation of wild and/or captive bears. Present levels of support from government and private sectors indicate few endangered bear populations will be rescued by these heroic means, fewer still in the developing parts of the world.

Next, changes in annual abundance of foods must be known. These data are used to reveal limitations to the density of bear populations, and explain bear movements, particularly those that result in loss of agricultural products or the bears themselves. The best bear habitat is characterized by having seasonally abundant food sources that are rich in calories (Servheen 1994) as well as a diversity of alternative foods that can be eaten if productivity of the former sources are poor.

Finally, monitoring information is needed on human activities that cause bears to leave areas or make them more vulnerable in them (e.g., road and trail construction, hunting, agriculture and grazing, fire, mining, timber harvest, tourism, housing, and industrial development). A disturbance's magnitude can be estimated by combining its data (e.g., road density, spread of slash and burn agriculture, location and number of grazing stock, density

Box 2.1. Monitoring techniques

Although most of the excellent information biologists have about bear species and populations was gathered using intrusive means, a great deal of the information management requires to monitor the general status of bear populations and habitat can be obtained without intrusive means (e.g., low impact methods in Table 2, Servheen 1994). Intrusive research on many radio marked animals for over 4–6 years may yield a reasonably small interval that managers can be confident contains the true population number (point estimate, Eberhardt and Knight 1996). However the costs to both management authorities and bears does not always justify its use (Servheen 1994). New techniques (Boyce *et al.* in press) allow the use of non-intrusive sighting data to estimate total population size with confidence intervals. A realistic goal is to obtain a minimum population estimate, particularly of females with cubs, the most important cohort of the bear population (Knight *et al.* 1995). However, field counts should not be used to estimate population trends unless observers' efforts to obtain the data are also measured rigorously and taken into consideration. Measuring effort is difficult and costly, but less expensive than a mark–recapture program using radio-collared bears.

Data on the presence of individual bears can be obtained from sightings, track measurements (normally taken prior to August 15 for Ursid bears), remote cameras (Mace *et al.* 1994), and DNA taken from scats, hair, and saliva (Woods, J.G., and McLellan, B.L., The use of DNA in Field Ecology, summary of a workshop in Revelstoke, British Columbia, Canada; January 29–30, 1997). DNA methods theoretically can be used to obtain a point estimate on bear populations. However, the calculations require knowledge of home range sizes for each sex. Also, assumptions must be met about population closure and no net movement of animals in or out of the study area. Given that radio marked animals are needed to obtain these data, it is likely that DNA technology will have its most immediate use: 1) where these data exist, 2) to determine minimum numbers of individuals in areas where home ranges are not known, 3) to identify individuals causing damage, and 4) to identify unique individuals for estimating the population size (Boyce *et al.* In press).

of hunters, etc.) with data on seasonal habitat use by bears. Annual food abundance also should be known to discriminate its effect on bear movements from those caused by disturbance(s). With this data set, managers might be able to mitigate the effect of disturbances before they reduce foods and other resources available to bears. Mitigation actions for bears range from relocation of communities (extremely costly, see Venezuela's Country Report) to temporary road closures to protect bears in areas they use seasonally (mildly costly).

Summary

In this chapter we emphasized combining scientific, organizational, and social/political skills to design and implement plans for bears. Each skill's advantages has limited potential to help bears without the support of the others. Here we summarize their strengths.

To the extent that management information is scientifically sound, planners are less likely to design faulty projects and implementors are more confident that they can counter problems. When the baseline science or its methodology are faulty, opponents can easily challenge a project's authority and goals. These challenges are exacerbated by unforeseen events, whether caused by deficient planning, poor monitoring, or natural disasters.

Organizational skills are essential to prioritize threats facing bear populations and to allow managers to maximize effectiveness of scarce resources to counter threats. Even uncertainty about bear populations and human threats to them can be addressed in an organized fashion. When good information is lacking, management of bear populations should be conservative. The primary needs of bears should be addressed first. Knowledge of how bear populations are responding to management action can be obtained with modest budgets. It is not necessary to know a great deal about bear populations (such as population estimates and trends) in order to plan and implement conservation steps. In fact, waiting to implement conservation actions on critically threatened populations while waiting for more research data is a major threat to the survival of these populations. The rapid rate that bear populations are declining and being fragmented makes it imperative to act efficiently and quickly while cost-effective options are still available.

While scientific and organizational skills make wildlife managers confident that projects will have predictable results and thus should be initiated, it is mostly social/political skills that prevent projects from failing once they are underway. This is because implementation is more about managing human behavior than bear behavior to achieve objectives. Project leaders should insist on regular monitoring and evaluation and view these tools as a learning process and not as threats to their authority. Organizations should use learning not only to modify the way projects are run, but also to modify the organization to make it more effective (including its structure and mission). These principles of "adaptive management" describe an optimal response to conserve bear species. In reality some degree of self-preservation takes the place of what individuals, organizations, and countries should do to sustain bear populations.

Our final word is to treat both bears and humans with as much respect and care as possible. Recently developed tools, such as remote cameras and DNA extraction from scats or hair, promise to reduce the dependency of managing agencies on intrusive methods to obtain population data. The battle of whether wild bear species survive or go extinct is as dependent on how humans treat each other as it is on how they treat bears. Disproportionate resource ownership, unjust judiciaries, lack of political participation, and greed encourage people that live with bears to take what they can before it is taken away from them. There is still enough space and other resources to support all the world's bears and people, but our will to preserve bears is diminishing as our population increases. If we won't save our shared resources for bears, will we save them for our progeny? Can the added presence of a bear shift our collective spirits to do what we otherwise find difficult to do for ourselves? Though we ask these questions of humanity, the answer depends on individual faith: faith that our personal efforts to do good for bears will help secure our own future existence as well.

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Chapter 3

Genetics of the Bears of the World

Lisette Waits, David Paetkau, and Curtis Strobeck

Overview

Many aspects of bear biology are well studied, but comparatively little is known about bear genetics. Historically, the scarcity of genetic information about bears can be traced to the technical difficulty and high expense of molecular genetic analyses. Due to recent developments in molecular technology, we have moved into a new and exciting age in which genetic analyses of any organism can be performed in a cost-effective manner with relative ease. As an indication of the potential importance of molecular analyses for monitoring the status of the world's bears, a genetics section has been added to this comprehensive status report. The goals of this section are threefold: 1) to summarize the progress that has been made in bear genetics, 2) to discuss the implications of current genetic research, and most importantly 3) to explore the potential of molecular techniques for providing new perspectives on bear biology and management.

Researchers can now routinely utilize genetic information in proteins and DNA to addresses questions about the behavior, ecology, life history, and evolution of bear populations. From a biological perspective, molecular genetic analyses have been utilized to uncover important characteristics of natural populations such patterns of gene flow (Paetkau *et al.* 1995), reproductive success (Craighead *et al.* 1995), genetic diversity (Paetkau and Strobeck 1994; Paetkau *et al.* 1995; Waits *et al.* 1998a), and evolutionary history (Taberlet and Bouvet 1994; Waits *et al.* 1998b; Wooding and Ward in press; Talbot and Shields in press a). From a forensic standpoint, researchers have demonstrated the ability to use genetic information to differentiate species (Cronin *et al.* 1991a; Waits and Ward in press), to trace individuals within a species to a particular geographic area (Waits 1996), and to identify individuals within a population (Paetkau and Strobeck 1994; Paetkau *et al.* 1995). The molecular methods that are used to analyze DNA and proteins include a wide range of techniques such as protein electrophoresis, immunological assays, chromosome banding, DNA hybridization, restriction enzyme analysis, DNA sequence analysis, and DNA fingerprinting. A detailed description of these techniques is beyond the scope of this manuscript; however, excellent reviews of molecular methods are suggested for further reading (Avise 1994; Lewin 1994). The most important point to convey about the use of different molecular techniques is the fact that each technique provides different information at different levels of resolution. The degree of detectable genetic variation (polymorphism) will vary greatly among markers. Thus, different markers will have different strengths and weaknesses for answering particular questions, and the results may have different implications.

One important distinction among DNA markers is the distinction between mitochondrial DNA (mtDNA) markers, Y chromosome markers, and nuclear DNA markers. Mammalian cells contain two distinct types of DNA: nuclear DNA and mtDNA. Nuclear DNA is found in the nucleus of cells, and it is inherited from both parents. Thus, cells have two copies of each nuclear chromosome, one copy from the mother and one copy from the father. MtDNA is a circular DNA molecule residing in the mitochondrion, a cellular organelle of the cytoplasm. Mitochondrial DNA is inherited uniparentally, from mother to offspring (Avise and Lansman 1983). The Y chromosome is also found in the nucleus, but it has a unique property compared to other nuclear DNA chromosomes. It is inherited uniparentally, from father to son. These differences in inheritance patterns have important implications for interpretation of results from DNA studies. MtDNA markers only provide information about maternal evolutionary history, gene flow, and genetic diversity; Y chromosome markers only provide information about paternal evolutionary history, gene flow, and genetic diversity; and nuclear DNA markers provide information about both maternal and paternal evolutionary history, gene flow, and genetic diversity.

This status report of bear genetics is organized in five major sections that reflect the five main areas of research: 1) interspecific phylogenetic analyses, 2) intraspecific population structure analyses, 3) genetic diversity within populations, 4) ecological applications, and 5) forensic applications. In section 1, we focus on questions relating to the relative age, evolutionary distinctiveness, and historical evolutionary branching pattern for each species. In section 2, we focus on studies at the species level that answer and raise important questions about historical and current migration patterns, evolutionarily significant genetic groups, and population structure. In section 3, we consider studies of population-specific genetic diversity that are instrumental for determining if threatened populations have suffered a significant loss of genetic diversity, which may lead to inbreeding depression and potentially threaten the survival of the population. In section 4, we explore potential ecological applications of genetic analyses such as DNA-based population census methods and the reconstruction of pedigrees. In the final section, we address the utility of molecular techniques in wildlife forensic identification.

1. Interspecific phylogenetic analyses

The delineation of the evolutionary relationships among the eight members of the bear family, Ursidae, is the framework that provides meaning and perspective to the unique biological and ecological traits of each species. The traditional use of paleontological and morphological data to reconstruct the genealogical history (species tree) of the Ursidae has produced inconclusive results (Kurten 1968; Thenius 1982; Kitchener 1994). An alternative method for defining the phylogenetic relationships among the Ursidae is molecular phylogenetics. By comparing homologous molecular markers generated from each species, it possible to estimate a gene phylogeny or tree. This gene tree can then be used to infer the species tree, but the gene tree is not always the same as the species tree (Nei 1987). Thus, it best to base conclusions about species phylogeny on data from multiple gene trees. To uncover the interspecific evolutionary relationships among the Ursidae, a variety of molecular methods have been employed: albumin immunologic distance (Sarich 1973; O'Brien *et al.* 1985), two-dimensional protein gel electrophoresis (Goldman *et al.* 1989), chromosome banding (Wuster-Hill and Bush 1980; Nash and O'Brien 1987), DNA hybridization and allozyme electrophoresis (O'Brien *et al.* 1985), alpha and beta hemoglobin protein sequence analysis (Tagle *et al.* 1986; Hashimoto *et al.* 1993), mitochondrial DNA (mtDNA) restriction enzyme analysis (Zhang and Shi 1991; Cronin *et al.* 1991b), and mtDNA sequence analysis (Shields and Kocher 1991; Zhang and Ryder 1993; Zhang and Ryder 1994; Vrana *et al.* 1994; Talbot and Shields in press b; Waits 1996).

The first evolutionary question that was addressed using molecular data was the placement of the giant panda within the Ursidae. Taxonomic classifications have placed the giant panda with almost equal frequency in the Ursidae, the Procyonidae (raccoon family), or in a separate family (Ailuropodidae) (O'Brien *et al.* 1985). Most molecular studies have supported the inclusion of the giant panda within the Ursidae (Sarich *et al.* 1973; O'Brien *et al.* 1985; Nash and O'Brien 1987; Goldman *et al.* 1987; Hashimoto *et al.* 1993; Zhang and Ryder 1993, 1994; Vrana *et al.* 1994; Talbot and Shields in press; Waits 1996), but two have suggested that the giant panda should be grouped with the lesser (red) panda (*Ailurus fulgens*) in the Ailuropodidae (Tagle *et al.* 1986; Zhang and Shi 1991).

Nuclear chromosome analyses of the eight bear species have provided much useful information about the evolutionary history of the Ursidae (Wuster-Hill and Bush 1980; O'Brien *et al.* 1985; Nash and O'Brien 1987). The six ursine bears (sun bear, American black bear, Asiatic black bear, brown bear, polar bear, and sloth bear) have a nearly identical karyotype and 74 chromosomes. The giant panda has 42 chromosomes, and the spectacled (Andean) bear has 52 chromosomes. Although the giant panda and the spectacled bear have fewer chromosomes than the ursine species, a detailed comparison of the banding patterns of the giant panda and spectacled bear chromosomes to ursine and procyonid chromosomes demonstrated two important characteristics: 1) nearly all of the banding patterns of chromosomes of the giant panda and the spectacled bear match the banding patterns of the ursine chromosomes, and not those of the procyonids, and 2) the smaller number of spectacled bear and giant panda chromosomes can be explained as fusions of the ursine bear chromosomes (Nash and O'Brien 1987). Thus, these molecular comparisons provide strong support for the inclusion of the giant panda in the bear family.

When addressing the question of the hierarchial relationships of all members within the bear family, molecular analyses agree that the giant panda is the oldest bear species followed by the spectacled bear (Nash and O'Brien 1987; Wayne *et al.* 1989; Goldman *et al.* 1989; Zhang and Ryder 1993, 1994; Talbot and Shields in press b; Waits 1996). Thus far, the use of cytological (Nash and O'Brien 1987), immunological, DNA hybridization, and isozyme data (O'Brien *et al.* 1985; Goldman *et al.* 1987; Wayne *et al.* 1989) to reconstruct the hierarchical phylogenetic relationships of the six remaining bears (ursine bears) has produced inconclusive results with the exception of support for a close grouping of the brown bear and the polar bear. MtDNA sequence analyses (Zhang and Ryder 1993, 1994; Shields and Talbot in press; Waits 1996) have improved the resolution of the branching order of the ursine bears, but ambiguities still remain. The mtDNA gene trees have suggested that the sloth bear lineage was the first ursine bear lineage to emerge (Zhang and Ryder 1994; Waits 1996; Shields and Talbot in press). The branching order of the remaining species is unclear. The first mtDNA study suggested that the American black bear and the sun bear lineages diverged as sister taxa after the sloth bear lineage and before the Asiatic black bear lineage (Zhang and Ryder 1994). In a second study (Waits 1996), the branching order of the American black bear, sun bear, and Asiatic black bear lineages could not be statistically resolved (95% confidence interval) suggesting that these three species underwent a rapid radiation event. The third study (Talbot and Shields in press) suggested that the American black bear and Asiatic black bear diverged as sister taxa after the sloth bear lineage and before the sun bear lineage.

At approximately the same time as the divergence of the American black bear, Asiatic black bear, and sun bear lineages, an ancestral lineage diverged that led to brown bear and polar bear lineages. The polar bear lineage emerged from within a cluster of brown bear lineages (Cronin *et al.* 1991b; Zhang and Ryder 1994; Waits 1996; Talbot and Shields in press a, b) as a sister group to brown bears from the Alaska islands of Admiralty, Baranof, and Chicagof (ABC islands). In contrast, results from a separate mtDNA sequence analysis (Zhang and Ryder 1993) suggested that the polar bear lineage was an ancient lineage that grouped with the spectacled bear lineage. In a more extensive analysis, Zhang and Ryder (1994) revealed that three polar bear lineages grouped with the brown bear and one polar bear lineage grouped with the spectacled bear. The authors suggest that the polar bear/brown bear grouping more accurately represents the true phylogeny of the polar bear. However, they also propose a recent hybridization event to account for the polar bear/spectacled bear relationship and suggest that future studies include additional polar bear samples.

Implications and future directions

The interspecific molecular phylogenetic studies of the bear family have important implications for bear biology, ecology, taxonomy, forensics, and conservation. From a biological and ecological perspective, these studies have established a genealogical framework upon which the unique biological, ecological, and behavioral characteristic of each species can be examined in an evolutionary context. From a forensic standpoint, these studies have provided baseline knowledge that can be used to develop molecular markers for the purpose of unambiguously identifying each species (see section 5). Results that were obtained using more than one molecular marker can also be used to resolve taxonomic controversies. For example, there is extremely strong molecular support for the placement of the giant panda within the Ursidae. In addition, the close genetic relationship of the polar bear and the brown bear reinforces recommendations that the polar bear genus *Thalarctos* should be abandoned by placing both species in the genus *Ursus* (Honacki *et al.* 1982). These results also have important conservation implications for the sloth bear because the mtDNA phylogenetic analysis results suggest that its unique morphological and behavior characteristics can be traced to its phylogenetic history.

As demonstrated in this section, much has been learned about the phylogenetic history of bears using molecular markers. As the characterization and availability of useful polymorphic markers continue to increase, it is clear that we will have the potential to learn much more. In future analyses, it will be important to use additional nuclear and Y chromosome markers to verify the results of the mtDNA analyses and to resolve the branching order of the remaining species.

2. Intraspecific population structure analyses

An important role of intraspecific genetic analysis in the conservation of natural populations is to determine the manner in which genetic variation is partitioned within and among populations. Analyses of intraspecific population structure can be used to generate two types of information that have important implications for the conservation and management of bear populations. First, intraspecific genetic analyses can identify populations that have evolved independently for a significant length of time with no gene flow between other populations. Conservation geneticists define these populations or groups of populations as "evolutionary significant units" (ESU's). The ESU concept was initiated to provide a basis for prioritizing taxa for conservation efforts with the goal of protecting the evolutionary heritage and potential within a species. The criteria for defining ESU's are not uniformly established (Moritz 1994); however, most researchers agree that classification as an ESU should include phylogenetic distinctiveness of alleles across multiple independent loci (Avise and Ball 1990; Dizon *et al.* 1992; Moritz 1994). The second type of information that can be obtained from intraspecific analyses is the description of genetic structure, or gene flow patterns, between populations that have not evolved independently. These data can be used to reveal migration patterns and to identify important corridors for genetic exchange between populations.

Currently, intraspecific genetic analyses have only been described for three bear species: the brown bear, the American black bear, and the polar bear. Population genetic structure in brown bears was first examined among individuals from North America using protein allozyme markers (Allendorf unpublished data). These efforts were largely uninformative due to low levels of variation, but allele frequencies at one locus suggested substantial genetic divergence between Montana brown bears and Alaska brown bears. More recently, mtDNA sequence analyses of brown bears from across their geographic range have revealed considerable population genetic structure and deep phylogenetic splits between five mtDNA lineage groups defined as clades (Cronin *et al.* 1991b; Taberlet and Bouvet 1994; Randi *et al.* 1995; Kohn *et al.* 1995; Taberlet *et al.* 1995; Talbot and Shields in press a; Waits *et al.* 1998b; Waits *et al.* submitted). Clade I contains brown bear lineages from western Europe; Clade II contains brown bear lineages from the Alaskan islands of Admiralty, Baranof, and Chicagof plus polar bear lineages; Clade III contains brown bear lineages from eastern Europe, Asia, and western Alaska; Clade IV contains brown bear lineages from southern Canada and the lower 48 states; and Clade V contains brown bear lineages from eastern Alaska and northern Canada (Figure 3.1). A particularly interesting result from these analyses is the close phylogenetic

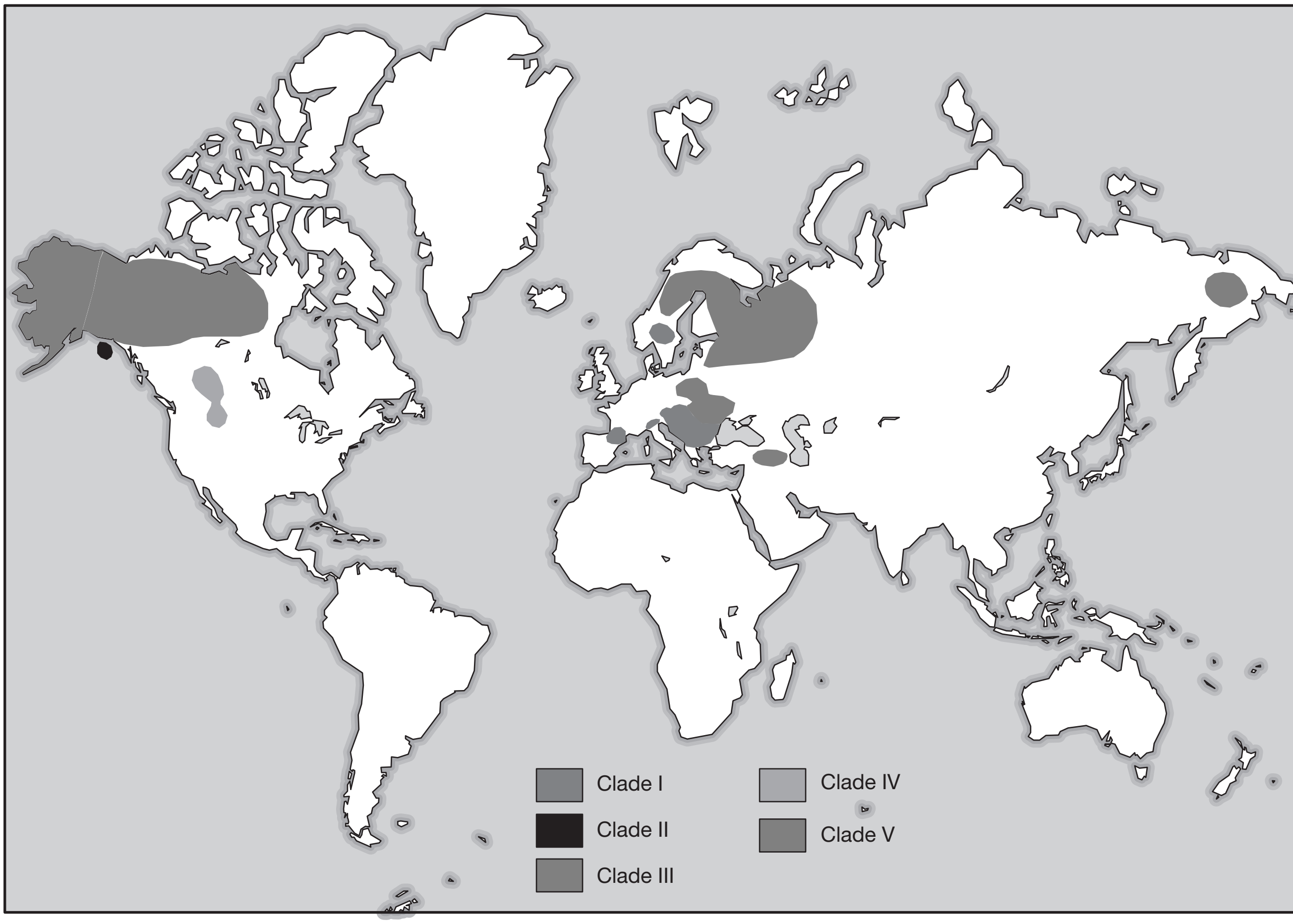


Figure 3.1. Geographic locations of the five mtDNA phylogenetic clades identified in brown bears (Waits *et al.* 1998b).

relationship of brown bear lineages from the ABC islands and polar bear lineages, which was briefly discussed in section 1.

The five clades of brown bears are geographically distinct with three exceptions: 1) clades I and III are found in two separate populations in Sweden (Taberlet *et al.* 1995), 2) clades I and III have been observed in the sample population in Romania, and 3) clades III and V are found in the Arctic National Wildlife Refuge. Waits *et al.* (submitted) suggested that the geographic distribution of these clades may be explained by isolation of brown bear populations in Pleistocene glacial refugia and divergence of mtDNA lineages, followed by limited female migration after the glacial ice receded. To complete the geographic coverage of the entire brown bear range, additional samples should be collected and analyzed from Asia and western Canada.

Population genetic structure in the polar bear has been examined using allozyme markers (Allendorf *et al.* 1979; Larsen *et al.* 1983), mtDNA markers (Cronin *et al.* 1991; Bodin *et al.* unpubl. data), nuclear restriction fragment polymorphisms markers (Amstrup *et al.* 1993), and DNA fingerprinting (Paetkau *et al.* 1995). Only DNA fingerprinting revealed significant population genetic structure in polar bears. Using eight highly polymorphic nuclear microsatellite loci, Paetkau *et al.* (1995) observed significant differences in allele frequency among four populations collected from the northern Beaufort Sea, southern Beaufort Sea, western Hudson bay, and the Davis strait off the Labrador coast. Measure of genetic distance between populations reflected the geographic separation of populations, but also revealed patterns of gene flow that are not obvious from geography and may indicate movement patterns of the individuals. In addition, assignment tests based on an individual's eight locus genotype placed individuals in the correct region 94% of the time, and in the correct population 60% of the time.

Population genetic structure of the American black bear has been examined using DNA fingerprinting (Paetkau *et al.* 1994), mtDNA restriction enzyme digestion (Cronin *et al.* 1991b) and mtDNA sequence analysis (Paetkau and Strobeck in press; Wooding and Ward in press). DNA fingerprinting analyses of Canadian black bear populations using four hypervariable microsatellite loci revealed considerable population structure, but the populations were not geographically close enough to examine gene flow patterns. MtDNA analyses of black

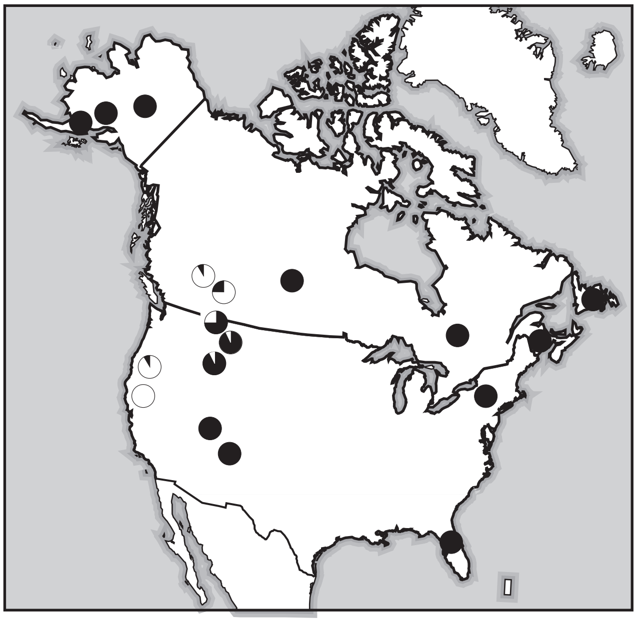


Figure 3.2. **Relative abundance of two mtDNA phylogentic clades of black bears in 18 North American populations. The circles represent pie graphs of the proportion of samples that were classified in clade A (black) or clade B (white). (Figure modified from Wooding and Ward in press)**

bears from throughout North America have identified two phylogenetic clades (Figure 3.2). In Alaska, eastern Canada, New Hampshire, New Mexico, Florida, only Clade A has been detected. In northern California, only clade B has been detected. Both mtDNA clades have been observed in Oregon, Montana, and the East and West slope of the Canadian Rockies. Within the region that includes individuals from both clades a general pattern emerged with a higher percentage of clade B individuals in the western part of this region and a higher percentage of clade A individuals in the eastern part of this region.

Implications and future directions

MtDNA clades with significant phylogeogenetic divergences have been detected for the brown bear and the American black bear using mtDNA analyses. If these results are used to infer female migration, the geographic distribution of these clades suggests historical separation of maternal ancestors followed by limited maternal migration. Currently, there are no genetic data from independent molecular markers to verify these phylogenetic groupings. Thus, classification of mtDNA clades as ESU's is premature, and future analyses of nuclear genes and Y chromosome genes are necessary to determine if paternal gene flow patterns also reflect similar phylogenetic groupings. However, until such data are generated managers should preserve the clades that have been identified and avoid transplantation of individuals from one clade into a region that currently contains a different clade. Currently, the presence of mtDNA phylogenetic clades is being considered in conservation plans for augmentation of endangered populations in Europe and North America.

Microsatellite analysis of polar bear populations has revealed genetic distinctiveness between individuals from different geographic regions in the Canadian Arctic. These data suggest that gene flow between local populations is restricted although long-distance seasonal movements have been documented among polar bears. This study also demonstrates the promising potential of microsatellite analysis for detecting population structure within species with low genetic diversity. Currently, there is little or no knowledge of population genetic structuring within the Asiatic and South American bear species. Thus, future efforts to obtain multiple samples from throughout the range of these species should have high priority.

3. Genetic diversity within populations

A primary role of population genetics in the context of conservation biology is to address questions relating to the loss of genetic diversity in populations whose size and connectivity has been reduced through human action. The immediate concern is that inbreeding depression will cause fitness problems that may threaten the survival of such populations. Also, the evolutionary options open to these populations will be reduced since genetic variation is the raw material of evolution (Franklin 1980; Soulé 1980). These concerns are particularly relevant for large mammals, like bears, whose populations consist of small numbers of individuals distributed at low density.

The amount of neutral genetic diversity found in a population at equilibrium is a function of the rate at which new genetic variation arises through mutation or immigration and the effective number of individuals in the population (Hartl and Clark 1989). The concept of effective population size is introduced to deal with factors such as non-random variation in reproductive rates between individuals or sexes. Estimates of effective population size have been made for brown bears and are considerably smaller than actual population sizes (Allendorf and Servheen 1986; Craighead 1994). It has been suggested that effective population sizes should be kept above 50 individuals to avoid inbreeding depression, and above 500 or even 5,000 individuals to ensure survival on an evolutionary time scale (Franklin 1980; Soulé 1980; Lande 1995).

The first attempts to measure genetic diversity in bear populations were made with allozymes and restriction digests of mtDNA (Allendorf *et al.* 1979; Cronin *et al.* 1991; Larsen *et al.* 1983; Manlove *et al.* 1980; Wathen *et al.* 1985; Shields and Kocher 1991). These methods proved largely uninformative because the markers only detected low levels of genetic variation. More recently, eight highly variable nuclear markers (microsatellites) have been applied to population studies of North American bears and have revealed considerable genetic variation (Paetkau and Strobeck 1994; Paetkau *et al.* 1995; Paetkau *et al.* in preparation). In addition, a large amount of mitochondrial sequence data are now available for brown bears bringing the number of markers employed in large population surveys to nine (Kohn *et al.* 1995; Randi *et al.* 1994; Taberlet and Bouvet 1994; Taberlet *et al.* 1995; Waits *et al.* 1998b; Talbot and Shields in press a).

The matrilineal inheritance pattern of mtDNA makes this marker more sensitive to reductions in population size (Avise *et al.* 1984) but insensitive to male-mediated gene flow. The result is that nuclear (biparentally inherited) markers and mitochondrial markers provide different but complementary views of changes in genetic variation. The importance of connectivity in maintaining genetic diversity has been investigated in North American black bears and brown bears by studying microsatellite diversity in insular and peninsular populations (Paetkau and Strobeck 1994; Paetkau *et al.* submitted). In these studies, peninsular populations show significant reductions in genetic variation relative to more central populations (Table 3.1). Insular populations, including Kodiak brown bears and Newfoundland black bears with population sizes of over 2,000 and 6,000 animals, respectively, have dramatically reduced levels of genetic variation. Similarly, brown bears from the recently isolated Yellowstone ecosystem appear to have lost genetic variation. A similar study of brown bears on the island of Hokkaido also found low levels of genetic diversity, but methodological differences complicate direct comparisons to North American data (Tsuruga *et al.* 1994).

Table 3.1. Mean heterozygosity (H) and total probability of identity [P(ID)] in a selection of North American bear populations using eight highly variable microsatellite loci. Data are from Paetkau and Strobeck (1994), Paetkau *et al.* (1995), Paetkau *et al.* (in prep.), and Paetkau (unpubl.)

Population (2N)	H	P(ID)
Brown bears		
Kluane NP (102)‡	76%	1 in 260,000,000
Richardson Mts. (238)	76%	1 in 290,000,000
Coppermine (76)*	60%	1 in 780,000
Seward Peninsula (30)	72%	1 in 15,000,000
Alaska Peninsula (28)	53%	1 in 28,000
Kodiak Island (68)	27%	1 in 93
Yellowstone (108)	56%	1 in 152,000
American black bears		
Banff NP (64)‡	82%	1 in 7,200,000,000
Newfoundland Island (46)	43%	1 in 1,300
Polar bears		
Hudson Bay (60)‡	63%	1 in 1,300,000

* Coppermine is in the middle of the peninsular barren-ground distribution of brown bears in the Northwest Territories.
‡ The values observed for these populations, which are part of relatively continuous portions of the species distributions, are typical of values observed in several other populations studied in each of the three species.

Genetic diversity data from nuclear microsatellite markers are also available for four Canadian polar bear populations (Paetkau *et al.* 1995). These populations have lower levels of diversity than observed in most continental populations of black and brown bears, but higher diversity levels than observed in insular populations of American black and brown bears. One possible explanation for this observation is that the global polar bear population is estimated to be approximately 25,000 (IUCN/SSC Polar Bear Specialist Group 1995), a value much lower than the estimates of North American brown or black bears.

Implications and future directions

Taken together, these results indicate that the maintenance of genetic diversity in North American bears at levels close to historical diversity levels will require: 1) populations numbering in the many thousands, or 2) the maintenance of gene flow between smaller populations. The results from island populations demonstrate that it is possible for populations to persist for thousands of years with dramatically reduced variation, however, they do not indicate whether survival is likely in the majority of cases, plus the fitness and evolutionary implications of such reductions remain uncertain. Clearly the goal of maintaining high levels of genetic diversity within populations will be difficult or impossible for some bear species, like the giant panda, where total population numbers are already well below targets for the long term maintenance of genetic variation.

While the population genetics of North American bears are becoming well studied, there is a conspicuous lack of data for bears on other continents. A major barrier to obtaining these data is the high cost and effort involved in collecting DNA samples. This stumbling block may be partially reduced, however, now that techniques have been developed to isolate DNA from hair (Taberlet and Bouvet 1992) and scat (Höss *et al.* 1992) samples collected in the field. Hopefully, these methods will make studies of population genetics in European, Asian, and South American bears possible in the near future.

4. Ecological applications

The highly variable nuclear markers that have been used to study the population genetics of North American bears can also be used to address questions at the individual level since these markers are so variable that they produce an effectively unique genetic identifier, or 'DNA fingerprint'. These DNA fingerprints can be used in various applications to identify individuals and their immediate relatives. Perhaps the most basic item of ecological information that is required for making informed decisions about the conservation of bears is a census of the numbers of individuals that exist in any particular population. Currently, there is very little information on population sizes for most populations of bears, particularly for Asian and South American species.

The use of a DNA-based population census may eliminate some of the logistical barriers to estimating population numbers. By combining the ability to identify individuals using DNA fingerprinting with the ability to collect hairs from scent-baited barbed wire enclosures, it is now possible to conduct a mark-recapture population census without actually handling individuals (Woods *et al.* 1996). The sex and species of the individuals from which hairs are collected can also be identified by using genetic markers on the X and Y chromosomes (Taberlet *et al.* 1993) and on the mtDNA molecule, respectively (Waits and Ward in press). This DNA-based approach to censusing has two major advantages over traditional mark-recapture methods: 1) it requires relatively simple and inexpensive field technology, and 2) it eliminates the necessity of physically capturing and handling individuals; an important benefit when studying small and endangered populations.

A second application of DNA fingerprinting in an ecological context is the reconstruction of pedigrees. This approach has been used to study male productivity and multiple paternity in North American black and brown bears (Craighead *et al.* 1995, Schenk and Kovacs 1995). If this type of pedigree information is combined with home range data from telemetry studies, it should be possible to gain a better understanding of the landscape requirements of populations. For example, the area occupied by several generations of related individuals could be identified. One limitation of this approach is that it requires very high sampling density, which may not be feasible in many studies. In addition, inherently low levels of genetic variation in small isolated populations may limit the power of these techniques.

An exact description of parent-offspring relationships is also critical in the genetic management of captive-bred populations. These populations, which may play an increasingly important role in the conservation of some bear species, are now managed explicitly to avoid inbreeding while simultaneously preserving the genetic variation present in the founding wild-caught individuals (Ryder 1994). DNA fingerprinting is now being used to confirm pedigrees in all non-North American species of bears (Zhang *et al.* 1994; Paetkau, D., Fain, S., and Strobeck, C. unpublished).

In the past, conservation biology literature has tended to consider ecological and genetic research as completely distinct areas, and workers in these two fields sometimes give the impression that they are working against each other (Caro and Laurenson 1994). With recent developments in molecular biology, it is now time to recognize that there is much to be gained by narrowing the gap between these two fields of study. The recent work on the ecological genetics of bears strongly demonstrates the rewards that can be realized when ecologists and geneticists combine their skills to approach problems of common interest. It is hoped that this type of collaborative research will grow to encompass more species of bears as well as other natural populations.

5. Forensic applications

Bears around the world are being killed in large numbers because of the value of their body parts. For some species, this source of mortality may actually constitute the single most important threat to survival. Eliminating the destruction of bears for financial gain is a task that will require complex cultural, economic, and legal changes, as well as the development of forensic methods for determining the origin of bear parts. Currently, DNA analysis can provide four distinct types of information to forensics studies: 1) species identification, 2) identification of geographic origin, 3) sex identification, and 4) individual identification.

Early attempts to identify bear species from tissue samples involved the use of protein electrophoresis to distinguish between American black and brown bears (Wolfe 1983). More recently, mtDNA sequence polymorphisms have been used to distinguish between North American bear species (Cronin *et al.* 1991; Shields and Kocher 1991) and between all eight species of bear (Fain *et al.* 1995; Waits and Ward in press). One of the most relevant examples of species identification from forensic samples in bears is the identification of the species from confiscated gall bladders. The U.S. Fish and Wildlife Service Forensics Laboratory reports that sufficient DNA for species identification has been obtained from gall bladders in approximately half of the cases attempted (Stephen Fain pers. comm.)

Once species identification has been accomplished, it is useful to obtain as much information as possible about the geographic origin of the sample. This information can be used to determine if the individuals come from areas closed to hunting and to assess the degree to which different regions are providing samples for markets such as the gall bladder trade. As discussed in section 2, mtDNA lineages display strong phylogeographic sorting in American black bears and brown bears. A similar pattern has also been observed in sloth bears from India and Sri Lanka (Fain *et al.* 1995). The use of several nuclear markers can also provide considerable information about the origin of individuals. For example, in a population survey of polar bears, researchers were able to trace the origin of an individual to the eastern or western side of the Canadian Arctic with 93% accuracy (Paetkau *et al.* 1995). Similar results have been obtained in North American brown bears (Paetkau *et al.* in prep). The major prerequisite for using molecular methods to determine the geographic origin of samples is the availability of data on geographic distributions of genetic variation, and the collection of these data represents a major challenge for the future.

Molecular forensic identification of the sex of a sample has various applications for enforcing hunting regulations. For example, identification of sex can be used to uphold restrictions on the sex of animals that are open for hunting, and it can be used to provide basic information about the degree to which the different sexes are being harvested. Two related methods have been developed for identifying the presence of a Y (male) chromosome in bears (Amstrup *et al.* 1993; Taberlet *et al.* 1993). These methods have been used successfully to identify sex in polar bears (Amstrup *et al.* 1993), brown bears (Taberlet *et al.* 1993), and American black bears (Woods *et al.* 1996).

The final application of molecular genetics to forensic investigations is the use of DNA fingerprinting to match biological samples from the same individual. The eight nuclear microsatellite markers used for population studies in North American bears are sufficiently variable to distinguish between individuals with the exception of island populations, such as Kodiak brown bears, where genetic variation is dramatically reduced (see Table 3.1). The identification of individuals using DNA fingerprinting has been successful in forensic cases involving bears killed illegally in Canada (John Coffin, research associate, University of Alberta, pers. comm.) and in the United States (Stephen Fain pers. comm.) For example, a group of Canadian hunters were recently charged based on DNA evidence that was extracted from blood on a plastic bag and definitively matched to one of five bears that had been shot illegally.

The current progress in wildlife forensics has demonstrated the utility of molecular genetics, but there is still much to attain. One major difficulty in molecular forensic work is the use of samples that provide only small and degraded segments of DNA. Pioneering steps have been taken in bear forensic identification using small amounts of DNA collected from hair and scat samples (Taberlet and Bouvet 1992; Höss *et al.* 1992), and other non-traditional sources of DNA that have been used successfully in wildlife forensics cases include blood stains on rocks and soil, plus decayed bones (John Coffin pers. comm.) While these forensic DNA samples have been successfully utilized in a number of situations, additional technological development is necessary to realize the full potential of these non-traditional sources of DNA. In closing, it is extremely important to standardize wildlife forensic techniques in order to obtain the rigorous standards established in human forensic studies. As this effort progresses, it is likely that DNA evidence will become a standard part of legal cases involving bears and other wildlife species.

Chapter 4

The Trade in Bears and Bear Parts

Christopher Servheen

Introduction

Parts of bears have been used in traditional Chinese medicine for thousands of years in Asia. The use originated in China, and then was adopted by users in Korea and Japan. Today, the use of traditional Chinese medicine is widespread throughout Asia and in Asian communities in North America and Europe. Bear bile from the bear gall bladder is one of the most treasured of traditional Chinese medicines. Prescriptions for bear gall first appeared in writing in the 7th century (Bensky and Gamble 1986). Bear parts once used in traditional medicine include fat, meat, paws, gall, spinal cord, blood, and bones (Read 1982). Practitioners of traditional Chinese medicine prescribe bear gall for serious liver diseases, heart disease, hemorrhoids and other illnesses (Mills and Servheen 1991). Bear bile is believed to have special qualities to treat ailments of the liver, stomach and a diverse illnesses from fever to digestive disorders. The use of traditional medicines such as bear gall has continued despite the westernization of many Asian countries and the rapid increase in wealth in certain Asian countries such as Taiwan, Japan and South Korea, and China (Mills and Servheen 1991). Bear skins are also valued for trade in some areas.

Bear bile from wild bears is difficult to obtain today as many populations of Asian bears have been reduced in numbers and range due to a combination of habitat loss and excess killing, much of which is for the use of bears in traditional medicine. This combination of rarity and assumed potency makes bear bile one of the most valuable of traditional medicines.

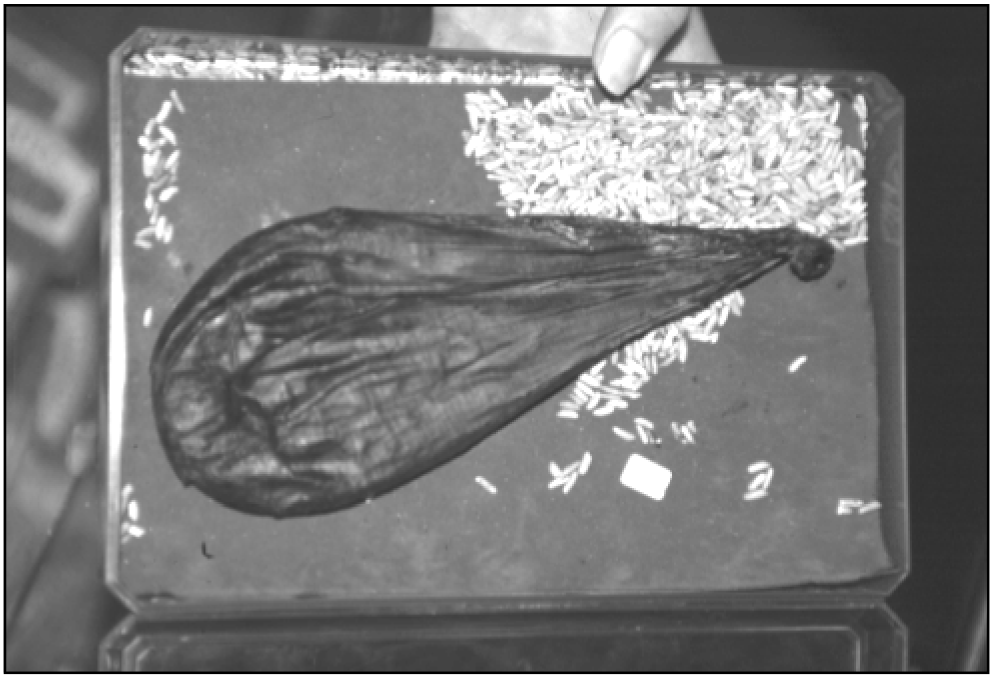
Origins of bile in trade

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is the foremost tool for regulating international trade in wildlife and currently has 143 signatories. The Convention prohibits international trade for commercial purposes for those species which may be threatened with extinction and are listed under Appendix I of the Convention. Appendix II lists species which are not now threatened by extinction, but which may become so if trade is not strictly regulated and monitored. Commercial trade in Appendix II species is allowed only if the state of export issues permits reporting that the trade will not be detrimental to the survival of the species in the wild. All species of bears are included in

Table 4.1. Bear species and their listing under CITES.

Scientific name	Common name	CITES listing
Ailuripoda melanoleuca	Giant panda	I
Helarctos malayanus	Sun bear; honey bear	I
Melursus ursinus	Sloth bear	I
Tremarctos ornatus	Spectacled bear	I
Ursus americanus	American black bear	II
Ursus arctos (all North American populations except *U. a. nelsoni*.)	Brown bear; grizzly bear	II
Ursus arctos nelsoni [1]	Mexican grizzly bear	I
Ursus arctos (all European populations)	European brown bear	II
Ursus arctos (all Asian populations including Iran, Iraq, Syria, Turkey, and former USSR areas except those listed specifically as Appendix I)	Brown bear	II
Ursus arctos (Bhutan, Chinese, and Mongolian populations)	Asian brown bear	I
Ursus arctos pruinosus [2]	Tibetan blue bear	I
Ursus arctos isabellinus [2]	Red bear	I
Ursus maritimus	Polar bear	II
Ursus thibetanus	Asiatic black bear	I

[1] Extinct
[2] The Bear Specialist Group is on record against the subspecific designation for *U. a. pruinosus* and *U. a. isabellinus* and instead believes these brown bears should be identified on the basis of geographic distribution



Asiatic black bear (*Ursus thibetanus*) gall bladder for sale in Singapore.

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either Appendix I or Appendix II of the Convention (Table 4.1).

Asian countries with low economic wealth levels and/ or little belief in traditional medicine are usually exporters of bear parts to more wealthy countries. Exporting countries include Russia, Laos, Vietnam, and Nepal where belief in the traditional medicine involving bear parts product is low and economies are weak, China where belief is strong but need for export income is high, and perhaps the United States and Canada where belief is limited to some Asian communities and bear populations are high. Until recently, South Korea, Hong Kong, Taiwan, and Japan were economic powers with considerable wealth, and prices for bear bile were highest in these countries (Mills and Servheen 1991, Mills *et al.* 1995). North American bears are also a source for bear bile used in Asia and in Asian communities in the USA and Canada. The specific numbers of bear parts in the bear trade are unknown as most of the trade is illegal and thus not reported. This lack of information on the numbers of parts in the illegal international market confounds understanding of the impacts of the trade.

Use and demand for bear parts is also high in Asian communities in Canada and the USA where the use of traditional medicine is often mixed with more "western" medical treatments. In many Asian medical communities, the use of traditional medicines is increasingly combined with "western" medicine. Belief in the value of many traditional medicines exists in a high percentage of Asian residents, and for serious illnesses, such as liver disease, valued traditional medicines such as bear bile are sometimes combined with "western" medical drug therapy and even surgical procedures.

Value of bear parts

Prices for bear bile have risen as the availability of the product declines and as users become more affluent. Documentation of this rise in prices is confounded in recent times by changing currency values, opening of international borders, and increasing amounts of farmed bile and counterfeit bile in markets in Asia. Many users of traditional Chinese medicine have the wealth to pay extreme sums for medicinal products. Bear bile is expensive because of the rarity of wild bears in Asia and the difficulty of obtaining bile from wild bears. Bile from wild bears is thought by many users to be more potent (Mills and Servheen 1991) and thus more valuable than bile from captive bears. Prices paid for individual wild bear gall in 1995 varied from US$5 to US$500 per gram (Table 4.2) (Mills *et al.* 1995). An

Table 4.2. Retain prices for bile being sold as bear bile in Asia, 1994–1995 (from Mills *et al.* 1995).
Prices are US$ per gram. Some of the bile in this survey was likely either of undocumented origin to the seller or was known to be from animals other than bears. This is the reason for the wide diversity in price.

Origin	Hong Kong	Macao	Korea
Australia	-	$21	-
China	$17–35	$1–69	$10–167
Europe	-	$52	-
Hong Kong	-	-	$63
India	-	$27	-
Nepal	-	$7	$50
Russia	$45	-	$23–167
Unknown	$21	$5–14	$13
USA	-	$5	$33–100
Zoo	-	-	$500

Table 4.3. Bear gall bladder prices in North America by level of the market for some US states and Canadian provinces in 1994–1995 (from Mills *et al*. 1995; Rose and Gaski 1995; Gaski 1997).
Prices are US$ per whole gall bladder unless otherwise specified. Underlined state/province allowed sale for year of survey.

Origin	Year	Hunter	Middle-man	Retail
Idaho	1994	$20–25	-	-
Colorado	1994	$40–120	-	-
Maine	1995	$45–50*	-	-
Arizona	1994	$50–25*	-	-
Saskatchewan	1994	$80–100	-	-
		$7–9/gram	-	-
Washington	1994	$100–150*	-	-
British Columbia	1994	$150–250	$800	$1,200
		$7–9/gram	-	-
Manitoba	1994	$8–15	-	-
California	1994	$180–200	$400	$1,200–2,000
Alaska	1994	$250–1,000[1]	-	-
		$40/ounce - $40/gram	-	-
	1995	-	-	$1,000–1,800
Price Range	1994–1995	$20–150	$800	$1,000–2,000
	1994–1995	$45–250*	-	-
	1994–1995	$250–1,000[1]	-	-

* Wet weight for whole gall bladder.
[1] Brown bear (*Ursus arctos*) gall specifically.

extreme price was as high as US$55,000 for a gall bladder from an illegally killed Asiatic black bear in South Korea (Mills and Servheen 1991).

Value of bile increases as it moves up the marketing ladder. A gall bladder that may cost US$150 if bought from the hunter in North America may cost US$1,200 or more at the retail level in North America (Table 4.3) and more in Asian retail markets. Prices for entire gall bladders are less expensive per gram than prices for small amounts of bile. The average dried bear gall bladder can range in size from 50 to 125g.

Prices vary according to the location of sale, proof of authenticity, and eagerness of the buyer. The highest prices have been recorded in South Korea where the use of bear bile is highly favored, local populations of Asiatic black bear are extinct in the wild, and where economic prosperity has given many people the ability to pay such high sums for medical products. Bile from wild bears draws the highest prices (Mills and Servheen 1991). Asiatic black bears were the origin of most bear bile for thousands of years of traditional Chinese medicine, and this is the species of preference for many users. However, since bile is unrecognizable as to species of origin, the species of bear is usually of little interest at the retail bile sale level.

There is considerable counterfeit bear bile for sale throughout the traditional medicine market ranging from 98% to 26% of tested samples (Table 4.4). False marketing is simple because gall bladders and the bile itself cannot be reliably differentiated by sight and color between species as different as bears, pigs, goats, cows, and even humans. Some traditional practitioners claim to be able to identify bear bile by sight, taste, smell, and through various "tests" such as placing some bile in a water glass and observing how it sinks to the bottom or how fast it dissolves. The precise effectiveness of such identification procedures are unknown, but some dealers believe their methods have great accuracy and are willing to pay considerable amounts for bile determined as authentic by such methods. The extent of false bile in the market is very high (Table 4.4) due in large part to the ease of deception, the rarity of wild bear bile, the ease of counterfeiting, and the high value of the product. Even manufactured traditional medicines said to have bear bile as an ingredient and which are commonly produced in China, Hong Kong and other

Table 4.4. Authenticity of bear gall bladders purchased from legal sources or seized from illegal trade as confirmed by chemical analyses (Mills *et al*. 1995; McCracken *et al*. 1995; Lau *et al*. 1994; California Dept. of Fish and Game 1992; Gaski 1997).

Origin	% actually bear	Sample size
Illegal market		
Asia[1]	2	n=143
California	10	n=?
Canada	74	n=489
United States	49	n=871
Legal market		
Hong Kong	35	n=81
Taiwan	63	n=24

[1] Samples seized in Hong Kong, India, Malaysia, and Taiwan.

areas may contain little real bear bile. Of five such manufactured traditional medicines tested, only two contained actual bear bile (Gaski 1997).

Bear farming

An important new activity associated with the trade in bear bile is the commercial farming of bears for production of bile without the need to kill the bear. This practice began in 1984 when North Koreans succeeded in extracting bile from living bears (Fan and Song 1997). The practice quickly spread to China which now is most active in the bear farming business. As of 1996, there were reported to be 481 bear farms in China holding 7,370 Asiatic black bears (*Ursus thibetanus*), 263 brown bears (*Ursus arctos*), and 9 sun bears (*Helarctos malayanus*) (Fan and Song 1997). Previously it was rumored that the goal of Chinese bear farming was to establish 40,000 bears in active bile extraction farms (Mills and Servheen 1991). This goal is now questionable considering that prices for farmed bile have decreased since 1988 from $2,400/kg to $360/kg in 1996 (Fan and Song 1997). Farmed bile production from a captive bear averages 1,500g/year. The total bile production of all Chinese bear farms was 7,800kg in 1995 (Fan and Song 1997). If these figures are correct, the reported annual production of 7,800kg would equate to 5,200 captive bears in farms producing 1,500g each annually.

Production of bile from captive bears involves surgically placing a tube in the bile duct of the living bear and draining bile into a tube that is periodically drained or continuously drained into a container or plastic sac. The donor bear must be restrained so they do not pull out the tube. Restraint is accomplished by placing the bear in a squeeze cage so that it cannot stand, move, or turn around for the months that the tube is in place and the bile is being drained. Another method of restraint involves fitting the bear with a "jacket" to prevent it from reaching the area where the tube exits the abdomen. Impacts on bears subjected to such treatment can produce physical and behavioral abnormalities, systemic infection, pain, discomfort, suffering, and even death (Robinson 1997).

There is continuing debate about the value of bear farming to conservation. It is fair to say that there are some conservation advantages and disadvantages to bear farming. While it is true that farmed bile does replace some bile from wild bears in the market, there also continues to be demand for wild bear bile which is thought to be more potent and effective in traditional medicine. It is well-known that there are three types of bear bile recognized by most marketers and practitioners of traditional medicine: real bile from wild bears; counterfeit non-bear bile from other species sold as bear bile; and bile from farmed bears (Mills *et al.* 1995; Gaski 1997). Bile from wild bears has the highest value (Mills and Servheen 1991). This three-tiered market and the fact that farmed bile is of less value medicinally and financially than bile from wild bears means that there will continue to be demand for bile from wild bears no matter how much farmed bile is available (Servheen 1997). This is especially true for those users who can afford to pay for the wild product. Another potential problem with production of farmed bile is by making bear bile more available in the marketplace farmed bile promotes and accelerates the demand for bear bile among a wider consumer audience. This relationship between increased availability of product and increased demand is substantiated by the statement of an Asian dealer in bear bile (cited in Gaski 1997, p. 65) that dealers in bear bile "began buying pig and cow gall bladders in the USA more than a decade ago in order to increase supply and therefore demand for galls". Bear farms are commercial operations requiring considerable investment and capital for maintenance and upkeep of resident captive bears. When prices and demand for farmed bile decline as they have in recent years, there is a need for increased marketing and promotion of bile. Bile farming legitimizes the use of this product whose use has detrimentally impacted wild bear populations throughout Asia. While this legitimization due to farming and commercial sale of bile is not the sole factor maintaining the bile trade, it does increase the trade and the acceptability of such trade.

The future of trade in bear parts in North America

As Asian bear populations decline and wild bear bile and other bear parts become more difficult to obtain, sources of bear parts outside Asia will be developed by traders and others willing to make significant profits. North America has more bears than all of the rest of the world combined. Increasing Asian populations in many urban areas of both Canada and the USA bring with them their beliefs and demands for traditional products. Many of these people also recognize the disparity in demand and price for bear parts between North America and Asia, and see a way to make profits from this disparity. Bear bile and gall bladders are easily smuggled and inspection of luggage for such items on leaving Canada and the USA is limited. Asian communities in North America are increasing demand for traditional medicine products within the continent. Laws concerning the commercial sale of bear parts vary throughout Canada and the USA complicating matters for law enforcement professionals. All of these factors contribute to the increase in trade of bear parts, particularly gall bladders, in North America.

Commercialization of wildlife and unregulated trade have been contributing factors in the reduction and loss of many wildlife species. At the turn of the century in North

America, populations of ducks were killed for commercial meat sale, egrets were sought for their tail plumes, beaver were sought for their fur, and even elk and deer in many areas were at an all-time low due to unregulated commercial activity to kill these animals and sell their parts for profit. Tens of millions of bison were wiped out as a wild species on the great plains due to commercial killing in just 40 years. Today, populations of rhinos and Siberian tigers are on the verge of extinction due to demand for their parts for use in traditional Chinese medicine and in Yemen in the case of rhinos. Elephant populations throughout Africa were depleted due to world demand for ivory. Once commercial profits can be made from anything including wildlife, there will be those who will try to make that profit despite laws to the contrary. The ongoing trade in illegal drugs is an example of this. The tendency to trade in such items is increased with increasing profit. The prices paid for bear bile in wealthy Asian countries now rival the prices for illegal drugs. In many areas of Asia it is thought that the organized networks selling drugs also handle bear gall bladders because of the high profits involved. The only difference is the limited fines and minimal risk of jail time in selling bear parts. Given this combination, it is likely that the demand for trade in bear parts will increase in North America. As wild bears in Asia continue to decline, North America will be one of the only places in the world to obtain gall bladders from wild bears. Demand for traditional Chinese medicine products is solid and may be increasing. Today there are 1.2 billion potential or actual users of traditional Chinese medicine worldwide. This demand will continue to fuel trade in bear parts unless changes in belief systems, or law enforcement and legal penalties can limit such activity.

Control of trade in bear parts

The control of trade in bears and bear parts is one of the most difficult of all bear conservation issues. No clear solution exists. However, the recent dialogues between conservationists and traditional Asian medicine practitioners give cause for optimism. There is a growing realization that the two groups can work together, respecting each other's beliefs to achieve a common purpose. It is clear that certain products in traditional Asian medicine cannot be substituted at present, and for these products, careful husbanding of the resource is necessary to ensure long-term survival of the species, both from a conservation perspective and from the perspective of supplying needed ingredients. Care must be used in any approach because the belief systems associated with the use of traditional Chinese medicine are rooted in the cultural systems of Asian society and criticisms of the belief system can be interpreted as criticism of the society and culture that developed this belief system.

Sas-rolfes (1997, p. 91) has suggested that a legal ban on trade would drive up the illegal market price for bear parts, drive up the poaching of wild bears and increase factory farming of bears in China. He also believes that elimination of farming would only increase pressure on wild bears. He advocates a three part approach:

1. Gain control of the supply of bear parts without restricting it unnecessarily. This would require adequate field protection, backed by appropriate law enforcement and carefully designed regulated harvesting.
2. Facilitate and expand the legal supply of bear products to out-compete illegal suppliers. This could imply more humane forms of bear farming, or better collection techniques of products from wild-hunted bears.
3. Encourage consumers to change their tastes and to substitute products. This implies concerted, long-term campaigns using moral persuasion to convince consumers of bear products to change their cultural attitudes and habits.

Servheen (1997, p.237–239) proposed the following alternate plan of action to limit the trade and its impacts on bear populations:

A successful approach to management of the trade in bears and bear parts will have multiple targets and each target will have to be addressed simultaneously for success:

1. Maintain regulations with continued efforts to improve standardization of existing regulatory mechanisms. This will send an important message to those involved in the trade. Conflicting laws in Canada and the United States relating to the trade in bear parts send a confused message to consumer countries. However, it is important not to be dependent on regulations.
2. Expand outreach efforts to consumers based on the impacts of the trade on wild bear populations and the availability and efficacy of alternatives to bear bile in traditional Chinese medicine. Such outreach efforts can best be done with consumer country government involvement and support.
3. Continue to send a clear message that farming of bears for bile production is not a solution for conservation of Asian bears. Farming of bile requires and is associated with marketing of the product. Marketing increases demand and makes use of bear bile acceptable. Farming of bile will continue a two-tiered consumer system: users of farmed bile and users of real bile with a large difference in price between them.
4. Expand our knowledge base of wild Asian bear populations. Documentation of the effects of trade as a mortality factor on Asian bear populations could be a key education and outreach tool as well as an important incentive to address the trade issue with more aggressive actions if necessary. Such research would also gather critical information on basic ecological factors on Asian

bear species necessary to their conservation and management. The basis of sport hunting of North American bears is careful limitation of mortality to sustainable mortality levels. This mortality management is based on sound biological information on the hunted populations. Mortality of Asian bear populations is not managed nor is it known what level of mortality is ongoing or sustainable. Given the demand for bears for traditional uses in Asia, and ongoing habitat losses due to human development and human population increases in Asia, this lack of knowledge about Asian bears is a recipe for disaster. Given what we know about Asian demand for bear parts, it seems reasonable to assume that mortality of many populations of Asian bears is excessive and not sustainable, and many populations and subpopulations are declining in numbers and range. The management of bear hunting at sustainable levels in North America is paid for by the hunters through purchase of hunting licenses. If users of bear parts in Asia supported research and management of Asian bear populations to assure that these populations could sustain the mortality resulting from the use of bear parts, there would be much less international conservation concern about such use.

5. We must continue to build ownership of bear conservation in Asia and worldwide. Interest in bear conservation is critical so people who use bear parts and live in bear habitat are willing to make the sacrifices to assure a future for wild bears. This ownership in bear conservation must be built through education and outreach efforts. Bears must have a value to local people if they are to be maintained and conserved at a local level. While this value may be related to sustainable use related to trade or hunting, it may also be an existence value, or value related to tourism. The importance of local value for the existence of animal populations is critical for their conservation, especially in areas where governments cannot afford elaborate conservation programs. This value will be built on local ownership of the animals and their continued existence.

There are four basic needs for successful Asian bear conservation programs for the bear populations most impacted by the trade in bears parts (Servheen 1998):

1. *Biological data* on Asian bear species.
2. *Social support* from those in bear range states and consumer countries built on an increasing awareness of the links between demand for bear products and the poor conservation status of many species and populations of bears in Asia.
3. *Political support* from central and local governments to achieve conservation success. There must be depth to this support so that necessary difficult decisions can and will be made when necessary to conserve bears.
4. *An organizational structure* including knowledgeable people in each country to enforce laws, develop and use biological data to properly manage bear populations, and to develop education and outreach programs for local publics.

The solution to the control and management of the trade in bear parts is not simple nor is it a one-step process. It will require further sensitive dialogue between conservationists and traditional medicine practitioners. It will require efforts to raise public knowledge of the endangered status of many species and populations of bears, and efforts to promote careful examination of existing beliefs in traditional medicine ingredients. The development of solutions for addressing the bear trade issue may well benefit from an examination of systems being tried for other endangered species which are also in demand for medicinal products such as rhinos, tigers, and musk deer. Successful management of the trade in bear parts will require understanding how and why people develop and maintain their beliefs in the use of some traditional wild animal products for medical purposes. The impacts of the bear trade on Asian bear populations cannot be assessed quantitatively, and it is clear that more information on the biological status of these populations and on the levels of off take for trade is urgently needed. Until more information is available on Asian bear populations, speculation about the specific impact of the trade in bears and bear parts on the conservation of Asian bear populations will be just that – speculation. However, even in the absence of detailed data, it is clear that the cumulative effects of habitat loss, human settlement in bear habitat, and the trade in bears and their parts creates a very serious threat to the future of Asian bears.

Chapter 5

Brown Bear Conservation Action Plan for North America

IUCN Category: Lower Risk, least concern **CITES Listing:** Appendix II
Scientific Names: *Ursus arctos*, *Ursus arctos middendorfi*, *Ursus arctos horribilis*
Common Names: brown bear, grizzly bear

Figure 5.1. Brown bear (*Ursus arctos*) distribution in North America.

Introduction

The brown or grizzly bear (*Ursus arctos*) is the most widespread of any bear species. In North America (where it is known as the grizzly bear) it is found throughout Alaska, into western Canada and in five subpopulations in the states of Wyoming, Montana, Idaho and Washington (Servheen 1990), see Figure 5.1.

Status and management of the brown bear in Alaska

Sterling D. Miller and John Schoen

Status of the brown bear

Alaska has the largest population of brown and grizzly bears (hereafter termed brown bears) of any state or province in North America. Internationally, larger populations occur only in Russia (Chestin *et al.* 1992). Brown bears in Alaska currently occupy all their historic range. In some portions of their range in Alaska, habitat destruction, hunting, and disturbance associated with development have reduced bear densities. Both North American subspecies are found in Alaska. *Ursus arctos middendorfi* occurs on Kodiak, Afognak, and other adjacent islands and *U. a. horribilis* occurs in the rest of Alaska and North America (Rausch 1963). Bears in coastal portions of south central and southeastern Alaska (including both subspecies) are commonly referred to as "brown" bears while those occupying northern and interior habitats are called "grizzly" bears. These distinctions have no taxonomic validity and, in this report, both are termed brown bears.

Brown bear populations throughout most of Alaska are stable (Miller 1993). There are concerns, however, because Alaskan brown bears face many of the same intolerant attitudes and threats that have led to extirpation of the species throughout most of their historic range in the lower 48 states and Mexico. Advances during the 20th century in ecological consciousness, legal protection, wildlife management, and the existence of large reserves of public lands in Alaska, however, appear adequate to assure the survival of both subspecies in Alaska through the 21st century. Reductions in population density and extirpation in some localized areas will likely occur in portions of Alaska during this period.

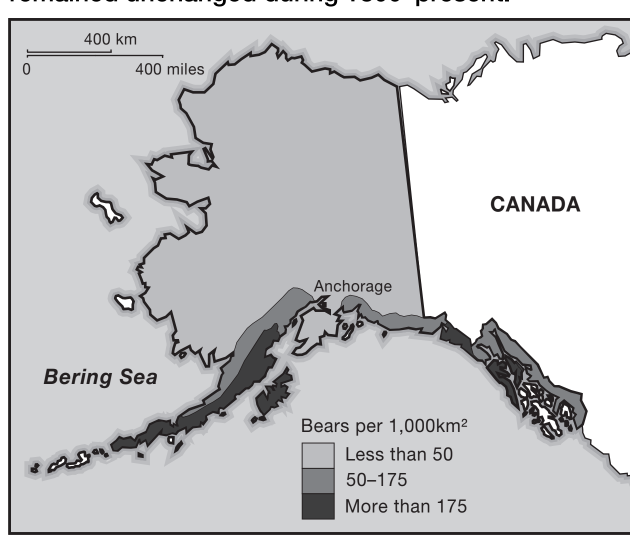
Distribution and density of brown bears in Alaska

Most of Alaska from sea level to approximately 1,500m elevation is occupied brown bear habitat (Figure 5.2). The subspecies *horribilis* occurs from Unimak Island, on the Aleutian chain, throughout mainland Alaska, to Alaska's north slope bordering the Arctic Ocean. Brown bears occur in the riparian corridors along the lower Yukon and Kuskokuim Rivers. A few wandering bears are occasionally found in the wetland delta habitat between these rivers but this area is not considered brown bear habitat (Figure 5.2). In Prince William Sound, they occur on Montague, Hinchinbrook, Hawkins, and Kayak Islands.

In southeastern Alaska, brown bears are abundant on Admiralty, Chichagof, Baranof, and Kruzof Islands but are absent from the more southern islands of Prince of Wales, Kupreanof, Etolin, and adjacent islands; a few wandering brown bears are occasionally found on Mitkof and Wrangell islands which are close to the mainland. In southeastern Alaska, black bears (*U. americanus*) and wolves (*Canis lupus*) occur on the large southern islands not occupied by brown bears (including Mitkof and Wrangell) but not on the northern islands occupied by brown bears. This distribution may reflect post glacial dispersal of brown bears from the north and by black bears from the south following retreat of Pleistocene glaciers (Klein 1963). Black bears, wolves, and brown bears are sympatric in many portions of interior Alaska.

The distribution of brown bears in Alaska appears to have remained relatively unchanged since European and Russian exploration during the mid-1700s (Figure 5.2). Brown bear densities vary greatly in different regions of Alaska. Density estimates conducted using standardized techniques (Miller *et al.* 1987) throughout Alaska reveal densities >175 bears/1,000km^2 in the coastal populations

Figure 5.2. Portions of Alaska occupied by high, intermediate, and low density populations of brown bears (*Ursus arctos*). Classifications were based on subjective extrapolations from areas where density was estimated through intensive studies (Miller *et al.* in prep.) Brown bear distribution in Alaska has remained unchanged during 1800–present.



of the Alaska Peninsula, Kodiak and Afognak Islands, and the northern islands of southeastern Alaska (Figure 5.2) (Miller *et al.* in prep.). Approximately 50% of Alaska's brown bear population occurs in these high density populations which represents about 8.5% of the brown bear habitat in the state (Figure 5.2). It appears likely that these high densities are supported in large part by abundant runs of up to five species of Pacific salmon (*Oncorhynchus* spp.) and lush plant and fruit resources found in these warmer maritime environments. Bears in these high density portions of the Alaskan coast are larger and generally darker than bears from interior and arctic regions of Alaska. These size and color differences have resulted in coastal bears being commonly called "brown" bears while the smaller and usually lighter-colored interior bears are called "grizzlies".

Densities less than 40 bears/1,000km^2 have been reliably estimated in the portions of interior Alaska without access to abundant salmon runs (Figure 5.2) (Miller *et al.* in prep.). These estimates range from 6.8/1,000km^2 on the coastal flatlands and adjacent foothills of the northeastern Brooks Range (Reynolds and Garner 1987) to 34 bears/1,000km^2 in Denali National Park (Dean 1987). These low density habitats represent about 84% of the brown bear's distribution in Alaska (Figure 5.2). Approximately 41% of Alaska's brown bear population lives in these low density habitats.

Intermediate densities of 40–175 bears/1,000km^2 are thought to occur in small areas of south-central Alaska near the coast and on the mainland in southeastern Alaska. These areas represent approximately 7.5% of Alaska's bear habitat and contain about 9% of the population (Figure 5.2). The classification of these areas as intermediate in density is based on subjective impressions; bear densities have not been directly measured in any of these areas.

There is no precise estimate on the number of brown bears in Alaska. During the period 1985–1992, however, information on brown bear density was estimated in 15 Alaskan study areas using standardized capture-mark-recapture techniques (Miller *et al.* in press). Density estimates using other techniques were available in four other areas (Miller *et al.* in press). In 1993, biologists from the Alaska Department of Fish and Game were asked to make subjective extrapolations from these density estimates to obtain population estimates for each of the 26 game management units in Alaska (Miller 1993). Biologists were also asked to subjectively estimate minimum and maximum numbers for their areas based on the reference density values. This resulted in an estimate of 31,700 bears in Alaska with a lower limit of 25,000 and an upper limit of 39,100 (Miller 1993). This estimate is lower than previous estimates for Alaska (Peek *et al.* 1987) not because bear populations have declined, but because of improved information on bear densities.

Legal status

State law (Alaska Administrative Code 5AAC 92.990) classifies brown bears as "big game." Under this classification brown bears may be legally killed by resident, non-resident, and subsistence hunters with the appropriate licenses and tags during specified seasons. In most of the state, hunters are not permitted to take a brown bear more frequently than once every four years. Hunters are not allowed to kill newborn or yearling cubs or female bears accompanied by cubs younger than two years old.

In addition to sport hunting, brown bears may also be legally killed in defense of life or property. Persons killing bears under such circumstances are required to file a report with a state wildlife protection officer and to surrender the hide and skull to the state.

Alaskan brown bears are on Appendix IIB of CITES. This listing is designed to protect threatened populations elsewhere in North America; the brown bear population status in Alaska is secure. Under this listing, a federal wildlife export permit is required before the hides or skulls of brown bears may be shipped out of the United States or transported through Canada.

Until recently, the State of Alaska has had almost exclusive management authority for brown bears and other species of non-endangered resident wildlife in Alaska. However, under the subsistence provisions of the 1980 Alaska National Interest Lands Act (ANILCA), the US federal government in 1990 assumed management authority for subsistence uses of wildlife, including bears, for rural Alaskan residents on most federal public lands in Alaska (about 62% of the state). Uncertainties associated with the recent mixture of state and federal management authority have created administrative and legal problems that have and will continue to complicate efforts to manage harvests of bears and other species in Alaska.

Population threats

Humans represent the most significant source of mortality on adult brown bears in Alaska. Humans kill bears for sport or subsistence, in defense of human life and property, and illegally for a variety of reasons.

Most hunting is for trophies but a small and under-documented proportion of the statewide hunting kill is for subsistence use by residents in rural villages. An unknown, but perhaps significant, amount of illegal killing also occurs throughout Alaska. Illegal kills occur in National Parks and other closed areas as well as in areas open to legal hunting. Although sale of bear parts is illegal in Alaska, the increasing value of these parts in overseas markets has doubtless resulted in an increased number of illegal kills. Throughout most of the state, the legal sport harvest is closely and accurately monitored and seasons and bag limits are adjusted to maintain harvests within levels thought to be sustainable.

In a few management areas in south-central and east-central Alaska, brown bear populations have been reduced through liberalized hunting regulations designed to reduce bear numbers. Such reductions are desired to increase moose (*Alces alces*) populations. Brown bears are known to be effective predators on newborn moose (Ballard *et al.* 1981; Ballard and Larsen 1987; Ballard *et al.* 1990), but it has not been demonstrated that these bear reductions have been successful in improving moose calf survivorship (Miller and Ballard 1992). The current areas where bears are being intentionally reduced are small and the management objectives for these areas require maintenance of "viable" bear populations. There is, however, widespread and vocal support for proposals designed to reduce bear numbers in many additional portions of Alaska (Miller and Ballard 1992). These proposals reflect a willingness to reduce bear populations thought to be too high for maximum moose production or from other human perspectives, including fear of or damage by bears. The intolerant attitude toward brown bears reflected in some of these proposals is similar to the attitudes that resulted in the extirpation of bears throughout much of their historic range in the United States (McNamee 1984; Brown 1985). Although, the bear reduction efforts ongoing in Alaska are geographically restricted and do not represent a threat to the species survival, they are a cause for concern.

Unintended declines in bear populations as a result of sport hunting can best be avoided by establishment of conservative harvest quotas (Miller 1990). Even with conservative quotas, legal sport kills combined with inadequately documented kills in defense of life and property, subsistence kills, and illegal kills may significantly deplete populations. Declines from this combination of factors may be gradual and go undetected for long periods because available methods for direct monitoring of bear population trends are imprecise and expensive (Harris 1986; Miller 1990; Miller *et al.* in prep.).

As human presence increases in once lightly occupied areas of bear habitat and in urban areas, killing of bears in defense of life or property has increased in Alaska (Miller and Chihuly 1987). Around urban centers and in heavily populated rural areas such as on the Kenai Peninsula, such kills are sufficiently frequent to have depleted local bear populations. The occasional human injury or death from bear attacks in Alaska increases fear of bears and these instances are usually followed by increased numbers of bears killed by persons who perceive bears as threats. Increased human presence and the commonly associated problem of bears being attracted to human foods and garbage increases the likelihood of damage to property or injury to people by bears (Herrero 1985). This pattern can initiate a cycle that may create population-level threats in large areas (Knight and Eberhardt 1988). With proper human behavior, education, and training, this cycle is not inevitable (Walker and Aumiller 1993; Aumiller and Matt 1994). The number of areas in Alaska where bear killing in defense of life and property will become significant sources of mortality will doubtless increase through the next century. This will lead to population reductions in additional localized areas and may reduce bear populations more widely in some important portions of Alaska.

Habitat threats

Alaska is unique among the 50 states in the USA because its major ecosystems are still relatively intact and they include healthy populations of all the large carnivores that existed prior to 1800. The vast tracts of undeveloped wildlands that still exist in Alaska bodes well for the future of brown bears in Alaska. For many of these lands, development is not imminent. However, some threats to brown bear habitat do exist.

Throughout the coastal rainforests of southeastern Alaska, industrial-scale logging on private and national forest lands is expected to significantly reduce brown bear habitat capability as important old-growth forest habitats are converted to second-growth plantations that are of limited value to bears and many other species (Schoen *et al.* 1994). Throughout much of this area, the timber harvests are concentrated in the highest-quality timber stands found in southeastern Alaska (Schoen *et al.* 1988). These stands are used extensively by brown bears during summer and have been identified as critical brown bear habitats (Schoen and Beier 1990). The impacts of this logging will be long-term and irreversible under current logging schemes. In addition, logging may reduce the long-term productivity of some of the region's important salmon spawning streams which would have obvious implications for bears.

In most of the rest of Alaska, brown bear habitat is still relatively intact and there does not appear to be a serious threat of losing significant habitat over the next 25 to 50 years. Although Alaska may not face the same level of habitat loss that has occurred throughout brown bear range in the lower 48 states, the suitability of bear habitat must incorporate the influence of human activities (Schoen 1990). Habitat fragmentation, roads, and garbage disposal are part of the infrastructure of resource development (logging, mining, petroleum development, hydropower development, agriculture, commercial and residential real estate development) that, along with tourism, is the major emphasis in Alaska's growing economy. These factors contribute significantly to direct mortality of brown bears as described below.

Management

Outside of National Parks, brown bears are managed for sustained yield harvests by hunters in most of the rest of Alaska. During the last decade, an average of 1,090 bears per year have been legally taken and reported in Alaska (Table 5.1). An unknown number of additional bears are killed annually and not reported. The number of bears harvested annually in Alaska has increased over the last three decades (Table 5.1). This increase reflects a rise in the popularity of bear hunting as well as expanding bear populations in some areas such as the Alaska Peninsula where populations are recovering from overexploitation during the late 1960s and early 1970s.

Except for rural subsistence bear hunters in northwestern Alaska, hunters are required to purchase a license and big game tag to hunt bears, and successful hunters are required to have the hide and skull of their kills examined and sealed by a representative of the Alaska Department of Fish and Game. During this examination, the sex of the kill is determined from the hide and a tooth is extracted from the skull to determine age by counting cementum annuli. Sport hunters may not take a bear more frequently than once every four years in most of Alaska. Compliance with kill reporting requirements is considered high in most areas of the state, but kills are underreported by hunters in many rural areas. Liberalized bag limits (1/year), elimination of the need to purchase a tag, and easier reporting mechanisms have been instituted in portions of rural northwestern Alaska in an effort to increase voluntary reporting of brown bear kills.

Table 5.1. Reported harvests of brown bear (*Ursus arctos*) in Alaska, 1961–1994.

Year	Harvest	Year	Harvest	Year	Harvest	Year	Harvest
1961	470	**1971**	739	**1981**	888	**1991**	1153
1962	534	**1972**	831	**1982**	823	**1992**	1285
1963	557	**1973**	924	**1983**	974	**1993**	1127
1964	634	**1974**	779	**1984**	1118	**1994**	1024
1965	776	**1975**	826	**1985**	1156		
1966	866	**1976**	832	**1986**	1121		
1967	790	**1977**	774	**1987**	1215		
1968	641	**1978**	818	**1988**	1104		
1969	510	**1979**	882	**1989**	1088		
1970	628	**1980**	882	**1990**	1145		
Mean	640.6	**Mean**	828.7	**Mean**	1063.2	**Mean**	1147.25

Table 5.2. Proportion of total area of brown bear (*Ursus arctos*) habitat in Alaska (1.48 million km^2), estimated brown bear population (31,700), and reported annual kill (10 year average = 1,078) in each of 3 density strata (>175, 40–175, and <40/1,000km^2).

	Percent of area (km^2)	Percent of estimated population	Percent of reported annual kill
High density	8.6	49.4	58.1
Intermediate density	7.3	8.9	9.2
Low density	84.1	41.7	32.7

The most popular brown bear hunting areas in Alaska are the Kodiak Archipelago, Alaska Peninsula, and northern islands of southeastern Alaska (Admiralty, Baranof, and Chichagof). In the Kodiak area, harvests have been limited by means of a lottery for hunting permits since 1976. On the Alaska Peninsula, harvest has been limited by closure of the area to bear hunting during alternate regulatory years since 1975. Together, 37% of the Alaska brown bear harvest derives from Kodiak and the Alaska Peninsula. An additional 10% of the harvest comes from high density populations on Admiralty, Chichagof and Baranof islands. Statewide, over half of the annual harvest comes from the high density south coastal populations where about half of the bear population occurs (Table 5.2).

Several areas in Alaska are also managed to provide enhanced opportunities for brown bear viewing. These include the McNeil River State Game Sanctuary, Denali and Katmai National Parks, O'Malley Creek on Kodiak Island, and the Stan Price State Wildlife Sanctuary on Admiralty Island. Anan Creek on the mainland in southeastern Alaska is being developed for black bear viewing. Public demand for bear viewing opportunities is higher than can be sustained without adversely impacting bears and the quality of viewing opportunities. Thus, human use is limited in some sites by access permits. As the tourism industry continues to expand in Alaska, public demand will likely grow for creating additional bear viewing sites.

Human-bear interactions

As generalist omnivores, brown bears recently occupied a wide range of habitats and had one of the greatest natural distributions of terrestrial mammals (Nowak and Paradiso 1983). Today, assuming the physical availability of suitable habitat, the most critical factor influencing brown bear conservation in Alaska and elsewhere is the degree of interaction with humans. Human populations in Alaska have increased dramatically. Prior to World War II, Alaska's human population numbered approximately 70,000. The Alaska population in July 1991 was estimated to be 570,000 and the state was listed as the second-fastest growing state in the nation between 1990 and 1991 (U.S. Commerce Department Census Bureau). Clearly, people will increasingly dominate the future landscape in Alaska.

As human populations expand and demand for resources increases throughout the industrial world, more pressure is placed on Alaska's natural resources. Today, resource extraction and tourism are the major industries shaping Alaska's economy. Major resource developments in Alaska include fishing, oil and gas development, logging, mining, agriculture, road and rail construction, real estate development, mariculture and aquaculture, and hydroelectric development. Logging, oil and gas development, and mining all require an extensive transportation infrastructure. This fragments previously inaccessible or lightly inhabited areas of bear habitat and increases opportunities for legal hunting as well as for adverse bear-human interactions including defense of life and property kills and illegal hunting. A direct correlation was found between autumn brown bear kill and cumulative kilometers of road construction on northeastern Chichagof Island during the period 1978 to 1989 (Titus and Beier 1991).

Outside of Alaska's major urban centers, the two regions most vulnerable to habitat fragmentation are the south coastal forests which are being extensively logged and the North Slope. Over the long-term, the transportation infrastructure will significantly increase the probability that individual bear home ranges will be bisected by a road or utility corridor. Increased human access inevitably leads to higher bear mortality (Peek *et al.* 1987; Miller and Chihuly 1987; McLellan and Shackleton 1988, 1989; Schoen 1990).

Another byproduct of development is garbage. Garbage dumps associated with mining, logging, petroleum development, and local communities have been an attractant for bears and resulted in significant bear problems throughout Alaska. Bears that become conditioned to humans and human foods usually become nuisances and may become threats to human safety (Herrero 1985). The usual result is that such bears are commonly killed. Such attractant sites end up as "population sinks" where bears are drained from ecosystems (Knight *et al.* 1988).

Although agriculture does not pose a serious threat to loss of bear habitat in Alaska, the livestock industry has the potential to significantly reduce bear populations through killing of bears seen as economic threats to livestock herders. Currently, the most significant threats derive from cattle ranchers on Kodiak Island and reindeer (*Rangifer tarandus*) herders in northwestern Alaska. Additional threats to bears would develop if schemes to develop moose or pig farming or to expand the area involved with reindeer ranching succeed.

Fish hatcheries and mariculture facilities developed within high-density coastal brown bear habitat are also potential sites of conflict. If human garbage, hatchery stock, and fish foods are not handled and secured properly, they may attract bears from long distances. As these facilities proliferate along the coast, a significant proportion of bears may be vulnerable to nuisance control actions.

Although most of Alaska's lands are public lands, parcels of lands selected by the State of Alaska have been widely converted to small privately owned plots. Many Alaskans have built recreational cabins on these plots in areas where there was previously little human presence or construction. Many of the persons using these cabins view bears as a threat to their personal safety and are angered by damage bears cause to their structures. There are currently places in the state where complaints from owners of these remote cabins have led to efforts to reduce bear numbers through increased hunting. It is probable that owners of these cabins also shoot many bears that are not reported as required by law. In some places, lands transferred to corporations of Alaskan natives under terms of the Alaska Native Claims Settlement Act have similarly been developed for maximum economic returns with corresponding losses to bear numbers and habitats.

Alaska's wilderness character has attracted adventurous travelers for more than a century but until recently only in small numbers. In 1951, fewer than 10,000 people visited Alaska. The Alaska Visitors Association estimated nearly one million people visited Alaska in 1992 generating $1.1 billion in revenue. Today, tourism has become Alaska's number one growth industry and is an important force in Alaska's economy. As more wilderness guides and tourists travel the back country, adverse encounters with bears will increase. On the positive side, however, there is an increasing demand for access to areas where tourists can view bears in natural settings and several bear viewing areas have been established in recent years. If managed carefully, such programs have the potential for educating people about the special needs of bears and increasing public support for bear conservation.

Public education needs

The image of the brown bear continues to both fascinate and frighten people. Improved public education will be an important component of conservation efforts designed to preserve this species in Alaska. Public education goals include educating visitors and Alaskan residents about ways to safely live, recreate, and extract resources in areas occupied by brown bears, and to provide the public with a balanced image of bear-human interactions. Goals for public educational efforts include: 1) reduce the number of human injuries by bears; 2) reduce the amount of property damage caused by bears; 3) reduce the number of bears killed unnecessarily, or in defense of life or property; and 4) increase hunters understanding of the need for conservative management of hunted bear populations.

Conservation recommendations

Research

1. Maintain long-term studies of hunted and unhunted bear populations in several different ecosystems within Alaska.

2. Quantify how human presence affects brown bear habitat use and population viability.
3. Quantify thresholds of habitat disturbance on bear population viability.
4. Develop cumulative effects models for development activities affecting regional bear populations.
5. Assess genetic variability of regional bear populations in Alaska.

Monitoring
1. Establish regional population benchmarks for selected brown bear populations throughout Alaska. These population estimates should be repeatable and include a measures of precision. These estimates are needed to monitor status and trends of populations so that management changes may be made before populations become threatened.
2. Monitor habitat integrity in selected regions of the state (e.g., North Slope oil fields, Southeast coastal rain forest, etc). Photographic and EROS satellite imagery will allow managers to track the habitat fragmentation by transportation and utility corridors and/or quantity and juxtaposition of clearcuts within a forest.
3. Continue to closely monitor sport harvest levels of brown bears within Game Management Units distributed throughout the state. Improve documentation of subsistence harvests, defense of life and property kills, and illegal kills.

Inventory
1. Inventory important/critical brown bear habitats within each region of the state.

Gap analysis
1. Conduct an analysis to determine regional gaps in habitat protection from an inventory of important/critical brown bear habitats.

Education
1. Develop a comprehensive bear safety education program with modules that cover recreation, industry, and rural residents. The purpose of this program will be to reduce defense of life and property kills.
2. Require bear safety training for resource agency, industry, and tourism organizations operating in bear country.

Policy
1. Develop improved interagency agreements on how to manage bear/human conflicts in Alaska.
2. Develop improved interagency agreements on solid waste management and bears in Alaska. The central focus for this policy should be the requirement for fuel-fired incineration of garbage at industrial camp sites and communities located in Alaska brown bear habitat.

Planning
1. Establish comprehensive regional planning as a major tool in bear management and conservation in Alaska. Regional plans should include a comprehensive inventory of brown bear populations and critical habitats with coordination among state and federal resource agencies and the Alaska Natural Heritage Program. Current and future industrial, agricultural, transportation, and recreational developments should be overlaid on the distribution of important bear habitat. A gap analysis could then identify areas where conservation planning should focus and cumulative effects analysis could predict impacts over time to regional and area specific bear populations. Planning on this scale would minimize the loss of critical habitats and reduce habitat fragmentation. Interagency cooperation is essential because of the varied and disjunct land management jurisdictions throughout Alaska.

Law enforcement
1. Increase funding for enforcement activity to monitor and reduce the illegal kill of brown bears in Alaska.

Ecotourism
1. Bear viewing programs in Alaska are in high demand. Future development of programs should be carefully planned and developed to provide a variety of viewing experiences ranging from high quality low participation programs such as that at the McNeil River State Game Sanctuary (Aumiller and Matt in press) to high participation programs like those in some Alaskan National Parks like Katmai and Denali.
2. Emphasize the economic value of brown bears to local residents. Many local residents in rural Alaska consider bears a nuisance and are inclined to kill them needlessly. The big game guiding industry and the tourism industry should work cooperatively with ADF&G and its cooperating agencies to assess the economic value of brown bears to Alaska and help ensure that some of that value is shared with local residents.

Conclusion

Alaska offers the greatest opportunity in the world for developing a model conservation program for brown bears. The successful conservation of brown bears in Alaska will require that managers incorporate an ecosystem perspective into their research and management programs. To maximize future options, it is critical that resource managers plan for large areas for long periods. Interagency cooperation will also be essential for maintaining Alaska's unique brown bear resource. A critical first step for ensuring the long-term conservation of brown bears is for Alaskan scientists, resource managers, policy makers, and educators to craft a strategic conservation plan. This plan should be designed to assure that Alaskan bear populations remain healthy in the face of accumulating threats.

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Status and management of the brown bear in Canada

Bruce McLellan and Vivian Banci

Population status and growing threats

The status of brown bears in Canada was reviewed by Macey (1979) and more recently by Banci (1991). Macey concluded that brown bears were not endangered or threatened but were extremely vulnerable. Because Canada is a large and diverse country and brown bears are distributed over approximately 3,470,000km^2 (2.4 times the size of the state of Alaska) Banci (1991) decided that an analysis of their status required dividing the country into 14 "brown bear zones" based on similar climate, land forms, and human activities. The status of brown bears in the zones is closely linked to the number and distribution of people. In inhospitable areas of the north or in the rugged mountains, there are limited human settlements and brown bears are relatively numerous for the habitat, while brown bears are relatively rare where people have settled.

Estimating bear numbers is notoriously difficult. Without an intensive marking program, only estimations based on largely subjective information and extrapolation from research areas are available (Table 5.3). Banci (1991) estimated that about 25,000 brown bears live in Canada and this number has unlikely changed significantly in the past few years. In two of the brown bear zones, the Non-Mountainous Boreal Plains and the Glaciated Prairies, brown bear have been extirpated. In the Hot Dry Plateaus, brown bears are rare and considered threatened. The status of brown bears in the remaining zones are often debated; some people suggest that they are vulnerable while others believe they are doing fine.

Table 5.3. Size, estimated numbers, and percent of potential population size of the 14 brown bear zones that still contain bears.

Brown bear zone	Area (km^2)	Current numbers	% of potential
Arctic Coastal Plains	754,905	2,860	96
Taiga Shield	467,740	790	96
Taiga Plains	557,810	1,520	93
Subarctic Mountains	397,372	2,540	98
Subarctic Mtns and Plains	370,440	5,680	94
Cold Boreal Plains	292,505	960	64
Cold Moist Mountains	92,500	2,940	76
Temperate Wet Mountains	161,500	3,310	59
Cool Moist Plateaus	127,300	1,100	64
Cool Moist Mountains	129,300	2,540	54
Hot Dry Plateaus	66,200	140	25
Cool Dry Mountains	52,000	930	83
Total	3,469,572	25,310	76

Arctic Coastal Plains: An estimated 2,860 brown bears occur in this zone. Although there have been some sightings on Banks and Victoria Island, these bears are mostly limited to the mainland. This zone is sparsely populated by people and there is little road access. Impacts on bears occur near settlements and petroleum exploration and development have had a significant impact in localized areas. Over most of the area, brown bears are likely near carrying capacity.

Taiga Shield: The status of brown bears in this region is poorly known but an estimate of 790 was provided by Banci (1991). The bear habitat is thought to be relatively poor on the Taiga Shield. There are no known recent records of brown bears from northern Manitoba or Saskatchewan. This zone has few human residents and bear kills are rare.

Taiga Plains: The bear habitat in this zone is also inferior and, although density estimates are poor, a total population of 1,520 bears has been estimated. This zone has few residents and access remains poor.

Subarctic Mountains: There are an estimated 2,540 brown bears in the Subarctic Mountains and this population has been hunted since 1965. The productivity of the population is low and hunting regulations are consequently strict. Access is limited in the zone and there are few human settlements.

Subarctic Mountains and Plains: The density of brown bears in this zone appears higher than the more northern and eastern areas. A total of 5,680 bears are estimated to live here. There are three major highways crossing this area and there are a few communities with more than 2,000

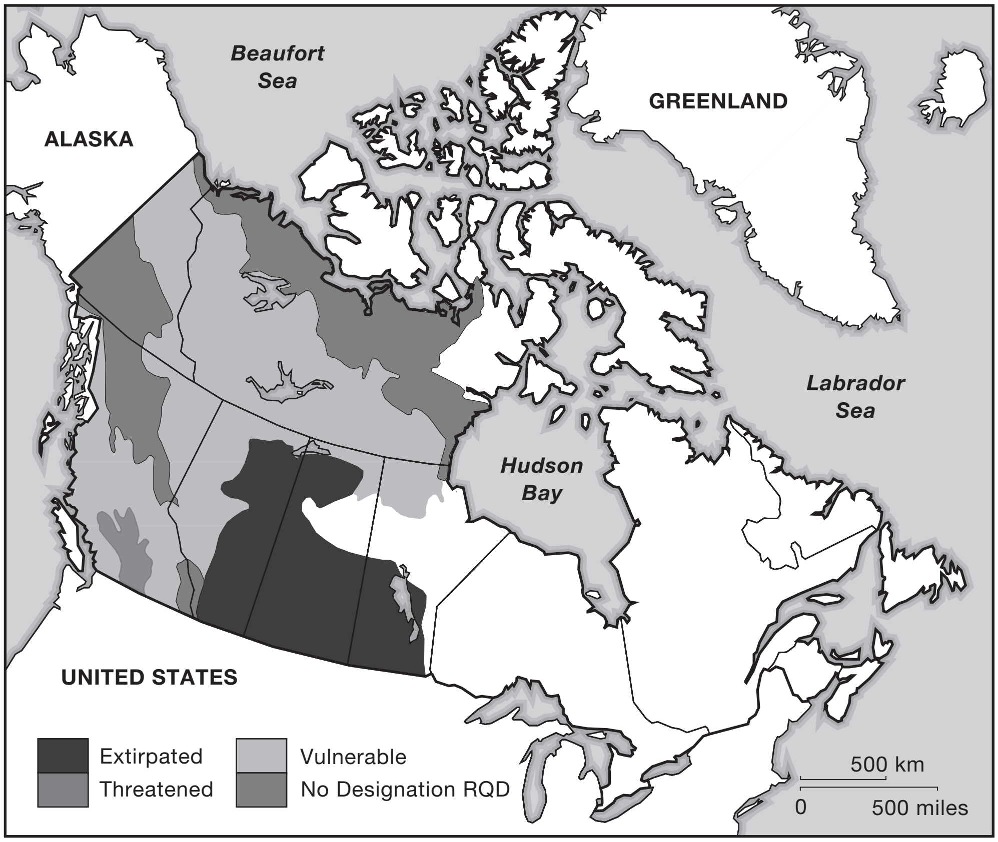


Figure 5.3. The distribution and status of brown bears (*Ursus arctos*) in Canada.

people. Poor garbage management has resulted in bear deaths and many translocations. Mining and petroleum are the major industries in this zone. Hunting mortality associated with big game guiding is the major source of bear mortality.

Cold Boreal Plains: Agricultural development has eliminated brown bears from a portion of this zone, however, an estimated 970 bears remain. Natural gas development is the major industry although the amount of forestry, in particular pulp production, is rapidly increasing. Access developed by the various industries is becoming a significant problem for brown bears. Human settlements are rare; however, there are three communities with over 4,000 people.

Cold Moist Mountains: This zone is relatively good bear habitat and has an estimated population size of 2,940 brown bears. Forestry, mining, and big game hunting are the major industries. Human settlements are rare and small in this zone and although access is currently limited, it is rapidly increasing in certain locations.

Temperate Wet Mountains: Some of the most productive brown bear habitat in the country occurs here. Vancouver, the largest city in western Canada, is located in the southern tip of this zone and the influence of such a large settlement has greatly affected brown bear numbers in this corner of the country. The southern coast supports about 90 brown bears which is only 5% of its estimated capability. There are few settlements in the north coast and access is generally difficult. Range fragmentation is a concern in the southern portion. Poor management of garbage and other attractants has resulted in bear deaths and many translocations. Although timber harvest and trophy hunting are very extensive in the north coast, an estimated 3,210 brown bears inhabit the area.

Cool Moist Plateaus: Cattle ranching is extensive in portions of this zone and intolerance of large carnivores has significantly impacted brown bear numbers. Due to the generally flat topography, timber harvest is highly mechanistic and extensive. There are several large and many small communities in this zone and road access is extensive. Poor management of garbage and other attractants has resulted in bear deaths and many translocations. The estimated number of bears in this zone is 1,100.

Cool Moist Mountains: This zone has some very productive bear habitat but there is also much rock and ice. A variety of human activities and in particular forestry, hydroelectric developments, and hunting have had a significant impact on bears in this area. Range fragmentation is a concern along transportation corridors. There are several towns of between 5–20,000 people and access is extensive. Poor management of garbage and other attractants has resulted in bear deaths and many translocations. Banff, Jasper, Glacier, and Mt. Revelstoke NPs are in this zone and although some very productive habitat occurs in these parks, as a whole, they are relatively poor for bears and support only about 250 of the estimated 2,540 brown bears in this zone.

Hot Dry Plateaus: For brown bears, this is a relatively unproductive zone and, when combined with extensive areas of human settlement, agriculture, forestry, mining, recreation, and extensive access, only about 140 brown bears remain. Most of these bears occur along the border of the Wet Temperate and Cool Moist Mountains. Range fragmentation is a serious concern.

Cool Dry Mountains: This zone has some very productive brown bear habitat but poor habitat is also common. Human activities are varied and brown bears have been impacted by agriculture, forestry, mining, hunting, and recreation. There are numerous small communities, and several with more than 5,000 people. Poor management of garbage and other attractants has resulted in bear deaths and many translocations. Access is widespread. Range fragmentation is a serious concern. There are an estimated 930 brown bears in this zone.

Legal status and hunting

In Canada, the management of nonmigratory wildlife is under the jurisdiction of Provinces and Territories. In the case of the brown bear, these jurisdictions include Alberta, British Columbia, Yukon, and the Northwest Territories. The legal status of brown bears in these jurisdictions is the same as most other large mammals; they are classified as indigenous wildlife and hunted wherever population sizes and productivity are sufficient. Hunting regulations are complex and vary within and among jurisdictions: Table 5.4 is a general summary of these regulations and

Table 5.4. Summary of brown bear hunting regulations in Canada

Jurisdiction	General regulations	Residents	Non-residents
Alberta (estimated population size of 574 plus 215 in National Parks)	1. Females with cubs and yearlings are all protected. 2. Compulsory reporting of kills. 3. Baiting not allowed. 4. No hunting in national parks and provincial wilderness, and Kananaskis. 5. No trade in bear parts.	1. Draw for a limited number of tags. 2. Bag limit of one in two years. 3. Spring only season. 4. Cost is $41.	1. No non-resident harvest.
British Columbia (estimated population size of 13,000)	1. Females with cubs and yearlings are all protected. 2. Compulsory reporting of kills. 3. Baiting not allowed. 4. No hunting in national parks and ecological reserves and some provincial parks. 5. No trade in bear parts.	1. Draw for a limited number of tags in most areas, open in others. 2. Some areas with spring only hunt, others both spring and fall. 3. Bag limit of 1 per year. 4. Cost is $70.	1. Must use a registered outfitter that has a quota. 2. Cost is $500.
Northwest Territories (estimated population size is 5,050) Due to ongoing native land-claims, the administration of hunting is changing. On Inuvailuit lands, regulations are set by a co-management board and other settlements will likely have a similar process.	1. Females with cubs and yearlings are all protected. 2. Compulsory reporting of kills. 3. Baiting not allowed. 4. No hunting in wildlife sanctuaries, preserves and national parks. 5. No trade in bear parts.	1. Land claims have quotas that can be used by natives or non-native residents or non-residents using guides. 2. Spring and fall seasons or fall only seasons on non-land-claims. 3. Bag limit of 1 per lifetime. 4. Cost is $5 for a resident and $10 for a non-resident Canadian plus a $500 trophy fee.	1. Land claims have quotas that can be used by natives or non-native residents or non-residents using guides. 2. Cost is $25 plus a $500 trophy fee.
Yukon (estimated population size is 6,300)	1. Females with cubs and yearlings are all protected. 2. Compulsory reporting of kills 3. Baiting not allowed 4. No hunting in wildlife sanctuaries and national parks. 5. No trade in bear parts.	1. Spring and fall seasons in most areas but fall only in some locations. 2. Bag limit of 1 bear per year, or every 3 years in some areas. 3. Cost is $10 for a resident and $75 for a non-resident Canadian plus a $25 seal fee. Non-resident Canadians also pay a $500 trophy fee for a male bear and $750 for a female.	1. Must use a registered outfitter that has a quota based on a point system where males count as 1 and females 3. 2. Cost is $150 a non-Canadian plus a $25 seal fee and a $500 trophy fee for a male bear and $750 for a female.

Table 5.5. Summary of average number of recorded brown bear kills in Canada, 1991 to 1993.

Jurisdiction and (Estimated population)	Hunter kill	Non-hunter kill	Male kill[1]	Female kill[1]	Total kill
Alberta (574 plus 215 in NPs)	17	8	18	6	25
British Columbia (13,000)	324	56	242	132	380
Northwest Territories (5,050)	13	9			22
Yukon (6,300)	79	13	57	35	92
Total (25,000)	433	86	317	173	519

[1] Males and females do not sum to total because of kills with unrecorded gender.

Table 5.5 accounts the average number of bears reported killed in each jurisdiction between 1991 and 1993.

Public education needs

Brown bears have one of the highest profiles of any animal in Canada and are commonly featured in the media. Because brown bears have frequently been the focal animal over land-use disputes and between groups either for or against hunting, the public receives conflicting information. Recently, several non-government organizations have become involved with educational programming. Messages the public should receive include:

1. **Status:** The variability of brown bears status should be stressed. The public should know that in some areas of relatively dense human rural and urban settlement, brown bears are threatened or have been extirpated while over much of their range populations remain healthy.
2. **Hunting:** The high natural adult survivorship and the variability of brown bear reproductive potential in various habitats and resulting variability in sustainable harvest levels should be stressed. In some areas, any harvest is likely unacceptable whereas in most areas, some hunting is ecologically sustainable. Whether society continues to support the hunting of brown bears due to ethical issues must be addressed from a neutral viewpoint.
3. **Protected areas:** The public should know that over 95% of the brown bears in Canada live outside National Parks and thus management actions outside protected areas are important influences on their viability.
4. **Range fragmentation:** The importance of connected bear range should be stressed. Habitats, even if they contain few bears but are located between areas with many bears, are very important and should be managed accordingly.
5. **Vehicular access:** The public should be aware of how important access management plans are to the long-term viability of brown bears as well as other wildland values.
6. **The value of brown bears:** People should be aware of the value of bears as a trophy to hunters, viewers, and photographers, plus as a wilderness symbol to tourists. They should also be aware of the potential value of bears to medical research.
7. **Human impacts:** Relationships between resource development, agriculture, and human settlement on brown bear habitat and populations should be clarified.

In addition, people that recreate, work, or live in brown bear habitat should receive information on:

1. **How to camp and hike in brown bear habitat:** The public should be informed how rare bear attacks are but at the same time learn how to act in bear country to avoid close encounters and what to do if a bear is encountered at close distance. Pamphlets and books are available and some suggestions are provided to people visiting National and Provincial Parks, but outside of parks, little information is available.
2. **How to operate industrial camps in bear habitat:** Over the past decade, major progress has been made towards reducing the impact of industrial camps on bears. Increased education for smaller businesses such as silviculture companies, smaller prospecting companies, and individual workers is still needed in most areas. A program to inform forestry workers and mineral exploration crews on bear safety would be beneficial in many locations.
3. **How to live in brown bear habitat:** Municipalities in bear habitat and the residents of these communities should be informed how to manage bear attractants such as garbage, fruit trees, aviaries, compost piles, livestock, and pet food. The lack of education for this group of people is a major shortcoming of current bear management in many locations.

Specific conservation recommendations

The conservation of brown bears depends on providing sufficient connected habitat of suitable quality and disturbance levels plus managing the rate of human-induced mortality.

Habitat

Ensuring sufficient connected habitat of suitable quality and disturbance levels will require land management planning and implementation on at least three scales:

1. *1:500,000 Scale*: Because viable populations of brown

bears require large areas, maintaining sufficient connected habitat will require land use planning at the 1:500,000 scale. Such a land-use plan is being developed in British Columbia. While maintaining viable brown bear populations may not require additional large protected areas, some key areas may need protection while many others may require special management consideration. In particular, human settlement and ranching must be limited in areas with important bear populations. Potential fracture zones between sub-populations will be identified at this scale.
2. *1:20,000 to 1:50,000 Scale*: Land-use planning at the 1:20,000 scale will ensure an appropriate juxtaposition of habitat conditions through time. Planning linkages through fracture zones will also occur at the 1:20,000 scale. This scale of management is needed mostly where grizzly bear habitat is managed, particularly by the timber industry.
3. *1:2,000 Scale*: Maintaining habitat in suitable condition for a period of time will involve stand-level plans at 1:2,000 in areas with exceptionally high habitat capability. This level of planning is needed mostly where there are resource use conflicts.

Mortality

Human-induced mortality can be classified as legal harvest including wounding losses, problem animal removal, defense of life and property, and illegal harvest. These forms of mortality can be addressed by:

1. *Legal harvest*: Some harvest from many populations is sustainable, however, because censusing brown bears in most areas is not yet economically practical, setting appropriate harvest levels is problematic. Brown bears have a relatively low reproductive rate so are susceptible to overharvest and, if overharvested, are slow to recover. Consequently, harvest rates should be conservative and the responsibility should be on the resource user to demonstrate that harvests can be increased. Intentional bear reduction programs by direct removal or increased legal harvest designed to stimulate ungulate population growth must be undertaken with accurate monitoring. Legal harvest is the only form of mortality that is relatively easy to modify.
2. *Problem animal removal*: Problem animal translocation and killing is common near several communities and in some remote camps. Poor garbage management is the dominant problem, although other sources of attractants such as fruit trees, compost piles, aviaries, livestock, and inappropriately cleaned and stored fish and game are also problem sources. Programs to remove attractants by relocating or fencing dumps and educating the public are being implemented.
3. *Defense of life and property*: As is the case with problem animal removals, defense of life and property killings can be minimized by proper management of personal attractants, particularly at remote hunting, fishing, or small industrial camps. Education programs and guidelines for fish and game cleaning and storage and garbage management are needed.
4. *Illegal killing*: Illegal killing of brown bears is often related to improper management of personal attractants at hunting and fishing camps and rural residences. This form of illegal killing can be reduced by education and camp management guidelines. Active poaching of brown bears is more difficult to manage but levels can be reduced by making it more difficult to use the carcass or market animal parts. Access management will also reduce or at least localize illegal killing.

Status and management of the grizzly bear in the lower 48 United States

Christopher Servheen

Historic range and current distribution

The grizzly bear (*Ursus arctos horribilis*) formerly occurred in at least 16 states of the western United States as late as the year 1800 (Figure 5.4). Its distribution began to change in response to excessive human-caused mortality and habitat loss in the early 1800s. The grizzly was considered a predator and a competitor of humans by the settlers who occupied the American West. As such it was shot, poisoned, and killed wherever it was found. It is estimated that there were approximately 50,000 grizzly bears south of Canada in 1800 (USFWS 1993).

Grizzly bears occupied a variety of habitats prior to the attempted extermination by Europeans. Grizzlies were found across the great plains east of the Rocky Mountains where they were dependent upon the millions of bison (*Bison bison*) that inhabited the prairies. Early accounts (DeVoto 1953) remark on the abundance of grizzly bears along the Missouri River in present-day Montana, USA. These bears were apparently attracted to the river by hundreds of drowned bison carcasses and the riparian zone foods such as shrubs. These carcasses resulted from mass drowning when hundreds of thousands of bison crossed the river. The grizzly was also distributed across the Rocky Mountains from northern areas in Montana and Idaho (Moore 1996) south to Arizona and New Mexico (Brown 1985). Grizzly bears were probably more abundant in California than any other state (Storer and Tevis 1955). Grizzly bears fed on salmon in California rivers, on beached whales along the coast and on the abundant mast crops of California oaks. Grizzly bears were so much a part of California that the grizzly was placed on the state flag, the only state to do so. Nevertheless, grizzly bears were shot, poisoned and trapped in California as in the rest of the western United States. The last wild grizzly bear in California was killed in 1922, leaving the

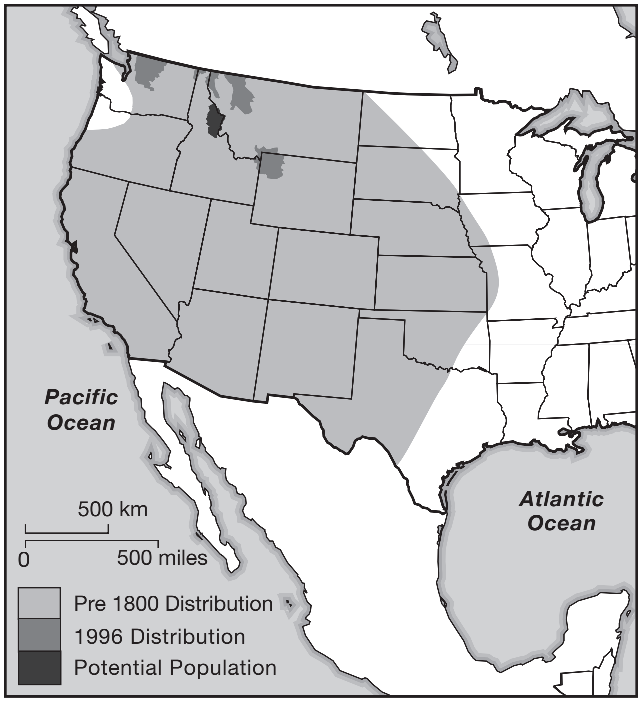


Figure 5.4. Historic and current distribution of the grizzly bear (*Ursus arctos horribilis*) in the USA, and a potential population in the Bitterroot Mountains of Idaho and Montana.

only grizzly bear remaining in California the symbolic bear on the state flag.

By the 1920s and 1930s, only 100 years after the arrival of European settlers, grizzly bears were being driven to extinction throughout much of their range. At this time, domestic sheep were a large agricultural interest that spread far into the mountains in the last refuges of the grizzly bear. Places that are now wilderness such as areas of the Bob Marshall and Scapegoat Wilderness in Montana and the Selway-Bitterroot Wilderness in Idaho were filled with herds of domestic sheep. The maintenance of domestic sheep in areas with grizzly bears and wolves (*Canis lupus*) required predator control techniques such as trapping and poisoning. By 1922 the range had been dramatically reduced and grizzlies were only present in isolated mountain areas. This was a reduction of approximately 75% in less than 100 years. By 1922 the range of the grizzly was a series of isolated populations which, because of their isolation, were more vulnerable to extinction.

The 1920s and 1930s saw the lowest numbers of grizzly bears surviving south of Canada. In portions of the present-day Sun River Game Preserve in Montana, a place now rich in grizzly bears, an entire summer of searching for bear tracks only turned up one or two. Hunting and killing of bears for protection of livestock continued into the 1970s. Of the 37 populations present in 1922, 31 were eliminated by 1975. By 1975 grizzlies had been reduced to 7–800 in less than 2% of the former range. Five separate populations remained in the four states of Wyoming, Montana, Idaho, and Washington (Figure 5.4, Table 5.6). The only refuge for grizzlies were the two National Parks, Yellowstone Park in Wyoming, Montana, and Idaho, and Glacier Park in Montana. Of these five populations, four were contiguous with larger populations across the Canadian border

It was thought in 1975 that grizzly bears still remained in the Bitterroot Mountains of Idaho and Montana. Investigations since 1975 have found no evidence that grizzly bears remain in this area. The last bear verified in the Bitterroots was in the early 1940s. In 1979 an adult female grizzly bear was killed by a hunter in the San Juan Mountains of southwest Colorado. This was the first grizzly bear seen in the area in decades. Following this find, two years of intensive research failed to document any verified evidence of grizzly bears in the San Juans. It seems likely that the bear killed by the hunter was the last remnant bear in this area more than 800 miles from the nearest existing grizzly bear population. The San Juan Mountains are remote and it is possible that a few remnant bears could exist for many years and escape detection, but the likelihood of a remaining population of bears is very low.

Table 5.6. The status of the separate grizzly bear populations in the lower 48 United States.

Population	Area (km^2)	Population estimate	Range status
Yellowstone	24,605	350–450	Expanding due to population increasing at approx. 4%/year.
Northern Continental Divide	23,051	400–500	Limited expansion to the east onto private ranch lands.
Cabinet-Yaak	6,734	20–30[1]	No range expansion.
Selkirk	5,180	25–35[2]	Increasing numbers within range; some bears recently seen outside existing range.
North Cascades	25,900	5[1]	No expansion. Distribution unclear.
Bitterroot	14,504[3]	0	NA

[1] US portion of this ecosystem which spans US and Canada.
[2] Includes US and Canadian portions of this ecosystem.
[3] Core area of this ecosystem.

In 1975 the grizzly was declared a threatened species in the lower 48 United States and came under the protection of the Endangered Species Act. This listing brought attention to the habitat and population management needs of this species. Research was initiated in areas outside National Parks, actions that could impact habitat such as timber harvest and road building were modified to minimize impacts on grizzly bears. Sanitation was improved in both front country areas around towns and campgrounds, as well as back country areas in wilderness and National Parks. The long-standing National Park Service policy of feeding garbage to bears was eliminated in both Glacier and Yellowstone National Parks.

The current distribution of the grizzly bear in the states of Wyoming, Montana, Idaho and Washington is shown in Figure 5.4.

Status

Progress has been made in improving the status of grizzlies in many areas of their range; however, many challenges still exist. Among these are private land development in bear seasonal range, continuing conflicts with bears in areas of human development, and the need to increase small populations in certain areas. The focus of threatened status for grizzly bears has resulted in the development of an interagency committee of land management and game management interests from State, Federal, Tribal, and Canadian agencies which implements the Grizzly Bear Recovery Plan (USFWS 1993). The Recovery Plan is the document that outlines all necessary tasks to achieve demographic and habitat recovery for grizzly bears in the lower 48 United States, and to build public support for bears. The status of the grizzly bear in 1997 is much better than it was in 1975, when the species was first listed as threatened. This change has been due to a concerted effort by management agencies and the public, who have changed the way they use bear habitat. There has been a general public realization that grizzly bears need special care if they are to survive. This highlights the importance of the public in the conservation and recovery of the grizzly bear. Public support and understanding are key to the success of any conservation program. The future of a successful grizzly bear conservation program will depend on both a concerted efforts by agencies and professionals, but also on continuation of public support and understanding of what needs to be done to conserve the bear.

The intention of the grizzly bear recovery program is to expand the range of the grizzly as much as possible within the large blocks of publicly owned lands in the northern Rocky Mountains and the North Cascades. Plans are being considered to reintroduce the grizzly into the Bitterroot Mountains. A program is ongoing to evaluate the linkage zones with the intention of maintaining the opportunity for reconnection between existing populations (Servheen and Sandstrom 1995). The range of the grizzly population in the Yellowstone ecosystem is expanding as this population continues to increase. The result is that the range of the grizzly bear may expand around, and possibly between, some of the existing populations.

Legal status

The grizzly bear in the lower 48 United States is listed as a threatened species under the Endangered Species Act. It is therefore protected under Federal law. The killing of grizzly bears is prohibited except in self-defense or defense of others. Actions such as timber harvest, mining, and road building in grizzly bear habitat on federal lands is subject to review to assure that such activities do not jeopardize the species. These reviews are carried out by Federal officials. Activities that are found to effect grizzly bears must be modified to minimize effects. The result of this legal protection is that every action on Federal lands in bear territory is modified to some extent to minimize impacts on bears.

Population threats

Human-caused mortality and small population numbers have threatened grizzly bear populations. Long-term declines in grizzly bear numbers have been the result of excessive mortality, where causes of mortality have changed as management actions have been implemented. Major efforts to improve human storage of bear attractants such as garbage, foodstuffs, and game meat have resulted in a reduction in human-bear conflicts as well as the number of dead bears. The fact that most bear-human conflicts now occur on private rather than public lands is evidence that future management and education efforts will have to focus more intently on these privately-owned lands where our legal ability to require proper food storage is limited.

The sustainable level of human-caused mortality is an important parameter that can be used to judge the impact of existing mortality rates. The rate that is assumed to be sustainable for a population of several hundred bears, based on the work of Harris (1986), is no more than 6% human-caused mortality. However, this is the total and not the known rate. It is assumed that the known rate is 50%–66% of the total mortality rate (USFWS 1993; R. Mace unpubl. data). The exact difference between the known and total human-caused mortality rate is a matter of constant debate and is important because the sustainable mortality level is critical to population recovery. In order to assure that this rate is conservative, it is calculated on a minimum population size based on the number of females with cubs seen and reported to managers, and the goal of the recovery programs is zero human-caused mortalities. Even so, the calculation of this mortality rate continues to be a source of controversy.

Habitat threats

Habitat threats relate to human activities such as resource extraction, housing development, road building in forested areas, improvement of existing high-speed highways, livestock grazing, and recreation.

Roads have two major effects on bears: 1) increased mortality risk for those bears using roaded areas, and 2) loss of habitat for those bears that avoid roads. A new Geographic Information System (GIS) analysis technique called the moving window technique allows us to monitor the spatial distribution of road density. Through this GIS approach and the innovative research approaches in Mace and Waller (1997) we now realize that grizzly bears use habitats less than expected where forest road densities are high. Closure of existing roads and prevention of unnecessary new road building in grizzly bear habitat is one of the most important tools we can use to improve grizzly bear habitat.

Continued recovery program efforts have limited new road development in forested areas and have initiated road closure and reclamation programs that have reduced road density in many areas. Pressure for road access continues, however, and it requires continued efforts to assure habitat security.

Private land development is one of the major threats to grizzly bears in the Rocky Mountains. Continual increases in numbers of human developments eliminate seasonal habitats from bear use. This is especially important in valley bottoms where most private lands are and which are also important spring habitat. Efforts to limit this development of private lands can only be successful by developing partnerships with local residents and their voluntary acceptance of lifestyles that have minimal impact on wildlife.

Habitat fragmentation is a major threat to grizzly bears as lands between existing populations are developed, usually by private owners. Habitat fragmentation is also occurring inside existing population areas due to private land development. High-speed highways are continually being upgraded to accommodate higher traffic volumes. As this is done, it makes these highways wider, with higher traffic volumes and usually less vegetative cover nearby. All these factors make highways effective habitat dividers.

Management

Management of grizzly bears and grizzly bear habitat is accomplished through an interagency cooperative effort to implement the Grizzly Bear Recovery Plan (USFWS 1993). This management involves habitat maintenance and monitoring, population monitoring, management of bears involved in livestock depredations and other bear-human conflicts, public education efforts, limiting the ability of bears to get human foods and garbage, and management of roads and extractive resource activities such as timber harvest and mining. In some areas of suitable habitat without an existing population of bears,

Marilyn French

Grizzly bear (*Ursus arctos horribilis*) with elk carcass. Yellowstone National Park, USA.

reintroduction of grizzly bears is being considered. Augmentation of small existing populations has been accomplished (Servheen *et al.* 1995) by moving young females into such areas to enhance the female population and hopefully increase reproduction.

Human-bear interactions

Human-bear interactions are the main source of bear mortality and habitat loss. Mortality factors are usually related to availability of garbage and human foods, livestock and agricultural activities, honey production, and fruit trees. Interactions between grizzly bears and elk and big game hunters are a regular source of conflicts resulting in dead bears. Indirect factors include timber harvest and mining in grizzly habitat that cause disturbance and reduce or eliminate habitat.

Few of the over 550 grizzly bears that have been captured and radio-tracked have died naturally. Most of these grizzly bear deaths are due to humans. Causes of death include management removal of repeat problem bears, illegal kills, self-defense by people who are threatened by bears, auto and train collisions, and mistaken identity kills by black bear (*U. americanus*) hunters.

Public education needs

The future of the grizzly bear will be built on the support of the people who live, work, and recreate in grizzly habitat. This means that public education about the needs of bears and realistic ways to live compatibly with bears are critical to the success of conservation efforts. Public education is now concentrated on hunters and recreationists to educate them about how to avoid confrontations with bears. Efforts have also been directed at livestock producers to minimize predation by special herding techniques, removal of dead animals from use areas, and electric fencing around bee hives and sheep bedding areas.

Further public education work is needed on private lands where the behavior of residents and people newly arrived to rural areas may determine the death or survival of resident bears. Some success has occurred with local communities by developing a sense of ownership in maintaining grizzly bears through local community planning (Pelletier 1996). To gain local community support, however, requires intense effort with community members in building trust, an effort that must be repeated in each community. There must be recognition that such local community conservation efforts are a vital part of any bear conservation effort so that resources are available to complete such programs.

Specific conservation recommendations

Key research needs (not necessarily in order of priority) include:

1. Testing the linkage zone prediction model's ability to predict the distribution of bears in relation to human activities, and the differential mortality related to occupancy around human use areas versus more remote areas; refining, if necessary, the assigned influence zones and scoring system based on this test;
2. Documenting effects of high-speed highways on bear habitat use and movements, and developing design guidelines to minimize detrimental effects of highways on bears and other large carnivores;
3. Documenting infection rate, distribution, and a possible cure for white-pine blister rust (*Cronartium ribicola*) on whitebark pine (*Pinus albicaulis*) in the Yellowstone ecosystem because whitebark pine cones are a major grizzly bear food; and
4. Improving comparative monitoring systems to assess productivity of major foods within and between all ecosystems.

Management needs include:

1. Monitoring female survivorship and reproductive rates in the Northern Continental Divide Ecosystem, Cabinet-Yaak, and Selkirk recovery areas to calculate population rate of change with a confidence interval;
2. Reintroducing grizzly bears into the Bitterroot recovery area;
3. Placing additional bears into the Cabinet-Yaak recovery area;
4. Completion of the access management task force recommendations for all recovery areas to assure habitat security and adequate road management;
5. Initiating public outreach and a process to augment the population in the North Cascades recovery area;
6. Improving public relations, including information and education involving local people in ownership of recovery, and targeting special groups such as backcountry users and new residents in spring habitats for increased outreach efforts;
7. Completing the linkage zone analysis between all recovery areas and implementing necessary management actions in areas where linkage opportunities exist;
8. Assisting in the development of locally-developed land management recommendations by private landowners in grizzly habitat so people can learn to live in such areas with limited effect on bears;
9. Establishing improved cross-border management planning with Canada; and
10. Improving easement actions to assure maintenance of grizzly habitat on private lands subject to development.

Chapter 6

Brown Bear Conservation Action Plan for Europe

IUCN Category: Lower Risk, least concern **CITES Listing:** Appendix II
Scientific Name: *Ursus arctos*
Common Name: brown bear

Figure 6.1. General brown bear (*Ursus arctos*) distribution in Europe. European Brown Bear Action Plan (Swenson, J., *et al*., 1998).

Introduction

In Europe the brown bear (*Ursus arctos*) once occupied most of the continent including Scandinavia, but since about 1850 has been restricted to a more reduced range (Servheen 1990), see Figure 6.1.

Status and management of the brown bear in Austria

Georg Rauer

Distribution and current status

At present, there are just a few brown bears living in Austria, but the situation is promising and bear numbers are rising. Austria is apparently in the first stages of a repopulation process. Since the extermination of the last indigenous populations in the 19th century (Rebel 1933; Tratz 1964) the bear has never disappeared completely from Austria for long periods. Time and again, individuals from the Slovenian population migrated into Carinthia and sometimes even further north (Amon 1931, Puschnig 1928 and 1930, Thurn-Valsassina 1965). These pioneers generally disappeared after a short stay and the efforts to shoot them were unsuccessful. In the fifties, the number of bear visits increased, and since then, tracks, observations, or damages have been recorded by the Carinthian hunting organization Kärntner Jägerschaft nearly every year (Anderluh 1987, Gutleb 1993a, Knaus 1972). In the 1980s, bears in Carinthia were still considered sporadic migrants (Bauer and Spitzenberger 1989). The incidence of females with cubs of the year in 1989 and 1990 in the mountains around the Weissensee (Carinthia) marks the transition point from a migrant to a resident population in southern Austria.

Today in Austria the brown bear occurs in two small populations (Figure 6.2). Three to six individuals are assumed to live in southwestern Carinthia, representing an outpost of the southern Slovenian population expanding into the border area with Austria and Italy (Gutleb 1993a and b). The second population is located in the Limestone Alps of Styria and Lower Austria and comprises 8–10 individuals; it is the result of a reintroduction project started by WWF-Austria in 1989. In addition to these populations, the Alps of Styria and Carinthia and to a lesser extent also of Salzburg and Upper Austria, are visited by migrating individuals with increasing frequency. A third center of bear distribution is emerging in northwestern Styria and the bordering areas of Upper Austria (Dachstein, Totes Gebirge, and Sengsengebirge) where, since 1990, 1–3 bears have been present almost continuously (Frei, J., Bodner, M., Sorger, H.P. pers. comm.)

Aste (1993) determined the distribution of suitable bear habitat over all of Austria by investigating these parameters: fragmentation of forests, density of human population, and intensity of tourism. According to this survey, appropriate habitats are found in central and southern Austria; in western Austria there are suitable areas only if the impact of tourism is reduced (Figure 6.2).

Legal status

In the majority of the federal states (Burgenland, Niederösterreich, Oberösterreich, Steiermark, Kärnten, and Tirol) the brown bear is protected by hunting law as a species with no open season. In Vorarlberg it is protected by natural conservation laws. Salzburg is the only state where the protection of bears is embodied in both laws. The capital of Austria (Wien) is the only federal state where the brown bear is not protected by law because it is regarded as non-existent (Kraus and Kutzenberger 1993). Most of these regulations came about 20 years ago as a reaction to the increase in the occurrence of migrating bears. At that time, public attitudes began to change

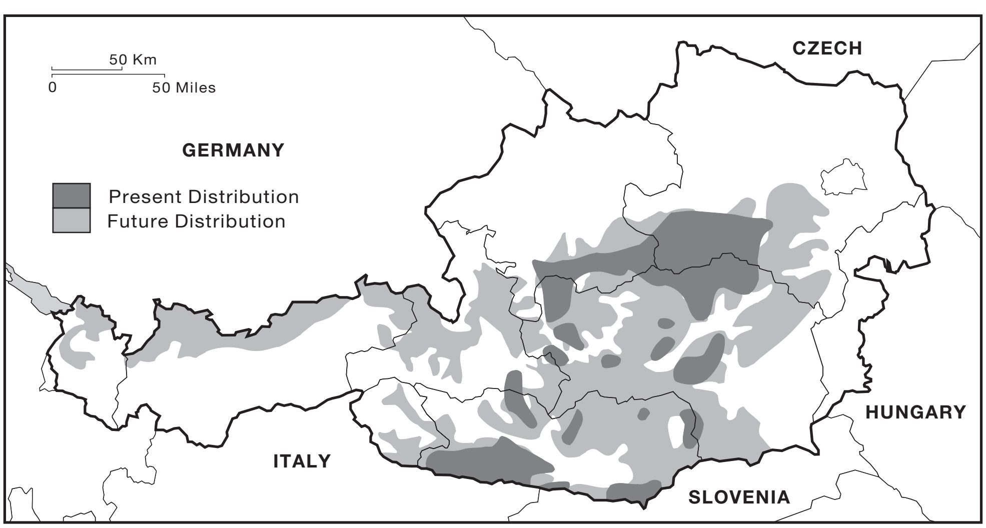


Figure 6.2. Present distribution of the brown bear (*Ursus arctos*) in Austria 1989–1993 (Gutleb 1993a; Rauer 1993; and Steirische Landesjägerschaft pers. comm.). Potential bear habitat in Austria (Aste 1993).

towards nature in general and, in particular, toward large predators and their right to exist.

Population threats

Bears in Austria are not endangered by direct persecution because the problem of poaching does not exist. Nevertheless the survival and growth of this fragmented population is not at all certain as the numbers are still far below the size of what is generally considered the minimal viable population. The expected increase of the Austrian bear population heavily depends on the increase of the Slovenian population and the continued existence of migration corridors to enable the Slovenian surplus individuals to reach Austrian bear habitats.

Habitat threats

The increase in human recreational activities and mobility put a heavy strain on bears and other wildlife. An increase in the impact of tourism on bear habitats of Lower Austria and Styria to the level of Northern Tyrol would shatter all the hopes for the establishment of a viable Austrian bear population.

The continual rise in the intensity of road traffic requires the construction of highways and the improvement of national roads, thus leading to increased dissection of potential bear habitat (e.g. Phyrnautobahn and Liesing-Palten Tal). In the Carinthian government's plans to build a new road through an undeveloped forest in the lower Gailtal to improve highway (Gailtalzubringer) access, it was stressed that this unspoiled forest, growing on the debris of an enormous ancient land slide, is an important corridor for bears to use in crossing the valley, and should not be destroyed (Mattuschka 1992).

Austria is a country with a very high forest road density (0.45m/km^2 productive forest including public roads used for logging; Österreichischer Waldbericht 1992 des Bundesministeriums für Land- und Forstwirtschaft). Although forest roads are generally closed to public traffic by barriers, they are constant sites of disturbance because they attract hikers, mountain bikers, and mushroom or berry pickers. The Austrian government still supports the construction of forest roads, especially in a program aimed at managing protected forests, where the accessibility is comparatively low (0.093m/km^2.). As a result, possible refuge areas are deteriorating.

Management

In most of the states where bears occur regularly, programs exist to compensate people for damages caused by bears. These insurance arrangements are funded by the federal hunting organizations in Carinthia, Styria, and Salzburg. In Lower Austria the insurance is paid by WWF-Austria. In Upper Austria, a full compensation program is still outstanding. The damages from 1994 were paid partially by a special fund with money from WWF, the hunting organizations, and nature conservation agencies of the state. In the northeastern part of the bear range (where a project is releasing bears), WWF also offers electric fences to beekeepers who set up hives at sites where the chances of bear encounters are high.

The aim of the WWF Bear Project is to build up a viable bear population in the Alps of Lower Austria and Styria. The idea for this project was prompted by the existence of a lone male bear who had migrated to this region in 1972. Between 1982 and 1986, a group of interested people and organizations headed by the hunting organization of Lower Austria investigated the feasibility of a release project (Hager 1985), but finally abandoned these plans. WWF-Austria continued this work and started the reintroduction (augmentation) project in 1989 with the release of a young female. This test bear was followed in 1992 and 1993 by an adult female and a young male respectively. The released animals have been radio tracked to gather data on their habitat use, foraging strategies, and migration patterns, and to document the fate of this small initial population (Dieberger and Rauer 1991; Rauer 1993). Three cubs in 1991 (of which only one survived until late autumn) and five cubs (three and two) in 1993 warrant the hope that this experiment will be successful. Because several migrants showed up in the project area in 1994, the release of further individuals has been canceled for the near future.

WWF-Austria and the hunting organizations of Carinthia and Styria are presently strong proponents of bear conservation in Austria. The efficient management of a growing bear population requires intensified cooperation from all the groups and organizations concerned, including the governmental nature conservation agencies, the hunting organizations, the beekeepers' unions and farmers' committees, and the private nature conservation associations. Realizing these demands, the governments of the states sharing the Austrian bear population have ordered wildlife biologists to conceive a management plan in 1995. Thereby all the organizations mentioned above will be invited to clarify their points of view and contribute their ideas and help to achieve common solutions to the problems inevitably arising in human-bear coexistence.

Human-bear interactions

Attacks on sheep and beehives make up the bulk of damages reported to the insurance companies, and attacks on cattle and pigs are exceptional (Gutleb 1993a; Steirische Landesjägerschaft pers. comm.). Sheep grazing in or close to forests are particularly in danger. Electric fences have proven successful in keeping bears away from beehives. A new phenomenon is the special interest of some bears in a rather surprising source of food, the rapeseed-oil used by lumbermen in chain saws. Radio tracking revealed that in late summer/early autumn, bears often visit old and nowadays barely used orchards in the vicinity of farms. In Lower Austria and Styria bears regularly come to roe deer feeding stations to feed on maize, oats, and pellets. Bears are also successful in locating the cereals and apples distributed by hunters to attract red deer to specific hunting areas at the beginning of the rutting season. One of the females released by WWF has acquired the strange habit of approaching sites where a shot has been fired in order to look for the dead deer before the hunter has secured it (four reported cases in autumn 1993). In 1993 a bold bear roaming the western parts of Styria, had the peculiar ability to let the water out of fish ponds in order to exploit the trout therein. The appearance of several bold individuals in 1994 caused a tremendous rise in the number of incidents where damage occurred and an alarming change in the quality of the damage (opening of rabbit-hutches in the rear of houses, entering into sheepfolds etc.). Stirred up by the frightened public, the local authorities issued shooting orders, and finally two bears were killed in autumn. Apparently the guilty bears were shot since the wave of damage ended.

The fact that bears are increasingly observed in areas close to farms, villages, mountain cabins, and hiking trails has lead to a debate about the shyness of bears. This shy nature has always been emphasized in discussions of the potential danger posed by these new members of the Austrian fauna. It is a common view that bears in Europe are as shy as they are because of centuries of intensive persecution. But what happens if persecution stops as is the case in Austria? Will bears in general (not only particular problem individuals) become more and more reluctant to avoid humans? What sort of measures can be taken to maintain this shyness without resuming hunting? Shall we conceive scaring programs for the beloved and feared newcomers to keep them at the right distance? It is certainly too early to decide if and to what extent this problem exists and what can be done, but constant awareness will be necessary to be able to react in time if these apprehensions turn out to be true.

Public education needs

Interest in bears and especially a positive reception of the aim to increase their numbers is primarily found in the cities. People living in the areas where bears occur are often much less satisfied about their presence. This group is the most important to be addressed by public education programs. People are not used to living with bears and often exaggerate the dangers associated with them. There is a need for basic information on how to avoid bears or how to behave in an encounter, as well as for general information on the biology of bears and their ways of life. “What do we need bears for ?” is the central question of all debates on bears. Public education has to find a way to make people feel that the protection of bears is not a question of utility and economy but of ethics – that the bear is part of the nature we want to conserve.

Specific conservation recommendations

1. Austrian bear habitat is dissected by barriers such as highways or densely populated valleys. It is evident that the Austrian bear population can only survive and grow as long as bears can cross these barriers. At the moment, we have only a very general knowledge of these barriers and corridors (Aste 1993). As a first step, it is necessary to gather all the basic data on the location and character of these crucial structures for bear migration. Not until then would it be possible to conceive how to preserve existing or to create new corridors. Special attention should be paid to planned highways or highways in construction.
2. In order to increase the efficiency of bear conservation measures, a greater involvement of the federal governments should be envisioned. For instance, governmental support of the reimbursement programs would strengthen the confidence of farmers and beekeepers through the assurance of the “bear lobby” that damages will be paid for in the future when bear numbers rise. The willingness of livestock farmers to accept the presence of bears will also depend on the settlement of questions concerning the repayment for the breeding value of the killed animals, the reimbursement for consequential damages, and the criteria to decide when a lost animal should be regarded as a bear kill.
3. Often enough people have asked that endangered species protected by hunting law be listed in the nature conservation law as well. At present, federal nature conservancy agencies are not supposed to use their financial resources for species listed exclusively under hunting legislation. Enlarging their competence would greatly improve the situation. In a step that points the way ahead, the government of Lower Austria intends to create a fund for the protection of endangered species (NÖ Artenschutzfonds). Its aim shall be to initiate and support programs to improve the status of endangered species. The brown bear will be one of the target species (Kraus 1993).

Status and management of the brown bear in Bulgaria

Nikolai Spassov and G. Spiridonov

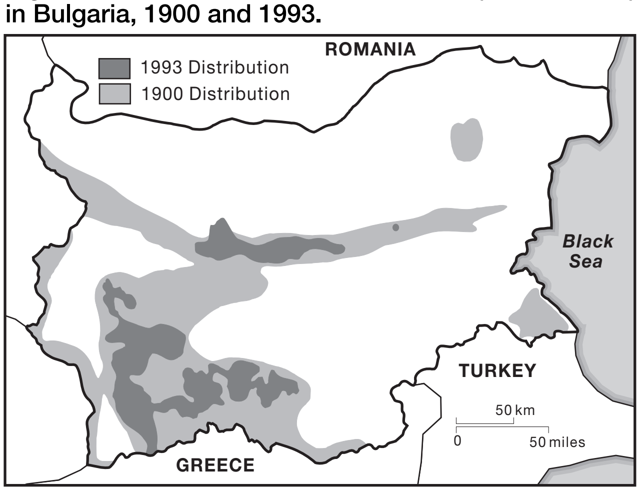
Historic range and current distribution

Bear remains have been discovered in a number of prehistoric sites, e.g. the Neolithic sites of Yasa Tepe, Kovatchevo (Stara Zagora District) and Malo Pole; the Eneolithic sites of Golyamo Deltcheva, Dolnoslav, Ovtcharovo, and Kovatchevo (near the town of Petritc); and from the Early Bronze site of Ezero. Although these finds consist of less than 1% of the total number of bones in separate sites, their presence shows that the bear used to be widespread throughout the country, even in the plains and lowlands of southern and northern Bulgaria.

Roman signs dating back to the second century BC from the town of Montana and the village of Staliiska Mahala (northwestern Bulgaria), describe huge bear and European bison hunts, with the participation of more than one Roman ally, as well as the transporting of dozens of bears along the Danube to fight in Roman arenas. During the Middle Ages, bears still inhabited large areas in the mountains, on the plains, and in forests that occurred throughout the country. The bear probably occurred in the now deteriorated Ludogorie forests of northeastern Bulgaria until the nineteenth century.

Data presented by Irecek (1899), as well as data obtained by Spiridonov and Mileva (unpublished questionnaire of the State Forestry Departments 1989–1990), gives a good idea of the species' distribution until 1900 (Figure 6.3), when its extermination was encouraged by the state through payment of incentives. This resulted from the bear's consideration as a species harmful to livestock. During the 1920s and 1930s, the species gradually disappeared from the regions of the Eastern and Western Stara Planina Mountains, and its distribution became similar to its present range.

Figure 6.3. Distribution of the brown bear (*Ursus arctos*) in Bulgaria, 1900 and 1993.



Current distribution encompasses four basic local populations (Spiridonov and Spassov 1990):

1. Central Balkan Mountain Range (Central Stara Planina Mountain Range): on the northern and southern slopes at elevations above 800m, spread over an area of 120km^2 along the range from Zlatitsa-Teteven to the Tryavna Mountains.
2. Rila Mountain: at elevations above 1,000–1,200m.
3. Pirin Mountain: at elevations above 1,000–1,200m.
4. Western Rhodopes Mountain: at elevations above 700–1,000m.

The micro-populations from the last three mountain ranges maintain permanent contact and make up a single Rila-Rhodopes population, while the Central Balkan micro-population has remained isolated since the beginning of the century (Figure 6.3).

To the south of Pirin, the Rila-Rhodopes population reaches the Slavyanka Mountains, where, according to the latest data, separate animals migrate sporadically into Greek territory. To the north of Rila Mountain this population reaches the smaller mountains, located south and southwest of Sofia, such as the mountains of Verila, Ljulin, Vitosha, Plana, inhabited by an insignificant number of bears. Current data show that there are isolated cases of migration to the west up to the Bresink region. A casual migrant to the western Balkan Mountains (Tchuprene) was recently reported. Present observations indicate the occurrence of a new micro-habitat in the Elena section of the Balkan Mountain Range (Eastern Balkan Range). Data on the occurrence of bears in the Vlahina and Malashevska Mountains, near the western Bulgarian border (see map in Spiridonov and Spassov 1990), have not been proven by a recent (Spiridonov and Mileva, unpublished questionnaire of the State Forestry Departments 1989–1990). It seems that these individuals were occasional migrants. The population of the western Rhodopes expanded its range to the west and to the south. According to the most recent data, single migrants have permanently settled in some parts of the eastern Rhodopes, e.g. near the village of Ardino in the Kurdjaly region (Gunchev pers. comm.) Separate bears reach the southern Bulgarian border in the region of Mugla village, near Smolyan, and probably in the region of the town of Dospat. It is likely that these regions are the points of contact with the limited Greek population, that is maintained through migrants from the Bulgarian population. Pictures of bear sign support the supposition that, in the region of Smolyan, there were separate migrants reaching the Greek border up to ten years before.

If the present conservation measures and optimum living conditions are successfully maintained, it is expected that the bear population will increase its numbers to roughly 1,000 individuals. It is also expected that the population density in certain regions will increase, and the range will be extended. Such an extension could be predicted for some regions in the central Balkan Mountain Range and in the western Rhodopes during the next ten years. These regions are not currently inhabited by bears. In the eastern Rhodopes, it is unlikely that bear range will be significantly broadened. Theoretically, it may be expected that the Ihtiman and the central sections of the Sredna Gora may serve as a corridor linking the Rila-Rhodopes population and that of central Balkan Mountain Range

Status

The brown bear is listed in the Red Data Book of the People's Republic of Bulgaria (1985). According to IUCN Red List criteria (IUCN 1996), the brown bear should be considered a rare species in Bulgaria. The species is potentially threatened, owing to the limited population number and distribution that results from human pressure. At the same time, its numbers have slowly increased in the last fifty years. Excluding Russia, the Bulgarian bear population ranks as the second largest national population in Europe after the Romanian population. Thus, the importance of Bulgarian bear conservation goes beyond the national scale.

The genetic peculiarities of the Balkan population (see below), add to the significance of, and reasons for, the conservation of this population. One of the largest populations in Europe, it numbers 2,700–3,000 individuals and follows the Finnish-Scandinavian, the Caucasian, and the Carpathian populations in size (Sorensen 1990). The Bulgarian micro-population inhabits the Rila-Rhodopes Mountain Massif (including the smaller mountains north of Rila), and numbers some 500 specimens. It is of specific significance for the preservation of the Balkan bear population, as the bears from this region have the opportunity to interact freely. It is likely that they are also crucial for the maintenance of the limited Greek population (see page 72). The Central Balkan population is of a high conservation importance because of its vital status and its high density (approximately 1 bear/20km^2 in the inhabited areas). One of the reasons for this is the fact that the population numbers in the Central Balkan NP (IUCN category II) and its adjacent areas are close to optimum.

Bear population numbers in the beginning of this century were likely quite close to current numbers, although the species used to have a broader distribution and inhabited some regions that are now unfavorable. The reason for this was mainly intensive hunting. According to Irecek (1899), 567 bears were killed between 1893 and 1898. During the 1930s the bear population reached its minimum – some 360 specimens (Katsarov 1935). The data referring to the period after 1941 when bear hunting was prohibited show gradual increases in population numbers – 450 bears during the 1950s (Ruskov 1961), and 600 bears during the 1980s (Spiridonov and Spassov 1985).

The 1980s data are contradictory. According to Stenin *et al.* (1983), the population numbered 850 at the time of publication. According to Genov and Gancev (1987) and Rosler (1989), whose data are also based on the statistics of the Committee of Forests, bear population numbers are significantly over 800. According to the Committee of Forests' annual count, bear population numbers increased from 486 in 1971 to 579 in 1972. Statistics also show that the bear population increased from 698 in 1985 to 921 during 1986. It is obvious that these data are not based on objective surveys and do not correspond to the real status. During this period, trends in rapid population growth were stimulated by promoting the bear as a significant subject of hunting.

Our current population estimations are based on:
1. Questionnaires of the State Forestry Department, aimed at the establishment of the species distribution and numbers (Spiridonov and Mileva, unpubl.);
2. Extrapolation of Raychev's (1989) data on the determination of bear numbers along the southern slopes of the central Balkan Mountain Range, as well as Spiridonov's (in print) data on the bear range along the northern slopes of the same mountain, according to the track analysis approach and;
3. Other personal observations.

Based on these data, the following picture might be drawn: 700–750 bears existed until 1986 and this expanded to hardly more than 750 bears by the end of the 1980s (Spiridonov and Spassov 1990; Spiridonov and Spassov 1993). These numbers are distributed as follows: 500–520 bears existed in the Rila-Rhodopes Massif (about 150 in Rila and over 200 in the Rhodopes Mountains), and about 200–210 individuals existed in the Central Balkan Mountain Range. These bear numbers might turn out to be slightly lower, owing to poaching which increased after social changes that occurred in 1989. It is much more likely that the present trend for increased population is obstructed, and even a reduction in the numbers could be expected.

Morphologic characteristics and taxonomic status

Inhabiting optimal habitats (see above, the natural density of the population), the Bulgarian bear not only reaches but even exceeds the maximum body parameters of the Southern, Western, and Central European bear. Adult males weigh about 200kg on average, yet there are animals reaching 300–350kg (N min=5). The visual data indicate that bears with a weight of 200–250kg represent some 6% of the total population, and those with weight over 250kg are some 2% of all (Gunchev 1990). Two males weighing some 400kg were shot in 1939 and in the beginning of the 1980s below the peak of Mazalat and in the region of Stara Reka.

Differing from the more northern populations, Bulgarian bears, as well as Balkan bears in general, show notable polymorphism regarding their coloration: there is a high percentage of rather light (golden) specimens. According to some observations, which have not been proven by enough statistical data, the Balkan bear shows slight trends toward having a thicker body and is less aggressive, compared to the Carpathian bears.

It is traditionally considered that the bear in Europe belongs to the sub-species of *Ursus arctos arctos* L. (Heptner *et al.* 1967; Corbet 1978). The Bulgarian bear is also thought to be a representative of this sub-species (Ruskov and Markov 1974). However, current investigations indicate that the affinities and taxonomic relations of the European populations are quite complicated. Recent surveys of Balkan bear morphology show that it differs from the Russian-Carpathian population, and is closer to the other Mediterranean populations (Spassov 1990). These conclusions were proven by genetic surveys of the European bear (Taberlet and Bouvet 1992, 1994). These surveys indicate that the localized Mediterranean populations, including the Balkan population, are very close and differ significantly from the populations in Central, Northern, and Eastern Europe.

We could speculate that on the Pleistocene-Holocene boundary, the European population that had found refuge in the Mediterranean during the glaciations, came in contact with the new wave of a dominant sub-species invading from the east, and covered the whole continent parallel to reforestation. Of the native population, the sub-population localized in the Iberian refuge, and the isolated one on the southern Scandinavian Peninsula, seem to be less affected by crossbreeding. The contact between these two sub-populations was probably maintained until later periods, maybe even during the period of the Upper Pleistocene interstadials, while the Balkan-Apennines native subpopulation lost contact with them much earlier. Crossbreeding of the native and the latter Holocene forms was likely more active in the Balkans. According to Heptner *et al.* (1967) and Tihonov (1987), similar crossbreeding processes between *U. a. arctos* and *U. a. syriacus* are on-going now in Caucasus. It seems possible that the Syrian sub-species, characterized by lighter coloration, is a form rather closer to the recent European-Mediterranean population and is a remnant of the ancient Mediterranean population.

Legal status

During 1941–1984, bear hunting was restricted by the Hunting Act, except for cases of problem animals. The bear became hunted in 1984 and the number of bears shot was strictly regulated. In relation to bear hunting development, a captive breeding farm was established in Kormisosh in 1968, and another farm was settled in Mazalat (the Central Balkan Mountain Range) in 1984. Some of these bears were released into nature.

Given that the species is comparatively rare, increased poaching and decreased hunting control justified the decision of the Ministry of Environment to designate the bear a protected species in January 1993. This decision restricted bear hunting again, except for cases of problem bears, bears that lost their fear of people, and in the case of overpopulation.

Population threats

Poaching: Increased poaching results from the weakening of a number of administrative hunting and forestry institutions after the socioeconomic change of 1989.

Problem bears: Artificial feeding of bears with carcasses in the hunting husbandries (1984–1992), until recently, was often a factor in creating problem bears. Some such animals were killed. These bears still present trouble for local farmers, yet in most cases the harm is overestimated. The practice of artificial feeding still exists. The extermination of bears treated as harmful animals is amongst the major factors affecting the population. Identifying a “harmful” bear is sometimes difficult, and at the same time other animals may be jeopardized in attempts to kill the problem bear.

Hunting: The establishment of hunting farms in the recent past led to increased international hunting tourism. The hunting may have resulted in disturbances of the structure of populations inhabiting the regions of the former Hunting Husbandries.

Destruction of genetic purity: Some destruction of the genetic purity of the Bulgarian (Balkan) bear population occurred in the Rhodopes Mountain, and to some extent in the Central Balkans. This occurred when farm-bred Carpathian bears were introduced into the Rhodopes in the 1970s and 1980s, and into the Central Balkan during the 1980s.

Isolation: The isolation of the Central Balkan micro-population represents a specific threat to the preservation of this population in Bulgaria. This is due to the possibilities of inbreeding and the consequent degeneration of the population. The gene pool of the particular population was maintained by some 100 specimens during the 1950s (Ruskov 1961). Its twofold increase is indicative of the vitality of the population for the moment.

Habitat threats

Disturbance and uncontrolled visitation in protected areas (inhabited by a quarter of the Bulgarian bear population) results from the lack of effective safe-guarding of these areas. Large highways represent barriers to the normal free migration and expansion of the range. Major obstructions of this type include the Vitinya Pass, the Sofia-Burgas motorway via Karlovo, and the Sofia-Plovdiv highway. Construction of motorways, forestry roads, and tourist facilities disturbs both the animals and their habitats.

Management

Because it was a game species until 1993, the bear population was managed by the Committee of Forests. Bear hunting, which was permitted between 1984 and 1993 (Table 6.1), and the subsequent urge to develop intensive international hunting tourism was the major reason behind efforts to increase population numbers at any price. This led to the establishment of a bear farm in Kormisosh, to the introduction of the bears bred in captivity into some of the hunting husbandries, and to the artificial feeding of bears there. This policy had decidedly negative effects on the bear population (see Population Threats). After bear hunting was prohibited, the artificial feeding of bears was also restricted by a decree of the Ministry of Environment in 1993.

After the Ministry of Environment designated two new National Parks (IUCN category II), Rila and the Central Balkans, in the beginning of the 1990s, the protected areas inhabited by bears were significantly enlarged, reaching 2,600km^2 (or 2/3 of all Bulgarian protected areas). Thus some 25% of the bear population is now under spatial protection:

1. Rila NP (IUCN category II) – 1,080km^2 inhabited by 70 individuals;
2. Central Balkan NP (IUCN category II) – 730km^2 inhabited by 60–70 individuals;
3. Pirin NP (IUCN category II) – 400km^2 inhabited by more than 40 individuals;
4. Vitosha NP (IUCN category IV) – 2600km^2 inhabited by 10 individuals;
5. Nine isolated Strict Nature Reserves (IUCN category I) – encompassing 120km^2 in total are also parts of the home ranges of several animals.

In an attempt to solve problems with the keeping of dancing bears, the Ministry of Environment registered and licensed all 24 Bulgarian dancing bears in 1993. Apart from the insignificant number of zoo and circus bears, 22 animals are still bred in captivity in the remaining bear breeding farm in Kormisosh. Most of them are either Carpathian bears or hybrids. The budget for their captive breeding comes to one million BLV or US$20,000 per year.

Human-bear interactions

Brown bears generally avoid contacts with humans. However, instances of bears meeting people in the mountains are frequent. In the cases where aggressive bear behavior was recorded, it appears that the animal was provoked. The reasons for such behavior can be classified as follows (Spiridonov and Spassov 1990): a) wounding the animal with fire arms or other strong irritation; b) defense of young; c) Crossing within critical distance during sudden encounters; d) defense of prey.

Out of 165 instances of contact between bears and people in the Balkan Range, the bear was peaceful in 126 cases. Various aggressive acts were registered in 39 cases and seven of these persons were hurt (Guntchev 1986). Large numbers of these cases involved armed persons. In the 1980s, cases of conflict with bears increased in some regions, owing to the release of bears bred in captivity that had lost their fear of humans. This is one of the negative consequences of the establishment of Bear Hunting Husbandries (Spiridonov and Spassov 1990).

Original and summarized data regarding bear damage to livestock, beehives, game, and agriculture exist in Ruskov (1961), Raychev (1985), Genov and Ganchev (1987), and Spiridonov and Spassov (1990). According to some data, more than 1,200 domestic animals were killed by bears between 1975 and 1983. Of them, more than 80% were sheep.

Public education needs

Specific public awareness programs for local farmers explaining preventive measures that may decrease bear damage will be extremely useful in diminishing human-bear conflicts. Another important measure is the development of a program targeting visitors to National Parks, to inform them of appropriate behavior in case they

Table 6.1. Bears officially shot in hunts in Bulgaria, 1984–1994 (does not include poaching, which is estimated at 20 bears annually).

Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Bears killed	3	7	7	8	6	5	?	30	12	7	5

meet a bear. It is also important to organize and implement a large information campaign promoting the conservation value of the species among the local population in mountainous regions. It seems likely that such a campaign may decrease poaching.

Specific conservation recommendations

The Wilderness Fund, a Bulgarian NGO, has developed a draft Bear Conservation Action Plan based on the species status, the conservation measures undertaken, and existing threats. The Action Plan is aimed at the protection, development, and maintenance of optimum bear populations in the country. The draft was prepared and discussed by the following experts and members of the NGO: N. Spassov, G. Spiridonov, V. Velichkov, V. Tvanov, L. Mileva, K. Georgiev, B. Mihova. The draft was submitted for revision and approval as a national strategy to the Ministry of Environment in 1994. It envisions the following measures:

1. Counting the bear population to provide a recent evaluation of its status. To ensure this, an integral methodology for determining the presence and numbers of bears has already been developed and approved by a team of experts.
2. In order to develop the Bulgarian bear population in terms of range and quantity, potential habitats and optimum population numbers should be determined. This requires coordination of the efforts of all interested and managing institutions.
3. *Habitat protection*: a) New protected areas (IUCN categories IV or V) should be established in the Western Rhodopes, and additional protected areas should be developed in the Balkan Mountain Range; b) The establishment of administrative bodies for National Parks inhabited by bears should be a priority among the institutional measures that are to be officially undertaken.
4. *Ensuring contact between bears of separate mountain populations*: a) develop methods of assuring the preservation of existing ecological corridors connecting local populations of separate mountains that make up the Rila-Rhodopes Massif; b) in the longer term, a plan should be developed to alleviate the isolation of the Central Balkan population. An ecological corridor should be provided. The genetic information exchange may be ensured by introducing a limited number of animals, originating from the Rila-Rhodopes population, into the Balkan Mountains and vice versa.
5. *Decreasing bear-human conflicts*: a) develop and approve a system that will compensate local farmers for bear damage. Shooting of problem bears, permitted by present legislation, may also be combined with limited hunting tourism. At the same time, taxes from bear hunting may be collected to form a special fund that will be used to reimburse local farmers for bears' damages. Part of the funds gained through ecotourism (e.g. wildlife photography) may also be utilized in a similar way; b) develop and implement a public awareness program for local people that will encourage the minimization of poaching.
6. *Preservation of genetic purity in the native Bulgarian (Balkan) population*: a) Issue specific permits for the elimination of bears with clear morphological and genetic features of Carpathian bears. This measure requires strict control and preliminary marking of specimens; b) sterilize bears originating from the Carpathians or bred in captivity at the former bear farm of Kormisosh.
7. *Resolving the problem of captive dancing bears*: a) Sterilizing dancing bears, preferably the females, and prohibiting the issuing of new licences to keep dancing bears. More secure marking, e.g. tattoos, of bears is needed. Thus, the practice will end when the bears die; b) meetings should be held with dancing bears owners to discuss alternatives to this activity.
8. To preserve the Balkan bear in its remaining habitats, a program should be developed with the participation of the neighboring Balkan countries. The first step of the program should be to consider joint activities with Greek organizations interested in the preservation of the bear population in the Rhodopes. The ongoing discussions between the Wilderness Fund (Bulgaria) and ARCTUROS (Greece) regarding such a joint program may be considered the beginning of the implementation of this idea.

Status and management of the brown bear in Finland

Erik S. Nyholm and Kai-Eerik Nyholm

Historic range and current distribution

In the beginning of the 19th century, the brown bear occurred throughout Finland as it does today. There are some 19th century reports on the damages caused by brown bears, as well as statistics on the numbers of killed bears (Mäensyrjä 1971; Nyholm unpubl.; Palmen 1913; Pullianen 1980; Voionmaa 1947). From these statistics, one can draw the conclusion that the brown bear population at that time was around 1000–1200 individuals. (Figure 6.4).

These statistics also show that in the first half of the century the bear population was nearly one fourth larger in numbers than in the second half of the century, when the decrease of the brown bear population began. Human population was spreading and more land was needed for cattle raising. As a result of efficient, government-supported hunting of large predators, no bears could be found in the south, southwest, and west of Finland in the 1880s (Figure 6.4) (Mela 1882). At that time there was still a brown bear population in the wilds of eastern and northern Finland. The decline of the brown bear population in the country continued up to the latter half of the 20th century, when the bear hunting season was shortened by 206 days.

As late as the first decades of the 20th century, the brown bear population in Finland was smaller than ever before, and only after 1920 did it start to grow again (Kivirikko 1940). Based on recent data from the count of the minimum population started in 1978, as well as on the comparison of annual mortality statistics, the brown bear population appears to be over its worst crisis. Since 1978, records show that the population has grown by 30.1 % in spite of relatively heavy hunting in those years.

The brown bear has gradually spread back to its former territory, increasingly so in the 1970s and 1980s (Pulliainen 1983). Today, the brown bear population occurs throughout the country except for the Ahvenanmaa Islands in the west and the open low mountain areas of Utsjoki rural district in the north (Figure 6.5) (Nyholm 1989a unpubl.).

Status

The species has adapted well to a growing human population and to drastic changes in its environment. Brown bears can be found quite close to human development, and some bears have even stayed for short periods within the boundaries of towns and cities. Partial changes in its habitat do not seem to disturb the brown bear very much. This species is very adaptable in making use of its surroundings, which ensures the utilization of any new opportunities that might arise. The nutritional resources in Finland could support a considerable growth of the brown bear population, but the population densities are still rather low (the average in the reindeer herding area

Figure 6.4. Distribution of the brown bear in Finland, 1820–1830 (Voionmaa 1947) and 1880 (Mela 1882).

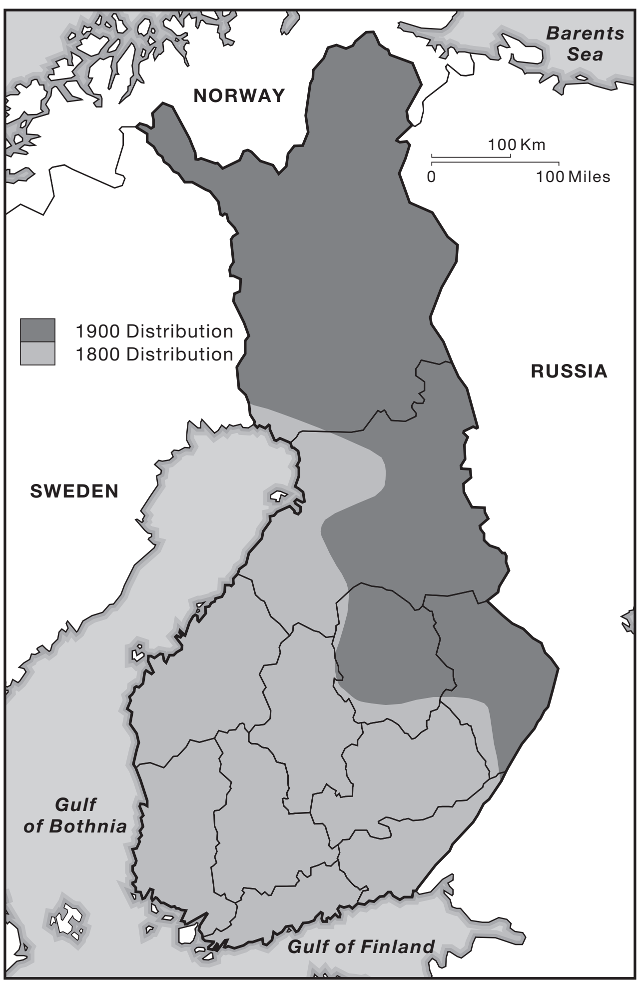
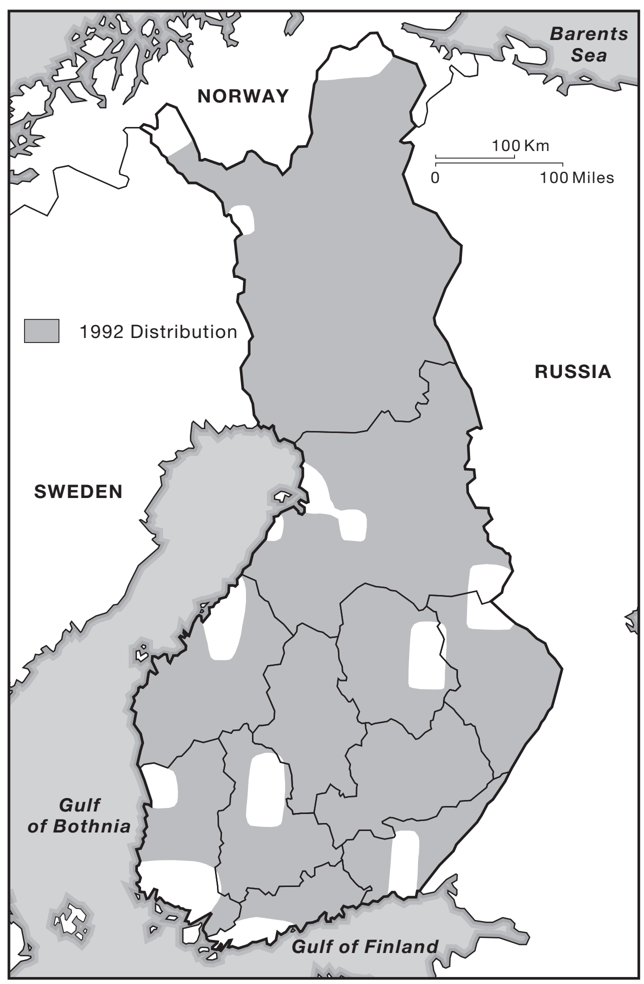


Figure 6.5. Distribution of the brown bear in Finland, 1992 (Nyholm and Nyholm manuscript).



is 1.0 individuals/km^2, and in the rest of the country 1.9 individuals/1000km^2) (Nyholm 1991a). Reports of increasing populations in many areas have become more numerous, and bears with cubs have been observed in the western part of the country (Nyholm and Nyholm manuscript). The current population of brown bears in Finland is estimated at 430–600.

The Finnish Game and Fisheries Institute (FGFI) Predator Division (PD) in cooperation with the Ministry of Agriculture and Forestry (MAF), in 1987 developed a plan for the management of the brown bear population. The plan was prepared in accordance with a motion issued by the Natural Resources Committee (NRC) in 1986. If this plan is carried out using an annual population growth of 6–7% as a basis, then there will be a brown bear population of 900–1,000 bears by the year 2000. This is large enough to ensure a stable and viable brown bear population.

Legal status

Until 1964, hunting of brown bears in Finland was allowed throughout the year without any restrictions. It was not until April, 1964 that a statutory order was issued that allowed hunting of the brown bear from 10 May to 15 October. In another statutory order issued on 30 December 1966, the spring hunting season of the brown bear was continued; however it forbade driving the bear out of its winter den in order to kill it.

The summer hunting season continued unaltered during the next few years. A statutory order issued in 1973 was enacted as follows: in the years 1974–75 and 1976–77 in the province of Lapland and in the rural districts of Kuusamo and Suomussalmi, the brown bear hunting season was to be from 15 May to 15 October. Elsewhere in the country, the season was to be from the beginning of August to the end of September, or 31 days. Furthermore, use of carrion baits was forbidden because it had proven to be too efficient.

When the hunting season for brown bears was divided into spring and autumn seasons in 1978, the hunting areas also became limited and hunters were obliged to report every killed bear to the local Game Management Association.

When the spring hunting season was lengthened by 15 days in 1980, the use of dogs for spring hunting was allowed, provided that the dog had been tested to prove that it would not chase reindeer. In 1981, brown bear hunting regulations were made stricter by ordering that the minimum weight of a factory-made soft point bullet be 8g, and that the energy on hitting the target should be over 2,500 joules at the distance of 25m. Furthermore, female bears accompanied by a cub under one year of age were protected.

In the Parliament Act of 1984, cubs under one year were protected, the length of the hunting season being the same as before. In 1987 shooting bears in oat fields was forbidden, since this had proved to be too efficient. At the same time it was forbidden to use an unleashed dog during the spring hunting season. The hunters were also ordered to report a wounded bear immediately to the local chief of police.

In 1993, the spring hunting season remained unaltered (statutory order 1993). Thus, bear hunting in the reindeer herding area (RHA) was allowed during a period of 46 days. The new hunting law and statute came into effect on 1 August 1993; it changed the hunting of brown bears fundamentally. Spring hunting became totally prohibited. Though hunting in many respects now differed from what it had been before, the autumn hunting season still remained unaltered for the year 1993.

According to the new law concerning brown bear hunting, Finland is divided into two parts: 1) Northern Finland (RHA and Game Management District of Kainuu), and 2) Southern Finland). In area 1, where the local inhabitants have the right to hunt freely on state lands, a quota will be set based on the number of bears that can be killed without endangering the existence of viable bear populations in those areas. All those who meet the required qualifications are allowed to hunt bears provided that they have hunting rights to the area where the hunting will take place.

New Restrictions Regarding Bear Hunting:

1.) It is not lawful to drive a bear out of it's winter den, bait it with carrion or other attractants, or kill it while it is feeding on an incompletely harvested field.
2. When using a rifle, the minimum weight of the bullet must be 9g and the hitting energy measured at a distance of one hundred meters from the muzzle of the barrel shall be at least 2,800 joules. Use of a full jacket bullet is not allowed in bear hunting.
3. Bear hunting is not allowed from 16 October to 19 August. Bears under one year of age are protected. A female bear with a cub younger than one year is protected.
4. A wounded bear has to be reported immediately to the nearest police officer.

Permits to kill bears in the rest of Finland will be given providing that the bear population in the local area concerned is large enough. Game Management Districts will issue these permits to local hunting clubs. Anyone participating in a brown bear hunt must have a lawful rifle and bullets and must be able to prove that one has passed the shooting test ordered by the MAF. According to the new hunting law, all the damages caused by bears to farms, forests, and fisheries will be compensated for by the government. With the help of these arrangements, it will now be easier to control the development of the brown bear population.

Population threats

Population counts of brown bears in Finland show that the population has grown by a third during the 16 year research period (1978–1993). Although the brown bear population decreased by 7.7% after 1982 due to intensive hunting, the overall 30.1% increase during the 15-year period indicates a positive general development of the population.

Poaching, in the strict sense of the word, is a minor problem. However, in some cases, statutory orders have not been followed, such as the obligation to report the bear kill and to have the hide marked by the authorities. The reason for this kind of negligence in most cases has been the country's taxation policy. For a middle-sized brown bear (about 150kg), the hunter may get an open market price of 17,000 FIM (US$3128). This will increase his taxes considerably when added to his other taxable income.

Interest in brown bear hunting in Finland is increasing. The admiration and fame won by the best bear hunters in the past (Kivilinna 1936; Korhonen 1935) seems to be the secret dream of many bear hunters of today. Virtually every bear killing in the country nowadays is considered newsworthy, and almost without exception, the hunter's name is mentioned.

The food supply for the country's present brown bear population of 430–600 individuals is very good, with high numbers of reindeer (250,000 reindeer in the reindeer herding area – RHA) (Paliskuntainyhdistys 1993) and moose (120,000 individuals) (Nygren 1993). In addition to this, more than 50 nature photographers provide carrion for bears and golden eagles to get photos of them. After hibernation the brown bear needs meat badly, and carcasses brought to the forest offer hungry bears an easy way to fill this need.

In Finland, cattle are no longer left to graze freely in the forests and meadows (this practice was quite common in the first half of the century). Now both dairy and beef cattle are kept in grazing areas surrounded with fences. Only sheep are kept on islands during the grazing season. Very often even the sheep are held in enclosures close to the dwellings. It is much more difficult to try to compensate for losses caused by bears to reindeer owners. Reindeer graze freely in the reindeer herding area of northern Finland, where the forests and peatlands are wide, roadless, wilderness areas. Finding carcasses of killed reindeer is difficult because the bear usually buries its prey. Full compensation in the present situation is not possible. It is therefore quite understandable that the reindeer owners fight for their source of livelihood and are strongly opposed to the idea of letting the populations of large predators grow in the RHA.

Since the government of Finland decided to start paying compensation to farmers for damages caused by large predators, including those made by the brown bear, the attitude towards this native mammal has become much more positive. However, the most important threat to the brown bear population in Finland is the possibility that the present positive attitude will turn negative. This might happen as a result of the first fatal bear mauling.

Habitat threats

Forests and peatlands are the typical habitats of brown bears in Finland. Since the 1950s, massive clearcutting and draining of peatlands has been undertaken. As a result of these silvicultural projects, brown bear habitat has changed considerably. This has not, however, had any significant negative effect on population growth, because the bear easily adapts to new living conditions. The seedling stands of clearcut areas have augmented the food supply of herbivorous animals such as moose and reindeer, consequently the food supply of the brown bear has improved considerably. Young seedling stands of deciduous trees are the favorite haunt of brown bears during their plant diet period (Nyholm 1991b).

Road densities in Finland have increased rapidly during the past two decades. Main roads have been straightened and re-surfaced. The worst disturbance to nature are the logging roads built by the Finnish Forest and Park Service. These roads traverse large wilderness areas, making them easily accessible. Thus, the disturbance caused by people in peaceful forested areas has increased. Though the numbers of bears seen by motorists is increasing, collisions of motor vehicles with bears are rather scarce (only 1–2 cases during a period of five years). Most of the bears killed in these accidents have been cubs between 0.5–1.5 years old.

Logging roads themselves do not seem to have disturbed brown bears very much. Quite often bears walk along the roads, leaving droppings and signs of their presence. In one instance, a temporary winter logging road ran past only one meter away from a winter bear den. Through the winter, heavy timber trucks drove past the den without disturbing the sleeping bear. This animal left its den in May when the snow started melting. A number of dens have also been found in the middle of large clearcut areas.

Management

According to the motion issued by the NRC (1986), the brown bear population in Finland should now be around 1,000 individuals. Using this as a basis, the MAF assisted by the PD developed a plan for the management of the brown bear population. This plan is intended to be put into practice by the year 2000. The plan can be realized only assuming that farmers, reindeer owners, and other taxpayers can agree on the measures to be taken, the timetable, and the necessary financing.

The plan for the management of the brown bear population prepared jointly by the MAF and the PD (Nyholm 1987 unpubl.) is aimed at increasing the population to the proposed level (NRC 1986). This requires that the hunting of brown bears becomes more controlled. The ministry changed the methods and times of bear hunting when it was needed. When, in 1963, bears were killed using snowmobiles, an order was issued for a period of three years, which allowed the brown bear to be hunted only from 10 May to 5 October, when there is no snow on the ground.

Human-bear interactions

Encounters between people and bears are becoming more and more common as the bear population has grown and spread to densely populated areas in the south and west of Finland (Nyholm 1991b). So far no people have been killed, but several bad maulings have occurred. In 1992 a brown bear mauled a man who went tracking a bear in winter that had been disturbed and left its den. Bear attacks on people most likely occur while the bear is feeding, when it is wounded during the hunt, when it is protecting its cubs, or if it is a male bear in rut. Several cases are known outside the hunting area where a brown bear has approached a farmyard or dwelling to eat apples, berries, or honey. Within the hunting areas, brown bears are shy and very seldom seen near people's dwellings (Nyholm 1989a). From 1978 to 1988, damages caused by the bears to the reindeer stock decreased considerably when individual bears causing this kind of problem were efficiently hunted. In 1992, when management of the population was neglected, the government had to pay almost one million FIM (US$184,000) in compensations for the damage caused by brown bears to farming and reindeer raising.

Public education needs

In recognition of the continuing growth and spread of the brown bear population to more densely populated areas, people should be given correct information about the behavior and routines of these large and strong predators. The information received through the mass media is often conflicting. This makes it difficult for people to know what to believe. In connection with the Predator Research Project of the FGFI, 1,200 local observers have been trained in different parts of the country. This unique organization has, so far, been completely voluntary.

People are very interested in brown bears and their ecology. If it were possible to arrange more public occasions to give information about the brown bear, the information would certainly be welcomed by people. Up to the present, protection and public education activities concerning brown bears have been rather scarce due to the lack of funds.

Conservation recommendations

The brown bear in Finland is in no respect endangered. Legislative changes that were made in connection with the new hunting law will promote the growth of the population, assuming that the Finnish society accepts the bear management plan prepared in cooperation with the MAF (Nyholm 1987). Funds for research should be increased, and there should be a central research station for the study of large carnivores, which would manage the brown bear population in the best possible way. There should be a balance between the growth and the hunting of the brown bear population. This balance is supported by the new statutes to the hunting law.

Predator research supervised by the FGFI is currently being decentralized to a number of separate stations, and it is also under a process of discontinuance. If this process continues, it will have harmful effects on the future of our relatively isolated brown bear population.

There are no special reserves for the brown bear in Finland, but hunting is now under much better control than ever before. Furthermore, the frontier zone along the border between Finland and Russia offers an excellent reserve for brown bears. This peaceful and safe region reaches from Virolahti in the southeast to Muotkavaara Hill in Inari in the north. Its total length is about 1,200km. In this area all hunting is prohibited, and berry-picking or fishing permissions are granted only exceptionally. There are exceptions, though. In the spring of 1993, Russian frontier guards shot bears marked by us because they broke the Russian controlling fences daily while crossing the border on their way to Finland for food.

The border between Finland and Russia serves as a large protection area comparable to a nature reserve. According to our follow-up studies, all large predators have made use of this area at least since the 1950s. At the moment, the significance of the border to large predators is being studied in cooperation with Russian researchers.

The 15-year follow-up study of brown bears in Finland has given authorities the facts they need to be able to manage and regulate the population according to varying needs at different times. Brown bear research should be developed further and funds should be allocated for the research. The brown bear population in Finland is living in an era of adaptation to new developments, and it would be good for the future of the species if research development could keep pace with the growth of the brown bear population.

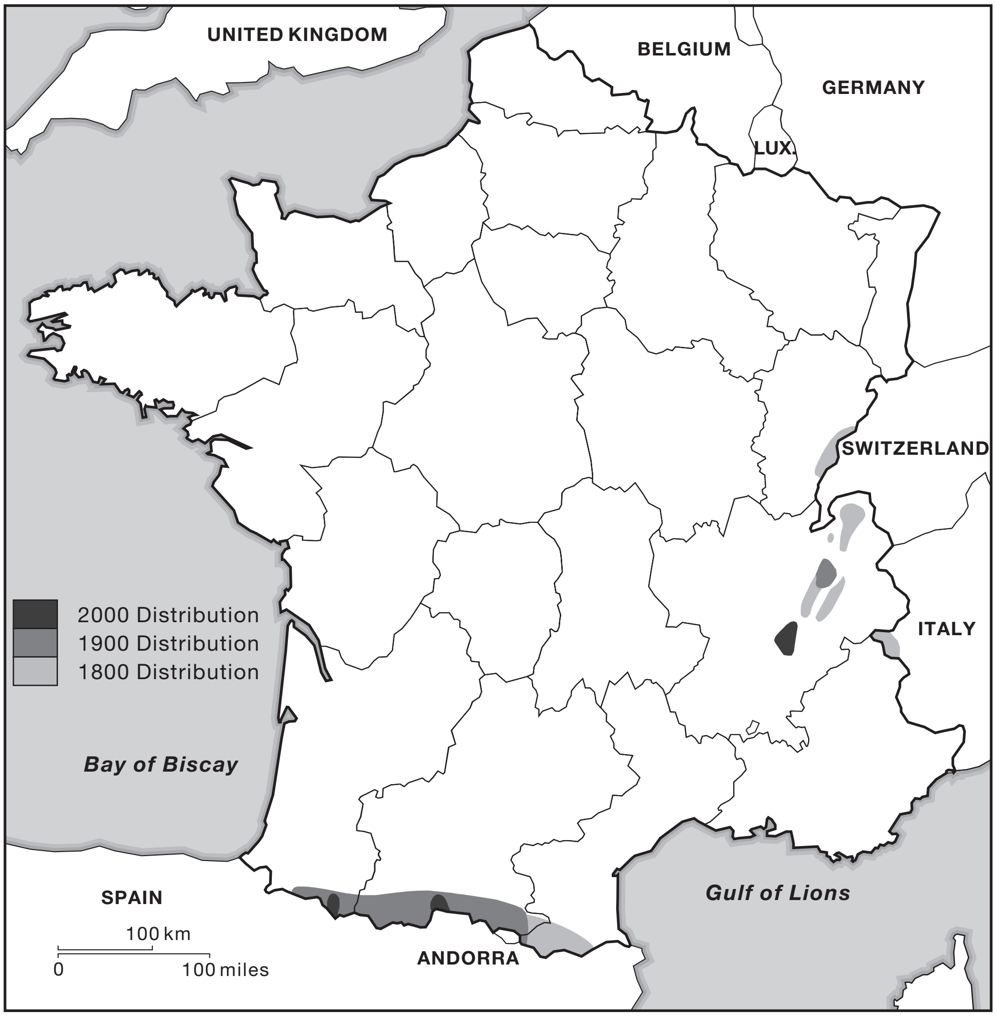


Figure 6.6. Approximate historic and future ranges of the brown bear (*Ursus arctos*) in France (Bourdelle 1937; Camarra 1989; Couturier 1954; Erome 1993; Parde 1984).

Status and management of the brown bear in France

Jean Jacques Camarra

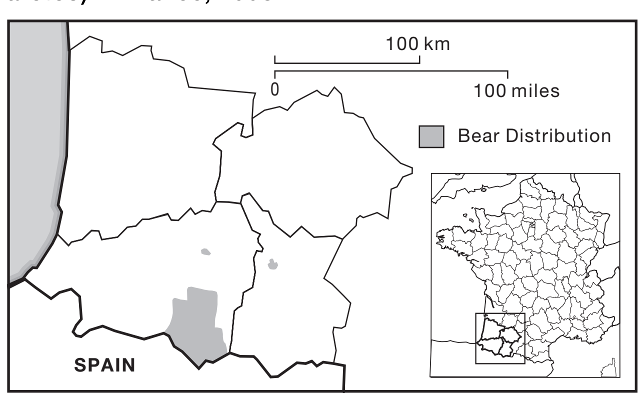
Historic range and current distribution

Several old accounts attested to the presence of the brown bear over the entire country in the early Middle Ages (Couturier 1954). By the end of this period, the rapid increase in human population at lower altitudes had resulted in forest destruction and brown bear habitat loss. In the mountain ranges, the species survived until the occurrence of guns and more efficient poisons. In the Ossau Valley (approx. 500km^2), four to five bears were shot every year by the beginning of the 17th century. The annual harvest dropped to two by the 19th century (Bouchet 1988). Figure 6.6 shows the historic and predicted future range of the brown bear in France; Figure 6.7 shows the current range.

Western Pyrenees

The species is present on the French side and to a lesser extent on the Spanish side. Exchanges between the two areas are usual. In France, the distribution area can be drawn in a 30km square, including the Ossau and Aspe Valleys, which total a range of about 525km^2 (Camarra and Dubarry 1992). Bears regularly frequent 300 to 350km^2 of this range and occur only occasionally in 150km^2 of the area. The main field data were collected in the mountains situated east of the Aspe River, with locally high densities

Figure 6.7. Present distribution of brown bear (*Ursus arctos*) in France, 1993.



on the left side of the main river in the upper Ossau Valley. On the other side of this river, the densities suddenly drop to low levels. Therefore, in contrast to observations from the last few decades, the main valley bottoms seem to be rarely frequented by bears. On the Spanish side, the bear distribution area covers 590km^2 (Caussimont and Herrero 1992). In the Pyrenees, the species is diffusely distributed over 1,115km^2, with one evident "shrinkage line" on the bottom of the Aspe Valley.

The population size in 1992, including two individuals on the Spanish slope, ranged from eight to 10 specimens, of which four to six were living in the eastern part of the distribution area limited by the Aspe River (Camarra and Dubarry 1992). The population size, monitored since 1980 (ave. n= 15–18), exhibited a sharp decline until 1986 (ave. n= 9–11). Over the last five years, one to two individuals may have disappeared (Camarra 1990b). Population density seems to be more a theoretical value rather than a realistic one in this heterogeneous country. The average value for the distribution area is one bear per 62 to 84km^2. In the core area, the regular presence zone reaches one bear per 44 to 58km^2.

Because of public pressure against trapping and radio telemetry, little is known about the population structure. However, the existing females with cubs, and a well-known male that had been monitored for 11 years by means of its foot-print size (Camarra 1992) and remote photo sensing, show us that at least one male and a few females were present until 1989, the last documented reproduction. In June 1994, we noted the high probability of the existence of a mating pair (Camarra 1994). In summary, we thus expect an older overall age structure.

From 1979 to 1984, the reproduction rate was supposedly lower (12.4%) (Camarra 1990b) than anywhere else in Europe. In the past 10 years, three cubs have been detected, both in 1984 and 1989. Such a reproduction rate cannot balance mortality. Since 1979, seven bear carcasses have been found in the area (Camarra 1992) but causes of death remain uncertain. We have only a set of presumptions, the discovery of a carcass, the population monitoring results, and some testimonies of local people to document the causes of death. In 1985, the last reliable case, a bear was most likely destroyed. The movements of three bears monitored by footprints (Camarra 1992) during the past decade confirm a shrinkage of range in 2–3 subpopulations although one specimen has sometimes been suspected to cross over. The last cub born in the area in 1989, a female, became a problem bear (Camarra *et al.* 1993).

Central and Eastern Pyrenees

During the 1970s, Parde (1984) estimated a population of 8–12 bears in this area. A decade later, the most relevant information is that only a few individuals (1–3) were present until 1988, the year of the last reliable testimony on bear presence. Over the last decades, the species exhibited a sharp decline until the late 1980s when it seems to have vanished.

Status

At present, France likely has the most threatened population of brown bears in the world. In spite of its recent citation in the List of Protected Species, it is becoming more and more endangered every year. Small population size and a changing environment are combining their negative effects. Recent genetic studies recognize that the Pyrenean, Cantabrian, and south Scandinavian bears belong to a distinct lineage (Taberlet and Bouvet 1994). Without prompt action taken during the next 1–2 years, the Pyrenean branch of this lineage will vanish.

In the Western Pyrenees, the population has been below the minimum viable population size for a long time, and we expect that the last specimen will vanish by the beginning of the next decade. In the Central Pyrenees, a restoration plan has been decided upon. The first bear, coming from Slovenia, will be released in the spring of 1995, and five other releases are planned for the next three years.

Legal status

The current French territory has supported a large brown bear population throughout the ages. Bears have been the king's game, pests, and objects of sporting hunts. Harvest increased during the latter part of the nineteenth century. It was primarily performed by professional hunters whose goals were to protect livestock against bear predation.

When bear hunting was abolished (1955–1958) and compensation for livestock damage was adopted, the species was only present in the Pyrenees. Animals responsible for significant and repeated damage could be killed. After some public disagreement in the 1960s, the bear became a legally protected species in 1972, and entered the List of Non-Huntable Species in 1981. The Pyrenees NP, created in 1967, covered at that time less than 5% of bear range. In 1993, the species was delisted for better efficiency and easier intervention in human-bear conflicts.

Population threats

For a long time, the local people considered the brown bear a pest. Chases with hounds were carried out each time a bear was spotted in the vicinity of sheep flocks or during the hunting season. Poisons, such as strychnine hidden in bear-killed carcasses, were successfully used by shepherds.

In the last centuries, several thousand bears were killed for livestock safety (Bouchet 1988), causing the disappearance of the species from most of the mountain ranges except for the Pyrenees, where it has survived. In the 1970s some bears were poached by hunting parties, and rumors suggest that kills have taken place as recently as the last decade.

At present, the shepherds accept the presence of the bear better than in the past. In their traditional way of livestock tending (flocking the sheep in an enclosure close to the cabin, accompanied by big Pyrenean dogs), they easily turned bears away from the corral. With the bear vanishing from most of its range, they are slowly turning to free-range grazing. This might unfortunately attract the bears and reinforce their predatory behavior (Camarra *et al.* 1993). In fact, a problem bear appeared under such circumstances in 1991. The main limiting factor of this population is the small population size and lack of reproduction which increasing the negative impact of accidental kills.

Habitat threats

Natural components and food availability: In the Western Pyrenees, the natural components of the habitat are supposed still suitable for a viable population of brown bears. Timber harvesting by selective cutting is a common practice, but the impact of such a technique is small and often limited to the removal of big trees and the loss of habitat from erosion along remote roads. The forest productivity of nuts is uncertain from one year to the next. The most palatable species for bears are very scarce (*Castanea*), or are essentially found at lower elevations (*Quercus* sp.), but are not readily available due to human activities. The easier access to pastures draws more livestock into bear habitat and uncontrolled fires in some key sites may lead to the landscape modification of some diurnal activity habitats such as bushes of *Buxus sempervirens*, *Fagus sylvatica*, *Corryllus avellana*, and oak forests (*Quercus* spp.). Little is known about bear-wild boar (*Sus scrofa*) competition for food in spring and late fall. Large ungulates, as potential prey, are absent (*Cervus elaphus*) or occur at extremely low densities (*Capreolus capreolus*, *Rupicapra pyrenaïca*).

Human disturbance: During the last 25 years, newly-built roads have allowed more access to remote sites. Human disturbance has increased dramatically in these areas which unfortunately include several potential and well-known breeding sites. Wild boar hunting with hounds may disturb bears during the major pre-denning period.

Fragmentation: In the main valley bottom of occupied bear habitat, a highway will be enlarged to service international traffic. Without some precautions, this event will fragment the area into subzones too small for sustaining viable populations on each side.

Potential recovery area: In fact, all the areas recently abandoned by bears during the past decade are no longer managed for bears. If nothing is done immediately, we will lose all bears as well as the possibilities for recovering them.

Management

Since 1984, several plans (Camarra 1990; Servheen 1990, 1993) have been submitted for approval by local people, the traditional owners of the land. Contrary to expectations, few were applied. Therefore, in 1990, the administration created hunting preserves, against the will of the local hunters. The official Management Guideline, presented by both the Ministries of Agriculture and Environment in 1988, did not address the local people, but rather dealt with administrative policy. It consisted of field management recommendations, almost all of which were suspected to represent a loss of power by local people.

To resolve this confrontation, local Representatives and the Minister of the Environment were involved in a charter for "long-term development of the valleys and protection of the bear". The main policies adopted by local people for the next few years are: 1) auditing the bear population status; 2) building access roads to many of the remote cabins in the area; 3) improving shepherds' way of life in their summer cabins as well as increasing cattle and sheep densities; 4) reduction of bear predation rate on domestic animals by improving safeguarding techniques against bears; 5) banning hunting or reducing hunting with hounds to lessen pressure on some key sites; 6) the reintroduction of six bears from Slovenia in the central Pyrenees, 80km from the present distribution area.

Guidelines that will be applied for several years and then reviewed:

1. **Monitoring of the population:** Since 1983, the "Brown Bear Network", the official field research network, has annually monitored bear presence and population parameters throughout the French Pyrenees. Footprint measurements, genetic imprinting, simultaneous presence, and remote sensing cameras are part of the monitoring techniques. Cartographic syntheses are produced every five years (Camarra 1990). In 1995, this work was to be carried out in official coordination with the recently created Spanish network.
2. **Pastoralism:** Damages due to bear predation will be well compensated (e.g. twice the slaughterhouse rate for a sheep kill). In addition, a helicopter will be provided free of charge every year to transport food and equipment to remote shepherd cabins, and radio equipment will be provided free to all shepherd cabins within the bear distribution area.

Recommendations that are under consideration but have not yet been decided upon:

1. **Carrying capacity:** Implementation of the carrying capacity by setting up additional feeding points, sowing cereal fields, and planting fruit trees.
2. **Fragmentation:** "Green bridges" large enough for bear crossings are proposed for several sites along the future international road that will cut through the Aspe Valley.
3. **Forestry:** In a few of the proposed key sites, there will no longer be any logging or road unloading of forest products, and owners will be compensated for loss of income. It is necessary to support the carrying capacity for bears by selective cutting, ceasing forest management from 1 November to 15 June, and leaving 2/3 of the bear management unit undisturbed each year.
4. **Road access:** Limit vehicle access on remote roads.

Human-bear interactions

In the Pyrenees, humans have suffered bear predation on their livestock for many years. All have learned to live with each other. The shepherds adapted their herding strategies and the bears became extremely shy. Under these conditions, a single bear was suspected of killing 3–4 sheep per year (Nédélec *et al.* 1992). Other domestic species were seldom attacked. Annual compensation for damages amounted to approximately US$15,000. The present change in livestock herding technique to a more free-ranging one may induce a higher bear predation rate and a loss of fear of humans. Such has been the case with a subadult female in 1991 and 1992. Two provoked bluff charges towards humans by a sow with cubs have been noted during the last 20 years.

The conservation of a highly threatened bear population can often lead to restrictions in human activity. Therefore, leading groups like hunters and shepherds disagree with the protection plan. In fact, bear presence disturbs the schedule of traditional activities proposed by the local people for remote places.

Public education needs

The biology of the brown bear should be taught in all schools within occupied bear habitat, in its surroundings, and in other potential recovery zones. Political leaders and the groups directly interested in bear protection problems, such as hunters, shepherds, and commercial interests, must be motivated by concrete results from positive examples of human-bear interactions. The public's concern for animal welfare has increased and has often changed their attitude towards handling, radio telemetry, and marking of wildlife. In fact, experience shows that with education the public can be very supportive of bear management programs.

Specific conservation recommendations

Compensation

Compensation schedules should be incorporated into the rural action plans for sensitive areas inhabited by bears. These plans should also allow the maintenance and/or enhancement of activities favorable to bears, with the help of state and EEC funding.

Habitat

Although in France, habitat factors have less immediate influence than population size, their management is the keystone for a recovery plan. Such a plan could improve the lives of the last remaining individuals and be useful in the involvement of both the general public and local people in bear protection concerns.

1. Guidelines should be applied in an officially designated French-Spanish recovery zone ranging at least from 1,000–2,000km^2, with the minimum range for a viable brown bear population estimated at 70–90 individuals (Shaffer 1984). The present bear distribution range could be managed in four types of areas: a) wilderness in key sites (resting, late fall, predenning, denning, and breeding sites); b) areas where only traditional activities are allowed; c) buffer areas with limited access by motor vehicles, and; d) areas subject to an environmental impact statement for harvesting big stands of timber.
2. Human activities should be timed to account for bear seasonal habitat utilization, with interruption of all activities during key periods.
3. Carrying capacity should be enhanced by an increase in food species diversity, favoring oak, chestnut and blueberry stands. When applying a short-term strategy, it is necessary to plant orchards, oats, and corn fields. During periods of low food availability it is necessary to manage additional feeding points. Prescribed natural fires, a common practice in the management of pastures, should be strictly controlled in order to augment bear habitat quality.
4. Management of human activities must be adapted in low elevation corridors, such as large roads running through valley bottoms, in both the present distribution and future recovery areas.
5. Livestock should be restricted from ranging freely.

Population

1. Reinforcement of the present population must be accomplished as soon as possible, before the species completely disappears. The Western Pyrenees, where brown bears still survive, must be the first target area.

From genetic and ecological points of view, this can be accomplished by introducing wild bears from nearby Slovenia and southern Scandinavia.
2. Management strategies for eventual problem bears must be devised.
3. Restocking of a captive Pyrenean-Cantabrian bear lineage is encouraged to further reinforce the population and maintain its genetic diversity.

Scientific research

Further studies are needed to assess:
1. Seasonal habitat use and the impact of human activities on bear survival in late summer and fall, when both the level of human activity and bear sensitivity are increasing.
2. Limiting factors to the reproduction rate.
3. Annual production and availability of bear food.
4. Relationships with wild boar (*Sus scrofa*) populations.
5. Potential for enhancement of the carrying capacity.

Conclusion

The brown bear population has been below the minimum viable population size for several decades. We feel that we are monitoring in detail the final stages of Pyrenean bear survival. Without population reinforcement the species will vanish within the next 15–20 years. Because of the similarity of situations in which the species currently lives in the Pyrenees and Cantabrian mountains, France and Spain should coordinate their scientific research and management efforts to save this specific lineage of brown bear.

Acknowledgments

Direction de la Nature et des Paysages of the Ministry of the Environnement, the Rangers of the Office National de la Chasse, the Parc National des Pyrénées and the Office National des Forêts, the members of the FIEP, E. Dubarry, P. Migot, L. Nédélec, P. Stahl, C. Servheen, and E. Taran.

Status and management of the brown bear in Greece

George Mertzanis

Historic range and current distribution

Over 100 localities distributed all over Greece contain the name "bear", and these, together with historic sources, inform us about possible historic brown bear distribution. In ancient times, its range extended over nearly the entire mainland [Pausanias (200 BC) 1969; Xenophon in Simopoulos 1984] (Figure 6.8a). Bear presence in the mountainous parts of Greece, including the Peloponnisos peninsula, seems to have been continuous until the 15th and 16th centuries (Pizzicoli, Candiloros, Guillet, and Dedreux in Simopoulos 1984) (Figure 6.8b). Brown bear range in Greece has decreased rapidly and dramatically within the last two centuries, leading to severe fragmentation. In the 18th century, there is evidence of a period of dramatic population decline (Mertzios in Papavassiliou 1963), due essentially to massive bear extermination for its skin and to habitat alteration.

More recent oral information confirms the species extinction in the 1940s from the southernmost and easternmost branches of the Pindus range (Mt. Parnassos, 2,457m and Mt. Olympos, 2,918m) (Figure 6.8d). One may assume that the main mountainous units of Greece (the Pindus range and Rhodope mountain complex), because of their inaccessibility and remoteness, have been the refuges and dispersal centers of the species in Greece throughout historic times.

Apart from some fragmentary information (Couturier 1954, Hainard 1964, and Curry-Lindahl 1972), no systematic knowledge of the status of the brown bear in Greece existed until the mid-1980s. Data on brown bear distribution in Greece have been systematically gathered since 1985 (European Union – EU Greek Ministry of Agriculture Project 1988; Mertzanis 1989, 1991, and 1992; Mertzanis *et al.* 1994; Mertzanis 1994a; Mertzanis 1994b; and Mertzanis *et al.* in prep.).

These data show that brown bear range in Greece presently consists of two separate population nuclei, located approximately 220km apart in the northwestern and northeastern part of the country, respectively in the Peristeri-Pindus range and the Rhodopi mountain complex. Total bear range comprises a surface of about 10,000km^2, 1,500km^2 of which are only occasional bear habitat.

Brown bear range in Greece is divided into four main units:

A) Peristeri-Pindus range (western nucleus: units I, II, and III):

- **Unit I**: The Peristeri range (Varnous, Vitsi, and Askion Mts.), with alpine meadows, large beech (*Fagus sylvatica*) forests between 1,200m and 2,100m, and oak forests on lower altitudes, all covering mostly granitic soils (Debazac and Mavromatis 1971; Quezel 1967).
- **Unit II**: Large parts of the northern Pindus range, including the valleys of the Aliakmon, Sarantaporos, and Aoos rivers as well as the Grammos, Voio, Smolikas, Timfi, and Lyngos mountains. Alpine meadows, large black pine forests (*Pinus nigra* ssp. *pallasiana*), beech forests (*F. sylvatica*) as well as mixed forests of black pine (*P. nigra*), fir (*Abies borisii regis*), beech (*F. syvatica*), and white pine (*P. heldreichii*), covering mostly limestone and ophiolithic soils. At lower altitudes the vegetation

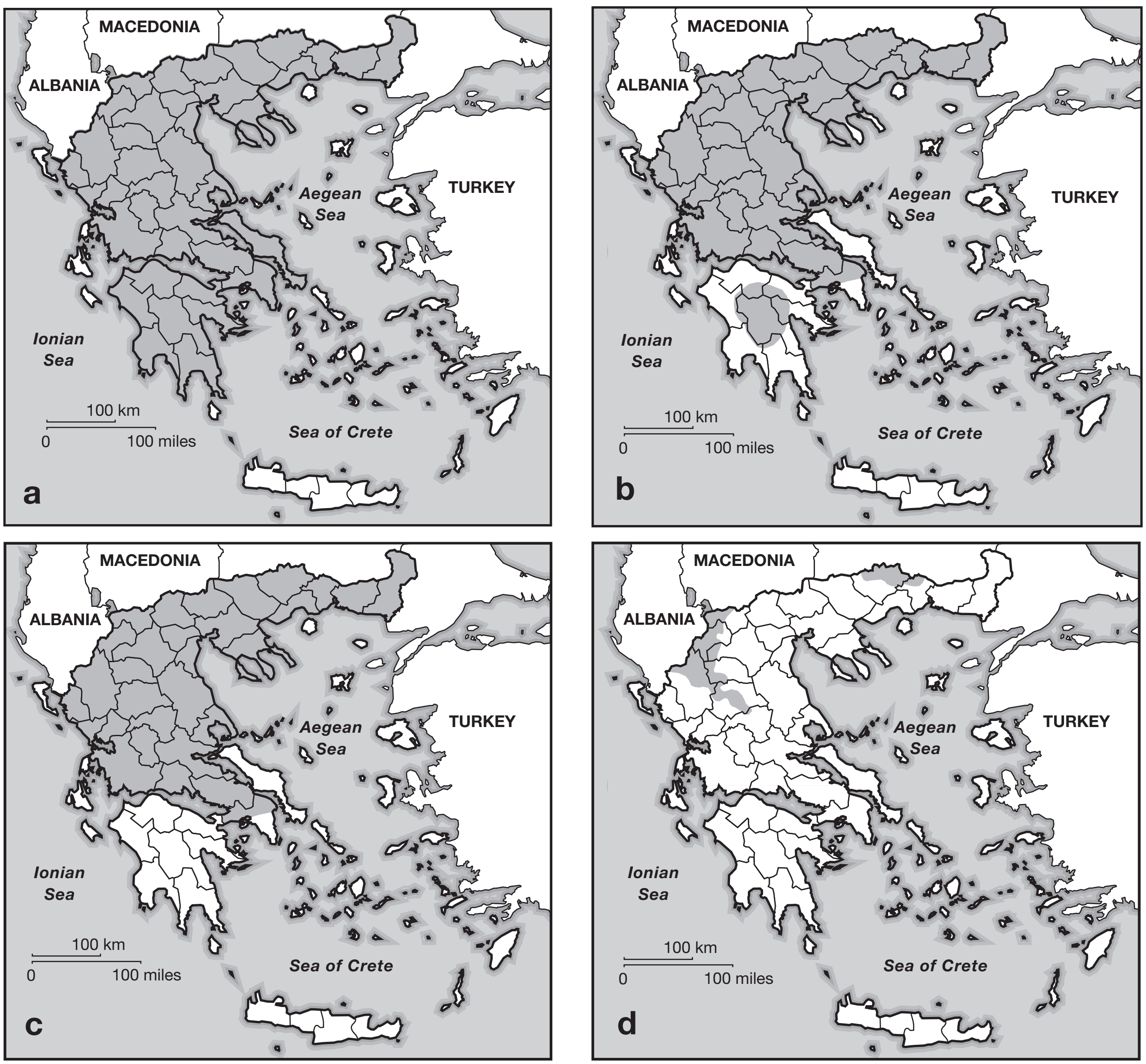
zones of *Quercion-frainetto* and *Ostryo-Carpinion* are present in a wide range.

- **Unit III**: The Acheloos river high valleys including the Peristeri, Triggia, Neraida, and Avgo mountains, with mainly large fir (*A. b. regis*) forests covering limestone soils and oak forests at lower altitudes.

The western nucleus extends over an area of about 6,200km^2 covering the northern and central part of Pindus-Peristeri ranges. This includes Varnous, Vitsi, Grammos, Askio, Voio, Smolikas, Tymfi, Lyngos, and Aspropotamos, down to approximately the Agrafa mountains (39° latitude). This sector is considered to be the southernmost distributional range of the species in Europe and therefore of outstanding zoogeographic importance. The western nucleus counts for about the 85% of the total bear population in Greece. The northern part of this population is connected with the populations in the "former Yugoslavia", and probably in Albania.

Main habitat types consist of large oak forests (*Quercus conferta*, *Q. petraea*, *Q. cerris*, and *Q. trojana*) on lower elevations, mixed or pure coniferous-hardwood forests of black pine (*P. nigra*), fir (*A. b. regis*), white pine (*P. leucodermis*), beech (*F. sylvatica*), and alpine meadows at higher elevations. Elevations range between 500m and 2,600m.

Figure 6.8. Historic and present distribution of the brown bear in Greece. **(a)** 2nd century; **(b)** 15th century; **(c)** beginning of the 19th century; **(d)** present.



Density of human settlements in rural zones reaches approximately three inhabitants/km^2, a lower density than in other bear areas of the European Mediterranean region.

Extensive logging, a high density of forest roads, accidental and criminal forest fires, hydroelectric and highway building, and mining projects are among the threats to bear habitat conservation.

A summary of current bear distribution in the western nucleus shows the following major characteristics:

1. A concentration of bears around the major mountain units of northern Peristeri-Pindus range.
2. A geographic continuity (that has to be updated and reconfirmed) with adjacent (neighboring) bear populations (Albanian, former-Yugoslavian) characterized by bear movements along the border.
3. Severe fragmentation of the area exists at the latitude of the town of Kastoria, due to the ongoing extension of agricultural lands upon forested bear habitat.
4. Sporadic bear occurrence in the extreme eastern range (area of Mt. Askion) and south-southeastern parts of the range (area of Metsovon, Trikala). These sectors are also characterized by a shrinking species range and risk of habitat fragmentation.

   Moreover, the planned construction of three segments of the "Egnatia Highway" through the above sensitive sectors will be an additional factor that will irreversibly deteriorate bear habitat, bear sub-population connectivity, and subsequently bear population viability in the wider area. After the completion of the work, about 250km^2 of critical bear habitat will be isolated.
5. *Occurrence of bears outside normal range*: Between spring 1987 and autumn 1989, several cases of bears occurring outside of their normal range in the extreme southern sectors (area of Karpenission, Agrafa Mts), were reported and confirmed by locating damage to beehives. In this zone, apparently isolated from the core bear range, one adult male, one subadult, and one female with a cub were seen. This is the first evidence of bears occurring in this area in the last 40 years. Recent data (Project ARCTOS 1996) confirm regular bear presence in this sector.

   In spring 1990, bear sightings were reported in the NW Pogoni area along the Greek-Albanian border. This represents the westernmost extension of bear range in Greece. More recent data (Project ARCTOS 1996) confirm bear occurrence in this sector on a more regular basis.

   In autumn 1990, bear sightings and damage to beehives were reported in the area of Dadia, in NE Greece (Thraki). That point represents the easternmost record of bear occurrence in Greece.

   One bear that occurred outside its normal range was relocated. The bear was caught in the Pindus range (Tzoumerka Mts.) and transferred into the Rhodopi Mts. (eastern population nucleus, B) 350km away from the "conflict" area (Mertzanis *et al.* in prep.; Project ARCTOS 1996).

   Finally, bear occurrence in potential bear range in the extreme north (area of Mt. Voras and Mt. Belles) needs further confirmation. However, in the first case (Mt. Voras), recent data (Project ARCTOS 1996) give further evidence of the existence of a relic sub-population shared with the Former Yugoslav Republic of Macedonia (FYROM).

B. Rhodopi mountain complex (eastern nucleus: unit IV):

- **Unit IV**: The Rhodopi mountains are a vast granitic mountain complex including Mount Falakron, covered with large forests of spruce (*Picea excelsa*), forest pine (*Pinus sylvestris*), beech (*Fagus orientalis*, *F. mosaecus*), and oak (*Quercus frainetto*, *Q. macedonica*, and *Q.* sp.).

The eastern nucleus (Unit IV) extends over an area of about 2,400km^2, and includes the forested region of the western Rhodopi mountain complex as well as the northern slopes of Mt. Falakron. Bear presence has also been observed to the west in Menikio and Lailias hunting reserves. This population nucleus comprises about 15% of the total bear population.

Main habitat types consist of large oak (*Quercus conferta*, *Q. petraea*, *Q. cerris*, and *Q. macedonica*) forests at lower elevations. Mixed or pure coniferous-hardwood forests of fir (*Abies borisii regis* and *A. alba*), Scots pine (*Pinus sylvestris*), spruce (*Picea excelsa*), beech (*Fagus sylvatica*, *F. orientalis*, and *F. mosaica*), and birch (*Betula verucosa*) occur at higher elevations. Elevations range from 700m to 1,900m.

The area is sparsely inhabited, and the western Rhodopi region is almost uninhabited (most human settlements have been abandoned since World War II). Extensive logging associated with forest road construction, as well as ongoing construction of three hydroelectric units within bear range are the main threats to bear habitat quality and integrity. This population nucleus seems to still be connected with the neighboring Bulgarian bear population. Available data on bear distribution also shows that the state of linkage areas between sub-populations indicates a serious risk of further intra-nucleus fragmentation.

A summary of present bear distribution in the eastern nucleus shows the following:

1. There is a concentration of bears around the central part of Rhodopi mountain complex.
2. Severe fragmentation of the range exists near the village of Lefkogia, due to ongoing extension of agricultural lands upon bear habitat.
3. Bears are occurring on a more regular basis than before (Project ARCTOS 1996) in the extreme western sectors (area of Serres-Lailias), and the probabilities of bear occurrence in adjacent sectors (Mt. Belles) are

increasing, making delineation of the bear range there more difficult.

4. Migration across the Greek-Bulgarian border has also been confirmed by radio tracking (Mertzanis *et al.* in prep.; Project ARCTOS 1996).

Status

Population size estimation, especially trends involving parameters such as age at first reproduction, reproductive interval, and adult female survival, are difficult tasks needing long-term monitoring (10 or 12 year cycles) and intrusive methods (capture and recapture of individuals) for reliable figures. In Greece such data is lacking, but attempts have been made to estimate the minimum population size based on unduplicated direct, or reliably reported, observations of females with cubs of the year, and on the assumption that a healthy population is composed of 10–12% females with cubs (Servheen 1989). As a result, the minimum bear population size in Greece has been estimated between 110 and 1,300 individuals (Project ARCTOS, 1996). The eastern population nucleus is estimated to have a minimum 15 to 20 individuals, and the western population nucleus to have a minimum of 95 to 110 individuals (Project ARCTOS 1996).

Legal status

The brown bear is considered an "endangered-vulnerable" species in need of strict protection (Council Directive 92/43/EEC of May 21, 1992, on the Conservation of Natural and Wild Fauna and Flora L 206/38 ANNEX IV) within the boundaries of the EU. Although the killing, capture, possession, and exhibition of bears has been illegal since 1969 in Greece (article 258, par. 2e, 2z. L.O. 86/69 of the Greek Forestry Code) such practices still continue. The main reasons for this are a misinformed public and inefficient damage compensation procedures. Another reason is the misuse of local prefectoral right to abolish, when judged necessary and despite central authorities opinion (!), the bear's protection status in case of massive damage caused by bears.

The problems of poaching and the exhibition of "dancing bears" by itinerant gypsies still persist. Moreover, only 7% of the total bear range in Greece is placed under protected area status. Legislation concerning compensation of bear depredations on livestock was improved in 1990 thanks to the efforts of the Game Management Department of the Greek Ministry of Agriculture. Complete financial compensation for livestock depredations was finally established (with some quotas on the number of animals lost). The improved compensation system does not cover cases of damage to beehives and crops.

Population threats

The status of the brown bear in Greece remains critical despite legal and institutional protection. We conclude that the major threats to Greek bear populations and habitat are: 1) human caused mortality, 2) habitat fragmentation at a range scale, and 3) habitat loss and habitat degradation.

C. Servheen

Greek brown bear (*Ursus arctos*) rescued from dancing bear traders.

Human caused mortality (poaching), although illegal since 1969, seems to be the main factor for negative population trends. An evaluation showed that this factor seriously affects brown bear populations with losses estimated up to an average of 14 bears/year (only for known and probable cases), which equals 12% of the minimum bear population in Greece (E.U.-Greek Ministry of Agriculture Project 1988; Mertzanis 1992; Mertzanis *et al.* in prep.; Project ARCTOS 1996). Recent data for the period of 1993–1995 give 11 confirmed bear kills.

The reasons for poaching are mainly: a) resentment for damage caused to livestock, beehives, etc., b) bear skin value (a good quality trophy may reach an average price of 200.000 drs., which is roughly US$800), c) casual encounters during wild boar (*Sus scrofa*) hunting, and d) killing of females with young to capture the cubs.

The highest levels of human caused mortality are concentrated during the hunting period (September to January), especially during drives for wild boar. Data from interviews and questionnaires show that during 22% of the hunts, bears are either disturbed or seen (Mertzanis 1989, 1992). Since the known human mortality rate is only a part of total mortality, and since hunting pressure is important throughout bear range, we may reasonably assume that actual human caused bear mortality rate in Greece is two to three times higher than known mortality. Taking into account other demographic parameters such as reproductive rate and natural mortality in relation to the above figures, it is reasonable to assume that Greek brown bear populations are declining.

Habitat threats

The main threats to brown bear habitats are analyzed in Mertzanis (1992,1994) and Project ARCTOS (1996). Habitat degradation occurs as a result of: the high density of the forest road network; the chaotic dispersal of timber felling areas; clearcutting in deciduous forests (mainly coppice oak forests); forest overexploitation; overgrazing in specific areas; indiscrimate logging and substitution of broad-leaved trees with conifers; accidental or criminal forest fires and; the lack of an environmental impact process for large scale public works (such as water impoundment on the Nestos river and the Egnatia highway). Range fragmentation at a national and trans-frontier scales encompasses all the above causal factors as well as the lack of a model of economic development compatible with bear survival.

Human-bear interactions

Some bears seem specialized in preying on livestock. Attacks mainly occur on sheep and cows (in 71.5% of cases according to veterinary authorities) and are concentrated mainly in the beginning of summer and late autumn. Damage to apiaries is often reported. As apiculture represents an important source of income for some local people, an electric antipredator fence has already been experimentally used in twenty (20) apiary units within the bear range to help to minimize damage. Results were positive. In the framework of "ARCTOS" Project, the use of this device has been extended to 50 more apiary units. Damage to orchards and crops does not seem to be of significant economic value.

Management

Conservation of Greek brown bear populations can not be envisioned within the existing protected area network because of the network's small size, restricted habitat representation, and lack of efficient wardening. We also realize the very important role that human activities play in habitat disturbance. These threats are very often related. Therefore, in some cases bear habitat may be suitable or available but still inaccessible to bears because of high levels of human activity or very low bear population densities (due to human caused mortality). In other cases habitat loss can lead to much more vulnerable populations. It is worth noting that human-caused mortality is the most important factor in management actions, and that the most important conservation step is to minimize human-caused mortality from all sources. Distribution of human-caused mortality is very important for the identification of bear/human conflict areas (Servheen 1994). That leads to questions of habitat security in relation to human activities, which is also an important factor in bear management actions (Servheen 1994). It is therefore very important to realize the extent of human activities in order to evaluate the level of disturbance. From that point it can be easily understood that the main problem in a conservation strategy is how to manage the human component.

Government and NGO actions

In 1988 the first large-scale Bear Action Project was launched in Greece. Mainly financed by the European Union (EU), it covered almost the entire bear range. This project was conducted in 1988 by the Wildlife Division of the Greek Ministry of Agriculture with the participation of the Hellenic Society for the Protection of Nature, and was supervised by the Royal Institute of Natural Sciences, Belgium. The main goals of the project were: 1) the first delineation of brown bear distribution; 2) the first rough estimation of the brown bear population size; 3) identification of causes of direct (human caused) mortality;

4) the experimental installation and test of an electric fence to prevent bear damage to beehives (the device was tested with positive results on 10 units distributed all over the bear range); 5) the creation of a small scale wardening and information network, and; 6) a public awareness campaign that produced a pamphlet and a poster.

On completion of this project it was clearly understood that a long-term integrated management strategy, based on better understanding of both brown bear ecology and bear-human interaction, was urgently needed. To achieve this main objective, a 2-year (January 1994–December 1995) national project ("ARCTOS" Project) was jointly launched in January 1994. This project involved the Greek Ministry of Agriculture (General Secretariat of Forests and Natural Environment – Game Department), and three NGO's: the ARCTUROS Society, WWF Greece, and the Hellenic Society for the Protection of Nature (HSPN). Because it was the first large scale project in Greece dealing with brown bear conservation at a range scale, this project encompassed several long-term goals and expectations which are outlined below.

ARCTOS Project guidelines

It was clearly understood that the complexity of bear conservation required a multilevel approach in order to evaluate the interactions between bear populations, bear habitat, and bear-human interaction.

This multilevel approach provided necessary data on the following issues: 1) bear occurrence and activity in time and space in relation to habitat suitability and availability; 2) demographic parameters dealing with direct mortality and natality for the evaluation of populations levels and trends; 3) identification of the ecological requirements of the brown bear; 4) identification and analysis of the main components of brown bear habitat, and; 5) identification of human activities versus bear activities.

The synthesis of the above information was achieved through creation and combination of thematic digitized maps using GIS. This led to the mapping of bear habitat, and identification of important bear areas in terms of needs for priority action and conflict zones. Identification and categorization of the important zones for brown bear in Greece are illustrated in Table 6.2. (Project ARCTOS 1996).

Details on distribution of important brown bear areas within the total range of the species, and total surface area of each category are presented in Table 6.3 (Project ARCTOS 1996).

The results presented in Table 6.3 have also created the framework for the development and implementation of a conservation strategy through the elaboration of: a) a general Bear Action Plan to deal with bear conservation problems at a range scale, and b) specific environmental studies to deal with bear conservation problems in priority cases.

Table 6.2. Categories of important areas for brown bears

Category	Code name	Brief description
1	Regular bear presence, especially during all critical stages of the annual cycle	Habitat structure and suitability meets species ecological requirements dealing with the most important stages of the cycle ensuring species' survival: reproduction, denning, use of spring habitat in combination with high food diversity, and a high degree of security
2	Regular bear presence during specific stages of the annual cycle	Systematic seasonal use in relation to important bioecological needs such as feeding, summer refuge, and probably denning
3	Sporadic and/or seasonal bear presence	Less systematic use in relation to the aforementioned ecological requirements
4	Regular bear presence in the limits of the species range	This category is of equal ecological importance with category 1 but is located in sectors of the species range which are under extreme conditions (in the limits of the range, adjacent to linkage areas)
5	Suitable bear habitat with recent absence or very low levels of bear presence	Despite high suitability of bear habitat, human-caused mortality and disturbance keep bear population density at very low levels
6	Extra-limital bear occurrence	Concerns sectors geographically disjuncted from the core bear range
.../S	Linkage areas between sub-populations with serious risks of bear range disconnection	Shrinkage and degradation of bear habitats in precise sectors of the species range. Connectivity and geographical continuity of bear habitats is continuously deteriorated due to human actions (changes in land-use, development of road infrastructure)
.../A	Definite disconnection (loss) of suitable bear habitat due to large-scale public works	About 200km^2 of important bear habitat is cut due to water impoundment construction (dam on Nestos river) in Sector I (Rhodope), and 220km^2. of bear habitat are going to be cut due to the Egnatia highway project (under construction)

Table 6.3. Distribution and surface area of important brown bear areas in the species range.								
Importance category/ sectors	Sector I (Rhodope – 2,400km^2)		Sector II (Peristeri – 1,150km^2)		Sector III (Pindus – 5,050km^2)		Total range (8,600km^2)	
	km^2	%	km^2	%	km^2	%	km^2	%
1	320	13	215	18.6	1,210	24	1,745	20.3
1/A	0	0	0	0	80	1.6	80	0.9
2	570	24	600	52.2	1,460	29	2,630	30.6
2/A	0	0	0	0	90	1.8	90	1
2/S	0	0	0	0	35	0.7	35	0.4
3	310	13	185	16.1	1,910	38	2,405	28
3/A	190	8	0	0	55	1	245	3
3/S	60	2.5	50	4.3	195	4	305	3.5
4	0	0	100	8.7	15	0.4	115	1.3
5	950	39.5	0	0	0	0	950	11
6	0	0	143*	-	187*	-	330	-
Total	**2,400**	**100**	**1,150**	**100**	**5,050**	**100**	**8,600 +330***	**100**

To achieve the above multilevel approach, a working scheme involving three main teams was scheduled, and each team was responsible for one of the following tasks: a) collection of data on bear biology and ecology, b) collection of data on bear habitat components with emphasis on forest vegetation, and c) collection of data on human activities and land use.

The results have been used as the main criterion in bear habitat mapping. Coupled with the degree of human presence and activities, they have also contributed to bear habitat ranking. They will be taken into account in the framework of management plans when scheduling human activities within bear range (logging, hunting, recreation, and natural resource exploitation).

ARCTOS Project long-term goals

1. Contribute to improving demographic parameters and distribution of the bear throughout available habitat.
2. Ensure geographic continuity of bear range in Greece. Protect and/or manage the areas required to maintain a viable population level. Within each distribution unit, preserve and/or restore habitat quality (in terms of integrity, availability, and diversity of natural resources) at suitable levels for the aimed population level. Protect or restore bear habitat, with special attention to habitat types listed in the 92/43 EC Directive.
3. Develop alternative approaches to bear-human interactions. Alter activities responsible for direct mortality, fragmentation of the bear range, degradation of bear habitat, and random and uncontrolled disturbance.
4. Create a permanent support unit for the research and management of bear population and habitat in Greece.
5. Promote cooperation among EU countries in matters related to the conservation of the brown bear and its habitat.

ARCTOS Project expected achievements

1. Ensure necessary conditions to achieve short (within the project period) and long-term positive population trends.
2. Control direct illegal mortality.
3. Preserve and/or enhance linkage areas between bear populations.
4. Ensure and/or improve habitat quality (natural resources diversity and availability).
5. Improve the efficiency of the existing wardening network.
6. Enhance efficiency of other direct protection measures involving bear-human interaction.
7. Reconsider and improve the existing network of protected areas.
8. Provide authorities with guidelines and specifications for regional planning.
9. Prepare and submit to the Ministry of Agriculture and the regional forest division, proposals for the improvement of forest policy (management and timber exploitation) in relation to bear habitat conservation criteria.
10. Prepare and submit proposals for Presidential Decrees to protect important bear zones under suitable status. Provide these zones with an integrated management plan.

11. Provide authorities with technical aid for the optimization of the socio-economic compensation procedure.
12. Increase and promote information and public awareness with special attention to different social groups.

Specific conservation recommendations

Addressing brown bear conservation needs is the major purpose of all the above efforts. But imminent threats cannot wait for long-term scientific studies to be controlled. Therefore, a strategy had to be developed and implemented in order to simultaneously neutralize imminent threats and to address long-term conservation needs. Immediate efforts should focus on minimizing illegal killing, improving habitat security by limiting human activities in important areas, maintaining linkages within and between bear populations, and increasing public support.

Tables 6.4, 6.5, 6.6, and 6.7 illustrate the steps to achieve these goals through the Greek Bear Action Plan.

Table 6.4. Illegal killing: list of main axes and guidelines of the Greek Bear Action Plan.

Immediate and future actions to be undertaken through the Bear Action Plan	Collaborating authorities, organizations and associations
Extension of electric fences in a number of sites, including orchards, cereal cultures, etc.	Ministry of Agriculture Forestry services
Responsibility for the selection, distribution, and management of the installation sites will be transferred to local communities and beekeeper co-operatives.	Beekeepers co-operatives
Proposal for the extension of compensation system to cases not included in current regulations: damage on beehive boxes, livestock below a certain quota, crops. Ask for the issue of Presidential decree to that purpose.	Ministry of Agriculture EL GA (Organization for farmer's insurance).
Information to livestock raisers through specific pamphlet on compensation system. Set up of a project for breeding and provision of a local breed of Greek sheep dog to shepherds for better protection of livestock.	Ministry of Agriculture Dog breeders and trainers
Intensification of hunters' awareness and information through seminars.	Regional and local Hunting Associations
Redistribution, spatial restructure, and creation of new game refuges in relation to important areas for brown bear	Ministry of Agriculture Forestry Services
Intensification of wardening. Employment and special training of permanent wardening personnel.	Ministry of Agriculture Forestry Services
Official restrictions in construction projects of new forest roads with priority to bear area categories 1 and 2. Proposal for the issue of a relevant presidential decree.	Ministry of Agriculture Forestry Services
Proposal for closure of secondary forest road network during the absence of forestry work. Implement this in bear areas of category 1 as well as in linkage areas.	Ministry of Agriculture Forestry Services
Improvement of brown bear legal protection status. Abolition of prefectoral authority to cancel bear protection status in cases of continual damages caused by the animal. Ask for the issue of presidential decree.	Ministry of Agriculture
Proposal for specific legislation dealing with taxidermy practices. Ask for the issue of relevant presidential decree.	Ministry of Agriculture
Closure of garbage dumps next to villages, with priority given to bear areas in categories 1 and /S. Cooperation between communities for the creation of common buried garbage dumps.	Regional authorities Communities
Creation of a new veterinary bear recovery center. Confiscation of the rest of the dancing bears.	Ministry of Agriculture Ministry of Public Order Communities of Aetos and Nympheon Veterinary School Farmers Association of Amyndeon Sponsors (Private Societies)
Set-up of standard protocol for cases of relocation of problem bears.	Ministry of Agriculture Local Forestry Services
Set-up of a standard protocol for systematic and long-term monitoring of the population and human-caused mortality, using the radio-tracking method	Forestry Services

Table 6.5. Habitat degradation and loss: list of main axes and guidelines of the Greek Bear Action Plan.

Immediate and future actions to be undertaken through the Bear Action Plan	Collaborating authorities, organizations and associations
Development of Specific Environmental Studies in three bear sectors of outstanding importance and application of national legislation (L.1650/86) (norms have already been officially approved by the Ministry of Environment). Issue of specific presidential decree for creation of protected areas and the establishment of specific management regulations in the framework of the above studies.	Ministry of Environment, Planning and Public Works
Contribution to the updating of the planning legislation at a regional and local level.	Ministry of Finances Ministry of Environment
Proposals for the support of traditional agriculture and livestock raising in the corresponding units.	Ministry of Agriculture Local governments Prefectures
Concrete proposals concerning specific measures for each bear area category, with reference to actual forestry practices and norms of forest management plans.	Ministry of Agriculture Forest Research Institute
Provision by local forestry service plant nurseries of suitable fruit trees that would be planted in each reforestation operation. Ask for the issue of a specific presidential decree.	Ministry of Agriculture Forestry Services
Preparation of presidential decrees for the implementation of specific articles of the legal framework (1650/86). Upgrading of national legislation according to EU directives concerning the protection of the environment.	Ministry of Environment, Planning and Public Works
Proposals for strict control of land use in terms of maintaining farming, forestry, and livestock activities at their present levels and spatial limits. Specific guidelines are given for the re-organization of recreational activities in respect to the spatio-temporal patterns of bears within the tourism units. Big infrastructure works should be planned and designed in respect to bear space needs.	Regional governments Prefectures Ministry of Environment Ministry of Finances
Concrete guidelines are given for the incorporation of the environmental component in the initial stages of planning of large scale infrastructure works.	Regional governments Prefectures Ministry of Environment Ministry of Finances

Table 6.6. Bear range fragmentation and shrinkage of linkage areas: list of main axes and guidelines of the Greek Bear Action Plan.

Immediate and future actions to be undertaken through the Bear Action Plan	Collaborating authorities, organizations and associations
Proposals for guidelines and standard protocol for international cooperation on joint projects for the conservation of interborder bear populations. The first steps between neighboring Balkan countries have already been achieved through international meetings.	Public authorities Universities NGO's (in the three neighboring countries: Bulgaria, FYROM, Albania)
Proposals for incorporation of environmental factors in regional planning.	Ministry of Environment Regional governments
Consider linkage areas as priority areas in the national arena.	Ministry of Environment
Formulation of proposals for specific management regulations in linkage areas. Ask for the preparation of a relevant presidential decree.	Ministry of Environment
Officially strengthen evaluation of environmental factors in the initial stages of planning for large scale public works.	European Union Ministry of Environment

Acknowledgments

We warmly thank the European Union (DG XI/D/2), the Greek Ministry of Agriculture, the Hellenic Society for the Protection of Nature, and the "ARCTUROS" Society for their support and collaboration. Special thanks go to Dr. Christopher Servheen for his valuable collaboration and advice on the framework of the "ARCTOS" Project.

Table 6.7. Lack of public support: list of main axes and guidelines of the Greek Bear Action Plan.

Immediate and future actions to be undertaken through the Bear Action Plan	Collaborating authorities, organizations and associations
Seminars for the guards of the Forestry District Departments, and for the employees of districts and prefectures	Forestry Service Ministry of Agriculture
Printed material for ELGA	ELGA
Proposal for the creation of one Center of Environmental Education	Community of Aetos and Nymfaion
Proposal for the organization of at least two Information Centers about the brown bear in the two bear range areas	Ministry of Education
Increase the number of local assistants up to 8, one for each prefecture of the bear range	Local Communities
Continuous contacts with and seminars for hunters	Hunting associations
Seminars and lectures for the local people	Prefectures and Communities
Proposals for a documentary about the brown bear, and TV spots for public awareness	Mass Media
Enrichment of the material included in the brown bear kit, and increasing kit number to 50 for their distribution all over Greece	Ministry of Education Schools

Status and management of the brown bear in Central Italy (Abruzzo)

Giorgio Boscagli

Historic range and current distribution

A progressive reduction of bear (*Ursus arctos marsicanus*) range has occurred from 1700 to the present (Figure 6.9a,b,c), but recent research (Boscagli *et al.* in press) notes the continuous presence of bears in the Central Apennine Mountains during this century. The map of 1993 distribution (Figure 6.9c) is the result of this research.

Present brown bear distribution can be considered to be continuous regardless of any ecological obstacles, such as highways, railways, and intensively cultivated areas. A high density central nucleus exists in Abruzzo NP, with peripheral parts of the population at progressively lower densities in the surrounding mountains. Thanks to the development of a chain of protected areas (regional and national parks) recently instituted by the Italian Parliament, one can expect an expansion of permanent bear range and an increase in bear numbers. We have begun to see the first evidence of this trend.

Status

Central Italy's brown bear population is considered to be the biggest in the western Europe. The last reliable estimate (1985) assessed the population's minimum at 70 to 80 bears (Boscagli 1990, 1991), and 49 of them were observed in Abruzzo NP and its buffer zone (600km^2). The other individuals were indirectly estimated in the Central Apennine Mountains surrounding the park. In 1991 these mountains were included within regional or national parks. The bears outside of the Park are much more endangered than those inside. (Boscagli 1987). The most important causes of bear mortality are poaching and accidents.

Legal status

Before the institution of Abruzzo NP in 1922, the area had been a Royal Hunting Reserve. Bears living inside were considered special property of the King, and damages caused by bears were compensated by the Royal House. Ironically, the King never came to hunt at the Reserve. After 1922, bears living inside the Park were considered legally protected but several poaching acts occurred. Many bears were killed outside the future Park's boundaries between 1900 and 1926 (Sipari 1926).

In 1939, the Hunting National Law assessed full protection for the species in all Italian territories. In 1974, the regions of Central Italy where bears live (Abruzzo, Lazio, and Molise) established regional acts to compensate for damages caused by bears to livestock and agriculture. Now the bear is fully protected and, as a penalty for poaching, the State could require the guilty party to repay the full economic value of the bear (around US$1.28 million per bear).

Population threats

In the past, illegal killing occurred when shepherds reacted to bear attacks on livestock (sheep). Also, several parts of

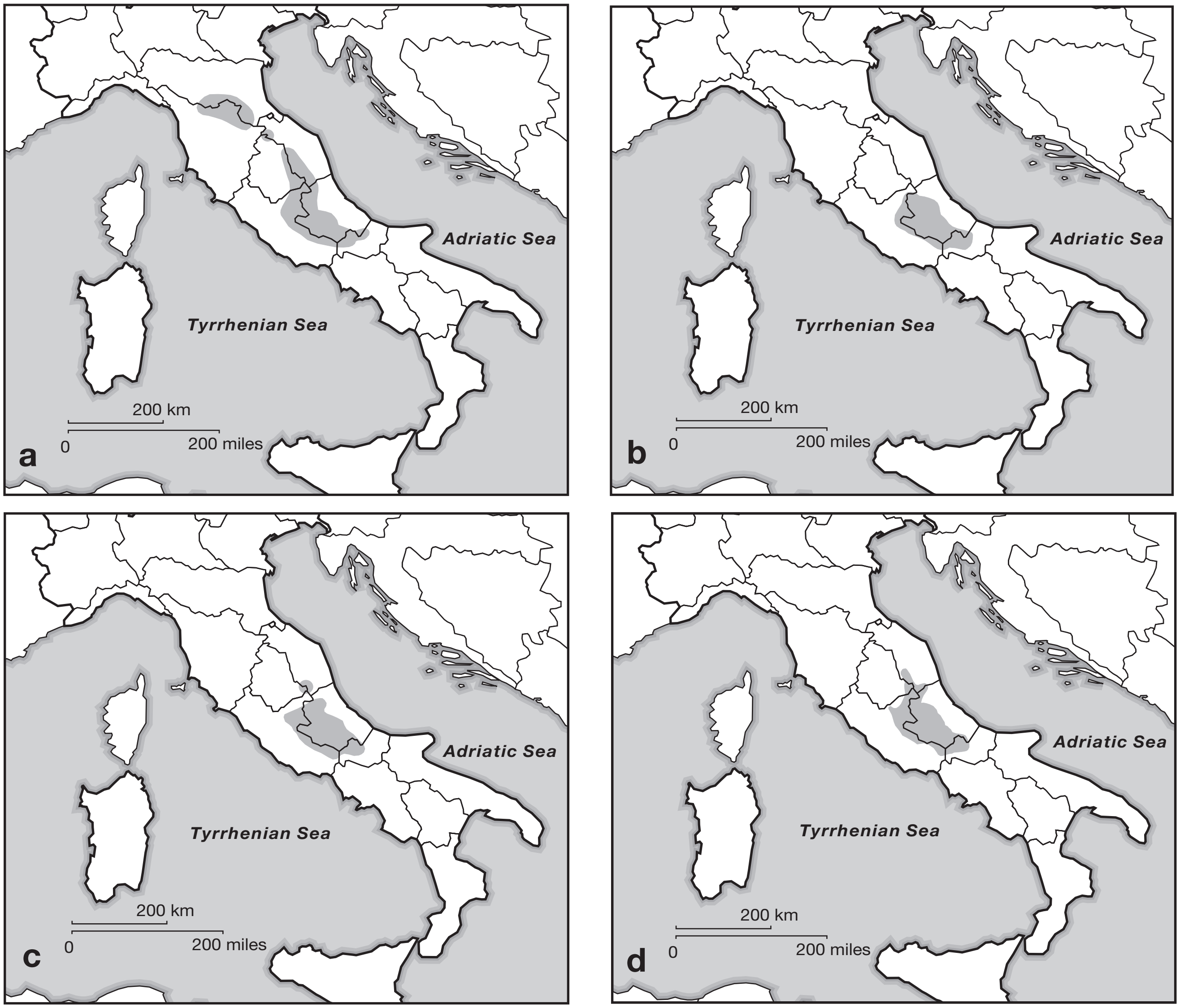


Figure 6.9. Past, present, and future distribution of the Marsican brown bear (*Ursus arctos marsicanus*) in Central Italy. (a) 1800 distribution; (b) 1900 distribution; (c) 1993 distribution; (d) projected 2000 distribution.

the bear are considered a delicacy, even to this day. Recently, illegal killings have occurred during shooting parties, or in connection with the poaching of wild boars (*Sus scrofa*). Some killings occurred as a barbaric demonstration against National Park policy. The Gruppo Orso Italia (Italian Bear Group) has collected some unconfirmed information regarding activities by foreign hunters and illegal killing for trophy mounts. In the buffer zone, a special agreement with local hunters was reached in 1989 which has achieved a strong reduction in poaching. Twenty bears were poached between 1979 and 1988, and only four cases were known between 1989 and 1993.

The "peripheral" bear population outside of Abruzzo NP may be experiencing the negative effects of genetic isolation. We have no evidence for this hypothesis, but the increasing existence of ecological obstacles could mean future isolation of small groups.

Habitat threats

The development of highways in Central Italy's bear range increase the risks for bears. Between 1970 and 1993, five bears were killed and two wounded by cars and six killed and an unknown number wounded by trains.

The historical connection (partial dependence for feeding habitat, particularly in late summer-early autumn) between bears and traditional agriculture has been interrupted because of a decline in these practices. In the last 40 years, more than 50% of rural cultivated areas have been abandoned for economic reasons. Generally, farmers' children are not interested in continuing the difficult, economically marginal practice of agriculture.

In order to understand the impact of the forest harvest, it is necessary to first differentiate between the areas inside and outside of Abruzzo NP. For the villages in the Central

Apennines, the forest harvest is the most important financial resource. Forest management is conducted by the Forest Service, generally, and by the park authorities inside the National Park. The park's authorization for harvest can only be obtained after performing a clear evaluation of the risks to wildlife. In those instances where harvest is not permitted, the park compensates the effected villages. (Sulli and Bernoni in press.). Outside the park, only economic evaluations are considered by local authorities and the Forest Service, except in natural reserves.

Most likely in the near future, the new regional (Sirente-Velino) and national (Gran Sasso-Laga and Majella) parks will employ a more "natural" management system within the bear's range. We suspect that, in these areas, over-harvesting of forests has affected the bear's needs. Bear signs are normally observed in those areas where more ancient and undisturbed woods exist.

In the thirty years since 1960, there has been interest in the development of ski lifts, related buildings, and other structures in the Central Apennines. Park authorities stopped the development of a ski lift in the park in the 1970s, but had no control over similar development outside. Notably, the areas inside the park (Russo and Boscagli 1992) near the ski lifts are less frequented by bears than any area of the park. This is the clearest evidence of the harmfulness of these structures. We think that, in the future, the ski lift will be the primary management problem of the Central Apennine parks.

Management

Based on recent experiences in Abruzzo NP, a new national law was enacted concerning protected areas in order to provide for a buffer zone surrounding all new parks. In these buffer zones, where hunting is normally admitted, only local hunters will be authorized. Special hunting rules will also be enforced (e.g. no collective hunting parties). In this way, the hunting pressure will be strongly reduced (less than one hunter per $0.3km^2$). In several of these Self Managed Hunting Reserves (SMHR), the hunting pressure is less than one hunter per $0.5km^2$. Hunters are normally required to restore the native vegetation and fruit-trees useful for bears and other fauna (ungulates). This is an essential part of the Management Plan of the SMHR.

Within the Abruzzo NP and its buffer zone, a "feeding campaign" has been organized to support traditional agriculture. The Park also autonomously cultivates many critical habitat areas. The use of man-made insecticides and anticryptogamic chemical is not allowed. In the Park since 1969, and more recently outside, park authorities and WWF - Italy developed a program of cultivation of certain plants (*Daucus carota*, *Zea mays*, *Malus sylvestris*, *Pirus pyraster*, *Prunus avium*, *Sorbus aucuparius*, *Sorbus aria*, *Cornus mas*) for bears and a special feeding campaign to support (with economic contributions to farmers) traditional agriculture.

In recent times, all of these management activities have been exported when possible to other areas of the Central Apennines thanks to the efforts of private conservation organizations (WWF-Italy and Legambiente). Unfortunately, it is not possible to permanently rely on these private organizations. We strongly encourage future park agencies to adopt the same strategy. A recent proposal from conservation associations advocates the coordinated management of present and future protected areas in the Central Apennines to conserve the habitats of the most threatened wildlife, including the brown bear, wolf (*Canis lupus*), and chamois (*Rupicapra rupicapra*). This proposal was submitted to the European Economic Community and the Italian Ministry of Environment, under the name "South European Park," and will include all of the protected areas of the Central Apennines.

Human-bear interactions

Human-bear interactions can be considered conflictual in three general categories: 1) Sporadic bear attacks on livestock (sheep); 2) sporadic crop depredation, and; 3) interaction between bears and hunters.

Livestock and crop depredation problems are normally resolved through damage compensation programs established by special regional acts. Some difficulties exist because of frequent delays in compensation. Interactions with hunters is the most common cause of bear mortalities, but as previously explained, attempts are made to reduce these conflicts in several ways (restrictive and collaborative measures). Public opinion of the bear is influenced by a friendly and non-aggressive image. No data exists about bear attacks on humans. In the 1930s, however, one event is known to have occurred when a shepherd approached a wounded bear.

Public education needs

The most important education needs involve increasing respect for bear habitat. These include the reduction of disturbance, proper management of the mountains for both enjoyment and forest harvest, and the development of a cultural (not only scientific) awareness that the presence of the bear is a symbol of wilderness.

A special bear museum will be built in Pizzone, a village in the Mainarde Mountains recently included in the Abruzzo NP. In the surrounding area, there are plans to build the Marsican Brown Bear Captive Breeding Center. The Mainarde Mountains are characterized by the highest bear density in Italy.

A cooperative project between Abruzzo NP and WWF-Italy began in 1993 to develop habitat management and educational programs with the slogans such as, "Plant an apple tree: you can save a bear". A similar project aimed at schools and family groups has been developed by WWF-Abruzzo Region for use in protected areas (National and regional parks outside of Abruzzo NP.).

Specific conservation recommendations

1. The Central Italy bear distribution will hopefully be contained within protected areas, but the recently instituted National Parks (Majella and Gran Sasso-Laga) and regional parks (Sirente-Velino, Ernici Mountains, and Alto Molise) are only "on paper." In other words no agency exists for the operation of these parks. An international appeal to the Italian Parliament for the quick resolution of bureaucratic problems and obstacles would be extremely useful.
2. Poaching instances could be resolved in two different ways: a) including the most vulnerable bear ranges within the parks (where no hunting is admitted by Italian law), and b) strongly increasing the cultural appeal for bear survival with educational programs. A similar project to (b) is planned but needs to be further developed. The cost could be covered by approximately 200 million It. Lires (US$120,000) per year for at least three years.
3. In the bear distribution range (approximately 5,000km^2), we need to reduce the level of product-oriented forest management, modifying this with more natural forest management or replanting native trees (especially *Fagus sylvatica* and *Quercus cerris*), employing the marginal, unproductive areas in wood production.
4. In the protected areas, strict control of ski lift and road development is needed. This may be applied by future park agencies, but outside of Abruzzo NP, no signs of support for this control exist today.
5. A research program encompassing the entire bear range (not only Abruzzo NP as is the present situation) could be very important in assessing ecological needs in different areas, especially for those bears living in marginal situations. Assessment of feeding resources, movements, chances for population development, and related information could be gathered by a radio-telemetry project with an annual budget of approximately 150 million It. Lires (US$90,000) for at least five years.
6. The bear would benefit from replanting fruit trees and caring for those already existing in the recently instituted National and regional parks. Replanting 3,000 trees per year over five years would require approximately 500 million It. Lires (US$300,000).
7. A campaign to stimulate adoption of the bear as a regional symbol could be useful. The cost would be approximately 200 million It. Lires (US$120,000).

Status and management of the brown bear in Italy (Trentino)

Fabio Osti

Historic range and current distribution

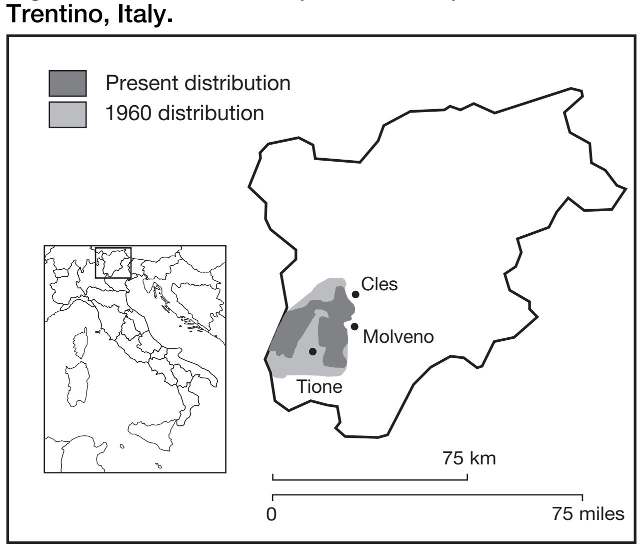
Bears were once widely distributed throughout the forested zones of Italy, extending southwards into Sicily (Figure 6.1). By 1500, they had been exterminated from most of the country. The historical regression suffered by the alpine bear population, undoubtedly due to the actions of man (illegal hunting, deforestation, habitat degradation, etc.), is clearly illustrated by the present day location of the last remaining bears in Trentino.

Today, the brown bear is found in Italy in three separate localities: Abruzzo NP and surrounding areas in the Apennine mountains, a small area in the province of Trentino in the northeastern part of the Brenta Mountains, and in the area of Tarvisio in the border region between Italy and Austria.

In Trentino, potential bear habitat extends only 1,500km^2 in the Adamello and Brenta mountains (Figure 6.10). The present bear distribution area is divided into the following categories, according to quantitative order of data collected:

1. Area with continuous presence of bears (primary area) encompassing a total of 240km^2. It includes classical feeding areas, reproduction areas (83.4 % of all cubs were found in this area in the last decade) and winter refuges. The denning area covers roughly 100km^2 and includes the northeastern portion of the Brenta Mountains and the Campa-Tovel Mountains in Adamello-Brenta Natural Park. Data from this area represent 91% of all bear signs collected from 1987 to 1991, and 81% of indicators of bear presence between 1982–1986.

Figure 6.10. Brown bear (*Ursus arctos*) distribution in Trentino, Italy.



2. Area only periodically used in summer by bears (secondary area) covering a range of about 500km^2. This area includes Valle di Sole (Mezzana-Vermiglio and Malè-Dimaro), Val delle Seghe (Molveno), Valle d'Ambies (San Lorenzo in Banale), Val Algone, and Val Manez. The information collected in these localities represents 7% of all data collected from 1987 to 1991. Only one female bear with two cubs has been observed in this area in the last 10 years.
3. Area only occasionally used by bears for feeding or as a result of human induced displacements, especially during summer months (transitional area). At present, this area includes Val di Rumo, Val di Bresimo, and some localities of Valle di Ledro e Giudicarie. The Adamello-Presanella Mountains (Val Genova, Val Breguzzo, Val di Fumo) have appeared abandoned by bears since 1985. This area, that encompassed about 690km^2 in the years 1982–1986, includes at present less than 100km^2.

Status

In Trentino, the brown bear population in the last 10 years has been estimated at around 10 individuals. Data collected indicate a decrease in the bear population.

Legal status

The brown bear in Italy has been completely protected by law since 1939. The Trentino population is centered mainly in the Adamello-Brenta Natural Park (established in 1967 but operating only since 1988). In a legislative move aimed at introducing proactive measures to safeguard bears, programs were established to provide immediate and total compensation for damage done by bears to beehives and livestock. Also, harmless defense measures were taken (the application of which is charged almost entirely to the provincial administration) to avoid possible damage done by bears.

Three restocking experiments have taken place in Trentino. The first two, in 1959–60 and in 1969, were unsuccessful because the bears were either recaptured or killed. The last experiment, in the spring of 1974, entailed the release of two bears on the eastern slope of the Brenta Mountain range. One of these animals survived until 1978.

Population threats

In addition to its small size, the alpine bear population has a low reproductive capacity, and in the last two years of this research, the indices of cub presence are non-existent. The last confirmed case of a human-caused wild bear mortality occurred in 1971 (Daldoss 1972). Bears are presently tolerated by local hunters and farmers.

Habitat threats

Bear habitats are situated between the altitude of 500 and 1,500m. Cultivated lands and orchards are found at lower elevations (under 700m). The majority of the vegetation consists of broad leaved forests of oak (*Quercus pubescens*), and beech (*Fagus sylvatica*), progressively mixed with pine (*Pinus sylvestris*), fir (*Abies alba*) and spruce (*Picea abies*). Around 1,200–1,300m marks the beginning the pure coniferous forest with fir (*Abies alba*) and spruce (*Picea abies*) dominant. At the upper elevations, the vegetation consists of an alpine forest of larch (*Larix decidua*) and mountain pine (*Pinus mugo*). The understory is composed mainly of *Sorbus* sp., *Prunus* sp., *Sambucus* sp., *Vaccinium* sp., and *Rhamnus* sp. Forests are frequently interspersed with alpine pastures where cattle graze during the summer. There are alpine grasslands above 2,000m.

The main threat to the bear in Trentino is habitat loss and disturbance caused by increasing human presence. In particular, the population is being squeezed into smaller and smaller areas. The principal threats to the Trentino brown bear population include: the fragmentation and deterioration of habitat due to exploitation of the forests for wood products, the increased construction of forest roads in the core area allowing motor vehicle access to critical bear habitat, and the reduced size of the population and its genetic isolation.

Management

Species monitoring: Monitoring techniques are based on indirect signs of bear presence (tracks, feces, bear sightings, moved stones, etc.). They are aimed at determining geographical distribution and population size, and at monitoring the effect of human management on bears. The monitoring of sample trails, a method applied since 1980, consists of the collection of all brown bear presence indicators on monthly monitored transects. Some valleys in bear range are monitored by a sample trail. Electronic methods for automatic monitoring were tested in 1989 by the Park and Forest Service. An automatic station consisting of a video camera with a weight scale were installed near the only feeding area existing in the Park. All the data are recorded on a normal video cassette, allowing recognition of individual bears and giving details on the presence of animals, their favorite hours of presence, and seasonal differences in weight. Another automatic monitoring system is presently being studied. This system consists of a small video camera with a battery and radio component, placed near where bears usually travel, to transmit images directly to a central office.

Habitat management: In general, tall beech forests are exploited by selective cutting in a rotation of 10–15 years. As tractors have replaced horses almost entirely, forest roads must be built. Increased accessibility to the forest means additional disturbance of bear habitat and easy access by motor vehicles for the purposes of hunting, poaching, and tourism. The main part of the forest inhabited by bears is state property, and for this reason it is possible to implement a management plan aimed at bear conservation. In the last two years, the Adamello-Brenta Natural Park promoted a project to actively protect traditional bear habitat. This exclusively naturalistic project of safeguarding the park, even if not yet approved by the Provincial Committee of Parks Management, shows a commitment to avoid the extension of the forest road network, limit the extraction of timber in the bears' core survival zone, and forbid construction or excavation in these areas. The Natural Park administration has financed alternative solutions in response to the demand brought forward by the local people who are the legitimate proprietors of the territory.

Human-bear interactions

In Trentino, bears live in an environment which is heavily utilized by people. However, because of the low density of the bear population, man and bears rarely come into conflict. Conflict has occurred in cases of predation on livestock, honey theft and hive destruction, and damage to crops and fruit trees. The protection of crops and orchards by electric fences has been in force in Trentino bear range since 1978.

Specific conservation recommendations

Bear conservation requirements in Trentino demand that all bear areas are the object of a management plan integrating legal protection measures and active management programs.

Habitat management

Forest policy measures specifically aimed at maintenance of the integrity of large forest complexes include:

1. Conservation or recovery of mixed broad-leaved forest, structural heterogeneity and a rich understory;
2. Upgrading of some forests by planting species useful for the bear.
3. Control of vehicles and persons entering the forest on existing trails and roads, and prohibiting construction of new forest roads.
4. Financial compensation for loss of income due to restraints imposed on forestry.
5. Forestry activities should be restricted in most of the core area, and development of tourism infrastructure should be curtailed.

Genetic evaluation and population restocking

We also advocate restocking (release of 5–10 individuals, presumably of Slovene and Croat origin) to increase the genetic variability and to contribute to a demographically stable and viable bear population. Analysis of the historical information available suggests that about 200 years of isolation (equal to about 20 generations) is not enough to bring about a significant genetic divergence. This hypothesis could be scientifically tested in a short time since three laboratories (in Germany, France, and Italy) are currently carrying out genetic analyses on various populations of European bears (including those in Adamello-Brenta Natural Park and Abruzzo NP). A restocking program must be coordinated with a conservation education project aimed at people living in or near bear range.

Status and management of the brown bear in Norway

Ole Jakob Sørensen, Jon E. Swenson, and Tor Kvam

Historic range, current distribution and status

Originally, and even into the 1800s, the brown bear occurred throughout Norway, including the larger islands (Collett 1911–12). As late as the mid-1800s, there were an estimated 2–3,000 bears in the country, and they occurred in all provinces (Elgmork 1979a, 1988; Swenson *et al.* 1994a). After 1850, the population declined rapidly, about 3.2% per year based on bounty records (Swenson *et al.* 1994a). This decline was due to very intense hunting as a part of the official policy to exterminate bears and other carnivores. The purpose was to increase populations of other game species, a philosophy that was encouraged by zoologists of that time. During the period of national bounties, (1846–1930), 8,291 bears were bountied in Norway. The policy was successful, and by the 1920s, the bear was functionally extinct in almost all of Norway (Swenson *et al.* 1994a). One isolated population in southern Norway survived until the 1980s (Elgmork 1994). The distribution of bears around 1900, based on bounties paid, is shown in Figure 6.11. The decline of the Norwegian bear population is described in more detail in Swenson *et al.* (1994a).

Today, bears are only found in a few areas next to the borders with Sweden, Russia, and Finland (Figure 6.12). The bear population in Sweden is large (over 600) and

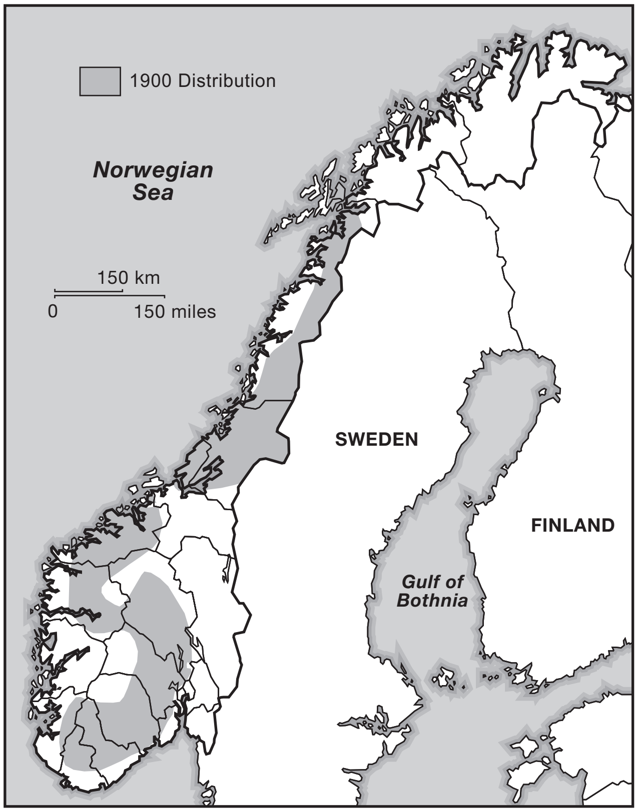


Figure 6.11. Distribution of brown bears (*Ursus arctos*) in Norway (c. 1900) based on records of bounties paid.

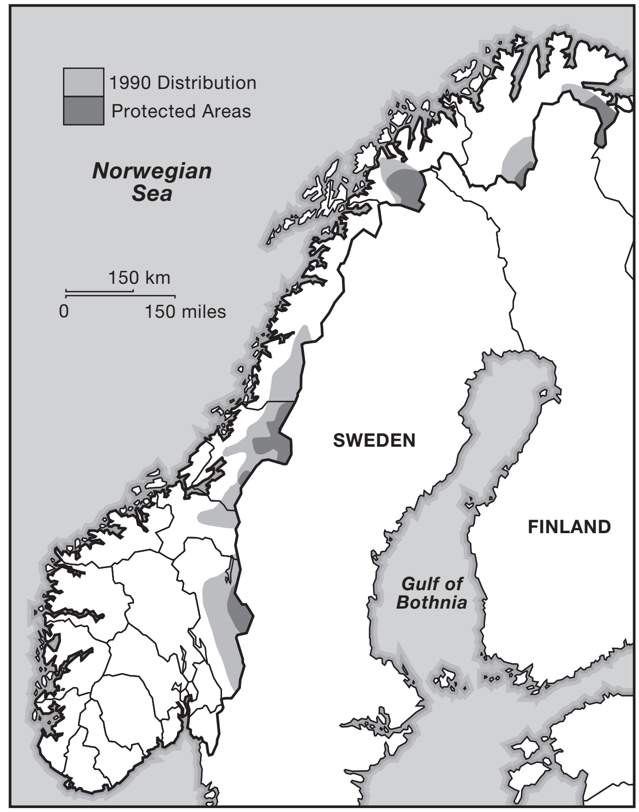


Figure 6.12. Distribution of brown bears (*Ursus arctos*) in Norway (c. 1990).

expanding (Swenson *et al.* 1994a, b). There are, at any time, probably only 10–20 bears in Norway, excluding the northernmost province of Finnmark, and these must be considered to be emigrants from Sweden (Swenson *et al.* 1994a). Together, the Scandinavian population is 650–700 bears (Swenson *et al.* 1994a).

The Pasvik Valley, on the northeastern tip of Norway, was recolonized from Russia and Finland (Wikan 1970). There are an additional 5–30 bears in eastern Finnmark that have a portion of their home ranges on the Norwegian side of the border (Sørensen *et al.* 1990 a, b; Bergstrøm *et al.* 1993), and belong to a common Russian-Finnish-Norwegian population that might number 400–500 bears (Makarova 1987; Nyholm 1985; Bergstrøm *et al.* 1993). At any given time, there is probably an average of 20–25 bears inside Norway, although this will vary by season and year. Previous estimates of the number of bears in Norway were considerably higher (Myrberget 1969, 1978; Elgmork and Mysterud 1977; Heggberget and Myrberget 1979; Kolstad *et al.* 1984, 1986; Kvam *et al.* 1990; Sørensen *et al.* 1990a, b). They were based on reports from the public, and overestimated the true numbers to varying degrees (Sørensen *et al.* 1990 a, b; Swenson *et al.* 1994a). The estimates given for each year by Sørensen *et al.* (1990 a, b) might have been more realistic, yet still overly optimistic, estimates.

Legal status and management

A national bounty, administered at the local level, was implemented in 1733. Administration was moved to the national level in 1845. This bounty was removed in 1930, but local bounties could be paid until 1972, when bears received total protection throughout the country. A local protection that began in the late 1930s may have prolonged the survival of the now-extinct Vassfaret population in southern Norway (Elgmork 1978, 1994). In retrospect, we realize that bears were protected several decades after the Norwegian part of the Scandinavian bear population was already functionally extinct.

According to the Norwegian Wildlife Act of 1981, all species of huntable wildlife are protected unless it is decided that the species and population can be hunted. A main purpose of this act is to ensure long-term viability of Norwegian wildlife populations. This is in accordance with the Norwegian ratification of the Bern Convention. With regards to the bear and other large carnivores, another aim of the act is to keep depredation of livestock, especially sheep and domestic reindeer, at reasonable and acceptable levels. Therefore, national authorities can give permission to kill depredating bears. Local pressure to issue a kill permit often begins when 10–20 sheep have been documented to be killed by a bear. Since protection was enacted in 1972, 33 bears have been shot, at an average of 1.6 per year. Nineteen bears have been shot with official permits and 11 bears have been shot legally by livestock owners protecting their stock, or by big-game hunters who have felt threatened. We are now convinced that even the legal kill is above a sustainable level, based on the amount of bears considered to be "Norwegian", and that the apparent small increase in bear numbers is due to increased immigration from neighbouring countries (Swenson *et al.* 1994a). Hunting permits in Norway are given only because viability is ensured by the common population with Sweden, Finland, and Russia.

According to regulations laid down by the Ministry of Environment, a livestock owner can be compensated for livestock killed by the lynx (*Lynx lynx*), wolf (*Canis lupus*), wolverine (*Gulo gulo*), and golden eagle (*Aquila chrysaetos*) (DN 1993a). Compensation is about US$150 for a lamb and US$400 for a ewe. Additional compensation for extra herding, fodder, etc. is also common. Losses due to bear predation have increased gradually over the past 20 years, but vary a lot from year to year. In 1992 and 1993, approximately 2,000 sheep were compensated as bear-killed. This represents about 0.08% of the sheep on open range. Less than 1% of the sheep owners apply for compensation due to bear predation, but the losses can be substantial for individual sheep owners. In 1993 one owner in Lierne, North-Trøndelag lost 28% of his total stock and 25% of his ewes were confirmed killed by bears (Kvam *et al.* 1994).

Livestock owners are generally satisfied with the level of compensation that is given, which represents a value up to 100%–200% of mean sale price for the slaughtered sheep. Livestock owners may feel that they have not been compensated for enough animals, though. Bear attacks in sheep flocks are unacceptable to the owners for several reasons: 1) based on old tradition, the farmers believe that this should not be tolerated, 2) such attacks might greatly disturb planned breeding, and 3) such attacks cause much more work regarding herding and the bureaucracy involved in documenting losses and claiming compensation.

The Norwegian Ministry of Environment and the earlier Directorate for Wildlife and Freshwater Fish started a research project in 1980 to estimate populations and devise a monitoring system to document occurrences of bears, wolves, and wolverines, as well as to document the loss of domestic animals killed by protected carnivores (Sørensen *et al.* 1984). The resulting system is now used in every province of Norway and, as a part of the compensation system, biologists are working at the local level with specially trained contact persons in every municipality to inspect animals claimed to be killed by carnivores. Permits to hunt bears are given by the Directorate for Nature Management, which can transfer the authority for execution of the kill permit to the County Governor's Environmental Authorities at the province level.

Approximately US$1 million is used yearly by the Directorate for Nature Management for the Government's "Carnivore Management Strategies". This money is used to pay for extra herding, and for the costs associated with delaying the release of sheep into pastures or taking them home earlier than normal.

In June, 1992 the Norwegian Parliament enacted a new policy for the management of large predators (Ministry of Environment 1992; DN 1993b). An important component of this policy was the establishment of five administrative core areas. Within these boundaries, bears will be allowed to establish reproducing populations, with a goal of maintaining viable Scandinavian and Fennoscandian/Russian bear populations. The management procedures and boundaries for these areas were approved in 1994 following public review (Ministry of Environment 1994).

Population and habitat threats

There is no question that the bear was nearly exterminated in Norway due to heavy hunting pressure. The greatest hindrance to a recolonization of Norwegian habitats is the killing of bears that kill sheep. After large predators were eliminated from most of Norway, sheep owners began to allow their sheep to graze almost completely unattended on open range in mountainous and forested areas. There are now over 2.2 million sheep on open and forested ranges in summer throughout Norway. This form of sheep management is successful where there are no large predators. Thus, the problem of re-establishing the bear in Norway is obvious. Norwegian government policy has been to maintain the settlement of rural areas. The policy is intimately linked to agriculture policies with the result that sheep farming is encouraged and financially subsidized (Øksnesutvalget 1974; Landbruksdept 1975, 1976, 1993; Alstadheimutvalget 1991). People in rural communities are generally opposed to re-establishment of the bear in their areas and see it as a threat to the social structure of rural communities.

Although illegal killing of bears most likely occurs, we do not think it is a major factor preventing re-establisment of reproducing females on the Norwegian side of the border. However, threats of illegal killing are often used in the current debate over bear management in Norway. This is even being encouraged by some local politicians, especially from the political parties that traditionally represent farmers.

We have not been able to identify important habitat threats to the re-establishment of bears in Norway. However, the widespread distribution of recreational cabins combined with road construction and urbanization in some valleys may have reduced habitat and may hinder dispersal (Elgmork 1978, 1983). Also, clearcutting in mountain forests might have a negative impact locally on the use of habitat, at least until adequate cover becomes established, normally at tree heights of 5–7m.

Public education needs

Norwegians generally want to maintain the brown bear in Norway. This is evident from the government policy referred to above and in an interview study where 80% of those questioned were in favor of having bears in Norway (Dahle 1987). However, the mass media tends to focus on the negative aspects of bears, especially sheep depredation (Frafjord 1988). The media often portrays this as a conflict between the powerful government and the weak, vulnerable individual. In addition, many Norwegians are afraid of bears (perhaps because of old stories). Public education about bears and the consequences of different management strategies is needed especially in the proposed core areas. This education should be focused at all social levels in the local communities – from kindergarten and primary schools through adult organizations. Even more specialized information should be focused on local politicians, farmers and hunters. Moose and grouse hunters may come into difficult situations with bears, and at least three bears have been shot in Norway because of this. Some of the potential dangers are real, but knowledge about how to handle such situations might prevent unnecessary killings.

Conservation recommendations

The brown bear has legal protection, and Norway uses a considerable amount of money to re-establish reproducing bear populations based on immigration from Sweden, Finland, and Russia. We feel that the present management practices are generally good.

In our opinion, a "rapid" re-establishment of bears has so far been delayed mostly by the legal killing of bears that prey on sheep. We believe it is important that Norwegian Wildlife authorities continue to focus intensively on that problem. The bear-sheep conflict has sociological aspects that should receive much more attention. For example, the authorities should actively inform people in core areas about goals for bear management, and what effects these goals will have for the future of the local community. We feel that people living locally must know approximately what numbers of bears a core area will be likely to have, or at least a goal for numbers of reproductive females in an area. Of course, this number must be revised as research results become available. Most importantly though, is that political policies should ensure farmers that they will receive help to establish new farm practices that conflict less with bears. This is already beginning in one of the five bear areas, but it should be stressed to people that it is not the bear that will make rural living impossible.

Status and management of the brown bear in Poland

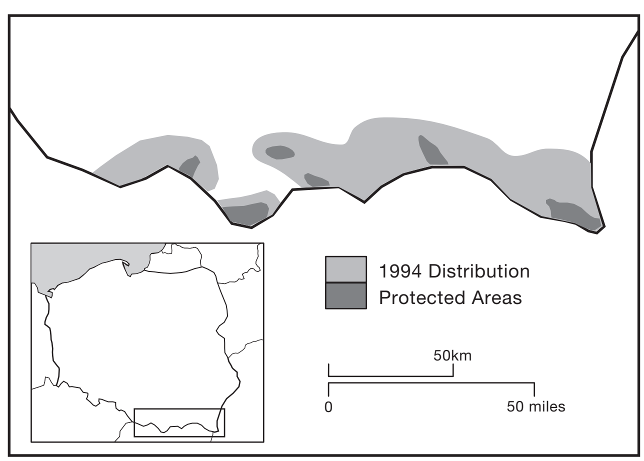
Witold Frackowiak, Roman Gula, and Kajetan Perzanowski

Historic range and current distribution

The earliest records on the occurrence of brown bears in Poland are from the 12th century (Kiersnowski 1990). At that time, bears were present throughout the entire country. The extension of hunting rights from royalty to the whole of gentry (the permit for bear hunting was formerly regarded as the king's special favour) and significant changes in habitat, especially the fragmentation of forested areas, caused considerable shrinkage of the bear's range in Poland. By the 18th century, brown bears had practically disappeared from the majority of Polish lands. At the beginning of 19th century, permanent refuges of brown bears in Poland were limited to the Carpathians, Bialowieska Forest, Lodzka Forest, and the part of Kielce Province (Jakubiec and Buchalczyk 1987). Outside the Carpathians, bears last disappeared from the Bialowieska Forest, where the last records of bear presence are known from 1873–78 (Karpinski 1949; Jakubiec and Buchalczyk 1987). At the beginning of the 20th century, bear range was limited to the Carpathians.

In the Carpathians, bears were hunted on a permanent basis, and in some parts of that range (i.e. Beskid Zywiecki) they were even treated as pests (Burzynski 1931; Augustynowicz 1939; Jakubiec and Buchalczyk 1987). The last individual in Beskid Slaski (the western Carpathians) was observed in 1918 (Jakubiec and Buchalczyk 1987). In 1937, there was a successful attempt to reintroduce bears into Bialowieska Forest (Karpinski 1947; Jakubiec and Buchalczyk 1987). These reintroduced bears were present there until 1947 (in 1946 five bears were recorded), but in 1947 bear tracks were seen only once

Figure 6.13. The distribution of brown bears (*Ursus arctos*) in Poland in 1994 based on official data of State Forest Administration and National Parks.



(Karpinski 1947; Jakubiec and Buchalczyk 1987). After World War II, numbers of bears in Poland were estimated at 10–14 individuals (Buchalczyk 1980). That number remained quite stable until 1960, when it began an increase to 70 animals in 1982 (Jakubiec and Buchalczyk 1987). The fastest growth of bear populations after World War II took place in the Bieszczady Mountains. This population grew from less that 10 animals in early 1950s (Grodzinski 1957; Ogonowski 1958) to about 60 individuals at present. This region became virtually depopulated as a result of the war, the density of the human population dropped from about 32/km^2 in 1937, to 1–2/km^2 by the end of the 1940s. Since the 1950s, the number of permanent inhabitants has slowly increased, and at present (not taking into account larger townships located at the edge of mountains like Lesko and Ustrzyki Dolne) it is reaching the level of about 10 people/km^2. Along the state-border zone, which is most strongly affected by the resettlement of local people, the density of human population is the lowest in the country at about 5/km^2.

Currently, the range of the brown bear is limited to the Carpathians in the southeastern part of the country. Bears occur in three provinces: Krosno, Nowy Sacz, and Bielsko-Biala, within a range of about 7,000km^2. The estimated distribution, based on data from Regional Forestry Offices and National Parks is given in Figure 6.13. The total population size is currently estimated at 80–90 individuals (according to the official data from the Forestry Department and National Parks).

Although the presence of bears is occasional along the entire Carpathian Range, there are five regions where bears are observed frequently (Table 6.8, Figure 6.13).

The Bieszczady Region

The eastern part of Polish Carpathians is the mainstay of Polish bears where females with cubs are observed on a regular basis. This area has an estimated total population of 50 individuals. The area is mountainous, spanning about 2,000km^2 with elevations up to 1,350m. The majority of the area is covered by a natural beech-fir (*Fagus silvatica*, *Abies alba*) forest, supplemented by areas of former farmlands afforested mostly with spruce. The area above the timberline (1,100m) is covered by subalpine pastures. The Bieszczady Mountains are relatively sparsely populated (about 10 inhabitants/km^2) compared to the rest of the country (120 inhabitants/km^2). The Bieszczady area is a popular tourist area. In particular Bieszczady NP attracts thousands of visitors annually, mainly hikers.

Beskid Niski

The lowest range in the Polish Carpathians (highest elevations just over 900m) is mostly mixed mountain beech-fir forest, and has low human densities. The region remains quite undeveloped and free of tourists, with an economy based on logging and small-scale agriculture. In 1995, a new national park (Magurski NP) will be established on 200km^2. Bears exist there in small numbers and are probably mostly resident animals.

Beskid Sadecki, Gorce Mountains, and Pieniny Mountains

These three neighbouring mountain ranges are situated to the west of Beskid Niski. The highest peaks exceed 1,300m and dominant tree species are the Carpathian beech forest in Beskid Sadecki and spruce stands in Gorce. The density of human population is relatively high compared to Bieszczady and Beskid Niski, due mostly to easier access from larger cities. Bear density is slightly higher compared to Beskid Niski, but much lower than in Bieszczady and Tatras.

Tatras

This area is the highest part of Carpathians with peaks reaching 2,500m and a well developed alpine zone. The

Table 6.8. Basic parameters of brown bear range in Poland, human pressure, and potential threats.

Main refuges	Total area (km^2)	Max. altitude (m)	Forested area (%)	Fragmentation of the forest*	Area of national parks (km^2)	Human density/ km^{2*}	Capacity of hotels/ km^{2*}	Estimated number of bears	Major threats
Beskid Zywiecki, Beskid Wysoki	1,100	1,725	40	high	17	80	1.4	7	habitat fragmentation tourism
Tatra Mountains	290	2,499	46	low	210	132	59	14	tourism
Beskid Sadecki, Gorce Mountains, Pieniny Mountains	1,570	1,310	40	high	89	89	20	8	habitat fragmentation tourism
Beskid Niski	2,100	997	40	low	200	28	1.9	8	logging
Bieszczady Mountains	2,000	1,346	52	low	270	15	1.5	50	logging poaching tourism

* After Jakubiec, 1993 mod.

forest is mostly spruce stands artificially introduced by the end of 19th century. Most of the area is protected by Polish and Slovakian national parks, but due to extremely high numbers of tourists visiting both parks and their vicinity, the degree of human pressure and human-related disturbance is very high. Bears have been present in Tatras on a permanent basis and their numbers remain quite stable, including one to two females with cubs observed every year on the Polish side of the range.

Beskid Zywiecki and Wysoki

The highest elevation exceeds 1,700m but only few peaks have well developed sub-alpine and dwarf-pine zones. The composition of forests varies from artificially planted spruce stands to small remains of original mountain beech-fir forest. The density of bears is moderate for the Polish Carpathians and females with cubs are observed within the zone close to the Polish-Slovak border.

In 1994, a single bear was noticed in the Sudeten Mountains, but apparently that case was exceptional. In the near future no reintroductions of brown bears are planned in other parts of Poland. The only possible sites where such a project could possibly succeed are forested areas of considerable size such as the Sudeten Mountains and Bialowieska Forest. In either case, any program of reintroduction should be preceded by the estimation of habitat capacity and careful evaluation of potential bear-human conflicts.

Legal status

A royal bill, which limited permits for bear hunting to only a few selected aristocrats during the seventeenth century, was the first officially enacted law concerning bear management in Poland (Kiersnowski 1990). A few centuries later, the law was disregarded more and more frequently, and even with severe financial penalties for illegal bear hunting, these animals were extirpated in many regions of Poland. In the Carpathians, bears were hunted in considerable numbers until World War II (Burzynski 1931). The first legal protection for bears as a game species was introduced in 1927 by decree of the President of Poland, which prohibited killing females with cubs, and introduced the possibility of closing the hunting season in some areas of Poland (Dziennik Ustaw R.P. 1927). A further modification to the decree occurred in 1932, changing the status of bears to a fully protected species did not prevent sporadic harvest (Kiersnowski 1990). After World War II, full legal protection of the species was initiated in 1952 (Dziennik Ustaw R.P. 1952). The brown bear is listed in the Polish Red Data Book of Animals as rare with a high chance of extinction (Polish Red Data Book of Animals 1992).

Population threats

Poaching: Since 1945, at least ten cases of bear poaching were reported (Podobinski 196; Parusel 1985; Jakubiec and Buchalczyk 1987; Jakubiec 1990a; Kiersnowski 1990). Due to poor economic conditions, poaching has become more intensive, particularly towards ungulates. The most common poaching device, the neck snare, creates a real danger for bears. The last registered case of bear poaching took place in November 1994, in Bieszczady, where a six-year-old male was captured in a neck snare that was probably set for a deer. Additionally, there were a few cases of illegal bear hunts organized for various officials before 1989.

Nuisance bears: Individual bears known to damage human property are shot under authority of permits issued by the Ministry of Forestry. Since 1945 four such permits have seen issued (Lenkowa 1966; Olszewski 1971; Jakubiec and Buchalczyk 1987; Jakubiec 1990a). One bear was shot because of attacking a hunter (Parusel 1985). One bear was accidentally run over by a bus (Bunsch 1967). In 1991 in Tatras, a female with three cubs, known to have fed at a garbage dump near a mountain shelter, was captured and transferred to the Wroclaw Zoo where she died a short time later (Tatra NP). According to the most recent information, the cubs remained in captivity.

However damage done by bears (about US$6,000 annually – see text below) are not economically significant. However, bears with no fear of humans are a serious problem. This is especially true in Tatras, with its high tourist traffic, lack of educational programs, and available garbage for wildlife. There is a need for nuisance bear control and public education in this area.

Habitat threats

Regional development: The quickly growing economy may cause significant changes in local areas where small-scale farming is now giving way to more intensive development. Bieszczady and Beskid Niski, which still remain basically undeveloped, may be threatened in this way. In these regions, considerable amounts of farmland (former parts of bankrupted state farms) are up for sale, and the future of these areas is uncertain. The most probable development scenario is the purchase of small plots by many owners, which may only worsen habitat conditions and lead to further habitat fragmentation. Local development planning has not included consideration of the habitat needs of large predators.

Tourism: The majority of the Carpathians is a popular recreation area throughout the year. A rapidly developing economy increases tourist business, with associated consequences such as increasing number of visitors (disturbance), and development of infrastructure like hotels, mountain shelters, and skiing stations. Particularly threatened are areas in the vicinity of national parks (Figure 6.13).

Timber harvest: Harvest is very intensive throughout the Carpathian range and is only limited in national parks to some extent. Although clearcuts are not permitted in the mountains, harvest of timber is the direct cause of: a) changes in the structure of tree-stands, b) decrease in the age of the forest, and c) lowered biodiversity. Additionally, the construction of forest roads make access easier for people, and logging activities increase disturbance.

Management

The Department of Forestry, currently part of the Ministry of Environmental Protection, Forestry and Natural Resources (MEPFNR), is responsible for the management of protected species and for issuing licences for nuisance bear control. MEPFNR is also obliged to compensate all damages done by bears to human property, i.e. to livestock, crops, beehives etc. The value of the damage is estimated by a committee that includes representatives of local administration and forestry. Compensation is paid from the state budget. Except for compensation, there are no other bear management practices.

Human-bear interactions

Since the range of brown bears in Poland overlaps with some areas of high human density (Table 6.8), bears sometimes cause damage to livestock (sheep and cattle), beehives, and, less frequently, to crops. The list of bear-related damages for the last five years is given in Table 6.9. The average annual value of bear-related damages is estimated at about US$6,400 (Bobek *et al.* 1993).

Since World War II, there have been no documented human deaths caused by bear attacks. In regions with high human presence (i.e. Tatras), there has been a slight increase in numbers of bears habituated to people. Such bears feed on garbage next to mountain shelters and are not afraid of people they encounter on mountain trails (Tatra NP data).

Table 6.9. The numbers of livestock killed and beehives destroyed by brown bears in Poland between 1987–1991 (after Bobek *et al*. 1993 mod.).

Year	1987	1988	1989	1990	1991	Total
Beehives	49	42	98	140	56	385
Sheep	41	101	115	32	77	366
Cattle	27	15	21	16	4	80
Pigs	2	0	3	0	0	5
Goats	2	1	0	1	5	9
Horses	2	0	0	1	0	3

Public education needs

1. The education of special interest groups such as:
   a. Hunters and foresters can help to monitor the bear populations because of the their high chance of observing bears in the wild and may be able to provide first-hand information about bears. If they are properly briefed, their data might be much more valuable. They should also be aware of the conservation needs of bear populations, because these people can directly contribute to the protection of bear refuges, dens etc. There is also an urgent need to properly educate hunters so they will not mistake bears for wild boars (*Sus scrofa*), especially when hunting in corn or oat fields.
   b. Tourists should be educated about responsible behavior in bear country in order to avoid unnecessary disturbance of animals and minimize the risk of bear attacks. This is most important in national parks.
   c. Farmers need access to information about their legal rights regarding claims of bear damage, and should be educated about proactive forms of protecting crops and livestock from bears.

2. Creation of greater public bear awareness through the media by providing information regarding the status of the species, potential threats, and protection to ensure the further existence of the species in Poland. Programs should be extended to schools to disseminate basic information concerning bears and emphasize the problem of their protection.

Specific conservation recommendations

1. **Population monitoring**
   a. Monitoring the minimal population size by annual counts of females with cubs. Additionally, records of litter size may provide indications about the reproductive status of the population. Spatial distribution of females and cubs should indicate locations of main refuges.
   Duration: annual
   Extent: entire range
   Primary methods: 1) Selection of credible foresters and park rangers; 2) Preparation of questionnaires; 3) Distribution of survey forms by mail; 4) Evaluation of data.
   Estimated budget: US$10,000 per year.

b. Spatial distribution of the population survey by questionnaires directed to Forest Districts, national parks, and hunting clubs (such data actually exist since foresters, hunters, and park rangers are obliged to perform annual counts of game species).
   Duration: every second or third year
   Extent: all of potential bear range
   Primary methods: 1) Preparation of questionnaires; 2) distribution of forms by mail; 3) evaluation of data.
   Estimated budget: US$10,000 per year.
c. Evaluating trends in the reproductive status of females using age of first pregnancy, breeding interval, litter size, and mortality of cubs.
   Duration: ten years
   Extent: sampling area
   Primary methods: 1) Capturing and radio monitoring of 10 females; 2) monitoring of winter dens (access to cubs): every year; 3) result: the model of population dynamics.
   Estimated budget: US$200,000 (entire project)

2) Habitat monitoring

a. Food habits: the composition of natural diet based on scat analysis.
   Duration: five years
   Extent: throughout all main habitats
   Primary methods: 1) Annual collection of scat samples; 2) analysis in laboratory; 3) evaluation of data.
   Estimated budget: US$30,000 (entire project)
b. Annual and spatial variation in the productivity of main food items.
   Duration: 10 years
   Extent: sampling areas
   Primary methods: 1) Annual monitoring of preferred fruits/nuts; 2) estimates of potential food supply in particular years; 3) data evaluation
   Estimated budget: US$50,000 (entire project)
c. Habitat size and trend of changes based on the analysis of forest and vegetation maps (GIS). Suitability of potential habitats using analyses of: food supply, cover, fragmentation and corridors, existing and potential disturbance by agriculture, logging, tourism, human settlements, roads, and local development.
   Duration: every five years
   Extent: entire range
   Estimated budget: US$75,000 (entire project)
d. Habitat use and preferences.
   Duration: 3 years
   Extent: sampling area
   Primary methods: 1) Capturing of 12 individuals; 2) radiotracking; 3) data evaluation.
   Estimated budget: US$60,000 (entire project)
e. The size of individual home range and movements.
   Duration: 3 years
   Extent: sampling area
   Primary methods: 1) Capturing of 6 individuals; 2) radiotracking; 3) data evaluation.
   Estimated budget: US$40,000 (entire project)

3. The implementation of guidelines to achieve viable bear populations for local development, tourism, and timber harvest.

Guidelines should be based on models of population trends, habitat changes, and habitat and food requirements of brown bears. The first areas to introduce and test such guidelines should be national parks and biosphere reserves, and further extension should be negotiated for landscape parks, State Forest Districts and hunting grounds. Because bears in Poland belong to the much larger Carpathian population, the existence of the species in Poland depends directly on the status of bears in Slovakia, Ukraine, and Romania. Therefore, cooperation and coordination with these countries is absolutely essential to any conservation effort.

Status and management of the brown bear in Romania

Ovidiu Ionescu

Historic range, current distribution and status

The brown bear is the largest predator in Romania. Its range is directly connected to the large forests that cover the Carpathian mountains. Historically, a great number of bears occupied the forests that covered Romania. However, in 1940, a population of only about 1,000 bears was estimated. After World War II, human pressures caused the numbers of bears to decrease. In 1950, a population evaluation showed 860 individuals. From 1950, bear numbers increased as a reflection of various management measures which had been taken (Table 6.10). The greatest number was reached in 1988 when the

Table 6.10. The increase of bear range and population in Romania.

Forest land (km^2)	Bear numbers	Year
21,000	2,000	1955
26,000	3,000	1960
29,000	3,800	1965
30,000	4,200	1970
31,000	3,850	1975
35,000	6,000	1980
36,000	6,000	1985
38,000	7,400	1990
38,500	6,600	1993

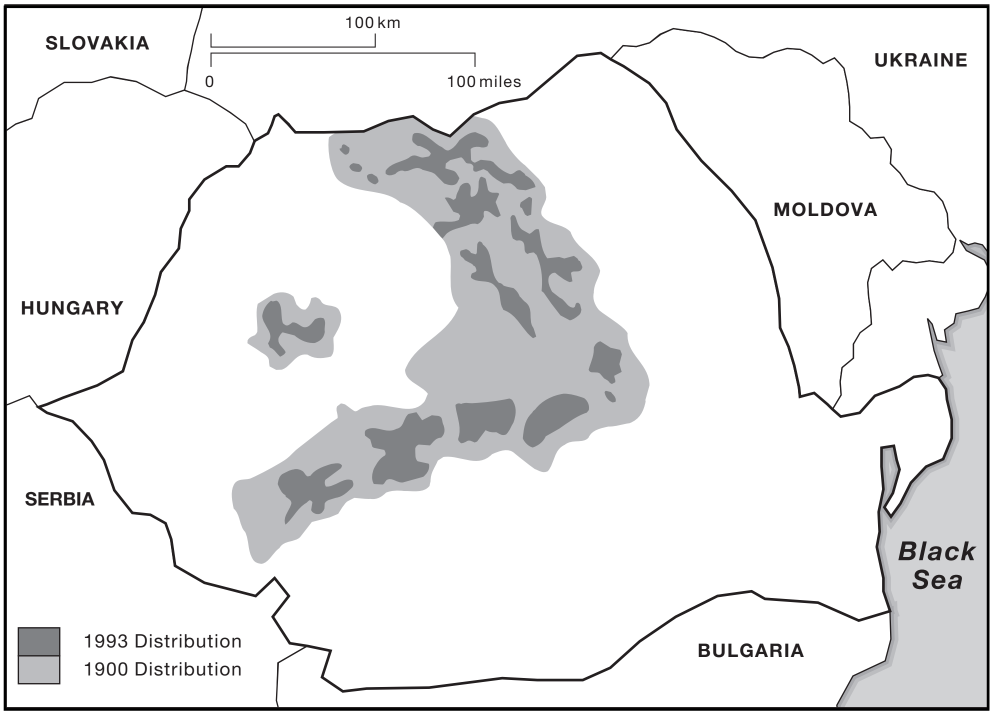


Figure 6.14. Present distribution of the brown bear (*Ursus arctos*) in Romania, 1993.

population was estimated to number 7,780 individuals. The latest evaluation of the bears in the spring of 1993 showed that 6,600 are present in 585 hunting areas with a forest surface greater than 38,500km^2 (Figure 6.14).

Aggressive stance of a mid-sized male brown bear (*Ursus arctos*), Romania.

Peter Weber

Management

The increasing number of bears created a need to establish a scientific basis for bear management in Romania. To accomplish this, it was necessary to establish areas that offered good conditions for bears, and that supported optimum numbers of bears within each hunting area. Researchers from the Forest Research and Management Institute Wildlife Laboratory created a key to define the suitability of an area for bear habitat. This key contained three categories of factors: a) abiotic factors such as altitude, relief, snow pack, and water; b) biotic and managerial factors like forest size, age class, species, thickness, utilization of browse by game, presence of orchards, and supplementary food; and c) human activity such as grazing, pesticides, forest harvest, and public attitude.

The analysis of hunting areas was done in collaboration with specialists involved in game management from forest units and hunting associations. The result was that 426 hunting areas comprising 31,000km^2 were selected as good bear habitat. It was possible to take measures to encourage bear populations because forest and game management in Romania were carried out in concert. The fruits of forest trees and shrubs play an important role in the bear's diet. The decision of silviculturists to maintain the natural composition of the forest offered a good basis for the diet of the bear. Also, the management of herbivorous prey species (red deer, roe deer, and wild boar) for increased populations assured that more food would be available for bears. In 1960, when populations were estimated, roe deer numbered 85,000, red deer 14,000, and wild boar 16,000.

Two brown bears (*Ursus arctos*) in Romania, probably three-year-old brothers.

Peter Weber

At the same time, wolf populations were estimated at 3,100 individuals. Wolves are the only predators that can coexist and sometimes prey on bears, but in that period wolves were considered a pest and were destroyed by all means. In 1988 when the bear population was the largest it had been since World War II (7,780), the herbivore population was 177,000 roe deer, 42,000 red deer, and 44,000 wild boar, while the wolves numbered only 1,900. Increases in livestock and expansion of the grazing system have given bears more opportunities to attack domestic animals, especially when livestock is not supervised while grazing in the forest.

Adequate cover is also important to bear survival. Bears prefer young, thick forests during the summer, and generally den in hilly areas during winter. Silviculturalists have taken special measures to protect areas in which dens are known to exist. Other measures aimed at protection have included: 1) barring gypsies from keeping bears in captivity (1960); 2) reduction of poaching; 3) limiting the harvest to those bears who greatly damage livestock; 4) permitting hunting only with a special license between March 15 and May 15, and between September 1 and December 31, to protect females with cubs; and 4) supplementary food which was made available in the spring and autumn between 1973–1975.

Repopulation of bear habitat has been attempted by capturing cubs at three, four, or five months old, and releasing them in the wild at about 16 months of age. This program began in 1974 with 42 cubs, and continued with 43 cubs in 1975, 42 in 1976, 29 in 1977, and 36 in 1978. It was not a great success. During the period in which the cubs stayed in captivity, they became conditioned to human food and presence. Better results were obtained by repopulation with adults. However, when the density of bears increased, they occupied all suitable habitats and even some which were not considered suitable.

Human-bear interactions

Even as bear population density has decreased, the range has consistantly increased. Beginning in 1978, as a result of protection measures, the total bear population exceeded the number considered to be optimum and spread out of its core range. This large density of bears created conflicts with farmers. Because every adult bear has its own territory, those individuals which are weaker are pushed to the edges of the range, and are obliged to find food in improper places. Overpopulation created great concentrations of bears and great damages to orchards. Young bears and females with cubs appeared near towns and obtained food from garbage. Others attacked farms at the edges of mountain villages trying to take domestic animals. Also, herds grazing in alpine meadows, mountain forests, bee gardens, and agricultural fields sustained some damages from bears. Compensation for these depredations are paid by a state insurance system and by the owners of hunting rights.

These large concentrations, which occurred in autumn and at the feeding stations, favored the spread of parasites in the bear population. Analyses of 323 bears between 1990 and 1993 revealed that 15% were infested with *Trichinella spiralis.* Other parasites present included *Toxascaris transfuga*, and the very rare *Dicrocelium lanceolatum*.

Table 6.11. Brown bear populations in Romania by district.

District	Hunting areas	Optimum population	Actual population	Annual harvest
Alba-Iulia	30	104	121	2
Arad	4	-	14	-
Bacau	20	185	192	12
Baia Mare	46	257	335	12
Bistrita Nasaud	31	235	257	14
Brasov	43	306	329	6
Buzau	17	280	342	4
Cluj	11	100	101	2
Deva	39	285	397	17
Drobeta Tr. Severin	6	20	37	-
Focsani	24	222	436	26
Miercurea Ciuc	48	425	794	62
Oradea	6	10	37	-
Piatra Neamt	29	215	166	2
Pitesti	22	265	335	12
Ploiesti	19	190	296	16
Resita	26	145	184	1
Rimnicu Vilcea	22	235	223	6
Satu Mare	4	15	14	-
Sfintu Gheorghe	29	400	600	55
Sibiu	33	155	234	6
Suceava	48	404	266	-
Tirgoviste	3	20	43	-
Tirgu Jiu	15	145	158	4
Tirgu Mures	40	250	425	40
Zalau	1	-	1	-
Total	**616**	**4,868**	**6,337**	**299**

Table 6.12. Brown bear population and harvest numbers in Romania by year.

Year	Population	Harvest	Year	Population	Harvest
1940	1,000	38	1973	3,690	177
1950	860	-	1974	3,761	203
1952	1,500	-	1975	3,834	65
1953	1,650	-	1976	4,269	89
1954	2,000	40	1977	4,609	58
1955	2,400	40	1978	5,204	84
1956	2,500	45	1979	5,681	42
1957	3,060	51	1980	6,014	66
1958	3,065	49	1981	6,260	53
1959	3,079	84	1982	6,342	36
1960	3,300	24	1983	6,534	74
1961	3,400	50	1984	6,713	59
1962	3,510	43	1985	6,837	68
1963	3,596	84	1986	6,974	70
1964	3,783	36	1987	7,253	51
1965	4,014	98	1988	7,780	63
1966	4,014	109	1989	7,770	131
1967	4,260	140	1990	7,422	164
1968	4,600	67	1991	6,880	288
1969	4,700	275	1992	6,653	299
1970	4,205	122	1993	6,337	-
1971	3,962	187			

Conservation recommendations

After comparing the actual population numbers with optimum population numbers (Table 6.11), we know that the hunting of bears can and must be allowed in certain districts. These districts include Maramures, Mures, Harghita, Covasna, Bacau, Buzau, Prahova, Brasov, Arges, Sibiu, and Hunedoara.

If hunting helps to manage bear populations at the existing level, then hunting and bear existence in Romania are indeed compatible.

Status and management of the brown bear in Russia

See Chapter 7, Brown Bear Conservation Action Plan for Asia, pages 136–143.

Status and management of the brown bear in Slovakia

Pavel Hell and Slavomír Find'o

Introduction

This report provides basic information on the brown bear population in the former Czech and Slovak Federal Republic (CSFR). The brown bear in Bohemia became extinct in the last century, therefore we describe only the situation in the Slovak Republic where the number of this species is higher than at any time in the past 100 years.

Historic range and current distribution

In the 17th century, the brown bear became a rare species in Bohemia. In the 19th century according to Kokeš (ex Hell and Sládek 1974), only seven bears were shot by hunters. The last brown bear to be shot in Bohemia was shot in 1856. This specimen inhabited Švarcenberg forests and had been living there for 15 years as a lone animal. According to Čabart (ex Hell and Sládek 1974), traces of the last Bohemian bear were found on February 24, 1864. Later on, this bear was killed by a poacher near the Volary village. In Moravia and Silesia the bear had been decimated, and around the 1600s, the last refuge became the Hrubý Jeseník Mountains. However, in the 18th century the bear became a rare species in this refuge and the last specimen was killed in 1790. The last bear in the Bohemian-Moravian highland (hunting area Předín) was killed in 1717. In the Moravian-Silesian Beskydy Mountains, the bear survived almost 100 years longer. The rest of the bear population in this region was exterminated between 1876 and 1887 near the villages Roznov, Morávka, and Ostravice. The last surviving bear in the Ostravice hunting area was recorded in 1908.

In Slovakia, the bear became extinct at the end of the 19th century only in the Bratislava district (Ortvay ex Hell and Sládek 1974). According to Matlekovits (ex Hell and Sládek 1974), from 1885–1894 no bears were hunted in the following districts: Tekov, Komárno, Hont, and Novohrad. In the same period, the annual harvest of bears by district were as follows: Nitra 1, Trenčín 4, Orava 4, Turiec 3, Liptov 10, Zvolen 7, Gemer-Malohont 4, Spiš 4, Zemplín 1, Abov-Turňa 2, and Užhorod 4 (including part of the so-called "forested Carpathians" of the Ruthenia-Ukraine). From 1885–1894 the mean annual harvest in Slovakia was approximately 42 individuals (Hell and Sládek 1974). At the beginning of this century, the bear in Slovakia was still abundant (Pazlavský ex Hell and Sládek 1974). However, by World War I, only 120 bears survived in Slovakia.

This rapid decrease in bear numbers was caused by persecution, aimed at eliminating damage to beehives and domestic animals, as well as by sport hunting pressure. For example, in 1901 the Count Andrássy's forest personnel in Gemer forests estimated bear numbers at 46 individuals. Of these, the mean annual harvest was 20 individuals, and 11 were once killed in a day! On the other hand, the feudal owners of large properties attempted to maintain their bear populations, so as not to lose the gentlemen's amusement. In 1905 near the Pol'ana Mountains, Habsburg Prince Frederick liberated two males and four females imported from Transylvania to reinforce native bear populations. Unfortunately, the fate of these animals is unknown. In the Javorina hunting ground (The High Tatras), Prince Christian Kraft Hohenlohe-Oehringen provided supplementary food for bears to maintain and increase their numbers.

In spite of decimated numbers, bears were intensively hunted after World War I. Annual harvests between 1927–1929 were 19, 12, and 11 bears respectively. In 1928, bear numbers were estimated to be only 30–40 individuals (Hell and Sládek 1974) and in 1932, estimates decreased to 20 individuals. According to other authors this number was underestimated by at least 50%. Since 1933, the bear has become a protected species throughout the year, although this regulation is applied only to hunters and not to land owners.

Due to this protection, the numbers of bear in Slovakia rebounded and many parts of the previous range have been re-established. According to Turček (ex Hell and Sládek 1974), in Slovakia after World War II, there were 50–80 bears, and by 1953 this number had increased to 200 (Feriancová ex Hell and Sládek 1974). Between 1966 and 1968, Škultéty and Randík (ex Hell and Sládek 1974) estimated bear numbers at 320 individuals. The core area of bear distribution is in the central part of the Western Carpathians (Figure 6.15). At that time in Eastern Slovakia,

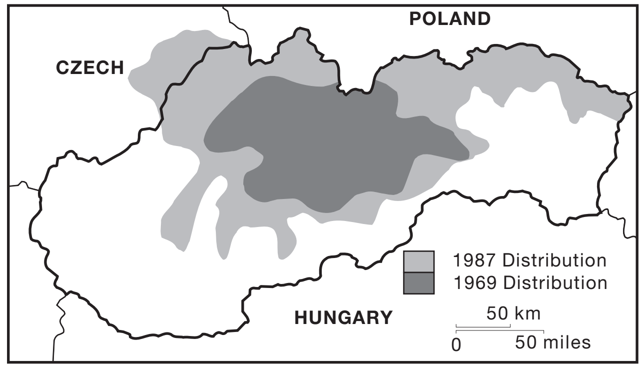


Figure 6.15. Distribution of the brown bear (*Ursus arctos*) in the western Carpathians, Slovakia, 1969 and 1987.

the bear did not occur, therefore the Western Carpathian population became isolated from the eastern population situated in Sub-Carpathian Ukraine and the Transylvanian Alps in Romania.

The present distribution of bears in Slovakia is given in Figure 6.15. The range covers the major part of the Western Carpathians with the exception of the southernmost and westernmost parts. At present the Slovak bear population is not isolated from its eastern counterpart as it was 20 years ago. A connection of the Slovak, Ukrainian, and Romanian populations has been recently recorded. The occurrence of bears in eastern Slovakia has been more frequent in recent years, further demonstrating the conjunction of populations, including a small one in Poland.

Status

The number of bears in the Slovak Carpathians has increased rapidly in the second part of the 20th century. According to official hunting statistics, in 1969 there were about 381 bears in Slovakia (Anon. 1969). By 1992 this number had increased to 954 individuals. This number is probably overestimated due to duplications in counting. Wildlife experts estimate about 25% fewer, or 700 bears. We notice that the population is still increasing although the bear is intensively hunted in Slovakia. Problems associated with this rapid increase will be discussed later. The optimal number of bears in Slovakia is considered to be 450 individuals.

As a result of the growing population in Slovakia, the number of bears in the neighboring northern part of the Western Carpathians in Poland had increased to 90 animals (Jakubiec 1987), but has recently decreased to 70 bears due to increased hunting in Slovakia (Jakubiec pers. comm.).

The total territory of bears in the former CSFR, including the transitionally inhabited zones, covers 13,000km^2, of which the core area covers 10,000km^2. Assuming a total population of 700–900 bears, the mean population density is 0.54–0.69 (core area) or 0.70–0.90 (total range) individuals per 10km^2.

Legal status

In the past, the bear had no legal protection in the territory of the former CSFR. On the contrary, bounties were paid for hunting to prevent damage to livestock, beehives, oats, and fruit trees, as well as to prevent direct conflicts with humans. Bears were also hunted for their skin, meat, fat, and bile to which curative effects had been attributed. According to Hošek (ex Hell and Sládek 1974), the bear was considered one of the most harmful species in Bohemia. The bounty for killing a bear in the 18th century varied within individual estates at around 7 gold coins, the same sum being paid for fur.

According to Josephine's hunting order (1738), bears could be killed by any person using any means. A similar allowance was made in the Provincial hunting law (1883) for Slovakia, which continued with certain changes until the enactment of the State hunting law No. 225 in 1947. This law, and the later Law No. 23 of 1962 designates the bear as protected "harmful game", with the state paying compensation for all damages caused to beehives and domestic animals. The poisoning of any animals is forbidden in both republics, further reducing the mortality pressure on the bear. In the Decree of the Slovak National Council No. 125:1965 on the protection of wildlife, the bear is designated a strictly protected species. The penalty for its illegal killing in 1972 in Slovakia was 15,000 Crowns with the possibility of a change in the base penalty by 100 to 300%. In the Czech Republic, the penalty is 40,000 Crowns. In the Red Book of Endangered Species of Plants and Animals of the Czechoslovak Republic, the brown bear is listed as a rare species.

Population threats

At present the greatest pressure on the bear population is due to intensive hunting. Illegal shooting of bears has been very rare but may increase in the future in response to a decreased standard of living, increased unemployment, and an increased crime rate. Occasionally, bears are killed by accident or in self-defense (e.g. at night or in twilight, mistaken as a wild boar). Because damage caused by bears to beehives and livestock is compensated, there is no reason for wilful and illegal killing of bears by injured parties. Sometimes bears are killed by trains, but accidents with other vehicles have not been registered.

Habitat threats

Bears are found most frequently in fir-beech, spruce-beech-fir, and spruce forests at altitudes between 700 and 1,250m. Bears also seek acorns, beech nuts, field crops, and other foods in beech-oak forests at lower elevations.

The best territories for bears are large and continuous forest areas. The construction of forest roads and skidding lines, as well as various human habitations can bring bears and people into conflict. Forests cover 40% of total territory of Slovakia and this percentage has stayed stable due to reafforestation. This trend will probably continue. The construction of highways in mountainous areas has been limited due to lack of finances.

The construction of weekend houses and hotels, which can lead to habituated bears, has been limited. The constructions of skidding trails has similarly declined, but the network that remains creates two problems for bears. First, the roads allow access for people picking forest fruits, especially raspberries, bilberries and cowberries. Even in the most remote places of the Carpathians, this access can significantly decrease the food base of the bear. Increasing unemployment and great interest of buyers may continue to spur this activity.

Bear habitat quality has been gradually worsening, and this process will certainly accelerate after the end of the present recession and the new economic development that will follow. Information concerning relationships between bears and other wildlife species is not available.

Management

Although the bear in Slovakia is a protected game species throughout the year, the increase in numbers and resulting damage to agriculture necessitated hunting beginning in 1962. In the beginning, the optimum harvest number was estimated to equal 5% of the total population, but soon it appeared that from the increase of bears in the Slovak Carpathians that the population was substantially higher. Bear numbers increased very quickly, making it necessary to increase the target harvest percentage.

During the first three years of the hunting period, an average of 3.67 bears were taken annually, but by the 1989–1991 period, the average had increased to 60.67, a 16.5-fold increase. The total number of bears hunted in Slovakia between 1962 and 1991 was an unbelievable 806. The addition of illegal and accidental kills would further increase the total human-caused bear mortality rate.

Large numbers of bears are hunted by foreigners who pay a fee that helps compensate people for damages caused by bears. A smaller number of bears are hunted by native hunters paying a lower fee. Only a small part of the total harvest is comprised of control shooting of dangerous and problem habituated bears. In spring, the use of animal or plant baits to attract and shoot bears is common. Recently molasses feed has been popular, especially in the areas with high occurrences of problem bears. With the exception of problem bears, hunting is limited to the borders of the range.

In the past, trophy hunting for large, old males affected the age and sex structure of the population. Therefore, hunting of bears larger than 150kg has been strongly limited and recently completely forbidden. The approval of bear hunting plans for individual hunting grounds and specification as to weight allowed is carried out by the Professional Commission of the Ministry of Agriculture, which issues special permits for hunting based on an agreement with the Ministry of Environment.

These regulations have affected both sex and age ratios. Hell and Sabadoš (in press) report an increase in sex ratios of bears harvested from 0.30 between 1980–1982 to 0.93 between 1989–1991. Mean weight of hunted bears decreased from 142.5kg during the years 1980–1982 to 101.8kg during the years 1989–1991. The representation of harvested individuals with the front foot wider than 15cm decreased from 35.2 % during the years 1980–1982, to 12.9 % during the years 1989–1991. The average annual harvest during the years 1980–1991 per 100km^2 of the bear area was 0.48 individuals.

The harvest regulations should continue to allow an increase in the percentage of older, large males and females in the population. The greatest problem is still the determination of the optimum sustainable harvest number. Up to now, game surveys have been carried out by forest administrations and forest enterprises through the mediation of the State Forests but also directly on individual hunting grounds through the mediation of state administration. Therefore, in our opinion it results in numerous duplications. With the present reprivatization of a large part of the forests, it will be even more complicated. The success of encouraging hunters and foresters to measure and note bear sign, which will be helpful in eliminating the duplicate counting of individuals, is not guaranteed.

Human-bear interactions

In the Slovak Carpathians, bears prey on livestock, especially on sheep in mountain meadows. They attack sheep mainly at night in the sheep-folds. The lack of preventive measures, such as guard dogs, convenient alarms and scare devices, and carelessness of shepherds contributes to the problem. Electric fences have been used successfully, but the mobile nature of sheep herding limits their application. Depredation of cattle occurs very rarely and is more frequent on the Polish side (Jakubiec 1987). Bears damage beehives, as they are often placed in the middle of bear habitat. Electric fences have been used successfully, but this equipment is expensive and requires regular checking that amateur bee farmers cannot afford. Damages to domestic animals and beehives reach 0.75–1.0 million Slovak Crowns (US$20,500–27,000) annually.

Bears also damage fruit trees (breaking off branches), especially plum trees, and crops of oats (*Avena* spp.). This damage is not significant and is not compensated.

Part of the bear population occurring in tourist areas is partially habituated to human garbage, and this often causes conflicts. This is a nuisance exacerbated by local inhabitants, cottage owners, and tourists who attract bears with various delicacies. Garbage containers are not closed properly or are not taken away frequently enough to prevent access by bears.

Nearly every year, individual cases of direct confrontations between bears and humans occur (Hell and Bevilaqua 1988), sometimes involving serious injuries to people, but more often the death of the bear. These conflicts occur mostly with hunters, beekeepers, people picking forest fruits, foresters, and tourists. Surprisingly, no person has been killed by a bear during this century in the Slovak Carpathians.

Damage caused by bears to ungulate game is tolerable and substantially lower than that caused by wolf and lynx. However, hunters often complain of the presence and activity of bears during the red deer rut.

Public education needs

Slovak citizens generally accept the presence of bears and therefore special educational activities from this point of view are not necessary at present. Most complaints come from private apiarists, and to a lesser degree from shepherds employed mostly by agricultural cooperatives. This problem will become more serious after reprivatization of forest and agriculture land. If the state does not compensate for damage caused by bears due to lack of finances, the situation for the bear will rapidly worsen. A more intensive educational program will be needed to prevent damage by bears, as well as to teach forest visitors about appropriate behavior in bear territory.

Specific conservation recommendations

1. Improving the population monitoring used for management so that favorable numbers, sex ratios, and age structures can be maintained.
2. Killing only problematic, habituated individuals.
3. With the privatization of hunting grounds, it will be necessary to increase the state supervision of the management of bear populations.
4. Limiting the hunting of bears near the borders of their range.
5. Cooperating closely with Polish authorities and possibly also with Ukraine (Sub-Carpathian Ukraine) in conservation and management of bears.
6. Ensuring further compensation for damages caused by bears.

7. Supporting the introduction of complex biological and technical damage control measures.
8. Improving the management of habitats and important food sources for bears, designating certain localities rich in forest fruits inaccessible to the public.
9. Publishing information for visitors in bear areas, giving guidelines on appropriate behaviour on close range encounters.
10. Continuing scientific studies of bears in the Western Carpathians (including radio tracking etc.), and supporting it with both ideological and financial support of international conservation organizations.

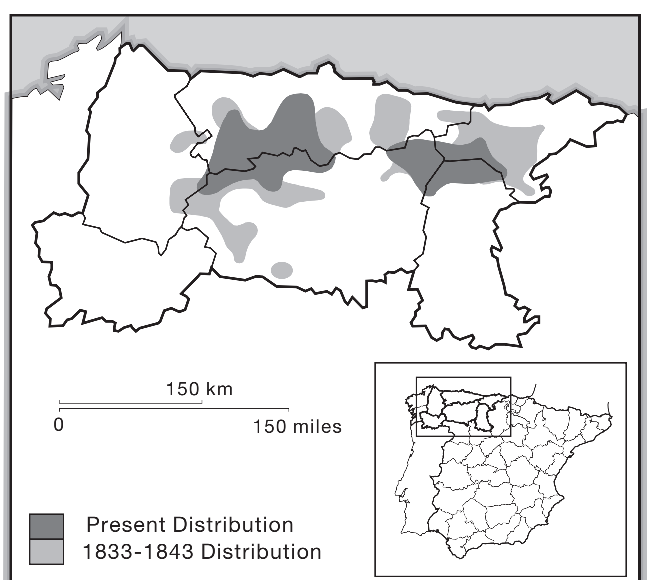
Status and management of the brown bear in eastern and western Cantabria, Spain

Anthony P. Clevenger and Francisco J. Purroy (eastern)
Javier Naves Cienfuegos and Carlos Nores Quesada (western)

Historic range

Brown bears were once found throughout the entire Iberian Peninsula. Their presence was documented as far south as Andalusia in the 14th century (Alfonso XI 1976). During the 16th century bears disappeared from the southern third of the Iberian Peninsula, while in the 17th century they were only found in the northern half of the country. A break between the Cantabrian and Pyrenean bear ranges took place between the 17th and 18th centuries (Nores 1988; Nores and Naves 1993). In the north, the last bears in the Basque Country were killed in Altamira and Urgoiti (Alava) around 1830 (Nores 1988).

Figure 6.16. Historic (Madoz 1843) and present brown bear (*Ursus arctos*) distribution in the Cantabrian Mountains, Spain.



At the beginning of the 19th century brown bears were found in just the Pyrenees and Cantabrian Mountains, occurring over 8,000 and 14,000km^2 respectively. At the beginning of the 20th century the western and eastern limits of the Pyrenean population were nearly the same as in the previous century; the southern limit receded towards the mountains, so that the Spanish occupied area shrank considerably. The population decrease was less severe in the Cantabrian Mountains, as bears lived in an area of about 9,200km^2.

Cantabrian bear distribution during the mid-1800s is compared with the present range in Figure 6.16. The earliest demographic information on the bear population in the five Cantabrian provinces was obtained from the geographic studies conducted by Madoz (1843) between 1833 and 1843. The data are not complete, as some villages historically associated with bear activity and folklore did not record bears as part of the local fauna for some reason. Nonetheless, the data do provide a general outline of the bear range during the middle part of the last century.

The range area reduction which took place during the 19th century corresponded with a decline in bear numbers. The Asturian bear population went from 400 bears during the first decade of the 1800s to slightly more than 100 bears in the 1900s, before hunting bounties were removed (Nores 1993). The consequence of this reduction in brown bear range and number has resulted in the present isolation of the Pyrenean population and the near extinction of their presence on the Spanish slope (Caussimont *et al.* 1993; Alonso and Toldra 1993).

Reductions in range during the last 150 years are most notable in two broad geographical areas: 1) eastern Asturias and southern Cantabria, and 2) southwestern Leon. Loss of habitat and continued uncontrolled hunting of bears are factors that best explain shrinking bear range during this period. The industrialization of the Cantabrian coast and its accompanying rise in human population beginning in the 1920s resulted in the cutting of nearby lowland deciduous forests. At the same time, exploitation for coal turned into large-scale operations in Asturias, with many of the mines being situated in the core of the bears' range. In southern Leon, as in the northern provinces, hunting and frequent use of strychnine and other poisons to reduce livestock damage by predators were the factors generally responsible for the bears' disappearance.

The current brown bear distribution in Spain occupies about 45% of that existing at the beginning of the century. In the Cantabrian Mountains in northern Spain, bears disappeared from the eastern part of Asturias and most of Cantabria between 1930 and 1950, producing the separation of the two groups which presently remains.

This population represents one of the last strongholds of Eurasian brown bears in southern Europe and is one of the largest of the four remnant populations surviving there. The population is divided and distributed over an area of approximately 5,500km^2 with both subpopulations roughly equal in area (Clevenger *et al.* 1987; Servheen 1990; Clevenger and Purroy 1991a). The Eastern and Western nuclei are separated by approximately 50km of mountainous terrain. Many large and small coal mining operations occupy the northern portion of the uninhabited area between the groups, while the southern part is characterized by open, low-shrub vegetation of heath (*Erica* spp.) and Spanish broom (*Cytisus*, *Genista* spp.). The Cantabrian population was believed to have separated at the beginning of this century (Nores 1988), and today it is unlikely that any interchange between the two occurs. Throughout their distribution, bears and their habitat are threatened as illegal hunting continues and development fragments their range.

Legal Status

Bear hunting has been encouraged by countrymen and rewarded by the government of Spain since early times. Bounties were awarded for bear hunting as early as the 16th century. During the first decade of the 19th century, 60 bears were hunted annually in Asturias. Harvests decreased to one third of this total seven decades later. In some municipalities, more than three bears were killed/100km^2/year (Nores 1993).

The exact date when bear persecution stopped is unknown, but at the end of the 19th century rewards for killing bears did not exist. Although livestock owners were responsible for local extinction of the species, during the second half of the 20th century sport hunters demanded the implementation of a closed season. This pressure prompted certain restrictive measures to be taken. Hunting was prohibited in the Cantabria province in 1949, and in 1952 the prohibition spread all over Spanish territory, lasting for a period of five years. Since 1955, the creation of the National Hunting Reserve System has helped reduce illegal bear hunting within the western bear area in the Cantabrian Mountains.

Comprehensive protection for the brown bear in Spain came after the national government passed a "temporary" law in 1967, which prohibited the hunting or harassment of bears, only two years after the last bear was legally killed. This law was intended to curtail hunting until a decision could be made concerning the population status and measures could be taken to insure the species' continued survival. Nevertheless, in 1968, with limited economic compensation for the damages caused by bears and opposition to the new protective measures, 11 bears were killed by poachers in Asturias (Notario 1970).

Several years later, the Protected Species law was passed by the Spanish government on October 5, 1973, and the brown bear formally became a protected species. The new law prohibited hunting, trapping, possessing, and commercially exploiting the animal, and fines were established for anyone violating the law. In 1980, the Protected Species law was adapted to the new government and constitution (post-dictatorship), and the brown bear was placed on the "strictly protected" species list (Real Decreto 3181/1980).

The passing of the Conservation of Natural Spaces and Wild Flora and Fauna law on March 27, 1989 required all Autonomous Communities to begin taking action and implementing measures to conserve endangered species (including the Cantabrian Brown Bear) and their habitat. Since 1989, governments from the four Autonomous Communities within the Cantabrian bear range (Asturias, Cantabria, Castile-Leon, and Galicia) approved special decrees for the conservation of the brown bear which included their respective recovery plans. The objectives of the four recovery plans are the same, and their conservation actions vary slightly among the different Autonomous Communities. The following types of actions are found in the four recovery plans: direct protection, habitat conservation, socio-economic considerations, research and monitoring, public education, and cross-community cooperation.

The National Catalogue of Threatened Species was established by the Royal Decree 439/1990, dated 30 March, 1990. In this Catalogue, the Spanish brown bear was considered a species "in danger of extinction".

Eastern Cantabrian subpopulation

Current distribution

The Eastern nucleus, (Figure 6.16) is found within four provinces (Asturias, Cantabria, Leon, and Palencia) representing three separate Autonomous Communities (Asturias, Cantabria, and Castile-Leon). The range extends from Campoo de Suso (Cantabria) in the east to Valdeteja (Leon) in the west. North-south boundaries are defined by the Asturian mountains of Ponga and the pine plantations of Rio Camba (Leon).

The bear population is found primarily in the provinces of Leon and Palencia. Two basic core areas exist, one in the Fuentes Carrionas National Hunting Reserve (NHR) (Palencia) located in the upper Pisuerga River (La Pernia, Los Redondos, Castilleria, and Sierra del Brezo) and another in the Riano NHR (Buron, Casasuertes, Hormas, Lechada, and Barniedo). A travel corridor between both areas runs from the hardwood forests of Lebanza and Resoba passing along upper part of the Carrion River (Cardano de Arriba, Valdenievas, and Valcerezo) and connects with the upper Valponguero valley along the southeastern edge of the Riano NHR.

In Cantabria, bears most commonly occur in the headwaters of the Deva River situated between Cosgaya and Salvaron Pass. The Remona Pass and Pineda-Sierras Albas divide are the most commonly travelled passes connecting with the Valdeon valley (Leon) and La Pernia (Palencia), respectively. On the northwestern edge of this nucleus, bears are found in the Asturian Sierra de Carangas and Cordal de Ponga.

Status

In the last 30 years, eight population estimates have been published for Eastern Cantabrian brown bears (Table 6.13). Most studies relied heavily on questionnaires and interviews with NHR game wardens and local people living in the bears' range. In 1986, a survey was conducted to clarify two questions regarding Eastern nucleus demographics. The survey sought to determine whether the 1962–1983 population estimate data (see pre-1986 estimates in Table 6.13) represented the actual population trend (increasing), and whether Spain's Protected Species Law of 1973, which legally protected the bear, had been effective in at least maintaining their numbers and preventing any further decline of the population (Clevenger and Purroy 1991a). The population trend index indicated that overall, bears had decreased in numbers in the Cantabrian Mountains during the last 13 years, as both Eastern and Western nuclei had negative trend indices. According to the game wardens interviewed who were working in the Eastern nucleus, the causes for the bears' decline was primarily attributed to illegal hunting and high human activity in the bears' range.

Thus, the Eastern Cantabrian population appears to be in a continuous and steady decline, however slight it may be, despite the protection afforded to brown bears in each of the three Autonomous Communities. The most recent population estimates put the Eastern nucleus at approximately 12–16 bears (Clevenger and Purroy 1991a). This figure was based on the estimated number of breeding females in the nuclei (Servheen 1989) and was supported by other field data (Clevenger *et al.* 1992a). In the future, the mountain system separating Leon and Palencia provinces would most likely be the part of the nucleus to show a decline in bear numbers that would result in the division of the subpopulation.

Table 6.13. Population estimates for the brown bear (*Ursus arctos*) in the eastern nucleus of the Cantabrian Mountains, Spain.

Author(s)	Estimate
Notario 1964	16
Notario 1970	10
Brana *et al.* 1979	12
Garzon *et al.* 1980	16
Notario 1980	17
Campo *et al.* 1984(a)	35
Campo *et al.* 1984(b)	39
Clevenger and Purroy 1991a	14

(a) 1982 estimate.
(b) 1983 estimate.

Population threats

The greatest threat to the Cantabrian bear's survival is from illegal hunting throughout its entire range (Brana *et al.* 1979; Garzon *et al.* 1980; Clevenger and Purroy 1991a,b). In the Eastern nucleus during the last 11 years, five bears are known to have died from human-related causes, including three males, one female, and one of unknown sex. Strychnine poisoning caused the death of an old female in 1982, a 7-year old male in 1984, and an old (≥20-years old) male in 1990. Two bears were shot by poachers in 1987 and 1988; one was a nine year old male, while age and sex of the others was unknown.

Unlike the Western nucleus, bears run little risk of being trapped in snares, as this type of activity is not commonly carried out in the Eastern part of their range. The most common cause of death is by accidental or intentional shooting during large game drives, and poisoning from strychnine-laced baits set out by livestock owners for wolves (*Canis lupus*). Livestock predation by bears in the Eastern nucleus is insignificant (Clevenger and Purroy 1991b) and the few losses annually caused by bears are compensated quickly and effectively by the respective Autonomous Communities. However, the delayed government reimbursements made to farmers who have lost livestock to wolf predation or have had hayfields uprooted by wild boars (*Sus scrofa*) force them to take the law into their own hands. This activity is threatening to the bear's survival in the Eastern nucleus and the entire Cantabrian range.

Cantabrian bears are also being killed by and for trophy hunters in search of this rare Spanish carnivore. There is evidence indicating that organized poachers operate in the Cantabrian Mountains and take clients out on furtive hunts in areas outside of the NHRs. Similarly, some mountain people actively engage in poaching bears and selling their hides or heads to interested parties, all of whom are willing to pay high prices for the illegally taken material.

Within the Fuentes Carrionas NHR there are several "controlled" hunting reserves which are leased by the village councils to private hunting groups. Game wardens from the NHR's do not have jurisdiction in the private reserves as the private groups hire their own wardens to carry out this function. Often the private wardens are absent or consent to illegal hunting in the reserves, and reports of bear poaching and harassment within them are common.

Habitat threats

Studies investigating bear-habitat relationships in the Cantabrian Mountains have only been carried out in the Eastern nucleus (Clevenger 1990; Clevenger *et al.* 1992b). Cantabrian bears prefer native beech (*Fagus sylvaticus*) and oak (*Quercus* spp.) forests, and have a greater tendency to use habitat situated further from villages and roadways than would be expected by chance. The high level of human presence and the fragmented nature of bear habitat in the Eastern nucleus is of important concern as concerted efforts will need to be made to protect and restore critical travel corridors to avoid extinction.

During the last 50 years, many large-scale reservoirs (30–70km^2) have been constructed in the Cantabrian Mountains and in core areas of the bears' range. Although they are situated in open lowland habitats rarely used by bears, some reservoirs may act as barriers to bear movements, requiring that they travel around the barriers and contact suboptimal habitats which will make them more vulnerable to human persecution or harassment. Road building and construction associated with reservoirs is believed to affect bear movements and behavior although it has not been documented in this population (Mattson *et al.* 1987; McLellan and Shackleton 1988). Presently, in the Eastern nucleus there are six large-scale reservoirs located within the brown bears' range. Another was scheduled to be constructed in the Palencian valley of Vidrieros in 1994. However, due to public opposition and the negative impact it would have had on the Eastern bear population it was abandoned by the Spanish government for the time being. The construction of the Vidrieros dam, situated on an important travel corridor between two core areas within the Eastern nucleus, would likely have further fragmented the bears' habitat, degraded habitat quality, and begun isolating the two main areas of bear activity.

At the moment there are tentative plans to build a winter ski resort in the Riano NHR. The resort will be privately owned and operated, but will need the authorization of the Castile-Leon Autonomous Community before the project is approved and construction begins. The location of the proposed ski area in the Naranco and Lechada valleys is not optimal bear habitat, consisting mainly of subalpine grazing lands. However, the area is of critical importance because it is also a travel corridor between the Leon and Palencia core areas. Bears frequent the area mostly during summer and travel through it practically year-round. As many as three bears have been observed in the Naranco Valley recently, all of which used the area for breeding activities (Clevenger *et al.* 1992a). Development in the Naranco-Lechada valleys will similarly erode the quality of bear habitat in the Eastern nucleus, as noted above, and will only result in expediting the extinction of this sector of the Cantabrian population.

Road construction is still a problem within the Eastern bears' range. Plans are being made to build a road connecting the villages of Corniero and Liegos within the Riano NHR. Both villages and the intervening area are located outside of the core bear area, but still receive a substantial amount of use, especially during autumn when bears frequently travel south to hard mast-producing areas like Pardomino Valley. Until now, the low human activity in this region facilitated bear travel between areas. The proposed road will most likely affect bear movements. Forest road construction is a serious problem in the Fuentes Carrionas NHR and the other core area of the Eastern nucleus. Road-building is spontaneous, is carried out with little regard for the local bear population, and is condoned by government resource agency officials.

Management

Management and conservation measures to conserve the Cantabrian brown bear population are part of the respective Autonomous Communities bear recovery plans. Five principal areas of management and conservation activity are described:

1. Application of legal measures which will guarantee the conservation of the bear's most important habitats;
2. Development of a forest management plan which will increase and conserve the amount of native deciduous forests;
3. Minimize the effects of forest roads and vehicles within the bear's habitat;
4. Regulate forms of tourism and recreation in bear areas that may affect their well-being;
5. Manage hunting activities in bear range so that their impacts will be minimum.

Each Autonomous Community is responsible for applying the measures and making sure that they are strictly adhered to. In the Eastern nucleus, only two of the five activities have been enacted. Several forest roads that entered into areas of critical bear habitat in the Riano NHR were closed (gated) to vehicular traffic. These measures were actually adopted in 1987, prior to the brown bear becoming a legally protected species in the Castile-Leon Autonomous Community and its recovery plan being prepared. There have been few, if any, road closures since official protection of the species. Nowhere else in the Eastern nucleus have forest roads been closed to protect important bear habitat.

Since 1990, the Autonomous Communities of Castile-Leon and Cantabria have begun to manage wild boar hunts so that they do not occur in valleys which are reported to be "important bear areas." These hunts begin in autumn and usually last through winter. No effort has been made to determine or monitor the effects of wild boar hunting on the local bear population. The remaining three principal conservation activities (legal measures, forest management, and tourism management) have not been put into effect anywhere within the Eastern nucleus as of the time of the preparation of this report.

Human-bear interactions

Human interactions with bears in the Eastern nucleus are limited to agricultural damage: these are relatively few each year and are compensated quickly by the respective Autonomous Communities. In the Eastern nucleus, there are an average of 5–10 agricultural damage incidents per year, costing the governments on average some 50,000–250,000 pesetas (US$400–1,800) annually. Attacks on livestock are the most common type of damage by bears, while attacks on beehives are less frequent (Clevenger and Purroy 1991b).

Public education needs

Educating the public about the plight of the Cantabrian brown bear population in the Eastern nucleus currently consists of: (1) presentations given to grammar school children living in the bear's range, and (2) educational efforts through brown bear interpretation centers. The Autonomous Communities administer the two public education programs. Local conservation groups are also active in making the public aware of the bears' situation through local campaigns which include audiovisual presentations and talks given by various people involved in bear conservation at the local, state, and national level. The public education program run by the Autonomous Communities needs to contact the adult population living in the bear's range, in addition to local school children and passing tourists at whom it is directing attention at the moment. Public talks should be organized in all county seats and important villages within bear range during the course of the year.

Specific conservation recommendations

1. Efforts should be made to include all of the Eastern Cantabrian bear range within the National Hunting Reserve system, or another type of public (natural reserve, regional park, etc.) or privately administered reserve. The objective of the reserves would be to provide protection for the bear by having trained personnel to effectively warden the area as well as prohibit or limit the amount of hunting activity occurring there. This could be accomplished by either buying the "open hunting" lands (*cotos libres*) belonging to municipalities which border the Reserves, or by obtaining the lease on the "controlled hunting" (*caza contolada*) lands situated inside the NHRs when the multi-year lease on each expires. Areas to be targeted in this effort include: (a) Leon province: Prioro, Morgovejo, Valderrueda, Besande, Cremenes, Lois, Pardomino, and Reyero; (b) Palencia province: all controlled hunting areas within the Fuentes Carrionas NHR, Branosera, Barruello, and Sierra del Brezo.
2. Travel corridors need to be protected and restored within the Eastern Cantabrian bear range, and between the two isolated Cantabrian nuclei. Measures that may help to accomplish this objective include the following activities in the Eastern corridor areas: reforestation, road closures, reduced number of livestock and human activity, and renting upland pastures and woodlands in corridor areas. Areas to be targeted include: Lechada-Naranco valleys with Alto Carrion, Valponguero with Valdenievas-Vidrieros, and Pardomino with Valdeburon via Primajas, Cornierno, Reyero, and Lois.
3. Reduce the forest road network in the Eastern Cantabrian bear range by closing or gating roads to unnecessary vehicle traffic.
4. Expedite the payment process for farmers affected by agricultural damages caused by wild boars and wolves in the bears' range. Start efforts to reduce the number of wild boars as they are direct competitors with brown bears for hard mast prior to denning.
5. Maintain long-term population trend monitoring work in the Eastern Cantabrian bear range (US$5,000/year).
6. A supplemental feeding program should be planned and developed to guarantee the availability of food resources during years of hard mast failures or low food abundance (US$5–7,000/year).
7. Develop a public education program designed to inform the people living in bear range about the situation of the species, its plight, and what efforts are being implemented to save the population from extinction (US$25,000 /year).

Western Cantabrian subpopulation

Current distribution

The western Cantabrian population (Figure 6.16) covers an area of 2,600km^2 within three different Autonomous Communities: Galicia (65km^2), Castilla and Leon (700km^2) and Asturias (1,835km^2) (Campo *et al.* 1984; Naves and Palomero 1993a). Within the western group, bears experience some range constrictions. The most important range constriction occurs near the Leitariegos mountain pass (Asturias/Leon), where a narrow 10km wide area joins the two subpopulations.

In Asturias during the last decade, there have been two cases of colonization of places where bears had not occurred in the 19th century (Marquinez *et al.* 1986; Nores 1988). Both colonizations took place after the 1950s, when the reduction of livestock activities improved the habitat for bears. Recently in the north of León, females with cubs have been observed. On the other hand, during the last decades, a considerable portion of the southeastern section of this population has suffered a population loss (Notario 1980) which is still taking place.

The wide-ranging nature of this species causes some cases of sporadic presence out of the limits of the distribution areas described before, even in far away places and those which are not considered as adequate bear habitat. Some places in the western and southern areas of this population are the most probable places where future range expansions might occur if conservation measures are properly enacted.

Status

Currently, the population estimate is around 50–65 bears (Palomero *et al.* 1993), taking into account that 10% of a healthy bear population is made up of females with cubs (Servheen 1989).

Population threats

One of the main short-term problems facing conservation of the Cantabrian brown bear is the difficulty in producing offspring to counterbalance losses due to poaching. If we also consider the small size of the Cantabrian populations, their future is quite uncertain. If we assume that demographic parameters of the Cantabrian bears are similar to those of North American populations, and therefore require similar minimum numbers for the continuance of populations (e.g. 70–90 bears in the case of the Grizzly Bear Recovery Plan of lower 48 United States) (Shaffer 1984; Knight and Eberhardt 1985; Allendorf *et al.* 1986), the present situation in the Cantabrian Mountains can be considered critical.

The isolation of the two populations of bears is particularly problematic. The recovery of a corridor between the populations allowing bear interchange would help overcome the threat of extinction in each population (Marquinez *et al.* 1986). Although methodologies have differed, recent studies describe a reduction in the number of adult females and a decrease in total population, apparently related to illegal hunting. In recent years 21 bears were killed in the western population, and it is probable that 12 more incidents occurred. The mortality rate included all age and sex classes (Palomero *et al.* 1993). Other authors report that from 1979 to 1981, 20–25 bears were killed by poachers in the Cantabrian Mountains (Brana *et al.* 1982).

Illegal shooting with no specific purpose accounted for 54.5% of non-natural deaths of bears in the western population. In some cases, bears were also killed during the legal hunting seasons of other game species. Although no bear offspring mortalities have been reported during hunting drives for wild boar (*Sus scrofa*) in winter, bear appearances during these drives are common. This type of hunting is traditional in the Cantabrian Mountains and is frequently carried out within the territory of the western bear population. In each hunting drive, two or even three areas can be covered with a frequency of about 23 hunting drives every 100km^2/year (Consejeria De Medio Ambiente y Urbanismo 1992). This type of hunting, which generally takes place during autumn or winter, appears to be on the increase within bear areas.

Snares, steel traps, and strychnine poisoning cause 36.4% of human-caused bear mortality. The number of dead bears due to poisoning may be underestimated, as it is often difficult to find the carcasses. This cause of death seems to be consistent with management problems for other species in the Cantabrian Mountains.

Over the last few decades, wild boar (Telleria and Saez-Royela 1985) and wolf (*Canis lupus*) (Blanco *et al.* 1992) have spread throughout the country, causing serious damages to local agriculture and farming. Because of the low economic compensation for damages caused by those species and the problems derived from their management, the use of illegal, non-selective means (snares, traps, and poisoned baits) has increased and contributes considerably to bear mortality (Naves and Palomero 1989; Purroy 1991; Garcia-Gaona in press).

In the western bear population, damage caused by wolves average about 800 head of livestock per year, with an economic value approaching 20 million Spanish pesetas (US$140,000 (Garcia-Gaona *et al.* 1990). Only the regional governments of Galicia and Asturias pay full compensation for damages caused by wolves in bear areas. In Castille-Leon, damages caused by wolves are only paid in National Hunting Reserves. Hunters also consider the wolf as a competitor for their game species. In the case of wild boar, the situation is quite similar. Damage to crops and cultivated grasslands within the bear distribution area approach 3,600 claims every year, with an economic value of about 60 million Spanish pesetas (US$420,000). These depredations, which are only paid in the National Hunting Reserves, are a source of disagreement.

Habitat threats

The range of the brown bear in the Cantabrian Mountains has been impacted by the presence of humans. In the area occupied by the western bear population, there are 19.4

permanently inhabited human settlements per 100km^2, with a total number of 12,948 inhabitants (12.1 inhabitants/km^2) (Reques 1993). The main economic activity in the bear area is raising livestock (35 animals/km^2), primarily cattle. Apart from this activity, there are others which may be locally important such as: mining, tourism and sporting (hunting included), agriculture, public works (reservoirs, highways, and roads), and timber harvest.

At present, the high level of human impact in bear territory results from land-use changes in response to several socio-economic factors. Traditional farming and agriculture are in decline, and the subsequent demographic changes (aging of the local population and exodus of the young adult population) have opened up some areas for a new stage of economic development. New human activities including tourism, reforestation with foreign species, timber harvest, and reservoir and hydroelectric power station development are having a high impact on the region's bear habitat.

Studies of human geography in the Cantabrian Mountains have shown that the western bear population is surrounded by a higher level of human presence than is the eastern population (Reques op. cit.). However, the western bear population has practically three times more bears than the eastern Cantabrian population (Campo *et al.* 1984; Palomero *et al.* 1993).

A clear example of this high level of human-bear coexistence can be seen in the reproduction area of Proaza. Here, forests account for 20% of the area (Indurot 1993), density of permanent human inhabitants is 28.6/100km^2, and the density of paved roads is 34 km/100km^2 (Reques op. cit.). Nevertheless, from 1982 to 1991, 7 family groups were observed (Naves and Palomero 1993a). Low rates of natural mortality among bear cubs (survival during the first year of life is 70.6%), the large mean litter size (2.24), and the interbirth interval (some two year intervals were observed) (Palomero *et al.* in press a) indicate that despite this high level of human activity and road density, bears are still thriving.

Availability of different kinds of dried fruits during autumn and winter seems to explain some of these demographic characteristics (Palomero *et al.* op. cit.). Studies of habitat quality for the brown bear give evidence that abundant food resources are situated in very few scattered places (Marquinez *et al.* in press). Chestnuts (*Castanea sutiva*), which have the greatest trophic value during the whole year, cover only 0.3% of the study area. Historic human activities have reduced the forest cover to 30% of the total surface of the western area (Indurot 1993). Purroy and Clevenger (1991) also emphasize the importance of deciduous forests for bears.

Human activity has also caused the alteration or destruction of other necessary bear habitats. Shelter and denning sites have been abandoned by bears due to the loss of understory cover (Naves and Palomero 1993b). The loss seems to be related to human-caused fires. Today, adequate shelter and den sites are found in no more than 17% of the total western bear area (Naves and Ruano 1993).

In the patchy landscape of the western part of the Cantabrian Mountains, human pressures along corridors between high quality habitats or between subpopulations

J.C. Blanco

Brown bear (*Ursus arctos*) and cub in Somiedo Natural Park, 1995.

are becoming critical. The most important examples are again the Leitariegos Pass, which is being developed by mining and tourism interests, and the area separating the western and eastern Cantabrian populations, which is home to a great number of human activities including highways, roads, railways, ski resorts, and mines. A mountain highway crosses the central part of the Cantabrian Divide from north to south, but the existence of tunnels leaves about 7km available for movements between the two populations.

Management

The approval of the Spanish Catalogue of Threatened Species in 1990 did not modify the classification of the brown bear as a species in danger of extinction, but it added a new administrative characteristic as well as more active conservation via the Recovery Plans. These schemes were approved subsequently in Cantabria (Act 34/1989 dated 18 May, 1989), Castille-Leon (Act 108/1990 dated 21 June, 1990), Asturias (Act 13/1991 dated 24 January, 1991), and Galicia (Act 149/1992 dated 5 June, 1992).

The contents of the four Plans are similar, reflecting the frequent movement of the bears from one Autonomous Community to another. This similarity was the product of several meetings and working groups. The International Workshop on the Conservation of the Bear in Europe, which took place in Covadonga (Asturias) in May, 1988, enabled Recommendation 10 to be passed by the Permanent Committee of the Congress on Conservation of Wildlife and Natural Environment in Europe (Berna Convention) (Council of Europe 1989).

The Recovery Plans seek to increase bear numbers, ensure stable distribution, foster contact between both populations in the Cantabrian Mountains, and bolster the demographic integrity of the whole. The need to join both populations and the plan for a demographic increase require that the Plans include potential range. In the case of the western population, no future expansion areas were considered in the schemes, and in the case of Castille-Leon, no contact among the Cantabrian bear groups was assumed.

The Recovery Plans provide an opportunity to call for the increase of Protected Natural Areas and to carry out environmental impact assessments in the bear area for projects not mentioned in national legislation (Royal Act dated 28 June, 1986). Assessments of small scale human activities are needed to determine whether they may, when combined, cause negative impacts to bear habitat.

Assessments of administrative and management performance and follow-through are included in the Plans. The Plan Coordinator must follow a program drawn up annually or biannually specifying the projects to be carried out during this period, the mechanisms for public participation, and the incorporation pertinent scientific findings. The Recovery Plans themselves should be submitted to a thorough periodic review process. The Recovery Plans have been in existence only a short time, making it difficult to assess their efficacy. Nevertheless, a first review of their implementation would probably not

J. Naves

Human presence in bear habitat is so important that sometimes dens are close to villages, as in Somiedo Natural Park.

give us an extremely positive assessment (Palomero *et al.* 1993b).

Though some of the measures taken have shown positive results (regarding compensations for agricultural damages and the increase in wardens), no progress has occurred in other management aspects. Environmental Impact Assessments (EIA) have not limited human activities in bear areas, and no plan of conservation activities has been agreed upon up to now. Mechanisms for technical input or public participation in the Plans have not been in use. The present participation of non-governmental organizations in the conservation of the bear and its habitat makes it necessary to establish mechanisms to coordinate or exchange information.

Support for the implementation of the Plans is being sought from a variety of sources. The European Community recently approved of a project for the "Conservation and Recovery of the Brown Bear in the Cantabrian Mountains", which was signed by the four Autonomous Communities and by the Institute for the Conservation of Nature ICONA (Spanish Ministry of Agriculture). This may be an important achievement. The project represents a general investment of 1,100 million pesetas (US$7.6 million) for projects carried out with the two Cantabrian populations from September 1992 to December 1995. Habitat protection and measures against poaching constitute more than 60% of the planned investments. There are great differences among the Autonomous Communities regarding criteria used to decide on the use of funds for each stated aim. The lack of coordination among the administrations limits the awareness of authorities responsible for bear conservation in rural areas. In some cases, these investments have actually degraded bear habitat.

One of the most important mechanisms in the conservation of brown bear habitat is the creation of Protected Natural Areas. At present, only 13.5% of the land over which the western population is distributed is in Protected Natural Areas. The first protected area was the Natural Reserve of Muniellos, created in 1982. After its enlargement in 1988, it now covers an area of 59.7km^2. In 1988, the Natural Park of Somiedo was created, encompassing an area of 292km^2. One of the most important reasons for its creation was the existence of the outstanding nuclei of brown bears therein.

The national law for the Conservation of Natural Areas and Wildlife has introduced important changes in the management of protected areas. As a consequence of this law, regional legislations soon followed: the regional Law dated 5 April, 1991 regarding the Protection of Natural Areas in Asturias, and the regional Law dated 10 May, 1991 passed in Castille-Leon. Estimations of expected Protected Natural Areas may represent 57% of the present range of the brown bear in this western population. There are no performance terms for these Protected Areas and financial support for their operation has not been defined up to now. All plans should be considered with certain care.

Human-bear interactions

Hunting is surely the oldest means of interaction between bears and humans. Documents dated from the 14th century indicate that, unlike some other European countries, the most important hunting activity of the Spanish nobility was bear hunting. At the end of the 19th century the so-called *oseros* or bear hunters, were well known for the heroic feats they inherited from their ancestors. Legend still surrounds bear hunting and hunters in the Cantabrian Mountains.

The tradition of bear hunting in southwestern Europe may explain the limited aggressiveness presently shown by bears toward humans. Bears that avoided human contact could have a longer life span and those characteristics would then be selected for in the population. Hunting may have also influenced the increase in nocturnal and forest-based activity. There have been no recent cases of bear attacks on humans and now it may be considered nearly impossible.

Currently, the most direct human-bear contact, apart from hunting which is now illegal, involves the damages caused by bears in the livestock and farm industry. Garcia-Gaona *et al.* (1993) studied 1,076 claims of compensation for damages due to the Cantabrian brown bears in the western population during the period 1973–1990. They found that 96.1% of them were from Asturias, 3.5% from Castille-Leon, and only 0.4% from Galicia. The claims referred mainly to horses (28.2%), and then to crops or fruit trees (21.7%), cattle (20.7%), beehives (11.8%), goats (10.5%), and sheep (7.2%). The estimated value of these claims, in the western population, approaches five million Spanish pesetas (US$35,000) each year.

Regardless of the total value of damages caused by bears, problems with the system of compensation increase the hostile attitude of the local people towards the bear, and as a result, difficulties for bear conservation arise. Nearly all the researchers who have addressed this issue agree that compensation for damages has a positive influence in the Cantabrian Mountains (Campo *et al.* 1984 and 1986; Clevenger and Purroy 1988; Campo 1989; Purroy 1991; Garcia-Gaona 1993; Garcia-Gaona *et al.* in press).

The Recovery Plans for the brown bear state that compensations should be processed quickly, with generous damage appraisals and extra compensation calculated from a percentage of the base payment. This aim is, at present, achieved by a simple reporting procedure followed by the injured party. Then a payment is made over one or two months, damaged assessments are continuously updated, and up to an additional 20% of the base

Cantabrian brown bear skull trophies obtained by illegal hunting in 1986.

J. Naves

compensation may be paid out, depending on the Autonomous Community involved.

At present, therefore, the main reason for poaching is not out of revenge for a bad compensation policy. It seems rather, that the leading causes are the excitement experienced from illegal hunting, or the accidental taking of bears when snares, traps, or poisons are used to hunt other animals. The economic gains from trading in skulls and skins, and the "pride" felt in owning an illegal and uncommon trophy may also contribute to bear poaching.

The Law on Conservation of Natural Areas and Wildlife refers to the killing of species "in danger of extinction" as a very grave action, and the legal value of each specimen is estimated that between 10 to 50 million pesetas (US$70,000–$350,000). The Brown Bear Recovery Plans require the application of the highest estimated appraisal. During current revisions to the Penal Code, there has been some support for making the killing of endangered species a criminal offense.

Public education needs

Several generic campaigns have been organized to encourage public support for measures protecting the brown bear. Other programs have been limited to school presentations. These first campaigns have been successful in the cities, but have received less approval from farmers. While continuing with these general educational campaigns, specific campaigns should address specific problems or social sectors. These programs may have the following aims:

1. To encourage public disapproval of poaching, as illegal hunting is one of the most important problems facing the Cantabrian brown bear's survival. Poaching is not justifiable given the small economic scale of damage by bears.
2. To foster specific programs addressing the administration of agriculture, farming, and public works activities in bear habitats, or activities concerning bear conservation (justice, civil guard, and protected areas).
3. To carry out campaigns addressing hunters to reduce the risks connected with legal hunting by introducing selective hunting techniques, and to isolate poachers from the broader hunting community.
4. To foster programs for environmental education that may be continuously carried out at schools, especially in towns and villages which are near bear areas.
5. To foster natural resource development which is compatible with bear conservation strategies so policies are not restrictive.

Specific conservation recommendations

The following recommendations on conservation concern the application and development of the Brown Bear Recovery Plans now in force, the enforcement of the Protected Areas in the different Autonomous Communities, and the implementation of current programs. Considering some conservation objectives for this decade, we can conceive two levels of priority divided in two different periods of time.

First Period (1993–1995)

Enforcement of the present Brown Bear Conservation Plans, paying special attention to:

1. Operation of mechanisms for technical and public participation;
2. Strict application of the measures mentioned in the Recovery Plans regarding environmental impact assessment;
3. Preparation of annual or biannual actions to organize and distribute the project's economic and other existing resources.

In Protected Areas, the priorities are as follows:

1. Formal declaration of Natural Parks in the Narcea area (including the Natural Reserve of Cueto de Arbás, Asturias) and Ancares de León (Castille-Leon), and of the Special Action Plans for Leitariegos and Huerna passes. These aims depend upon the following activities: (a) public information and communication in the local areas involved; (b) preparation of documents and regional research programs concurrent to their legal declaration; (c) guarantee the necessary funds for administration, conservation, and restoration activities for the five years following the declaration.
2. Guarantee the operation of the present Protected Areas (the Natural Reserve in Muniellos and the Natural Park in Somiedo, both of which are in Asturias).

Revision of the Recovery Plans (at least in Asturias and Castille-Leon). Further technical studies and documentation need to be considered for future plans to overcome present deficiencies, including:

1. Increased cooperation with other administrations that carry out activities in the bear area, especially those in charge of Protected Natural Areas and forest management.
2. Specification of technical and methodological criteria to identify high quality habitat areas: shelter and denning sites, feeding areas, forests, corridors, reproductive nuclei, and any other potential use areas.
3. Specifications to assess the environmental impact of human activities, and methods outlined to control these activities.
4. Increased conservation activities may also increase restrictions on some human activities. Therefore, it is necessary to specify measures for social and economic development of small communities consistent with the proposed aims. Implementation of agricultural insurance programs, compensating losses due to wild animals, and encouraging forest preservation projects with local benefits may be workable measures.
5. Specification of priority criteria and increased funding for each of the proposed aims.

Second Period (1996–2000)

1. Implementation of the new Conservation Plans for the brown bear.
2. Establishment of the Protected Areas and Special Action Areas approved during the first period.
3. Preparation of a new revision of the Plans and declaration of the other potential Protected Areas.

Economic Consideration: Before calculating the cost of these conservation measures, some previous considerations shall have to be mentioned:

1. Considering the high levels of human development in the bear area, where the ownership is largely private or community-based, substantial economic investments will be necessary to prevent problems and to compensate local people. Therefore, it is essential to ask for financial support from sources other than the Autonomous Communities. This may take many years before implementation can be achieved.
2. Habitat conservation measures, especially those referring to the Protected Natural Areas, influence not only the brown bear but the conservation of natural resources and wildlife in general in the Cantabrian Mountains.
3. Consideration of economic costs associated with Protected Natural Areas is based on experience with the Natural Park in Somiedo, with adaptations in accordance with the difference in land area, population, and problems involved. General substructure costs are excluded.
4. The necessary financial support for the priorities outlined in the First Period (1993–1995) is about 1,554.1 million pesetas (US$10.7 million). Previous estimations of necessary funding have been lower. It is urgent to either find some extra financial support or to redistribute currently available resources.
5. The necessary funds for the Second Period (1996–2000) are about 6,690.4 million pesetas (US$46.0 million). Depending upon the size of the Autonomous Community, between one and three administrative experts would be needed to implement these measures and manage the Recovery Plans. In the Protected Nature Areas, an increase to one gamekeeper every 20km^2 and the addition of three administrative experts for the management of each area is proposed. For Leitariegos and Huerna passes, one expert and two gamekeepers each are thought to be necessary for the implementation of the Special Plans.

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Status and management of the brown bear in Sweden

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Historic range, current distribution, and status

The brown bear originally occurred throughout Sweden, but it disappeared before 1700 in the southernmost parts of the country. The estimated distribution around 1800 is presented in Figure 6.17, based on the verbal description in Lönnberg (1929). The rapid decline of the Swedish bear population during the last half of the 1800s is illustrated by hunting statistics. In 1905, the Royal Swedish Academy of Sciences declared that it was a "matter of honor for our country that this interesting animal be protected from complete extinction" (Lönnberg 1929). The distribution of bears at this time was mapped by Ekman (1910, Figure 6.17). By 1900, bears were only being shot in the three northernmost provinces. The bear population was probably at its lowest level, perhaps about 130 bears, around 1930 (Swenson *et al.* 1995).

Since then, the bear population in Sweden has increased both in size and distribution. The number of bears in the country has been estimated on four occasions: 294 in 1942 (Selander and Fries 1943); 350–450 in 1966 (Haglund 1968); 400–600 in 1975–76 (Bjärvall 1980); and about 620 (300–900) in 1991 (Swenson *et al.* 1994b). The 1991 population estimate was revised in 1994 to 670 bears (Swenson *et al.* 1995), and about 1,000 bears (800–1,300) in the spring of 1996 (Swenson and Sandegren unpubl.) This suggests a rapid increase during the past 50 years. The approximate present distribution, based on records of hunter-killed bears and observations, is presented in Figure 6.18. Thus, brown bear distribution in Sweden has expanded to that reminiscent of the mid-1800s, based on Lönnberg's (1929) descriptions.

Today, female bears are mostly confined to four areas in Sweden. These "female core areas" probably represent remnant populations that survived the population

Figure 6.17. Approximate distribution of the brown bear (*Ursus arctos*) in Sweden around 1800 (from Lönnberg 1929) and around 1900 (Ekman 1910).

Figure 6.18. Present distribution of the brown bear (*Ursus arctos*) in Sweden, 1993 (Swenson *et al.* unpubl. data).

bottleneck at the turn of the century (Swenson *et al.* 1994b). Population expansion is occurring from these four areas, and most bears found outside of them are males (Swenson *et al.* 1994a). We have not identified any factors that will limit the present distribution or population size. We predict that the population and the distributional range will continue to increase, and that the population will number well over 1,000 bears in the year 2000.

The brown bears of Sweden belong to two different mitochondrial DNA lineages (Taberlet *et al.* 1995). The bears in the southern-most female core area (200–300) are most closely related to bears in Spain and France, and are the largest and most secure population in this lineage. The bears in the other three female core areas number 600–1000 and are most closely related to the bears in Russia. Although the border between these two mitochondrial DNA lineages is quite sharp (Taberlet *et al.* 1995), preliminary data suggest that there is no correspondingly sharp border in nuclear DNA, indicating extensive gene flow between these two mitochondrial DNA lineages (unpubl. data).

Legal status

National bounties were paid for bears killed in Sweden starting in 1647. Originally, the bounty was rather low, but local governments could augment it. In 1864, the national bounty was increased about 10 times to 50 riksdaler banco (Lönnberg 1929), which roughly equaled the value of a cow. In addition, the skin and meat were valuable; a skin was worth about as much as the bounty at this time (Zetterberg 1951). Economic incentives, plus the general improvement in weapons and transportation, were important factors in the near extermination of bears in Sweden (Lönnberg 1929).

A motion was made in the national Parliament in 1889 to remove bounties on bears. It failed, but the bear received successively more protection after that. Bounties were removed nationwide in 1893. The Royal Swedish Academy of Sciences recommended protection for bears in 1905. Bears were protected in national parks in 1909, the general permission for everyone to kill bears regardless of land ownership was removed in 1912, and the bear was protected from hunting on Crown lands in 1913. As further protection seemed necessary to save the bear from extinction, all economic incentives to kill bears were removed in 1927, when dead bears became Crown property (Lönnberg 1929).

After this, the bear population began to increase. In 1943, fall hunting was allowed in two areas, one in central Sweden and one in northern Sweden. There has been a fall hunting season every year since 1943, and areas open to hunting have been gradually expanded.

Habitat and population threats

Presently, no habitat threats to the brown bear have been identified in Sweden. Population increases have occurred along with a period of rapid increases in the density of forest roads and intensification of forest management, including practices such as clearcutting, thinning treatments, deciduous tree control, ditching, and even-aged stand management. Brown bears use areas close to villages and heavily traveled paved highways less than expected, both in denning and non-denning periods, but this effect is not necessarily true for other roads (Swenson *et al.* 1996a). However, during this period of bear population increase, the human population density has declined drastically in rural areas of central and northern Sweden, as has the number of domestic livestock. Concurrently, moose numbers have increased dramatically.

Based on the previously described history of the brown bear in Sweden, the only obvious negative factor for the population is overexploitation. Additionally, changes in the perceived trends of the population during the past 30 years are highly correlated with harvest rates (Swenson and Sandegren in press). Although poaching does occur, it does not appear to be a major problem on a national level, given the bear population increase in spite of a relatively high legal hunter kill (see below). However, poaching appears to be a problem locally, especially in areas of the north where domestic reindeer are raised.

Management

The national policy regarding bears calls for allowing the population to increase in size and naturally recolonize previous habitats. Artificial translocation will not be allowed. Continued hunting regulated by quotas will be allowed. A management plan is being prepared and will probably be implemented in 1997.

No habitat management for bears occurs in Sweden, nor does any seem necessary at this time. The State has compensated livestock owners for economic losses in the past when bears killed domestic animals, although this program was terminated in 1995. However, bears were only responsible for 5% of the value of livestock losses to predators in 1992, which totaled SEK 22 million, or roughly US$3.8 million.

The brown bear has been hunted as a game animal during a fall hunting season since 1943. In 1981, this was changed to a quota system, where quotas were decided by the Swedish Environmental Protection Agency after discussions with provincial governments and provincial offices of the Swedish Hunters' Association. This system was modified in 1992 when female subquotas were added

Table 6.14. Type of hunting season and harvest of brown bears in Sweden, 1981–1995.

Year	Season type	Total quota	Female subquota	Number killed
1981	Total quota	33	-	16
1982	Total quota	38	-	21
1983	Total quota	39	-	34
1984	Total quota	39	-	27
1985	Total quota	35	-	27
1986	Total quota	40	-	35
1987	Total quota	50	-	41
1988	Total quota	52	-	46
1989	Total quota	67	-	49
1990	Total quota	67	-	42
1991	Total quota	50	-	45
1992	Total quota and female subquota	50	16	34
1993	Total quota and female subquota	50	16	34
1994	Total quota and female subquota	50	16	29
1995	Total quota and female subquota	50	16	35

to the quota system, and the quotas were set according to subpopulation size based on the results of a national population estimate (Swenson *et al.* 1994b). Young-of-the-year and females with cubs are protected from hunting. All hunters with rifles approved for big game hunting and with hunting rights in the area may shoot bears. After shooting, the hunter must report his kill and provide a tooth along with other samples and information to the bear research project.

During the 53 years from 1943 to 1995, 1,289 bears have been harvested legally and the population has increased rapidly. This suggests that the population can sustain a legal harvest rate of about 7.0% per year. Recent calculations based on observed reproductive and mortality rates of radio-marked bears suggests that the sustainable harvest rate is even higher than 10% (unpubl. data). The national harvest of bears during 1981–1995, when quotas were in effect, is summarized in Table 6.14.

Public education needs

The brown bear enjoys a relatively high degree of support among the Swedish public (Norling *et al.* 1981), and hunters appreciate it as a valuable big game animal. During this century, bears have not caused any known deaths or serious injury to humans, except for a reported death caused by a wounded bear in 1902. Seven people were injured by bears between 1976–1995, five by wounded bears. Even so, the bears in Scandinavia are among the least aggressive brown bears in the world (Swenson *et al.* 1996b). Education is important to maintain this support as the population continues to increase.

Specific conservation recommendations

Although the situation for the brown bear in Sweden is very good, we see two problems. One is poaching, primarily in reindeer herding areas in the north. The second is the possibility that support for bears may decrease as the bear population increases. This increase will undoubtedly bring more bears to populated areas, and they may begin to kill more livestock. Conflict will occur, especially now that livestock owners no longer receive compensation for their losses.

Data needed by management agencies, and answers to scientific questions about natal dispersal and colonization, are being provided by a joint Scandinavian Bear Research Project funded primarily by the Swedish Environmental Protection Agency, the Swedish Hunters' Association, the Norwegian Directorate for Nature Management, the Norwegian Institute for Nature Research, and WWF-Sweden. This project began in 1984, and in 1996 over 70 brown bears had functioning radio transmitters in two study areas.

Status and management of the brown bear in the former Yugoslavia

Djuro Huber

Bosnia and Hercegovina

Historic range and current distribution

The total area of what is now the Republic of Bosnia and Hercegovina (BiH) (51,804km^2) was historically brown bear range. The lowland parts south of the Sava river along the Croatian border were the first to become settled, deforested, agriculturalized or urbanized, and thus lost as bear habitat. This process probably was completed before the end of the last century. There are no documents on brown bear distribution in 1800 and 1900. Figure 6.19 includes an estimate of former range based on human population distribution and increase, and on topography. Because of poor older data, no access to recent bear managers, and no way to estimate the current damage to bear populations, the data on current distribution in Figure 6.19 is in part provisional.

Most forests survived in mountainous regions and this is where the bears may be found today. Roughly 10,000km^2 (20%) of BiH is bear range, including approximately 46% of 21,830km^2 of BiH forests. Brown bear habitat in BiH is in the middle part of the Dinara Mountains, the mountain range that runs parallel to the Adriatic Sea coast from

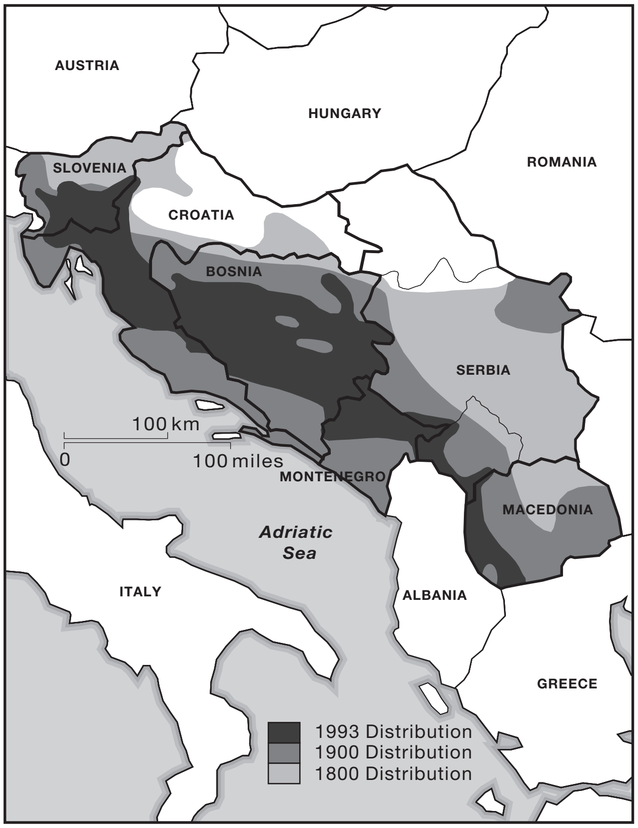


Figure 6.19. Estimated historic and present distribution of the brown bear (*Ursus arctos*) in the former Yugoslavia (Bosnia and Hercegovina, Croatia, Macedonia, Montenegro and Serbia, and Slovenia).

northwest to southeast, extending from Slovenia through Croatia, Bosnia and Hercegovina, Montenegro, Macedonia, and Albania to Greece (Pindus Mts.). One of the core bear areas is around Bugojno. The topography of the bear habitat has partial karst features and the forest covers about 70% of the habitat.

Status

An estimated population of 1,195 brown bears exists in BiH (Huber and Moric 1989). They are connected with bears in Croatia on the northwest, and with bears in Montenegro and Serbia on the southeast. There are large marginal habitat areas where bears are not always present. Population estimates by systemized counts of bears visiting permanent bait stations are done only by some hunting organizations.

Legal status

Bears in BiH are classified as a game species with specially regulated hunting quotas, except outside of designated areas. In 1992, the entire country entered into a devastating war. All bear areas were affected by major war operations.

According to the SSC criteria (Mace *et al.* 1992) brown bears in BiH may be listed in the "Vulnerable" category, though this can only be resolved after the country recovers from the war.

In the bear areas in BiH, bears are hunted during a hunting season (1 October to 15 May). Outside of this, area bears are not protected unless the local hunters have a local management plan.

Population threats

The main source of mortality is hunting which took 83 of a total 85 bears in 1987 (Huber and Moric 1989). The mortality due to the recent war can not be estimated. However, there is some evidence that mortalities occurred because of these circumstances. A rescued brown bear cub was brought to Zagreb (Croatia) in April 1992 after his mother and a sibling were killed by war operations.

Habitat threats

Forest exploitation and extension of forest roads have decreased the habitat carrying capacity. The forest has also been exploited by gatherers of other products (mushrooms, berries, medical plants, etc.). The recent war is by far the major habitat threat: areas up to 400km^2 were intentionally burned around Bugojno by the Serbs as a means to help them occupy the area (Huber 1993).

Management

In BiH, bear hunting was conducted during the season (1 October–15 May) from elevated stands over exposed baits at night. Bears were managed by hunting reserves, the forestry service, and hunting clubs. Due to the changes after the end of socialism in 1990, most organizations were in the process of privatization and the number of bear managing units was unclear. The only clear case was the "Koprivnica" hunting reserve near Bugojno, the former hunting area of the late president Josip Broz Tito. After Tito's death the reserve operated commercially, killing up to 30 bears per year, mostly catering to foreign hunters. In the "Koprivnica" hunting reserve the bear feeding program was particularly intensive: at 12 feeding stations 175,000kg of corn and 375,000kg of animal remains were delivered yearly. The rise of the local bear population from 12 in the 1960s to 138 in 1987 resulted in increased bear concentrations around feeding sites and tree damage.

Around 1984 bears started to peel the bark from trees and to feed on sapwood. In four years at least 4,916 trees were damaged (Huber and Moric 1989). A supplementary feeding program to reduce tree damage was initiated in 1989, but the war stopped the program, as well as the documentation of the results.

With the onset of war all management practices ended, including the feeding program. Consequently, the bears were approaching human settlements in search of food and were often killed (Huber 1993).

Human-bear interactions

In 1987, 1,164 cases of bear damage in BiH were recorded: 560 on domestic animals (99% cattle), 372 on fields, 209 in orchards, and 23 on beehives (Huber and Moric 1989). Also in 1987, one child was killed by bear that was later proven to be rabid.

Public education needs

This might be important only after the country sufficiently recovers from the war.

Specific conservation recommendations

Until the devastation from the war ends, no other conservation measures may be discussed. The international community should be more involved in rebuilding from the war, not only for the people's sake but to save rare European wildlife (including bears) and their habitats.

Croatia

Historic range and current distribution

With exception of the islands in the Adriatic sea, the total area of today's Republic of Croatia was historically brown bear range. The lowland parts of northern Croatia were first to become settled and thereby lost as a bear habitat. This process began probably over a thousand years ago and was completed for the most part more than 200 years ago. Most forests survived in mountainous regions and this is where the bears may be found today. Except for man-made and natural forest openings and the mountain peaks above timberline, no nonforested areas are considered bear habitat.

An estimate of former distribution (Figure 6.19) is based on increasing human populations, topography, frequency of bear names in geographic features, and limited information from the beginning of this century. There are no documents on brown bear distribution in 1800 and 1900.

Roughly 9,800km^2 (17%) of Croatia is currently bear range, including approximately 34% of 19,800km^2 of the Republic's forests. The extent of bear distribution in southeast Croatia is questionable. Due to the recent occupation of about half of bear habitat during five years of war, little recent data is available. The northern part of Croatian bear range has been used by bears with increased frequency in the last decade. If management increases result in tolerance of bears here, it may become regular bear range.

All brown bear habitat in Croatia is within the Dinara Mountains which parallel the Adriatic Sea coast, running from northwest to southeast, and extending from Slovenia through Croatia, Bosnia and Hercegovina, Montenegro, Macedonia, and Albania to Greece (Pindus Mts.). Elevations in the Croatian part of the Dinara Mountains range from 0 to 1,912m above sea level. The area is politically divided into Lika and Gorski kotar regions with Plitvice Lakes and Risnjak National Parks, respectively, as bear core areas.

The topography of the bear habitat has typical karst features and various depressions without surface drainage. Limestone bedrock is covered by shallow soils; the mountain peaks and steep slopes (>60 degrees) are formed of bare rocks. Forest covers about 70% of habitat and is dominated by a mixture of beech (*Fagus sylvatica*), fir (*Abies alba*), spruce (*Picea abies*), and other tree species varying in composition with elevation and exposure.

Status

An estimated population of 400 brown bears lives in Croatia (Huber and Moric 1989). They are connected with the bears in Slovenia to the northwest and to bears in Bosnia and Hercegovina on the east. The highest concentrations (about 1 bear/10km^2) are in Gorski kotar and central Lika around Plitvice Lakes National Park. In other areas densities are much lower (down to 1 bear/45km^2), and there are marginal areas where bears are not always present. Occasional reports of bear sightings from previously unoccupied areas were the most frequent in the last decade. For example, in June, 1993 two bears were reported (one was found dead) in Krka National Park near Sibenik at the Adriatic Sea coast where bears have not been present for at least 50 years. Population estimates in Gorski kotar are made each spring by systemized counts of bears visiting permanent bait stations (Frkovic *et al.* 1987). In other areas, estimates of population size are based on much weaker grounds. However, indices show that the population grew approximately four times from 1946 till about 1980 when it stabilized at present numbers (Frkovic *et al.* 1987).

Legal status

Bears in Croatia are classified as a game species and are subject to specially regulated hunting quotas. The importance of Croatian brown bears in Europe has increased in the last four years as a source for reintroductions to other countries. According to the IUCN Red List criteria (Mace *et al.* 1992), brown bears in Croatia are listed in the "Vulnerable" category. Because of restricted access to scientists in the aftermath of the war, no recent data from the area are available

During two years after World War II (1946–47) brown bears in Croatia were totally protected to help them recover from the low numbers after the war. From 1947 to 1965 a two month hunting season for bears (Nov. and Dec.) was allowed. However, no legal harvest occurred until 1955, and during the next ten years averaged only one bear/year. The total mortality in this period was 63 (3.0 per year), of which 40% (N=25) bears died from poisoned baits set for wolves (Frkovic *et al.* 1987). In 1966, the bear hunting season was extended to 7.5 months, and in 1976 it became nine months.

Population threats

Accurate data on overall bear mortality are available only for the Gorski kotar region where a total of 281 bear deaths were recorded during 1946–1985 (Frkovic *et al.* 1987). An additional 163 bears were removed from the population during 1986–1992. Comparison of these two sets of data reveals some important trends. The increase of the total mortality rate from 7.0 to 23.2 per year is highly significant (Chi-square = 9.74, P<0.01). The main source of mortality has been hunting, legal and illegal. During 1946–1985, 205 bears were hunted (mean = 5.1; range = 0 to 19). In the period 1986 through 1992 hunting mortality increased to 16.0 annually (total = 112; range = 14 to 20). The illegal kill remained similar in both periods: 17.6% and 15.2%, respectively (Chi-square = 0.15, difference not significant).

Poisoning, which accounted for 26 (9%) of total deaths causes in the 1946–1985 period, is no longer a mortality factor. The last poisoned bear was recorded in 1972. The number of bears killed by vehicle collisions was 31 in each analyzed period but the percentage due to vehicle collisions has significantly increased from 11% in 1946–1985 to 19% in 1986–1992 (Chi-square = 4.83, P<0.05). From 1986–1992 eight bears were removed from the population alive: two exported for reintroduction in Austria, and six were rescued as orphaned cubs and were placed in zoos. In the sex ratio of dead bears, the share of females significantly increased from 23.0% in 1946–1985 to 35.2% in 1986–1992 (Chi-square = 6.22, P<0.02). Distribution of bear mortalities over the year and the share of bear age classes didn't change in the last seven years compared to older data presented by Frkovic *et al.* (1987).

Habitat threats

Forests are commercially utilized outside of Risnjak and Plitvice NPs. Within the National Parks only so-called "sanitary and corrective" logging is officially allowed. Timber harvest is done by selective cutting and by occasional circular (<100m in diameter) clearcuts. Reforestation is usually done by planting only spruce seedlings (Dokus *et al.* 1992). After 1960 log hauling became mechanized. Forests began to be opened by truck roads, and since 1950 the total length of forest roads has increased 31 times: from 3.0 to 11.8m/ha on average. The forest road network is continuing to increase (Krpan 1992). Presently a new modern highway is under construction from Karlovac to Rijeka that runs through the middle of Gorski kotar.

Increasing tree mortality in Croatia has been noticed since the 1980s and has been attributed to environmental pollution. The area of Gorski kotar within Croatia, has been the most severely affected (15% of all trees damaged), and the Lika area was in second place (12.6–15% of all trees damaged). Among tree species, fir was the most vulnerable; almost 80% exhibited visible damage (Prpic 1992).

Management

Bears in Croatia are hunted from 1 September through 31 May. Shooting is performed exclusively from elevated stands over exposed baits on moonlit nights. The hunter pays a fee proportional to the trophy value of the harvested bear. The yearly harvest quota is calculated not to exceed 10% of the estimated population size. In 1986 and 1987, 29 and 19 bears respectively were reported killed by hunting in all of Croatia. For the last five years, we estimate that 20 to 30 bears are hunter-killed annually.

Bears are managed by forest enterprises in over 80% of the habitat, and by hunting clubs in the remaining areas. The hunting club may manage bears if their hunting ground is >70km^2. That is insufficient because the range of any sex/age class of bear is much larger (Huber and Roth 1986). A new hunting law (of 1994) will regulate the management of hunting areas through a leasing/renting system. Direct bear management includes feeding of bears at bait stations with animal carrion and corn year-round. Feeding is most intense during the hunting season when it is used to bring in bears to feeding areas used by hunters. Some feeding stations occasionally use truckloads of general garbage. Bears also visit local garbage dumps which are usually unfenced and unguarded (Huber 1991, 1992).

Human-bear interactions

The last complete survey of bear damage in Croatia was done by Huber and Moric (1989) in 1987 when a total of 247 cases of bear damage were recorded. Among 13 domestic animals killed by bears, eight were cattle and three were sheep. The main crops damaged were oats (N=107) and corn (N=94). The only fruits taken by bears were plums (N=23). The organization that manages bears in the area is responsible to pay damage compensation. Where bears are not managed, no one is responsible for compensations.

In the last 50 years in Croatia there has been only one recorded case of fatal attack by a bear on a man, which occurred in March, 1988 at Plitvice Lakes NP.

Public education needs

A questionnaire (Moric and Huber 1989) showed that a reasonable positive attitude towards bears and wolves (*Canis lupus*) is proportional to actual knowledge about animal biology, behavior, and habitat needs. Persons that know more about these species are more positively oriented toward them. The amount of damage suffered from bears contributes to a negative attitude. People that share the habitat with bears show less fear of them compared to people from urban areas and from countries with no bears (Moric and Huber 1989). Public education in areas where the bear population could expand would be the most powerful means of increasing total bear range in Croatia.

Specific conservation recommendations

After reaching present numbers, the brown bear population in Croatia seems to be stable and is slightly increasing in range. Part of the reason for occupying new areas may be due to the recent war. The occurrence of two bears in the Krka NP is probably related to the war in Bosnia and Hercegovina, which was 45km away by air. To facilitate an increase in bear range, the acceptability of bears by local people must be ensured by a dependable source of funds for the compensation of bear damages. Hunting pressure seems to be balanced with natural reproduction, although the effect of a 3.3 fold increase of annual known mortality in the period 1986–1992 in Gorski kotar might be a cause of concern.

There are several threats and corresponding conservation needs for the future of bear populations in Croatia:

1. A medium-term threat is the increasing disturbance of bear habitat due to new forest roads, other forestry operations, and, in particular, the construction of a new highway through Gorski kotar. The highway itself has a potential to fragment bear and other wildlife populations if proposed mitigation measures are not fully implemented. The overall disturbance in habitat interferes with natural life cycle of bears, but also contributes to 19% of known bear mortality through traffic kills which have significantly increased in the period 1986–1992. At least two tunnels (about 300m each) and 10 viaducts (total length about 3,000m) should be built at strategic places along the new highway through Gorski kotar. The cost of these mitigations would be around US$50 million. Several bear crossings should be built over the existing railroad to decrease the number of bears killed by trains. No new forest roads should be build in bear habitat.
2. Another medium-term threat might arise if bear management became increasingly localized. Animals with wide-ranging movements like bears should be managed uniformly on a landscape level within their entire habitat. The new hunting law should reflect this need.
3. A long-term threat is habitat deterioration due to exploitation, spruce monocultures, and increasing tree mortality. The natural composition of forests should be maintained by modifying the logging quotas and methods, and by adequate replanting. Forest mortality should be controlled by international agreement and cooperation.
4. The most important long-term threat is garbage conditioning of bears, which, over generations, changes their natural feeding and living habits and makes them less shy and more tolerant of sharing space with humans. Bear feeding stations should not increase in numbers and amount of food delivered. Only standard bear food such as corn and carrion should be used. No garbage should be available to bears. All garbage dumps should be eliminated from forest areas and fenced against bears. The proper rearrangement of dumps in Gorski kotar would cost at least US$1 million.

We conclude that brown bears do survive in the forests of the high mountains of Croatia, not because this habitat is the best suited for their needs, but because these areas are the least affected by man. However, continuous gradual changes in this region are shrinking its size and deteriorating its suitability for bears. We propose a certain level of protection of the entire habitat (e.g. a Biosphere Reserve), as well as strict protection of critical places for bear denning, resting, and feeding where all human related activities should be excluded.

Study and monitoring of all threats to brown bears should be continued and intensified. An approximate budget of US$18,000 per year would be needed for this monitoring.

Macedonia

Historic range and current distribution

All of Macedonia (25,713km^2) was historically brown bear range. The lowlands around the country's capital, Skopje, were the first to become settled and thus lost as bear habitat. This process probably was completed before the end of the last century. Most forests survived in mountainous regions and this is where bears may be found today.

There are no documents on brown bear distribution in 1800 and 1900. Figure 6.19 is an estimate based on human population increase and topography. The connection with the bear population in Bulgaria was probably lost in the last century. Because of poor data on current distribution, occasionally used bear ranges might be larger and/or different than shown in Figure 6.19.

Roughly 820km^2 of Macedonia is bear range, including approximately 10% of the country's forests. Most of the bear range in Macedonia is along its western borders with Kosovo, Albania, and Greece. Brown bear habitat is in the southeastern end of the Dinara Mountains, the mountain range running parallel to the Adriatic Sea coast from northwest to southeast. The topography of bear habitat has partial karst features. A mostly deciduous forest covers about 70% of the bear habitat.

Status

An estimated population of 90 brown bears lives in Macedonia. The population estimate is not scientifically based. The population is connected with the bears in Kosovo, Albania, and Greece.

Legal status

Bears in Macedonia have been classified as a game species only since 1988. According to the IUCN Red List criteria (Mace *et al.* 1992) bears may be listed in the "Vulnerable" category.

Bears are hunted during the hunting season (1 October to 1 January) which was established in 1988. Before that there were no rules or limitations on bear hunting.

Population threats

In 1987, only eight bear deaths were recorded, and all of these were from hunting (Huber and Moric 1989). Actual mortality was no doubt higher. There is no information regarding how and if the present law is enforced.

Habitat threats

No specific information is available. The political disturbances and consequent economic crises are likely to negatively impact bear habitat and the population itself.

Management

In Macedonia there is no specific bear management or hunting methods in use.

Human-bear interactions

In 1987, 131 cases of bear damage in Macedonia were recorded: 66 on domestic animals, 15 on fields, and 50 in orchards (all cherry trees). Twenty wooden telephone poles were reported damaged by bears (Huber and Moric 1989).

Public education needs

It would be very important to start an intensive public education campaign.

Specific conservation recommendations

Not enough data are available for specific recommendations. Obviously the present laws should be enforced, damage done by bears should be compensated, their habitat should receive some sort of protection, and the human population should be educated about the international value of bears.

Montenegro and Serbia (with Kosovo)

Historic range and current distribution

Montenegro and Serbia (with Kosovo) have called themselves the Yugoslav Federation since 1991. The total area of these countries (13,812 and 88,361km^2 respectively) has historically been brown bear range. The lowland northern province of Vojvodina was the first to become settled and thereby lost as bear habitat. This process was probably completed before the end of last century. Most of the forests survived in mountainous regions and this is where the bears may be found today.

There are no documents on brown bear distribution in 1800 and 1900. Figure 6.19 is an estimate of historic range based on the increase of human population and topography. The connection with bear population in Romania was probably lost in the last century, although there were some more recent data on bear observations in northern Serbia. Because of poor, older data, no access to recent bear managers, and no way to estimate the current damage on bear populations due to political instability, data on current distribution in Figure 6.19 is partly provisional. In particular, judgement of occasionally and continually used bear ranges in Montenegro contains certain levels of guessing.

Roughly 500km^2 in Montenegro and 1,670km^2 in Serbia are bear range, including approximately 518km^2 and 1,624km^2 of the countries' forests. Most of the bear range in Serbia is within the province of Kosovo. Brown bear habitat exists in the southeast part of the Dinara Mountains, the mountain range that runs parallel to the Adriatic Sea coast from northwest to southeast. The topography of the bear habitat has partial karst features, and forest covers about 70% of the habitat.

Status

An estimated population of 250 brown bears lives in Montenegro and 180 in Serbia (100 of the latter in Kosovo) (Huber and Moric, 1989). The population estimates are not scientifically based. This population is connected with the bears in Bosnia and Hercegovina, Albania, and Macedonia.

Legal status

Bears in Montenegro and Serbia are classified as a game species with specially regulated hunting quotas, except outside of designated areas. According to the IUCN Red List criteria (Mace *et al.* 1992) brown bears may be listed in the "Vulnerable" category. Due to political disturbances it was not possible to obtain any recent data.

Bears are hunted during the hunting season (1 October to 30 April). In Serbia (mostly Kosovo) hunting is done from elevated blinds over bait, while in Montenegro bears are hunted when encountered during chases and ground hunts.

Population threats

Out of a total known bear mortality of 26 in Montenegro and 25 in Serbia in 1987, only 11 and 8 respectively were legally hunted (Huber and Moric 1989). The political disturbances and consequent economic crises are likely to reduce the enforcement of laws that protect bears and other wildlife.

Habitat threats

No specific information is available. The political disturbances and consequent economic crises are likely to have negative impacts upon bear habitat and the population itself.

Management

In Serbia the organizations that managed bears were also feeding them at permanent stations where hunting was done during the season from elevated stands over exposed baits. In Montenegro no specific bear management or hunting methods are in use.

Human-bear interactions

In 1987, 23 cases of bear damage in Montenegro were recorded: 20 involving domestic animals and 23 involving beehives. In the same year in Serbia, 124 cases were recorded: 49 on domestic animals, 55 on fields, 17 in orchards, and three on beehives (Huber and Moric 1989).

Public education needs

This will be important only after the political and economic situations are more stable.

Specific conservation recommendations

Before the political instability and devastating war in neighboring countries can be recovered from, no other conservation measures may be discussed. The international community should be more involved in this recovery, not only to help people but also to save rare European wildlife (including bears) and their habitats.

Slovenia

Djuro Huber and Miha Adamic

Historic range and current distribution

All of today's Republic of Slovenia (20,251km^2) was historically brown bear range. The lowland parts of central Slovenia were the first to become settled and thereby lost as bear habitat. This process began probably over a thousand years ago and was completed for the most part more than 200 years ago.

There are no documents on brown bear distribution in 1800 and 1900. Figure 6.19 shows the estimated historic range of brown bears in Slovenia. Following Austrian hunting legislation from the 18th century, the brown bear was nearly exterminated by the mid-19th century in most of Slovenian territory. A small stock persisted in the forests on large private estates in Kočevje, Planina, and Javornik-Snenik in the Dinarics. But despite low densities of bears in the Dinarics in the 19th century, individual bears penetrated into the Alps, where they were persecuted and regularly killed. According to the earlier data on the presence of brown bears outside of the core area, it is evident that the northern corridor used to be the most important emigration route for bears from the Dinarics into the Alps. Its use was reduced in the mid-20th century. Although the reasons are unknown, we speculate that the construction of the motorway Ljubljana-Zagreb after 1960, as well as elevated quotas of yearly bear harvest in Kočevje since 1966, might have supressed northern corridor functioning. The northern corridor has recently become reactivated.

Most forests survived in mountainous regions and this is where bears may be found today. About 5,500km^2 (27%) of Slovenia is currently considered bear range, including approximately 54% of the country's forests (10.2km^2). In 1966, 3,000km^2 of Slovenia was bear range. Brown bear habitat in Slovenia is at the very northwestern end of the Dinara Mountains, the mountain range running parallel to the Adriatic Sea coast from northwest to southeast, extending from Slovenia through Croatia, Bosnia and Hercegovina, Montenegro, Macedonia, and Albania to Greece (Pindus Mts.). The main bear areas are Notranjska and Kocevje where bears are intensively managed by year-round supplementary feeding (Adamic 1987). The topography of the bear habitat has partial karst features, and forest covers about 70% of the habitat.

The importance of Slovenian, together with Croatian brown bears in Europe has increased in the mid-1990s as a source for reintroductions to other countries. The northern part of bear range in Slovenia has been used by bears with increased frequency in the last decade. If the political decision is to tolerate bears here, it may become regular bear range. The projection of range in the year 2000 is hoped not to be beyond the current continually occupied range. If management is close to optimum, most of today's occasionally used range may become continually occupied.

The Slovenian population is connected to that of Croatia on the southeast. The connection with the Alps in northern Italy and southern Austria has been practically blocked by habitat interruption and numerous physical obstacles (mostly highways). There are marginal areas where bears are not always present. Population estimates are made each spring by systemized counts of bears visiting permanent bait stations.

Status

After centuries of unlimited hunting, brown bears in Slovenia reached low numbers of 30 to 40 animals at the beginning of this century. After World War II their numbers rose, and since 1966 bears in Slovenia are considered a game species.

The calculated size of the population of brown bear in Slovenia, derived from the results of 1995 and 1996 censuses, performed on nationwide level is 350–450 individuals. Although there is an average density of bears within the core area, calculated at 0.6–0.8 bears/10km^2, pronounced differences occur among regions inside the core range. Densities reached a maximum of 1.3 bears/10km^2 in the area of Kočevje in southcentral Slovenia, but the minimum density was 0.3 bears/10km^2 in the newly occupied western and northwestern part of the range.

Legal status

Bears in Slovenia are classified as a game species with specially regulated hunting quotas. The hunting season lasts from 1 October until 30 April, and on average 43 bears are harvested annually (Kr'e 1988). The importance of Slovenian, together with Croatian, brown bears in Europe has increased in the last four years as a source for reintroductions to other countries. According to the IUCN Red List criteria (Mace *et al.* 1992) brown bears in Slovenia may be listed in the "Vulnerable" category.

Population threats

The main source of mortality is hunting which increased from 33 annually in the period 1965–69 to 45 in 1980–1984 (Adamic 1990). Regularly controlled harvest accounted for 80% of all extracted bears between 1991–1996, which represents the key mortality factor for brown bears in Slovenia. An average of 37 bears have been harvested annually in this period. Traffic kills account for 9% of all extractions, and are the second most important mortality factor. On the highway section between Vrhnika and Postojna (about 30km), five bears attempting to cross the highway were hit by vehicles in 1992 alone.

Habitat threats

Forest exploitation and extension of forest roads are decreasing habitat carrying capacity. The forest is also exploited by gatherers of other products (mushrooms, berries, medical plants, etc.).

The impacts of accelerated highway construction in Slovenia result in broad levels of environmental destruction. Fragmentation of habitats and its long-term impact upon wildlife populations are among the most serious consequences, and large mammals with big home ranges, e.g. the brown bear, are among the most affected. Fragmentation effects upon populations are far more serious than just wildlife-vehicle collisions. Great efforts have thus been invested to study the permeability of the corridors, connecting the core bear area in the Dinarics with the Alps and Alpine bear population occupying habitats on the border of Slovenia, Italy and Austria. Some bear friendly modifications have been made, which provide bear underpasses, planned fencing of critical sections, additional electric fencing, and the building of two ursiducts (bridges for bears in areas of frequent bear-vehicle collisions).

Management

Bears in Slovenia are hunted during the season (1 October–30 April) exclusively from elevated stands over exposed baits on moonlit nights. The hunter pays a fee proportional to the trophy value of the harvested bear. The yearly harvest quota is on average calculated at the level of 15% of the estimated population size. Female bear reproduction interval is usually two years.

Bears are managed by professional organizations in the designated areas (Notranjska and Kocevje). There, they are fed with carrion and corn year-round at permanent feeding stations that are spread at least one every 60km^2. Outside of these areas they have no protection. In the period 1970–86 a total of 80 sightings outside of bear range were recorded and 21 bears (20 males and one female) were killed (Adamic 1990).

Due to the population expansion in the period 1966–1995, a new conservation strategy had to be enacted, including: 1) Stating fixed size and spatial distribution of yearly harvest quotas for brown bear; 2) Yearly censusing of the bear population on statewide level; 3) Functional extension of core management area; 4) Compensation of damages to human property with State funds; 5) Central registration of bear mortality, and; 6) Accounting for the bear presence in any extended spatial planning activities (e.g. the construction of highway network).

Human-bear interactions

In 1987 only one case of sheep depredation by a bear was recorded (Huber and Moric 1989). Also in 1987 one woman was killed by a bear while picking mushrooms. Since that period only four cases of aggressive behavior towards humans have been recorded, all which involved female bears accompanied by cubs. The last case took place in April 1996 near Velike Lašče. Accelerated expansion of brown bears into the Slovenian Alps during 1967–1995 resulted in rising predation upon free-pastured sheep on alpine pastures. In the area of Tolmin in northwestern Slovenia, more than 60 cases of bear predation upon sheep were recorded between 1992–1996. Repeated predation and fear from local people, which has been supported by local press, was the reason that the Ministry of Agriculture and Forestry decided to issue permits to extract several problem bears in the mentioned period.

Public education needs

Education of the public living on the margins of bear areas would be the single most powerful means to increase total bear range in Slovenia.

Specific conservation recommendations

The brown bear population in Slovenia seems to be stable and its range is increasing. To facilitate the increase of bear range, the acceptability of bears by local people must be assured by a dependable source of funds for compensation of bear damage. Hunting pressure seems to be balanced with natural reproduction, although the effect of 27% increase of annual known mortality in the last 10 years might become visible in the coming period.

There are several threats and corresponding conservation needs for the future of bear populations in Slovenia:

1. A medium-term threat is the increased disturbance and obstacles in bear habitat due to the opening of new forest roads, other forestry operations, and by old and new highways and railroads. Traffic on roads and railways significantly contributes to bear mortality. Bear crossings should be built over existing roads and railroads. This would also facilitate the spread of bears towards Alps. No new forest roads should be build in the bear habitat. Many current roads should be closed to increase habitat security.
2. Garbage and human-related food conditioning of bears is probably the most important long-term threat. Over generations, the changes in natural feeding and behavioral patterns will make them less shy and increase conflicts with humans. Bear feeding stations should not increase in number or amount of food delivered. Only standard bear food should be used there. No garbage should be available to bears. Garbage dumps should be moved out of forested areas and fenced against bears.

Gradual changes in bear range are deteriorating its suitability for bears. A certain level of international protection of the entire habitat (e.g. a Biosphere Reserve) is proposed, as well as strict protection of critical habitat for bear denning, resting, and feeding where all human related activities should be excluded. The establishment of continuous low-density bear populations outside of today's official range is possible and desirable. The cost of such management, including the payment of all bear damage compensations, would be in the range of US$30,000 per year.

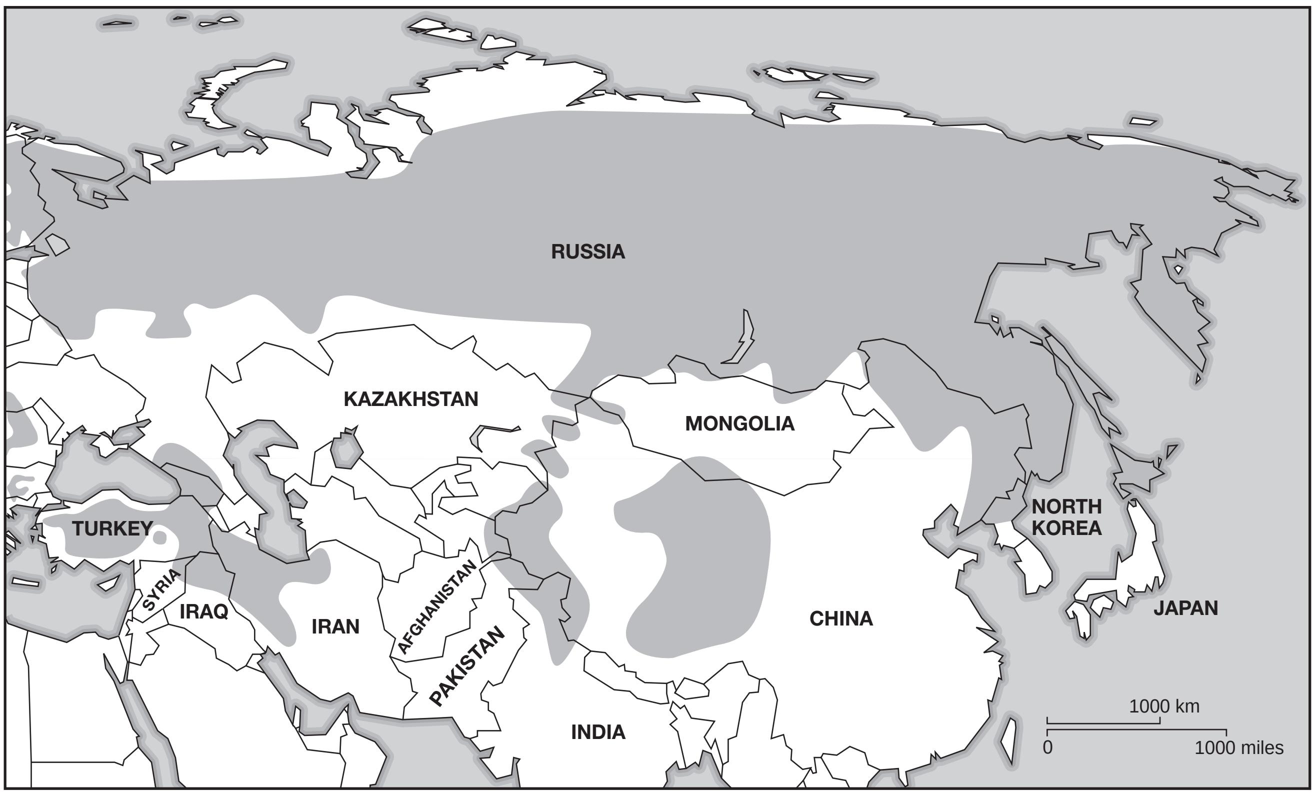
Study and monitoring of all threats to brown bears should be continued and intensified. An approximate budget of US$12,000 per year would be needed for this.

Chapter 7

Brown Bear Conservation Action Plan for Asia

IUCN Category: Lower Risk, least concern **CITES Listing:** Appendix II; Appendix I (China, Mongolia)
Scientific Names: *Ursus arctos*, *Ursus arctos lasiotus*, *Ursus arctos isabellinus*, *Ursus arctos yesoensis*
Common Names: brown bear, Himalayan brown bear, Hokkaido brown bear, Gobi bear

Figure 7.1. General brown bear (*Ursus arctos*) distribution in Asia.



Introduction

In Asia the brown bear (*Ursus arctos*) is widely distributed from the tundra and boreal forests of Russia in the north to the Himalayas in the south (Servheen 1990), see Figure 7.1.

Status and management of bears in Heilongjiang, China

Cheng Jizhen

Status and distribution

Heilongjiang province is one of the main strongholds of bears in China. In recent years, however, the number of bears has dropped significantly in response to human-caused changes in the natural environment, and as a result of great hunting pressure. Understanding the status of bears in Heilongjiang will aid in the understanding of the conservation status of bears throughout China.

Both Asiatic black bears (*Ursus thibetanus ussuricus*) (Figure 10.2) and the brown bear (*U. arctos lasiotus*) (Figure 7.2) are found in Heilongjiang. Brown bears are distributed throughout the forested areas. Until the 1950s, the black bear was also distributed throughout the forested areas, but by the end of the 1970s it was found only in the mountains east of the 127°E longitude.

Because bears cause damage to agricultural crops, they were considered a destructive pest species up until the 1970s. Populations seem to have declined over the last 20 years. This is reflected in the decline in the sale of bear

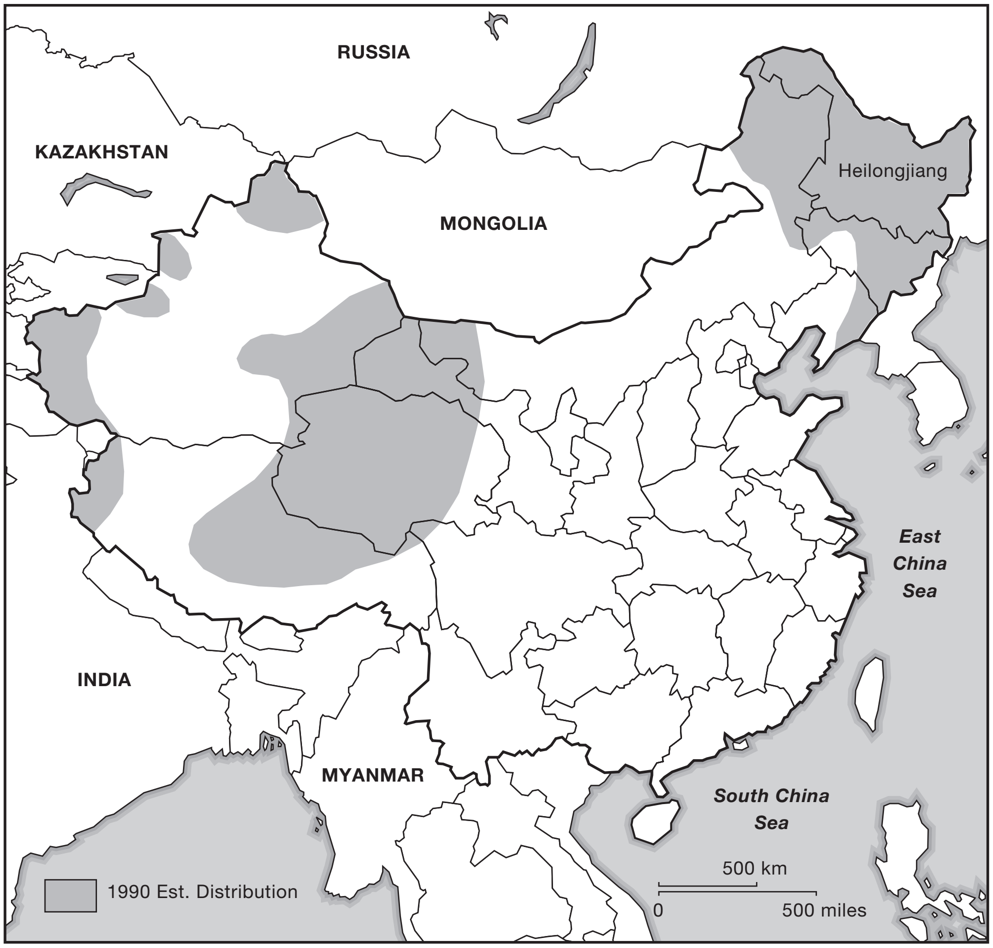


Figure 7.2. Estimated 1990 distribution of brown bear (*Ursus arctos*) in China.

G. Schaller

Brown bear (*Ursus arctos*) in Lhasa Zoo, Tibet.

Table 7.1. Bear (*Ursus arctos* and *U. thibetanus*) numbers in regions of Heilongjiang Province, China

Regions	Total (black & brown)	Density (no./100km^2)	Brown bear numbers
Yichun	1024	2.62	436
Songhuajiang	866	3.35	381
Mudanjiang	759	2.54	329
Hejiang	354	4.13	154
Daxing'an Mtn.	?	?	?

(investigation reliability 80%)

skins in Heilongjiang between 1971 and 1982. Currently there are an estimated 3,000–4,000 bears in Heilongjiang Province. Brown bears account for about 500–1,500 of this total. Both species are classified as "Vulnerable Species" in Heilongjiang. Data on bear numbers in the various districts can be found in Table 7.1.

Population and habitat threats

The growth of bear populations is limited by several factors. The most important of which include human-caused habitat disturbances, the growth of human population, cutting of forests, and related deterioration of habitat. These factors contribute to a loss of feeding sites and cover areas for the bears. Consequently, distribution ranges for the bears have become isolated and comparable to islands. In the Xiaoxing'an Mountain district, where bears are abundant, the human population has increased by 16 times in the last 30 years, forest area has decreased between 40 and 60% since the 1950s, and the area of cultivated lands has increased by 1.5 times in the last 10 years.

In addition, because of the high economic value that bear parts command, illegal hunting and capture has become a very serious contributing factor to the decline in bear numbers. In 1983, Heilongjiang exported 300kg of bear paws to Japan (equivalent to approximately 40 bears). In Dalian City in 1990, 2,700kg of bear paws were ready for export, including many from Heilongjiang Province. In recent years, China has energetically developed bear ranching operations, now containing between 6,000 and 8,000 bears. Because more than 1,000 bears for these ranches were captured in Heilongjiang Province, the control of illegal hunting and capture has become a top priority.

Management

In 1988, China issued a Protective Law of Wildlife which now lists bears as Class 2 protected species.

The main protection measures are: 1) Publicizing the law, developing wildlife education programs, and encouraging awareness of conservation among the citizenry; 2) Establishment of natural reserves for bears at higher densities (17 reserves have been established for the bears in Heilongjiang); 3) Control forest cutting in bear range; 4) Prohibit illegal hunting and capture of bears; 5) Carry out biological research on bears.

In recent years there has been great interest in the captive raising of bears in order to extract bile from their gall bladders. One living bear can provide as much bile as 35–40 hunted bears. Now, there are 17 bear farms in Heilongjiang province, with more than 300 bears being raised. Most of these bears were removed from the wild, and the impact on the population of wild bears was substantial. There continues a difficult relationship between bear protection and utilization. Currently, bear farms conduct studies on artificial breeding of wild bears to become captive breeders (thereby eliminating the need for further captures in the wild). In Heilongjiang, a natural F2 generation has been produced by natural reproduction in a captive population.

Specific conservation recommendations

The population of wild bears and their habitat in Heilongjiang Province has decreased. Protection of the remaining habitat and effective control of illegal hunting and capture activities are serious problems to be overcome. In addition, further efforts in artificial breeding among captive bears might ease demand for bears from the wild. These activities should be brought under a broad program for bear conservation in the Heilongjiang Province.

Status and management of the Himalayan brown bear in India

S. Sathyakumar

Historic range and current distribution

The Himalayan brown bear (*Ursus arctos isabellinus*) occurs in very low densities in the alpine regions of the Greater and Trans Himalayan regions in India. It is rare and usually encountered between 3,000 to 5,000m in elevation. Populations of brown bear are largely confined to the western and northwestern Himalayan ranges in India (Figure 7.3) and occur in the states of Jammu and Kashmir, Himachal Pradesh, and Uttar Pradesh. A small population exists in the central Himalayan regions of India i.e., Sikkim, which may be the subspecies *U. a. pruinosus*. This subspecies is also reported to be present in the alpine regions of the eastern Himalayan region (Arunachal Pradesh) but this needs to be confirmed. Very little information exists on the past and present status of Himalayan brown bear in India.

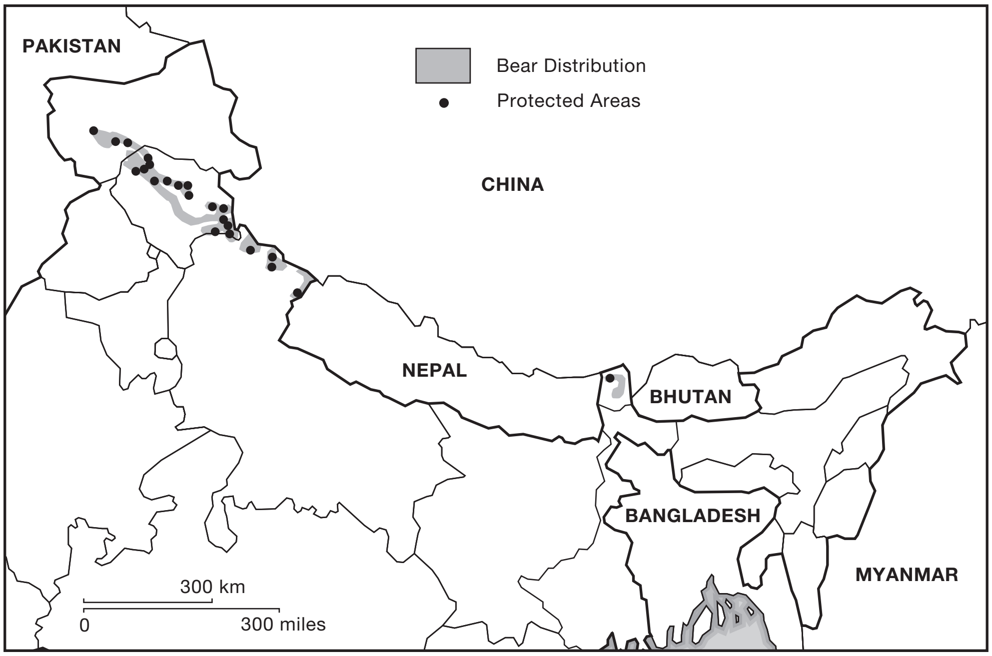


Figure 7.3. **Estimated present distribution of the Himalayan brown bear (*Ursus arctos*) in India, and protected areas.**

Table 7.2. Protected Areas in India with Himalayan brown bear (*Ursus arctos*) populations, and their status.

Name of the State and Protected Area	Area (km²)	Past status	Present status
Jammu and Kashmir			
Dachigam NP	141	RR (1989)	UK (1995)
Kistwar NP	400	UK	UK (1995)
Limber-Lachipora WS	106	UK	UK (1995)
Overa WS & Overa-Aru WS	457	RR (1991)	UK (1995)
Himachal Pradesh			
Daranghati WS	42	UK	FC (1994)
Gamgul Siahbehi WS	109	UK	UK (1995)
Great Himalayan NP	620	FC (?)	FC (1994)
Kais WS	14	FC (?)	FC (1994)
Kalatop-Khajjiar WS	69	UK	UK (1994)
Kanawar WS	54	RR (?)	RR (1994)
Kugti WS	379	FC (1992)	CM (1993)
Lippa Asrang WS	31	UK	UK (1995)
Sangla WS	650	RR (?)	RR (1994)
Rupi Bhaba WS	125	RR (?)	RR (1994)
Sechu Tuan Nala WS	103	UK	UK (1995)
Talra WS	26	UK	UK (1995)
Tundah WS	64	FC (1992)	FC (1993)
Uttar Pradesh			
Askot WS	600	UK	UK (1995)
Govind WS	953	RR (1988)	RR (1992)
Kedarnath WS	975	UK (1981)	RR (1991)
Nanda Devi BR	2,237	RR (1983)	UK (1993)
Valley of Flowers NP	88	UK	UK (1995)
Sikkim			
Khangchendzonga NP	850	UK	UK

WS – Wildlife Sanctuary; NP – National Park; TR – Tiger Reserve
RR – Rare; CM – Common; FC – Fairly Common;
VC – Very Common UK – Unknown;

Schaller (1977) stated that the Himalayan brown bear is largely confined to the rolling uplands and alpine meadows above timberline, ecologically separated from the forest dwelling Asiatic black bear (*U. thibetanus*). Potential Himalayan brown bear habitat range in India is about 4,229km², of which very little is protected under the existing network of Protected Areas (PAs) (WIINWDB 1995).

The distribution and status of the Himalayan brown bear in Indian PAs is presented in Table 7.2. It also occurs in suitable undisturbed habitat in the major valleys in its range. The following gives sources for the data presented in Table 7.2.

Jammu and Kashmir

Dachigam National Park (NP); Overa Wildlife Sanctuary (WS) (T. Price pers. comm.); Overa-Aru WS, Limber-Lachipora WS and Kistwar NP (Green 1993). It is also reported to occur in suitable undisturbed alpine areas of this state such as Zanskar valley (S.P. Sinha pers. comm.) However, the present status of brown bears in this state is not known.

Himachal Pradesh

Present in 13 PAs (Singh *et al.* 1990; Green 1993; WIINWDB 1995) and in some valleys. Great Himalayan NP (S. Pandey pers. comm.); Kais WS (G.R. Thakur pers. comm.); Tundah WS, and Kugti WS (P. Singh pers. comm.). Kanawar WS (P.S. Chauhan pers. comm.); Sangla WS (A. Gautam pers. comm.); and Rupi Bhaba WS (K.K. Gupta pers. comm.). Brown bears are also reported to occur in Malana Valley, Hamta Pass, Solang Valley (S.P. Sinha pers. comm.), Bara Bangal, Parbati Valley, Ropa

Valley, Kaksthal, Manali, Pooh, Lingti, and Ensa Valley (Lahul and Spiti). It is reported to be fairly common in Bara Bangal, Ropa (Kinnaur District), and Ensa (in Spiti) valleys (S. Pandey pers. comm.).

Uttar Pradesh

Himalayan brown bear occur in and around Nanda Devi NP and Biosphere Reserve (BR) (Lamba 1987), Kedarnath WS (Sathyakumar 1994; J. Ram pers. comm.), Valley of Flowers NP, Govind WS, Askot WS (WIINWDB 1995), and in alpine regions of Yamunotri, Gangotri, Badrinath, Mana, Almora, and Pithoragarh areas. The status of brown bears is not known in other areas.

Sikkim

U. a. pruinosus is reported to be present in the upper reaches of Kanchendzonga NP and in suitable undisturbed alpine areas. (G. Tewari pers. comm.). The past and the present status of the species in this state is not known.

Captive populations

Only a few zoological facilities such as Himalayan Nature Park, Kufri (Himachal Pradesh), Sri Chamrajendra Zoo, Mysore (Karnataka), and National Zoological Park, Delhi have brown bears. The number in captivity may not be more than 10 individuals.

Legal status

The Himalayan brown bear is listed as 'Vulnerable' in the Red Data Book (IUCN 1974). The subspecies is not listed in the 1996 Red List (IUCN 1996). It is in Appendix I of CITES in India (Anon. 1992a), and in Schedule I of the Indian Wildlife (Protection) Act (Anon 1972) and its 1991 amendment.

Population threats

The Himalayan brown bear is threatened in India due to poaching to reduce predation on livestock and for skins (ornamental). Migratory grazers (gaddis and bakkarwals) in Himachal Pradesh often eliminate brown bears while grazing their livestock (goat and sheep) in the alpine pastures to reduce predation. Poaching for skin or trophy is very rare.

Habitat threats

Himalayan brown bears are also threatened by large scale habitat destruction in the form of developmental activities (road construction). Very little potential Himalayan brown bear habitat in India is protected under the existing network of PAs (Rodgers and Panwar 1988; WIINWDB 1995). In Jammu and Kashmir, the major threat to brown bear habitat in India is from the militants and their activities, and consequent lack of protection. In Himachal Pradesh and Uttar Pradesh, habitat destruction results from livestock grazing in alpine pastures. In Sikkim, activities of the Indian Army, mountaineering institutes, and trekking clubs have led to large scale destruction of brown bear habitat. Medicinal plant collection from the alpine pastures by the local villagers also has an impact on brown bear habitat.

Management

The Indian Wildlife (Protection) Act, 1972, and its amendment in 1991 help in protection of the Himalayan brown bear. India ratified CITES in 1976 and the brown bear is in Appendix I, which bans international trade in its products. TRAFFIC-India also keeps a check on trade of this species and its products. State Forest Depts. have started compensating for livestock killed by brown bear.

Conservation recommendations

1. The Himalayan brown bear should be listed as "Endangered" by the IUCN.
2. The proposal for declaring new PAs and proposed extensions of existing PAs in the trans Himalayan regions of India (Rodgers and Panwar 1988) has to be executed by concerned State Forest Departments as soon as possible.
3. Some large PAs such as Nanda Devi BR, Kedarnath WS, Govind WS, and Great Himalayan NP can be brought under the proposed Snow Leopard Recovery Program (Project Snow Leopard) to enable improvement in infrastructure and management.
4. Developmental activities such as road construction in Sikkim need to be controlled by the Central and State Governments to reduce impact on brown bear habitats.
5. Awareness programs for migratory grazers, Indian Army, border police personnel, and the general public are needed.
6. Status surveys for brown bears have to be conducted in its entire distribution range in India. Even basic information on presence/ absence of brown bears in different parts of India is not available.
7. Monitoring of brown bear status and numbers based on direct and indirect evidence in different PAs has to be initiated. Research on ecology of brown bears is necessary as information on food and feeding habits, habitat utilization, and ranging patterns are crucial for long-term conservation and management of this species.

Acknowledgements

Sincere thanks to all scientists, foresters, and researchers who have provided valuable information about the status of black and brown bears by returning answered questionnaires and through discussions. Thanks also to the Chief Wildlife Wardens and officials of the State Forest Depts. of Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh, West Bengal, Sikkim, and Arunachal Pradesh. At the Wildlife Institute of India, Shri S.K. Mukherjee, Director, and Dr. A.J.T. Johnsingh, Head, Wildlife Biology Faculty, for their help and constant source of encouragement. Shri Sanjeeva Pandey, Dr. V.B. Mathur, senior faculty colleagues, who helped in the completion of this report. Smt. Vidya R. Athreya, Research Fellow and Shri. G.S. Shanmugam, cartographer, helped in the preparation of the figures. Shri. J.S. Kathayat helped in the retreival of information from the National Wildlife Database. My special thanks are to my loving wife Archna for her help and support in the preparation of this report.

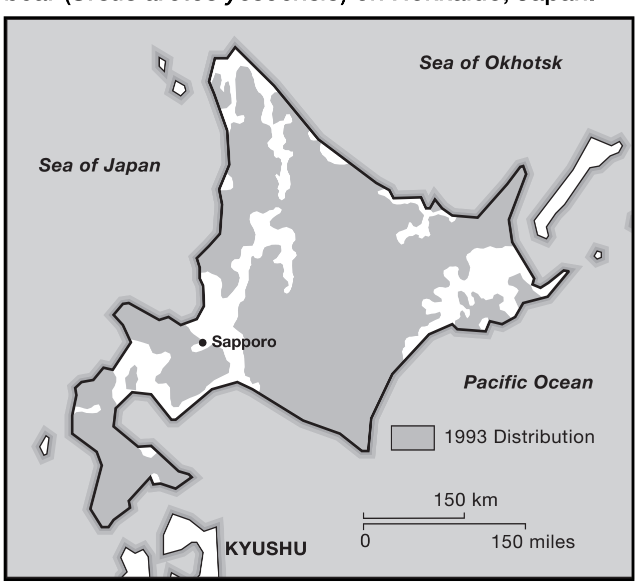
Status and management of the Hokkaido brown bear in Japan

Tsutomu Mano and Joseph Moll

Historic range and current distribution

The Hokkaido brown bear (*Ursus arctos yesoensis*) inhabits the island of Hokkaido and the neighboring Russian controlled islands Kunashiri and Etorofu. Until the latter half of the 19th century, brown bears were distributed throughout Hokkaido's mountains, plains, and coasts (78,073km^2). However, after colonization and development of the island by the Japanese government beginning in 1871, low elevation temperate deciduous forests were mostly converted to cultivated and residential areas. Because developers considered bears to be agricultural pests and threats to human life, they were targeted for extermination.

Figure 7.4. 1993 estimated distribution of the brown bear (*Ursus arctos yesoensis*) on Hokkaido, Japan.



The distribution of brown bears decreased from an area of approximately 47,000km^2 or 60% of the island in 1978 to roughly 40,000km^2 or 50% of the island in 1991 (Hokkaido Prefectural Government 1978). As a result of the development of major plains and riparian areas, five regional subpopulations are now recognized. Of these, the small size and isolation of the Western Ishikari subpopulation has warranted its listing as an endangered subpopulation in Japan's Red Data Book (Environment Agency 1991). Similarly, the isolation of the Oshima Peninsula (Figure 7.4) and a rapid decline in the distribution of the Teshio/Mashike subpopulation (Figure 7.4; Aoi 1991) have received recent attention.

Status

Based on interviews with local hunters, it was estimated that the 1992 population sizes ranged from 90 to 152 in the West Ishikari Region and from 84 to 135 in the Teshio-Mashike mountains (Hokkaido Institute Environmental Sciences 1995).

Legal status

Since the enactment of the Civil Law (1896), wildlife in Japan has been considered "without keeper." Only with collection do the rights to its possession become recognized under public law (The Civil Law, Article 239). At the same time, bears are considered a game species under the Wildlife Protection and Hunting Law (WPHL; 1918). In theory under this law, the harvest of wildlife is illegal, with exceptions made for "special purposes." In application these special purposes include, 1) wildlife protection and reproduction, 2) pest control, and 3) safe hunting, all of which contribute to "… the improvement of the human living environment," and "…the promotion of agriculture, forestry, and fisheries" (WPHL, Article 1). Thus, depending upon the interpretation of "appropriateness," it becomes a measure concerned with the protective breeding of wildlife and the extermination of wildlife pests via hunting. Indeed, excepting the special regulations governing the "technical capture" of species recognized to be in decline in Japan, the wildlife hunted or harvested as a pest becomes the property of the "collector."

The designation of Wildlife Protection Areas occurs under the WPHL (8-8), as long as their establishment is recognized by the affected land-holding interests (WPHL, 8-8: 4). Compensation is available to those landholders affected by Special Protection Areas (WPHL, 8,9), but this option has never been applied on behalf of bear management.

The Law for Conservation of Endangered Species of Wild Fauna and Flora (LCES) was established in 1993 to "contribute to the assurance of the healthy and culturally rich lifestyle for present and future citizens by the protection of wildlife species" (LCES, Article 1). Taking, transferring, and trading of specific Endangered species are prohibited by the law, and habitat conservation can be designated. Brown bears in Japan are defined as International Endangered Species and commercial trade is regulated according to CITES guidelines.

As seen above, Japanese law shows little concern for wildlife as a renewable natural resource. Furthermore, although wildlife conservation enforcement should be tailored to regionally specific issues, the national WPHL restricts prefectural governments from initiating such management tools as a hunting tag system. With growing worldwide interest in sustainable resource use and the maintenance of biological diversity, reconsideration and revision of the Japanese law system is necessary.

Population threats

Excessive harvest continues to be the most immediate threat to the persistence of Hokkaido brown bears. Before the 1970s, average annual harvests exceeded 500 bears. Harvest numbers have declined in the last two decades, such that in the four year period between 1990–1993, the average annual harvest was 247 bears. Although there is little available information regarding changes in hunter effort, the decline in total harvest numbers can be interpreted as a decline in numbers at least in some regions. Mano (1990, 1993) demonstrated that in the Oshima peninsula, mortalities exceed allowable harvest rates for ensuring long-term persistence of that subpopulation, and Aoi (1990) documented the decline of bears in the Teshio/Mashike region. The Oshima Peninsula, the Hidaka mountain range, and the Kitami mountain area still support heavy harvests, while in the areas facing the sea of Japan, the range of mountains from the Shakotan peninsula extending toward Eniwa/Chitose, and the mountains from Mashike to the Teshio area, harvest is now minimal.

There has been great variation in total annual harvest, due mainly to fluctuations in the number of bears taken in damage control management actions. This is particularly notable from the mid-1960s through the early 1980s, when spring den hunts were used as a tool to minimize agricultural and other property damage. In recent years the ratio of controlled kills to sport harvest has declined, likely a result of the cessation of the spring hunt in 1990.

Vehicle collisions have become a considerable source of human-caused mortality. Between 1988 and 1992, there were five train related accidents, and two auto related accidents resulting in seven individual bear mortalities.

Habitat threats

Brown bear habitat in Hokkaido has been severely limited by human activities, especially forestry practices and road construction. Forest development increased after the World War II, reaching its greatest intensity between 1960–1975. At that time, the area of natural forests declined as conifer plantation forestry became standard practice. As a result of this change in forest composition, fewer stands of beech, oak, and other mast producing hardwoods trees are available as food sources and denning sites. Because beech family trees typically require at least 20–30 years of growth before producing any mast, even second growth natural forests are only slowly returning to productive habitat. Against this slow restoration, the road network continues to grow, further subdividing habitat areas and increasing the volume of people with which bears must contend.

Management

After Japanese colonization of Hokkaido in the late 19th century, brown bears were considered a dangerous impediment to development of the island. Conservation efforts have only begun in recent years, when it became apparent that annual harvest levels are likely unsustainable.

The sports hunting season for brown bears extends from October 1 to January 31 of the following year. Licensed hunters in Hokkaido are able to harvest all game species, so incidental harvest of bears may be high. There is no limit to the number of bears that can be taken by a single hunter. Also, there are no restrictions on age or reproductive status of bears taken as game. Hunting is forbidden in "special wildlife protection areas", "closed hunting areas", and in "special protection areas" within National Parks, but other lands are basically open to hunting. Use of guns in hunting, as well as traps in damage control actions are allowed as capture methods.

Damage control kills are allowed all year long throughout all regions of Hokkaido in cases where bears are considered a threat to crops, property, or human safety. Control kills are carried out in each region by members of the local hunting organization, with per diem compensation and bounties provided by local governments. The increasing average age and decreasing number of hunters in Hokkaido may lead to a situation where "necessary" pest control kills cannot be carried out in a particular area (Aoi 1990).

Government recognition of the need for wildlife conservation and management based on scientific studies has grown slowly since the first national studies of wildlife distribution in the 1970s and 1980s. From that period, the government of Hokkaido began to gather biological data on the bear (Hokkaido Prefectural Government 1986, 1987). In 1991, Hokkaido built the nation's first prefectural level Institute for Environmental Sciences. The Wildlife section within its Natural Environments Research Branch now carries out research in earnest.

With field research indicating a decline in bear distribution (Mano 1993, 1990a; Aoi 1990; Hokkaido Government 1994, 1995), the Hokkaido Government has begun to re-examine its long-standing policy of proactively decreasing bear numbers. The use of box traps and leg hold snares during the sports hunting season were forbidden in 1985 and 1992 respectively. After it became clear that spring den hunting (government sanctioned since 1966) was heavily impacting subpopulations in areas of deep snow (Aoi 1990), the government eliminated that special season in 1990. Recent efforts have included the distribution of pamphlets describing bears for the general public, and a National Hunter's Association self-imposed limit on bear harvests. These steps offer some hope for coexistence between humans and brown bears on Hokkaido.

Human-bear interactions

Although brown bears are a highly valued game animal, the difficulty of the hunt limits the number of hunters who pursue them. The greater challenge for decreasing human-caused mortality is in the system of damage control kills. Most control kill actions occur in rural mountains and farming areas, where the possibility of damage to crops and danger to humans is feared. Bear-caused human injuries were high in the 1960s but have decreased in recent years. Bear-caused damages to agriculture were estimated to be US$931,750 in 1993 (Hokkaido Government Nature Preservation Division unpublished Internal document 1994). In government produced cautionary pamphlets, the inappropriate disposal of trash and agricultural and marine refuse has been recognized as a major attractant and thus an ultimate cause of conflict, (Yamanaka 1986; Mano 1990a, b; Hokkaido 1992), but more thorough public outreach is necessary.

Public education needs

There is a great need to increase the level of public awareness regarding the natural history, current population status, and habitat conservation needs of the brown bear in Hokkaido. This is most important for preventing human injuries and property damage, and for improving local acceptance of the bear. A number of policies and programs should be developed to redress this situation.

First, a public education program should be established to introduce the findings of scientific research on bear-habitat interactions and the disruptive effects of human activity on them. This is necessary not only to prevent damages or accidents involving bears, but also to affect a change in citizens' attitudes towards them. In regions inhabited by bears, the fear and loathing of them remains strong. This may reflect the strength of stories passed down of historic damages and accidents. It also results from the lack of public outreach that conveys research findings or guidelines that could minimize conflicts and damages. Few people understand that casually discarded garbage creates food-conditioned bears and can invite later damage. Problem prevention outreach programs should be directed to forest workers, hikers, fishers, food gatherers, and other outdoor enthusiasts who spend their time in bear habitat.

A number of approaches should be used to create outreach programs on several audience levels. This should include specific recommendations on minimizing conflicts with bears for people living near bear habitats, as well as elementary and middle school programs describing the critical role of the brown bear in the natural history of Hokkaido. This outreach activity should not be limited to the realm of government wildlife agencies, but should be carried out cooperatively with foresters, land developers, teachers, non-governmental organizations, and journalists.

Conservation and management recommendations

The history of forest development has brought human settlements into close contact with habitat areas favored by brown bears (Mano 1994). The two most pressing concerns for brown bear management in Hokkaido are how to control total harvest numbers and how to conserve habitat. Furthermore, a system for assessing brown bear population status and human attitudes toward their conservation is necessary. Wildlife management staff who can respond to damage problems and potentially dangerous situations should be placed in the field to ensure the support of local communities for management plans. Such a program will require the input and cooperation of government and non-government organizations as well as the commitment of adequate financial support.

The current reliance on the removal of "problem bears" should be reconsidered. Brown bears show apparent behavioral variation by individuals, often a result of situation specific learning (Stirling and Derocher 1990). Rather than treating all bears encountered as pests, a management system that recognizes and responds to food conditioned and similarly dangerous bears will help avoid serious human injury (Interagency Grizzly Bear Committee 1986) while better controlling the total number harvested. The identification of nuisance bears and notification of people in the area is important for gaining public support for management. Various management options such as the relocation of nuisance bears, the use of electric fences and other deterrents, and compensation systems should be considered in addition to traditional reliance on removal of bears.

Bear habitat conservation should become a consideration of the forest planning process, road construction, and other development projects. The regrowth of low elevation deciduous and mixed forest habitats neighboring cultivated land and residential areas may contribute to an increase of bear-human interactions (Mano 1994). It will become increasingly important to restore important bear habitat areas away from cultivated or residential areas to assure long-term conservation of the bear. As a part of this, the forest management system should encourage the re-establishment of mast producing deciduous stands instead of its historic reliance on second growth conifer plantings. Finally, minimizing habitat fragmentation by protecting linkage areas between subpopulations, and through the closure of unused forest roads should also be encouraged.

A third area of concern relates to the international trade in bear gall bladder and other parts. A strategy should be developed to inform the Japanese public of the connection between the regulation of trade and worldwide bear conservation. Since many people in Japan might interpret an attempt to regulate current wildlife consumption practices as a critique of Japanese culture, mere criticism could cause an emotional nationalistic response. Government agencies, NGOs, and the media in Japan must all participate in the development of an appropriate information program.

Finally, successful conservation practices that encourage social acceptance for coexistence with a large mammal like the bear require much work! Proactively addressing these problems requires a learned, experienced, and committed work force. Unfortunately, the need for well-trained wildlife management personnel is not well recognized among the Japanese people. The future of brown bear conservation in Japan will depend in part on the creation of a system that nourishes the development and placement of these well-trained wildlife managers.

Status and management of the Gobi bear in Mongolia

Thomas McCarthy

Historic range and current distribution

The Gobi bear (*Ursus arctos*), or *mazaalai* as it is commonly referred to by local peoples, may well be the rarest animal of the People's Republic of Mongolia. Listed in both the IUCN and Mongolian Red Books, the bear is found only in the isolated southern massifs of the trans Altai-Gobi. Its current range (Figure 7.5) falls entirely within the boundaries of the Great Gobi National Park and Biosphere Reserve (GGNP). Situated in the southwestern corner of Mongolia, GGNP is presently the largest nature reserve in that country. Established in 1976, the park is comprised of two disjunct sections. Sector A, the larger of the two, is 44,190km^2 in size and supports populations of several rare and endangered species, including all known mazaalai. While little investigation of this secretive species has been conducted, available information suggests that as few as 30 animals may remain. Living in the harsh environment

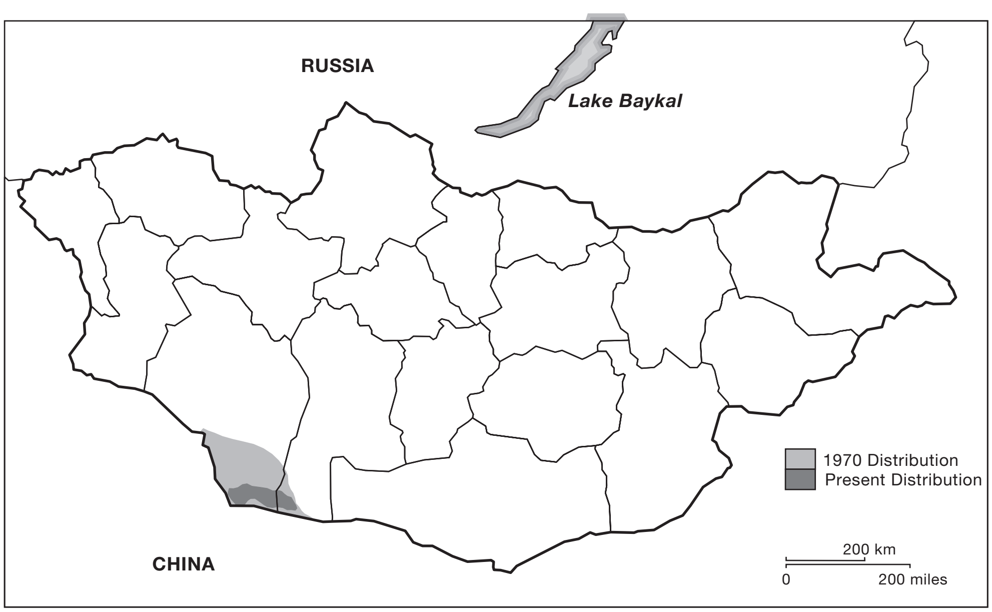


Figure 7.5. Distribution of the Gobi bear (*Ursus arctos*) in Mongolia.

of the Gobi desert, the bear's continued existence is considered precarious.

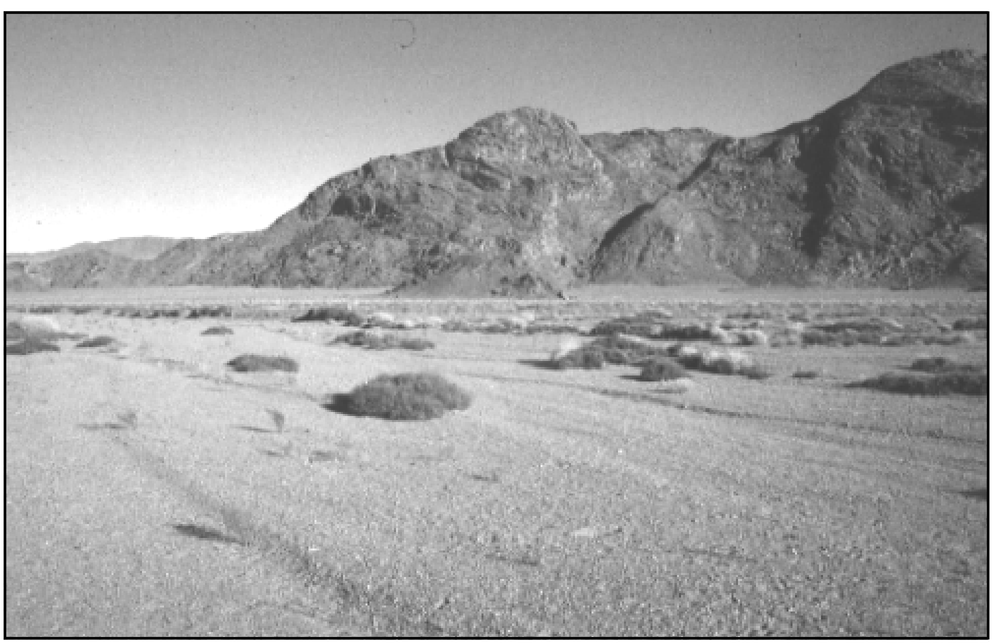
The first recorded reports of an unknown bear dwelling in the Gobi come from the notes of V. Ladygin. In 1900 he found its tracks and diggings near Tsagan Bogd, Tsagan Burgasny-bulak, and Shar Khulst; all sites that are still thought to support small populations of the bears. Joint Soviet and Mongolian scientific expeditions in the mid-1930s were unsuccessful in studying the bear due to its rarity. The first confirmed observations of a Gobi bear did not come until 1943 during an expedition carried out by the Science Committee of the Mongolian People's Republic. The results of that investigation are detailed by Bannikov (1954) who first described the distribution and ecology of the bear. In the 1960s and early 1970s, Mongolian scientists further defined the range of Gobi bears. With the establishment of the GGNP in 1976, emphasis was placed on investigating the distribution, number, and ecology of the bear. Additional data, particularly on distribution, was made available by researchers on the UNEP funded project of 1980–83.

Bannikov (1954) suggests that range of the Gobi bear previously extended as far east as the Tost-Ula mountains some 50km east of the present Park boundary. That population may have been extirpated by hunting. As late as 1970, the northern border of their range was reported to be near the Edrengiyn mountains and included the Aj Bogd range. Since that time their range may have been reduced by as much as half. Gobi bears are thought to be restricted entirely to the southern half of the GGNP; an area of some 15–16,000km^2, although there have been recent reports of the bears making movements into the Gansu Province of China. Within the Park, bear activity is centered around Atas Bogd, Shar Khulst, and Tsagan Bogd mountains and associated oases. Individual home range size has not been determined. Zhirnov and Ilyinski (1986) felt that range sizes varied seasonally with food availability, but that bear ranges remained relatively small and individuals rarely ventured far from oases. Despite the use of radio collars, Schaller *et al.* (1993) obtained only incomplete data on range size, in part due to logistic problems. However, in contrast to Zhirnov and Ilyinski's contention, they found one male bear to have a minimum home range size of 650km^2 with north to south movements exceeding 48km, taking him far from the oasis on which his activity was centered. There have been no apparent attempts to document movements of bears between activity centers, thus leaving unaddressed the important question of population isolation within the range.

Status

After apparent declines since 1970, population estimates for the bear have been relatively constant since the early 1980s. Zhirnov and Ilyinski (1986) estimated that 25–30 bears remained in the early 1980s. Schaller *et al.* (1993) believed that was still a reasonable estimate after conducting surveys in 1990. Reports on recruitment rates are sporadic and incomplete.

The status and ecology of the Gobi bear have yet to be thoroughly investigated. Its general food habits have previously been reported (Bannikov 1954; Zhirnov and Ilyinski 1986; Anon. 1988; Schaller *et al.* 1993), however, there have been no attempts to delineate seasonal diet shifts, or changes in food selection in response to annual fluctuations in forage availability as mediated by weather or other factors. Availability or biomass of bear forage



T. McCarthy

Gobi bear habitat in the Great Gobi National Park and Biosphere Reserve, Mongolia.

plants within the Park has not been quantified. Also lacking are data on distribution, population size/trend, and such parameters as age at first reproduction, average litter size, mortality and natality rates, denning ecology, breeding behavior, or intra-specific contact.

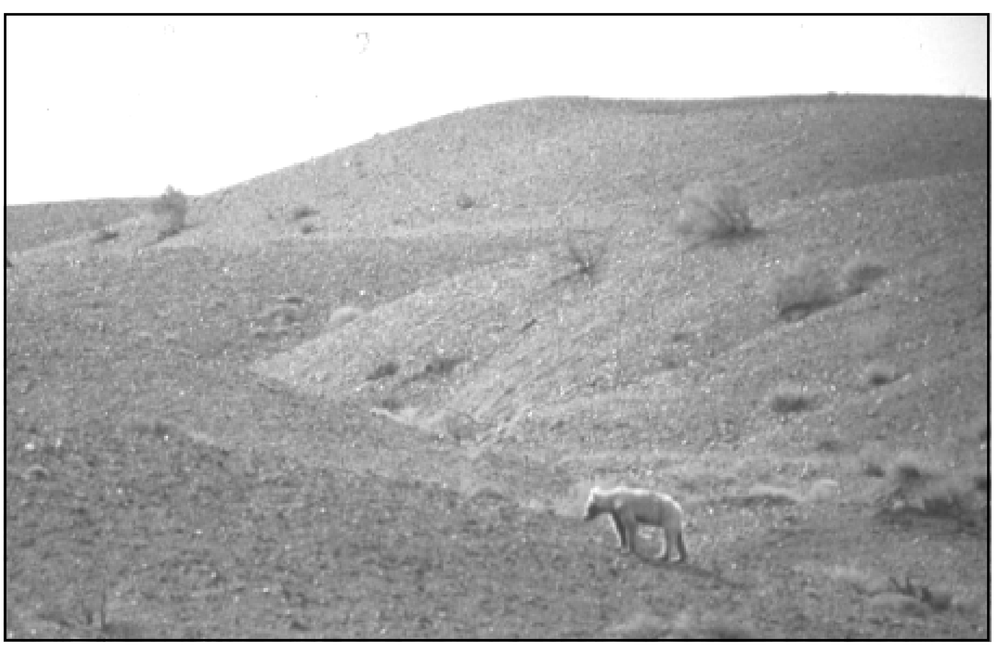
Taxonomic status

The question of taxonomic status of the Gobi bear has yet to be settled. In contrast to other brown bears, Gobi bears are relatively small with reports of adults weighing between 100kg (Anon. 1988) and 120kg (Schaller *et al.* 1993). It is light brown in color, and the head, belly, and legs can be noticeably darker than the rest of the body. Light stripes or a collar are often discernible about the neck, and the ears often have long shaggy hairs (Anon 1988, Schaller 1993a). Assuming similarity to the Tibetan brown bear, mazaalai have been referred to as *Ursus pruinosus* Blyth, 1854 or *U. arctos pruinosus* (Mallon 1985; Zhirnov and Ilyinski 1986). Schaller *et al.* (1993), having observed both the Gobi bear and the brown bears of the Tibetan Plateau, note distinct differences in appearance and question the likelihood of them being the same species or subspecies. The Tian Shan and Altai mountain ranges nearly converge in close proximity to the GGNP and both ranges support populations of brown bear. *U. a. isabellinus* occur in the Tian Shan within sight of occupied Gobi bear range, while *U. a. arctos* can be found where the Altai range crosses through northwest Mongolia and into Russia. The latter subspecies is also present in several northern Mongolia locations including the taiga forests of the Khentai and Khovsgol regions. Although local inhabitants can not recall a time when brown bears inhabited the Altai mountains to the north of the Park, Schaller *et al.* (1993) speculate that this must have been the case. Although the past known distribution of Gobi bears may then have overlapped with *U. a. arctos*, they believe the Gobi bear to have its closest affinity with *U. a. isabellinus*, assuming that subspecies is valid. Sokolov and Orlov (1992) established the Gobi bear as a distinct species, *U. gobiensis*. However, they base that contention on morphological measurements from a limited number of individuals, thus leaving the new taxonomic distinction questionable. A study was planned for 1995 that would deal with the taxonomic question through modern genetic analyses.

Legal status

The Gobi bear receives complete protection in Mongolia and appears in the national Red Book. It is also listed in the IUCN Red Book, but is considered the same species as the Tibetan brown bear. All brown bears in Mongolia and China are listed in Appendix I of CITES, including the *U. a. arctos*, *isabellinus*, and *pruinosus* subspecies. Mongolia has indicated it will accede to CITES and was in attendance at the 1995 world council session. Final action is pending in the Mongolian Great Hural (Parliament). It is anticipated that they will join without taking any species reservations.

With the fall of communism early in this decade, Mongolia entered into a new era of democratic rule and is still in the process of promulgating numerous laws pertaining to natural resource management. Two laws enacted in 1995 will have ramifications on Gobi bear conservation. These include the Mongolian Law on Hunting and the Special Protected Areas Law. Under the


Joel Bennett

Gobi bear (*Ursus arctos*) in Mongolia.

Hunting Law there is no provision for the taking of a mazaalai, although there is a season specified for brown bear elsewhere in the country. Mazaalai are listed as a "very rare" species and thus protected even outside the boundaries of the GGNP. Translation of the new law into English has left unclear the question of taking mazaalai for scientific collections, such as zoos or museums. This needs clarification. The Special Protected Areas Law provides definitions of the various protected area designations. The GGNP falls under the Strict Nature or Scientific Reserve category. Within these types of reserves three management zones may be designated. Most of Gobi bear habitat in the GGNP is reportedly designated Zone I with the remainder in Zone II. Under Zone I guidelines only limited research activities are allowed. Tourism, hunting for the purpose of research or population control, soil and flora rehabilitation, fodder production, and forestry are disallowed in Zone I, but possible in Zones II or III. No sport or subsistence hunting is allowed in a Strict Nature Reserve.

Population threats

With a population that likely does not exceed 50 animals and may be as low as 25, the bears are without question highly inbred. Three population centers are now thought to exist and limited genetic interchange between them may be further reducing population viability. Existing at the absolute fringe of the species' ecological tolerance, Gobi bears subsist on a marginal diet. Scavenging carcasses or the taking of small rodents may supply a limited amount of animal protein, but the bulk of the diet is vegetable matter. Graminoids, often the senescent, dry over-winter remains in early spring, are the principal natural food. Roots of wild rhubarb (*Rheum nanum*) and onion (*Allium* sp), and *Nitraria* and *Lycium* berries add seasonal variety. The low quality diet may provide for little beyond maintenance needs; a situation that likely contributes to an observed reproductive rate that is low even for the species. Females are rarely seen with more than one young.

Water is a precious commodity in the Gobi and several years of severe drought in the 1980s may have put additional pressure on the bears as green plants became even more scarce and oases dried up. While there was no readily apparent decline in numbers between surveys conducted in the early 1980s and estimates made in the 1991, the effect of any lost or reduced cohorts may not yet have been fully felt.

Habitat threats

Despite the fact that Gobi bear range lies completely within the GGNP, a strict nature reserve with restrictive provisions on human use, there are habitat threats. In the past few years Mongolia has greatly increased trade with China. In August 1992, Mongolia and China signed a border agreement to promote trade. Several trading posts were established on both sides of the border, including one opposite the GGNP in China. Two roads through the Park were established that ran past oases in Gobi bear range. After two years of protest by the Mongolian Ministry of Nature and Environment and international conservation organizations, the roads were officially closed and the Chinese trading post removed. The road closure is, however, difficult to enforce given the limited human and transportation resources of the Park. Illegal travel continues and may be increasing. Poaching and disturbance of animals at oases is likely an ongoing problem.

Several military border stations exist within the Park. Some are sited at oases and livestock are kept at all posts. This situation causes disturbance to local wildlife and deprives them of already rare water sources. The potential for poaching is real and the incentive high given the value of bear galls on the Chinese market. While trade is being advanced between the countries, Mongolia remains convinced of the need for military stations along its border with China and removal is not likely in the near term. Elimination of all military posts may in fact have a negative impact on the Park, as cross-border poaching would likely increase without their presence.

At present there is a strong national interest in promoting eco-tourism. The Gobi Park is presently not open to extensive visitation and no facilities exist to support that. The Ministry of Nature and Environment in cooperation with UNDP's Biodiversity Project is currently revising the GGNP management plan. The plan will address tourism with respect for the critical habitat areas that include oases within Gobi bear range.

Management

Concurrent with the dissolution of the Soviet Union, Mongolia experienced a period of rapid change, yielding economic and political crisis. The loss of the USSR as a trading partner and cooperator in scientific endeavors within Mongolia was apparent in much reduced management activities in the national parks and reserves, and near elimination of the research functions of the Mongolian Academy of Sciences. With a new openness to the west, several foreign entities, private, national, and international, have stepped in to provide aid directed at maintaining Mongolia's unique natural heritage. George Schaller of the Wildlife Conservation Society (WCS) initiated research on several Mongolian species in 1989, including the Gobi bear. In 1993, UNDP established a Biodiversity Project in Mongolia that is ongoing and focuses much of its attention on the GGNP. Despite the concern that both UNDP and WCS have expressed over the plight of the bear, there is presently no research being conducted on the species. In 1995 the GGNP and the Mongolian Ministry of Nature and Environment (MNE) identified the Gobi bear as a species of special concern and in need of immediate protective measures and additional research. Clearly, appropriate and more effective conservation efforts cannot be undertaken until a better understanding of the bear's population status, ecology, and genetic standing is gained.

Management is currently limited to providing supplemental feed and efforts to reduce human contact by limiting access to oases where bears seek natural food and water. In the mid-1980s, the Park established a number of feeding stations and have continued to provide livestock pellets as a supplement to the meager natural diet. Foods of higher nutritional value could be more effective in elevating the bears reproductive rates, but are beyond the limited financial means of the government at present. Simple fecal analyses to determine seasonal diet shifts and to identify yearly trends could be conducted by current park staff. Annual production of *Nitraria* berries, a critical high caloric food, could then be used as an indicator of bear's nutritional plane, thus allowing managers to provide additional or higher quality supplements during critical years.

Mongolian officials have suggested that a captive breeding program for this species be initiated. Such a program is currently beyond the capabilities of the GGNP and is of questionable value at best. It is uncertain if bears would breed well in captivity and the difficulty of returning "uneducated" young to the harsh wilds of the Gobi may doom any such effort to failure. Besides, these bears have managed to maintain a small but stable population with limited human interference. Because the loss of even a single reproductive female from such a small population would be extremely deleterious, any management or research activities that call for capture or handling bears should receive the most critical review.

At present few Mongolian wildlife biologists are prepared, trained, or equipped to conduct the types of studies required to address even basic wildlife management needs. The key to responsible management of their unique faunal complex may be recruitment of a cadre of Mongolian biologists interested in conducting the demanding long-term field investigations required. Limited resources and low salaries, coupled with a new reliance on western experts to lead most research, is not conducive to the development of national capabilities. To that end, international research and management experts must be coupled with motivated Mongolian counterparts that can be both trained and equipped, leading to a self-reliance not apparent today. This is occurring on a limited basis now with promising results.

Human-bear interactions

Many human-bear interactions are inextricably linked to habitat threats and have been discussed above. Other anthropogenic disturbances have arisen from sources such as foreign film crews documenting the Park's unique wildlife complex. While responsible teams have managed to attain footage of rare species with little or no disturbance, recent cases have been brought to light where actual physical injury to Gobi bears likely occurred in the process. A strict policy on such activities is needed.

Internal interest in research on Gobi bears and other rare species of the Park is increasing. Management actions, such as additional radio-telemetry studies, captive breeding, and translocating bears to facilitate genetic exchange have been promoted by both Park biologists and senior scientists within the MNE and the Mongolian Academy of Sciences. Until such activities can be skillfully and safely carried out, they should be discouraged. More importantly, the rational and potential efficacy of the programs should first be thoroughly examined with input from expert sources. As an example, it is unlikely, or at a minimum unproven, that an impediment to genetic exchange between oases exists. Thus, the proposed translocations are unwarranted and potentially disastrous.

Public education needs

In a pastoral society such as Mongolia, predators of all forms are usually vilified. Perhaps because its range has been reduced to the uninhabited and desolate reaches of the Gobi, mazaalai enjoy a somewhat unique level of respect from Mongolians. Still, general wildlife conservation ethics and the concept of parks and reserves that exclude or limit human use should be promoted through public education efforts.

Mongolia has greatly added to its protected areas system over the past few years, and laws governing natural resources and land use/ownership have even more recently come into being. Nomadic herders that make up more than 50% of the country's population are often unaware of or confused by the rapid changes. To maintain and foster a respect for protected areas and the country's unique natural heritage Mongolia, in cooperation with such entities as the UNDP Biodiversity Project, has initiated a multi-faceted educational campaign. Mongolia is fortunate among developing countries to have a very high literacy rate which allows use of widely disseminated written materials. Additionally, despite its sparse and nomadic populace, radio and even television reach most areas. There is a strong interest among urban and especially rural people in learning about local natural history. During this critical period in Mongolia's development, when revenue generating resource extraction is being weighed against conservation of biodiversity, an extensive, well-funded, and effective educational program is highly desirable.

Of particular concern for many species in Mongolia is the increasing trade with China where demand for wildlife parts, including bear galls, is high. Any educational efforts to address this issue need to be carefully crafted so as not to result in a counter-productive increase in awareness of the trade value of rare species.

Specific conservation recommendations

1. The acquisition of basic ecological information on Gobi bears is an integral component of establishing sound conservation and management plans. Most importantly, the genetic standing of the bear must be more clearly established. Such information is critical to determination of the type and extent of conservation actions.

   In the spring of 1996 field collection of bear hair tissue for DNA analysis was to be initiated using techniques that minimize potential risks or disturbance of the bears. Collection sites were to be selected after consultation with GGNP staff. At least three oases will be sampled with consideration of the goal of identifying population isolates. The study goals include establishing a minimum population estimate, determination of sex ratios, determination of inbreeding patterns and genetic exchange between known population centers, identification of isolated populations (if they exist), and the relation of mazaalai to other Asian brown bears.

   Field work was to be completed in spring of 1996 and laboratory analyses by summer of that year. Final reports were expected in late winter with management recommendations being provided to Mongolian officials and Park managers at that time. The budget for this project was approximately US$11,000. This work was possible at that funding level due to association with other ongoing research in the Park under the auspices of WCS.
2. Supplemental feeding should be continued. Costs of this activity are moderate and currently supported by the GGNP's annual budget.
3. Park rangers and biologists need to establish standardized monitoring activities. These can be as simple as sign counts along walked transects, but must be repeatable and done on a regularly scheduled basis; annually would be best, but semi-annually should be a minimum target. No more than four months per year would be required. Fuel, food, and personnel costs should not exceed US$500.
4. A more detailed examination of the mazaalai's diet should be undertaken with an emphasis on seasonal variation. Annual assessments of key forage production should follow as an index to nutritional status of the bears. Fecal analysis to identify diet content is possible at the existing Park headquarters in Bayantooroi. Costs would be minimal as collections could be made during scheduled trips to oases by rangers and other staff. Any nutritional analyses would need to be conducted at a laboratory in Ulaanbaatar, or outside the country. Costs would vary by lab but would be least expensive if done in-country.
5. A management plan for the Park is now being formulated. It should contain an action plan for this species with emphasis on limiting disturbance factors. The above research and management recommendations have been forwarded to the Park and the international team now working on the plan.

The level of conservation actions that should be taken for these bears is partly dependent on its taxonomic standing. Yet even if it is determined to be the same subspecies as bears of the Altai, Tian Shan, or Tibet plateau, the uniqueness of its ecological situation, existing as a remnant population under extreme environmental conditions, justify actions to prevent its demise. National pride in the *mazaalai* is arguably a valid impetus to protect them and even seek to promote an expansion into former range.

No management or research activities should be conducted that would place individuals or the population at risk without extensive international peer review. Such actions include capture for any reason, movement or translocation, and attempts to establish an artificial breeding program.

Status and management of the brown bear in Russia

Igor Chestin

Status

Russia has the largest brown bear population in the world, apparently exceeding populations in other countries altogether. In most areas, it is a common game species. Brown bears are found in almost all forests from Kola Peninsula in the northwest to Khanka Lake in the Russian Far East (Figure 7.6). Bears also reside in the mountains of the Caucasus and Altai in the south of Russia. A 1990 survey of brown bear numbers in Russia estimated about 125,000 animals (Table 7.3). That was probably the maximum number during the 20th century, when the bear population experienced a decrease until the late 1960s. The most dramatic increase in brown bear numbers in the 1970s–1980s occurred in European Russia.

Figure 7.6. Brown bear (*Ursus arctos*) range in Russia, 1993.

Historic range and current distribution

Historic range of the brown bear in Russia was estimated by Geptner *et al.* (1967). The former range of the species included not only forests, but also forested steppes, floodplains along Volga and Don valleys, and even steppes. Thus, in the 18th century brown bears occurred throughout Russia, except for the marginal north tundra areas, and the dry steppe to the southwest and southeast of Baikal Lake.

The northern and eastern borders of brown bear distribution did not change significantly until recently. The northern border coincides with the boundary between forested tundra and tundra zones. The eastern border follows the Pacific coast. Bears still inhabit Paramushir, Iturup, and Kunashir islands, but are extinct on Shumshu in the Kurils. Shantar Islands and Sakhalin are still inhabited by the species.

The distribution of brown bears in Eastern and Central Siberia is nearly the same as it was several hundred years ago, although bears disappeared from some extensively developed territories along the Baikal-Amur railway, and coal mining areas in Kemerovo oblast. However, in the 19th and especially in the first half of the 20th century, brown bear range was progressively shrinking northwards in European Russia. In the 18th century bears were spread as far to the south as the Crimean Peninsula, thus inhabiting almost all of the Ukraine. Since that time the southern border of their distribution has moved, in some places 1,000km to the north. In the 1940s–1950s bears disappeared in Moscow and Vladimir oblasts, and some parts of Tver (former Kalinin), Smolensk, Bryansk, Kaluga, Orel, Ivanovo, and Tambov oblast. This process continued approximately until the 1970s, as confirmed by surveys done in Okskiy Reserve (Priklonskiy 1967; Polyakova 1975).

The most recent survey, completed in 1992 in European Russia (Chestin in press) showed great expansion of the brown bear range southwards. Bears became resident in all the Tver oblast, in the north of Moscow oblast, and in Kaluga oblast. Population density also increased in all of European Russia (Chestin *et al.* 1992). There are also four to six isolated populations in Bryansk, Nishniy Novgorod, Ulyanovsk, and Orenburg oblasts, and in Mordovia and Chuvashia. The status of these populations is unknown, as no special study has been carried out on any of them. Considering the Russian part of the Caucasus, one can see progressive narrowing of the brown bear range, especially since the end of the last century. Before that time the species' range was probably pulsing towards the European

Table 7.3. Number and density (individuals per 1,000km²) of brown bears (*Ursus arctos*) in different regions of Russia in 1990 according to the official data of State Department for Game Management.

Region	Center of administrative unit	Number	Density
North and middle taiga of European Russia	Arkhangelsk	6,500	0.21
	Murmansk	500	0.05
	Petrozavodsk	3,500	0.20
	Siktivkar	7,000	0.17
	Total	**17,500**	**0.18**
South taiga and north temperate forests of European Russia	Vologda	4,500	0.31
	Tver	1,800	0.21
	Kirov	4,000	0.33
	Kostroma	2,000	0.33
	Sanct-Peterburg	1,900	0.22
	Novgorod	1,350	0.24
	Pskov	700	0.13
	Yaroslavl	700	0.19
	Total	**16,950**	**0.26**
Temperate and steppe forests of European Russia	Bryansk	10	?
	Nizhniy Novgorod	600	0.10
	Ivanovo	200	0.08
	Kaluga	3	?
	Yoshkar-Ola	400	0.17
	Saransk	20	?
	Moscow	10	?
	Ryazan	8	?
	Penza	10	?
	Smolensk	200	0.07
	Kazan	3	?
	Izhevsk	15	?
	Total	**1,479**	**?**
Mountain taiga of Ural	Ufa	1,500	0.21
	Perm	4,000	0.25
	Yekaterinburg	3,000	0.15
	Chelyabinsk	400	0.15
	Cheboksari	600	0.14
	Total	**9,500**	**0.19**
Mountain forests of the Northern Caucasus	Makhachkala	150	0.10
	Nalchik	200	0.20
	Krasnodar	470	0.19
	Vladikavkaz	100	0.25
	Stavropol	290	0.18
	Grozniy	200	0.26
	Total	**1,410**	**0.18**
Plain taiga of West Siberia	Kemerovo	900	0.14
	Novosibirsk	230	0.04
	Omsk	400	0.06
	Tomsk	3,000	0.09
	Tyumen	4,500	0.04
	Total	**9,030**	**0.06**
Mountain taiga of Altai	Gorno-Altaisk	**5,000**	**0.40**
Mountain taiga of East Siberia	Irkutsk	4,000	0.05
	Krasnoyarsk	10,000	0.05
	Kyzyl	2,500	0.21
	Total	**16,500**	**0.06**
Plain taiga of East Siberia	Ulan-Ude	3,000	0.12
	Chita	2,500	0.08
	Yakutsk	12,000	0.04
	Total	**17,500**	**0.05**
Taiga and broad-leaved forests of the south Far East	Blagoveshchensk	3,500	0.10
	Magadan	3,500	0.04
	Vladivostok	2,500	0.15
	Khabarovsk	8,000	0.10
	Yuzhno-Sakhalinsk	2,500	0.29
	Total	**20,000**	**0.08**
Mountain taiga and tundra of Kamchatka	Petropavlovsk-Kamchatskiy	**9,000**	**0.19**
TOTAL FOR RUSSIA		**123,869**	

part of the range depending on climatic and therefore vegetational changes (presence or absence of forests in the river valleys and steppe zone lying between the Caucasus, and broad-leaved forests roughly to the north of 50°N) (Vereshchagin, 1959; Geptner *et al.* 1967). No restoration of the former range has been observed recently.

In conclusion, the range of brown bears did not experience significant changes during the last two centuries in the Far East and Eastern Siberia, slightly narrowed in the south of Western Siberia, and dramatically moved to the north in south-European Russia. However, in the last two decades, a new expansion to the south has occurred, and there are still several vulnerable isolated populations which give some indication of the species distribution 100 years ago.

Regarding possible future range, it probably will not change in Asian Russia, although a decrease in number can be expected in the Far East due to extensive poaching. In European Russia, the species range can continue its expansion to the south, but some isolated populations farther in the south may disappear if special measures are not undertaken. In the Russian Caucasus, the expansion of bear range may be limited by continuing development.

Legal status

Brown bears have always been, and still are, traditional game animals. Moreover, in areas with extensive agriculture (like European Russia) bears were eliminated because of livestock depredation. Land owners often paid bounties for eliminating brown bears on their lands, while others, in contrast, prohibited hunting to keep bears for their own game. The above is true mostly for European Russia, while in remote Asian parts of the country people hunted bears very rarely, although hunters killed bears when encountered in the taiga.

After the October Revolution in 1917, bears were declared harmful predators and their elimination was promoted by the state in the form of bounties, or by the land users (mainly collective farms) who rewarded hunters with livestock or grain. Only in the 1950s was that practice canceled in several oblasts of central European Russia, where bears were nearly extinct by that time. By 1960, bear hunting was prohibited in all European oblasts to the south of Moscow's latitude, but bounties persisted in Asian Russia until 1970. In the 1960s more and more oblasts started to regulate bear hunting by setting the seasons (usually from mid-August until mid-May, sometimes until the end of denning), or even by introducing free licenses as in Krasnodar kray. In 1974, bear hunting in Russia was restricted to three months with particular seasons set between the 15 August and the 15 January by local authorities. Bounties were canceled and sows with cubs of the year were not allowed to be hunted. More and more oblasts in European Russia, like Bryansk, Kaluga, Tula, Orel, Ryazan, and Vladimir listed brown bears as protected species.

In 1981, the Head State Department of the Game Industry of the Russian Federation (Glavokhota RSFSR) established a license system for bear hunting throughout Russia. The price for the license was 70 roubles (approx. US$115) in European Russia and 50 roubles (approx. US$80) in the Asian part of the country. This system, despite being opposed by many specialists who called for free licenses for at least Asian Russia, is still active although the prices are different and are finally set by local authorities. Bear hunting remains prohibited in Vladimir, Ivanovo, Ryazan, Moscow, Orel, Tambov, Ulyanovsk, Bryansk, and Kaluga oblasts, and in Mordovia, Chuvashia, and Tatarstan.

Population threats

Besides game hunting, brown bears in Russia are also killed if they become nuisance animals (preying on livestock, damaging crops or beehives, or attacking humans). In some areas poaching is extensive and can lead to a population decrease. In a healthy bear population, the impact of the elimination of nuisance animals is very small.

According to data obtained during a survey on brown bear-human interactions (Chestin 1993), the number of permits annually issued for eliminating nuisance bears vary from 0 to 0.6% of the total bear population in 20 different regions, with an extraordinarily high figure (3.5%) in Novosibirsk oblast. Assuming that the success of eliminating nuisance bears is slightly higher than 50%, the role of this management measure is really limited. Of course, some nuisance bears are eliminated by land users, herd keepers, and apiarists without being reported, but these losses are hard to estimate.

In some areas in Siberia (especially in the Baikal area) there are years of bear disaster when the crop of their ultimate autumn food, Siberian pine nuts, is very low. This forces bears to approach settlements in search for alternative food, and many bears become very aggressive. In such years, special teams of hunters are organized to eliminate bears from the vicinity of human settlements, and associated population losses can be really dramatic. For example, the data given by Zhdanov and Pavlov (1972) provided the evidence that a brown bear disaster in 1962 and 1968 took place in all Asian parts of Russia, at least from Tomsk oblast through Krasnoyarsk kray, Irkutsk oblast, Buryatia, Amur oblast to Khabarovsk and Primorskiy krays, and Yakutia. In the summer and autumn of 1962, 13 bears were shot near one village in Krasnoyarsk kray. More than 60 bears were shot in the vicinity of another village in the same district. One hunter in Buryatia reported that he killed 11 bears in the period of

August 20–September 20. According to Zyryanov and Smirnov (1992), in Tuva Republic, 1951–52, 1962, 1972, and 1978 were the years of bear disaster. Seven hundred sixty-seven bears were shot in Tuva (119,400km^2) in 1962. Together with those who died because of starvation and cannibalism, the losses approached 1,000 individuals, or 67% of population.

Poaching can be subdivided into commercial and non-commercial, the former done for trade, and the latter for the personal needs of a poacher. Non-commercial poaching always existed in Russia and probably did not seriously affect bear populations. Extensive commercial poaching arose fairly recently.

Commercial poaching does affect brown bear populations, especially in the Russian Far East. Surveys done in 1992–1993 (Poyarkov and Chestin 1993; Chestin and Poyarkov in press) showed a dramatic increase in poaching for bear gall bladders, and to a lesser extent for hides, in 1990–1991. Before that, it existed to a very small extent in the south of the Far East where many North Koreans have been working for the timber industry. They purchased bear gall bladders from local hunters and then sold them in North Korea and China. Recently the demand for wildlife parts in South East Asia has dramatically increased due to rapidly growing living standards, and hence the ability of more and more people to use traditional Asian medicine which they formerly could not afford. This unfortunately coincided with impoverishment of the Russian population and the weakening, if not loss of, state services including both wildlife and customs control.

Surveys demonstrated that in 1991–1993 many people poached for a living, illegal networks of dealers were established, and wildlife products, including brown bear bile and hides, found their way abroad through all big cities in the Far East. The international airports or ports used for this trade included Vladivostok, Nakhodka, Khabarovsk, Blagoveshchensk, Magadan, and Petropavlovsk-Kamchatskiy. Not all of the products went through organized dealers. Dispersed trade by sailors was also very prevalent particularly for illegal export to Japan.

According to our data (Chestin and Poyarkov in press), the Far-Eastern trade network accumulated bear products from the regions between Pacific Ocean and the Yenisey River. To the west of the Yenisey River, poachers sell bear parts to dealers from European Russia (Moscow and Saint Petersburg), the Baltic countries, and the Ukraine.

The impact of poaching on bear populations is hard to estimate and only a few such estimations have been recently undertaken. Zheleznov (1993) from Anadyr, Chukotka reported great reductions in bear numbers because of poaching done by domestic reindeer herdsmen. According to his data, a team of herd keepers eliminates up to 35 brown bears each spring. There are about 100 such teams in the region and even if only 10% of them are engaged in poaching, the annual population loss far exceeds the rate of reproduction. Bears are hunted mainly for gall bladders and hides, which are sold to dealers who come from big cities after each season, and either buy these products or exchange them for liquor.

Nikolaenko (1993) from Kamchatka presented data on not less than 1,500–2,000 bears eliminated annually in the oblast. The official quota in 1994 was about 600 bears, and the total population was estimated in 1990 as 9,000 individuals. However, Valentzev (pers. comm.) estimated that the poaching rate in one district was much lower if extrapolated to the area of Kamchatka, in which there is approximately one poached bear per bear legally taken.

At the same time, in 1994 there was evidence of a decrease in bear trade as well as poaching in the Far East. After three to four years of extensive market development, it became saturated and prices for bear bile and hides decreased (if calculated in hard currency). In 1992–1993 poachers sold bear bile for US$5–8 per g, but now they can hardly get more than US$2–3 per g. People's incomes also became higher, as did prices for food and other goods. According to the opinion of some respondents, it is not quite so popular to trade in bear parts as it was in 1991–1993 (Chestin *et al.* 1994). The development of bear farms for supplying bear bile to neighboring Asian markets may create a problem in the region. Until the end of 1994, one such farm had been reported on Sakhalin Island.

Habitat threats

There have been no studies on how particular kinds of development and habitat transformation affect brown bears. Thus the data are very scarce and come primarily from experts' estimations. Deforestation in order to promote crop agriculture was probably the main reason for diminishing brown bear range in the past (Geptner *et al.* 1967). At the same time, the negative impact of logging was observed only in the south of European Russia. In the northern oblasts (Vologda, Yaroslavl, and Kostroma) and Karelia, the density of brown bear populations even grew for some time after timber harvesting was done, as understories started to recover. Rukovskiy (1981) explained this with more diverse habitats which usually develop in partly harvested areas. However, the latter is true for forests with good reproduction rate and similar tree species composition in recovered stands. For example, in Siberia and the Far East, former Siberian pine forests are replaced by spruce. Siberian pine provide bears with nuts, which are crucial in autumn for accumulating fat for the denning period. In the Baikal region these nuts are almost an exclusive autumn food and cutting Siberian pine forests leads to starvation in the bear population.

Forest fires destroying bear habitats and causing population disaster due to starvation are mostly common in Altai Mountains and Central and Eastern Siberia. For example, in three districts of Irkutsk oblast near Baikal Lake in 1984–1986 nearly 700,000km^2 of forest were burned (Ustinov 1993).

Grazing and cutting mountain forests is a serious problem for bear habitats primarily in the mountainous areas in the Caucasus (as well as in the Central Asian portion of the former USSR; this was one of the main causes of diminishing brown bear populations in Kopet-Dag, Tian-Shan, and Pamir). However, nearly all appropriate alpine meadows have already been developed for grazing, leading to a decrease in brown bear populations in the 20th century. Therefore, future deterioration due to grazing is not expected.

The following potential threats cannot be assessed because of lack of any data: 1) Oil and gas mining; 2) Tourism; 3) Road construction; 4) Irrigation.

Management

Until recently the state organization responsible for rational use and management of wildlife was Glavokhota RF (Chief Department of Game Industry, Council of Ministers, Russian Federation). In 1994, it was transformed to a Department of Game Industry of the Ministry of Agriculture and Provisions. This governmental organization maintains all control over the use and management of game species. At the same time there is a Department of Biological Resources, Ministry of Nature Protection and Natural Resources, which is responsible for the protection and control of all users of wildlife. Department of Game Industry has regional offices in every oblast, kray, and republic in Russia (Departments of Game and Trapping Industry) and those territorial divisions are governed both by federal Department and local administration. Every oblast, kray, and republic is divided into administrative districts. Each of the latter has one to three game managers, who perform the actual management and follow the guidance of local Departments in oblast (kray, republic) center. The main applicable functions of the Department of Game Industry and its local branches are:

1. Control of all users of game in order to ensure their proper use;
2. Setting up the quotas for harvesting all game animals for oblasts, krays, and republics (set by the federal office) in coordination with the Department of Biological Resources, Ministry of Nature Protection;
3. Determination of hunting seasons for all species and regions (set by the 'Hunting Rules in Russia' with slight annual corrections by local branches depending on phenology) in coordination with the Department of Biological Resources, Ministry of Nature Protection;
4. Issuing permission for elimination of game animals outside of hunting seasons (for nuisance animals, or for scientific and cultural purposes; can be issued both by federal and local offices).

The following is a description of the most typical situations and ways in which they are managed:

- If a bear attacks a hunter and he shoots the animal, he should report the conflict to the local game manager. After an examination of the conflict site, the game manager and the hunter sign a document with a description of the situation and send it to the local branch of Glavokhota.
- If a bear attacks and seriously injures a person, the local game manager should contact the local branch of Glavokhota and ask for a permit (which differs from regular license for sport hunting) for elimination of a nuisance animal. Usually such permission is issued, and then the local game manager, with several volunteer hunters, tries to locate and shoot the animal. Of course, quite often they shoot not the particular nuisance bear but the first one they meet.

Similar procedures take place if bears start preying on livestock, damaging beehives, or entering settlements. Owners report to a local game manager who applies for a permit from the local game department to kill the animal.

According to Geptner *et al.* (1967) in the 1930s, 3,000–4,000 bear hides were annually purchased from hunters. Of course, many hides were kept by the hunters for their own needs. Geptner *et al.* (1967) believed that those accounted for up to 60% of the total. Using this percentage, about 4,600–6,400 bears were harvested annually. Since there were no special regulations, all bear hunting was legal. Filonov (1981) mentioned that in European Russia in 1935–1953, 1,896 bear hides were annually purchased. Up to 0.57 hides annually were coming per 100km^2 of habitat in Stavropol kray, and 0.51 per 100km^2 in Vologda oblast. Between 1954–1960, state procurement remained practically the same – 1,892 per year on average with maximum harvest density in Mariy Al (0.48 hides annually per 100km^2) and Bashkortostan (0.33). However, between 1960–1971 the state procurement came down to 496 hides per year because more hides were being kept by the hunters and the harvest rate was likely lower. The maximum number of skins purchased from hunters in European Russia in one year was 2,733 in 1953.

In 1981 after the establishment of a system of prepaid licenses for bear hunting, and with the total population in Russia equaling about 80,000 bears, 4,200 licenses were sold. Only 1,400 bears actually were shot (1.75% of the population). In 1982, 5,000 licences were purchased by hunters, but only 1,900 bears (2.4%) were harvested (Sitzko 1983). The above figures do not include losses resulting from poaching. The annual harvest quota was set according to the demands of local Departments of Game, but not exceeding 10% of the population.

Table 7.4. Number of brown bears (*Ursus arctos*) legally shot in 1989.

Region	No. of bears shot
North (Arkhangelsk, Murmansk and Vologda oblast, Karelia and Komi)	921
Northwest (Leningrad, Novgorod and Pskov oblasts)	241
Central (Ivanovo, Kostroma, Smolensk, Tver and Yaroslavl oblasts)	470
Volga-Vyatskiy (Kirov and Nizniy Novgorod oblasts and Mariy Al)	492
Northern Caucasus (Krasnodar and Stavropol krays, Dagestan, Kabardino-Balkaria, Northern Osetia, Chechnya and Ingushetia)	57
Uralskiy (Chelyabinsk, Perm and Sverdlovsk oblasts, Bashkortostan, Udmurtia)	409
Western Siberia (Kemerovo, Novosibirsk, Omsk and Tomsk oblasts, Altai kray)	261
Eastern Siberia (Chita and Irkutsk oblasts, Krasnoyarsk kray, Buryatia and Tuva)	527
Far Eastern (Amur, Kamchatka, Magadan and Sakhalin oblasts, Primorskiy and Khabarovsk krays, Yakutia)	1,576

Since the brown bear population was growing, the legal harvest of 1987–1988 reached 3,600 bears, slightly more than 50% of licenses sold (Gubar *et al.* 1992). Thus about 3% of the population was legally harvested. In 1989, 4,954 bears were legally shot; their distribution among the regions is shown in Table 7.4.

Together with losses from poaching, total harvest probably did not exceed 10% of the population. Assuming that hunting was successful about 50% of the time, and that further population growth in many areas was undesirable, the quota for annual harvest was recommended to be 15% on average and up to 25% in particular areas (Gubar *et al.* 1992). In 1992, 4,058 bears in Russia were legally shot, and for 1993–1994 there were about 9,000 licenses available.

Human-bear interactions

The main role of brown bears in people's life in Russia is as an object of game hunting. Livestock depredation by bears is much less of an issue, and is overshadowed by that by wolves. Occasionally, as was observed in 1961, 1962, and 1967 in the Baikal region, and in 1985 in the north of the Russian Far East, bears experience a dramatic lack of autumn food sources and start preying on people. Crop depredation, despite being fairly common in oat fields, is not regarded as a serious problem. Damage to beehives in the areas with developed honey production is a problem, and in areas such as Bashkiria, most of the bears eliminated as nuisances were those which visited apiaries.

Public education needs

In fact, the general public in Russia are quite aware of bears and their habits. Legal bear hunting was traditionally regarded as a job for good, experienced hunters, and was treated with great respect. At the same time, poaching in the reserves, killing animals for their bile, or killing them for illegal sale has never been thought of as a good thing to do. Recently this has changed because the economic crisis has made many people dependent on poaching. Currently, it seems as though nobody cares about the source of supplementary incomes, except for those that involve crimes against humans. Arguments that bears and other wildlife can be used for future development of the region are not convincing, since people do not connect the well-being of a region with the well-being of individuals. Therefore it seems that the matter is not a problem of education, but of changing social conditions.

Another serious problem is that nearly all bear research programs are now stopped because of lack of funds. Before 1990–1991, both Universities and the Institutes of the Russian Academy of Sciences and Natural Reserves carried out extensive research which allowed them to monitor population trends in almost all regions. In fact, this review is based mainly on those data. Recent information on numbers and population densities is not available (except for expert estimations). National organizations demonstrate no interest in initiating any projects on bears. Some international organizations seem to be interested in bear protection, but their interest is concentrated more on practical measures, like developing management strategies. At the moment it is still possible to do this based on three or four year-old studies, but within a few years management practices will have no up-to-date scientific background. Also important is that many national bear biologists, having no funds for their research, switch to other activities which results in the loss of national professionals for future projects.

Specific conservation recommendations

The primary need seems to be a monitoring program to assess bear populations and trends, at least in the areas where bears are most vulnerable. One of such areas is the Russian Far East where recent growth in poaching probably led to the most dramatic decrease in bear numbers. There are bear specialists in Chukotka, Kamchatka, and Magadan oblast who have no funds to accomplish this task. No bear specialists are available at the moment in the south of the Far East (Primorye and Khabarovsk krays) nor on the Kuril Islands and Sakhalin. Monitoring can be fulfilled by establishing a network of bear observers coordinated at the national or international level.

Secondly, there are remnant isolated brown bear populations in European Russia. Bear specialists exist in the region but no single field survey has been done on any of the isolated populations.

Monitoring programs can be achieved by establishing a network of bear observers who would be responsible for both monitoring population trends and running some urgent research projects. This network can be coordinated on a national or international level.

Probably the most difficult task is stopping poaching and the illegal trade in bear parts. Despite the signs of recently decreased trade in bear parts mentioned above, it still remains a problem. The problem can be solved by either improving wildlife controls to prevent poaching, or enforcing customs control to prevent trade. If there is no international trade, there will be no commercial poaching because there is extremely little demand for bear parts within the country. Unfortunately one can hardly anticipate essential changes in either of these two systems because of the lack of governmental funds. Moreover, despite several wildlife protection laws existing in the country, legislation is extremely ineffective because of local corruption. In a recent survey, about 24% of respondents mentioned situations where poachers were investigated or dealers stopped at customs with wildlife products, but none of them was ever called to court (Chestin and Poyarkov in press).

Regarding the above, one way to combat the problem would be to establish an international foundation which can support control services, preferably in the form of bounties, for personnel who investigate poachers. Another option would be to develop management plans for various areas with developed bear game hunting. This would ensure that hunters would cover the expenses of control and census services. Such a plan is being developed now for Kamchatka by WWF.

Chapter 8

American Black Bear Conservation Action Plan

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IUCN Category: Lower Risk, least concern **CITES Listing:** Appendix II
Scientific Name: *Ursus americanus*
Common Names: American black bear, *oso negro americano*, *ours noir americain*

Introduction

Physical description: Black bears are plantigrade, pentadactyl, and have short (2–3cm), curved, nonretractable claws. Average weights range from 40 to 70kg for adult females and from 60 to 140kg for adult males; an occasional adult male will exceed 250–300kg. Full skeletal growth is reached at four to five years for females and six to seven years for males, although weights for both sexes may continue to increase for an additional two to three years. Fur is normally uniform in color except for a brown muzzle and an occasional white blaze on the chest. A black color phase predominates in the eastern portion of the range and brown, cinnamon, or blond phases tend to be more prevalent in the western portion of the range. Unique white-bluish phases occur on the Pacific coast in northwestern North America. The dental formula is 3/3, 1/1, 4/4, 2/3 = 42. The first three premolars of each jaw are usually rudimentary. Dentition is bunodont not flattened. Black bears have a relatively straight facial profile. Ears are small, rounded, and erect. Eyes of young are blue but turn rich brown with maturation. The tail is short and inconspicuous.

Reproduction: Black bears breed in summer. Females have been detected in estrus as early as mid-May and as late as mid-August. Black bears are promiscuous breeders, and males often have brief fights over a receptive female. Females are induced ovulators and exhibit delayed implantation. The gestation period is seven to eight months; the blastocyst implants in late November to early December with a six to eight week period of fetal development before birth from mid-January to mid-February. Females have


Milo Burcham

Marked American black bear (*Ursus americanus*) in Banff National Park, Alberta, Canada.

six functional mammae. The normal litter size is two, but litters of three or four young are not uncommon. Young stay with their mother 16 to 17 months before dispersing, thus females typically breed every other year. Age at sexual maturity, breeding interval, and litter size are all related to food quality. Poor nutrition causes a delay in sexual maturity from three years to six or seven years of age, and decreased litter sizes from 3–4 to 1–2 cubs, and in some instances, a total lack of reproduction.

Social behavior: Black bears are normally solitary animals except for female groups (female and young), breeding pairs in summer, and congregations at feeding sites. Adult females establish territories during summer. Temporal spacing is exhibited by individuals at other times of the year and is likely maintained through a dominance hierarchy system. Larger bears dominate smaller bears with threatening gestures (huffing sounds, chopping jaws, stamping feet, or charging). Actual fights are uncommon except among males competing for females and a female protecting her young. Family groups communicate using a variety of sounds such as the "purring" of young when nursing, squalling of young when threatened or uncomfortable, and a low grunting sound by the female to assemble her young. Tree marking is another form of communication that peaks during the summer. The ritualistic nature of this biting, clawing, and rubbing behavior, its intensity, and its defined location suggest that it is associated with some important aspect of the social structure of a black bear population. Why black bears mark objects is still open to question. Black bears are normally crepuscular but breeding and feeding activities may alter this pattern seasonally.

Habitat preferences: Prime black bear habitat is characterized by relatively inaccessible terrain, thick understory vegetation, and abundant sources of food in the form of shrub or tree-borne soft or hard mast. Black bears are very adaptable and have maintained populations surprisingly well in the presence of humans where their numbers are not overharvested. If quality habitats consisting of some form of refuge are not available, local populations succumb to the intolerance of humans. In the southwestern portion of the range, characteristic habitats consist of chaparral and pinyon-juniper woodland sites. In the southeastern portion of the range, habitat is characterized by oak-hickory and mixed-mesophytic forests in mountainous areas and on low, coastal sites with a mixture of flatwoods, bays, and swampy hardwoods. In the northeastern portion of the range, black bears inhabit beech-birch-coniferous forests and swampy areas of white cedar. The spruce-fir forest dominates much of the habitats of this species in the Rocky Mountains. Along the Pacific coast, redwood, sitka spruce, and hemlock predominate as overstory cover. Throughout the range of this species in North America, preferred habitats consistently have thick, sometimes almost impenetrable, understory vegetation encompassing part of their habitat. This understory ranges from impenetrable pocosin or Ti-Ti swamps, to thick laurel "hells", to white cedar bogs, to steep, dry chaparral ridges, to young or stunted spruce-fir "thickets". As the pressures of human activities increase, the importance of these sites in providing both refuge cover and food also increases.

Historic range, current distribution and status

The American black bear historically occupied most forested regions of North America (Hall 1981) (Figure 8.1). The present distribution of the species is primarily restricted to less settled, forested regions (Pelton 1982) (Figure 8.1). Based on 1993 survey responses from each province in Canada, black bears inhabit much of their original range, however they are absent from the southern farmlands of Alberta, Saskatchewan, and Manitoba. The black bear was extirpated from Prince Edward Island in 1937, and consequently, will not be considered in this report. Based on 1993 survey responses from seven provinces, the total black bear population is 327,200 to 341,200 (Table 8.1). This estimate does not include bear populations in New Brunswick, Northwest Territories, Nova Scotia, and Saskatchewan whose population sizes are unknown. All provinces indicated stable populations of black bears over the last decade.

In the eastern United States, the current range of the black bear is continuous throughout most of New England, but exhibits increasing levels of fragmentation southward through the middle Atlantic and southeastern states. Nevertheless, this distribution seems to have expanded during the last decade (Maehr 1984). Based on the 1993

Table 8.1. Population estimates and trends of American black bears in Canada, based on 1993 survey responses.

Province	Population estimate	Trend
Alberta	39,600	Stable
British Columbia	121,600	Stable
Manitoba	25,000	Stable
New Brunswick	Unknown	Stable/declining[a]
Newfoundland	6,000–10,000	Stable
Northwest Territories	Unknown	Stable
Nova Scotia	Unknown	Stable
Ontario	65,000–75,000	Stable to increasing
Québec	60,000	Stable
Saskatchewan	Unknown	Stable
Yukon	10,000	Stable
Total	**327,200–341,200**	

[a] East and Northeast – stable; West and Central – declining.

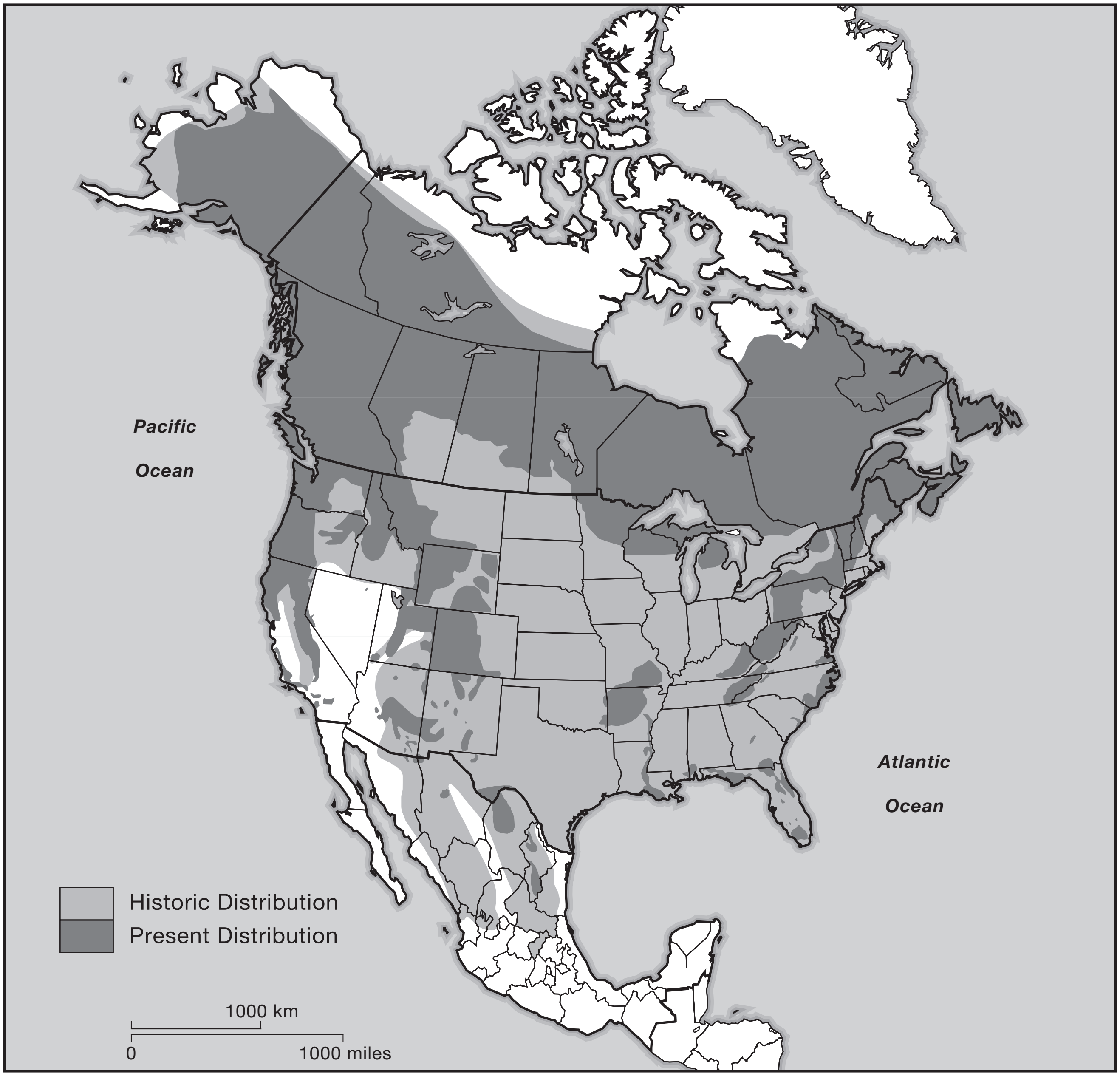

Figure 8.1. **Historic and present distribution of black bears (*Ursus americanus*) in North America.**

survey responses from 35 states, black bear populations are stable or increasing with the exception of Idaho and New Mexico. The total population estimate of black bears in the United States is between 186,881 and 206,751. This estimate does not include data from Alaska, Idaho, South Dakota, Texas, and Wyoming, whose population sizes are unknown.

Leopold (1959; Figure 8.1) believed that the range of the black bear in Mexico included the mountainous regions of the northern states of Sonora, Chihuahua, Coahuila, Tamaulipas, Nuevo Leon, and Durango, extending as far south as Zacatecas. He noted that the range may have previously extended further south, but may have been reduced due to hunting and habitat loss. Baker and Greer (1962) mentioned the possibility of a population in northern Nayarit, and Hall (1981) also included the additional southern states of San Luis Potosi and Aguascalientes. No recent attempt has been made to qualify the present distribution of the black bear in Mexico. As of 1993, known populations of black bears in Mexico exist in four areas. Distributions of other populations, as previously marked on Leopold's map (1959), have not been updated. Some isolated populations are increasing due to protection by private landowners. In general, however, the black bear is threatened due to an increasing human population, poaching, and extensive habitat loss.

Status and management of the black bear in Canada

Surveys were sent to bear biologists in all 12 Canadian provinces to request information on distribution and population status, legal status, population and habitat threats, population and habitat management, human-bear interactions, educational programs, and management recommendations. All provinces responsed.

Legal status

The black bear is considered both a big game and furbearer species in all provinces except New Brunswick and Northwest Territories, where they are designated as a big game species only. Black bears are regarded as a pest species in agricultural areas of Manitoba.

Population and habitat threats

There are no major threats to black bears in Canada. The general remoteness and lack of human settlement in much of Canada leaves vast expanses of undisturbed habitat for black bears. Some provinces, nevertheless, reported limited threats to the species on a local scale. Forest clearing for agriculture along the St. Lawrence river between Montreal and Québec City has caused loss of black bear habitat in Québec. Similarly, in New Brunswick, forest clearing and human development is responsible for some loss of black bear habitat. Saskatchewan and Yukon Territories also reported limited threats to black bears due to poaching and depredation kills. All other provinces reported minimal or no threat to black bear populations.

Population management

Hunting levels: All provinces hold both spring and fall hunting seasons, with a bear hunting license required. The estimated annual number of hunters varies greatly by province, and totals 80,822 across all of Canada (Table 8.2).

Harvest limitations: In all provinces, both sexes may be legally harvested using several methods (Table 8.3). However, there are some constraints regarding cubs-of-the-year (COY) and females with young. With the exception of Saskatchewan, COY are not legal for harvest. Females with COY are not legal for harvest except in Nova Scotia

Table 8.2. Bag limits, number of hunters, and annual harvest of American black bears in Canada, based on 1993 survey responses.[a]

Hunting, trapping, and mortality	Alberta	British Columbia	Manitoba	New Brunswick	Newfoundland	Northwest Territories	Nova Scotia	Ontario	Québec	Saskatchewan	Yukon
Annual bag limit	1, 2, 6[c]	1, 2[d]	1[e]	2	2	1	1	1	2	1	?
Hunters (No.)[b]											
Resident	11,286	17,544	2,000	1,184	?	?	245	7,673	18,977	?	?
Non-resident	1,445	2,265	950	2,406	?	?	14	10,347	4,486	?	?
Total	**12,731**	**19,809**	**2,950**	**3,590**	**-**	**-**	**259**	**18,020**	**23,463**	**-**	**-**
Country total = 80,822											
Harvest (no. killed)[b]											
Resident hunters	1,458	3,270	600	195	100	30[f]	88[g]	1,565	2,424[g]	1,300[g]	87[h]
Non-resident hunters	925	795	700	768	50			5,198			
Shot by trappers	79	*	200–400[i]	?	?	?	?	14[i]	656[i]	250[i]	?
Trapped	-	-		-	?	-	58				?
Damage and nuisance	280	409	200–400	20–25	>25	10	?	?	24	<100	14
Illegal/unreported	>1,000	*	*	51	?	*	16	?	9	?	?
Highway mortality	?	?	*	21	?	*	*	?	?	?	4
Total	**3,742**	**4,474**	**1,900**	**1,060**	**175**	**40**	**162**	**6777**	**3,113**	**1,650**	**105**
Country total = 23,198											

[a] Based on most recent data available.
[b] ? = unknown; - = not applicable; * = “insignificant”.
[c] Bag limit of 1 or 2 depends on management unit; trappers on registered traplines may harvest 6 bears.
[d] Bag limit of 1 or 2 depends on management unit.
[e] On registered traplines annual harvest limit varies from >1 to unlimited.
[f] Sport harvest figure includes resident and non-resident harvest. Native harvest termed “small”.
[g] Sport harvest figure includes resident and non-resident harvest.
[h] Total harvest including resident hunters, non-resident hunters, and trappers.
[i] Trapper harvest figure includes those shot and trapped by licensed trappers.

WWF/Terry Domico

American black bears (*Ursus americanus*) eating at a garbage dump, British Columbia, Canada.

Table 8.3. Legal harvest methods of American black bears in Canada, based on 1993 survey responses.

Hunting method	Alberta	British Columbia	Manitoba	New Brunswick	Newfoundland	Northwest Territories	Nova Scotia	Ontario	Québec	Saskatchewan	Yukon
Firearms	X[a]	X	X	X	X	X	X	X	X	X	X
Archery	X	X	X	X	X	X	X	X	X	X	X
Bait	X[b]		X	X	X		X[c]	X	X	X	
Dogs		X						X	X	X	X
Traps			X		X		X[d]	X	X	X	X

[a] X = Legal harvest method.
[b] Designated management units only.
[c] Hunting permitted only over registered bait sites.
[d] Separate snaring license required.

and Saskatchewan. In Alberta, females with COY are protected on public lands, whereas in New Brunswick and Ontario they are protected only during the spring hunt. In Northwest Territories, females with yearlings are also protected. British Columbia and Yukon Territory protect bears less than two years of age and bears accompanied by bears less than two years. All other provinces allow harvest of females with yearlings.

Annual mortality: Annual black bear mortality in Canada exceeds 23,189 bears. Causes of mortality include hunting, trapping, road kills, and depredation kills.

Habitat management

Alberta is the only province currently managing habitat for black bears. Their management program consists of habitat inventory, protection, retention (integration of bear management goals with those of other resources), and enhancement (increase forest diversity through habitat manipulation).

Human-bear interactions

Encounters with black bears are inevitable where humans and black bears share the same territory. There have been 16 recorded nonfatal assaults by black bears and 14 human fatalities in Canada over the past few decades (Table 8.4).

Black bear damage and nuisance complaints commonly involve crop and livestock depredation, apiary damage, and garbage nuisance. Five provinces reported some level of damage and nuisance bear translocation. Alberta, British Columbia, and Saskatchewan reported fewer than 100

Table 8.4. Non-fatal and fatal attacks by American black bears on humans in Canada, based on 1993 survey responses.

Province	No. non-fatal attacks	No. fatal attacks
Alberta	12[a]	5[a]
British Columbia	0[b]	3[b]
Manitoba	Unknown	Unknown
New Brunswick	0	0
Newfoundland	2[c]	0[c]
Northwest Territories	"Rare"	0
Nova Scotia	0	0
Ontario	2[d]	6
Québec	Unknown	Unknown
Saskatchewan	"Exceedingly rare"	0
Yukon	Unknown	Unknown

[a] Data collected since 1974.
[b] Data collected from 1980–1986.
[c] Data collected since 1922.
[d] No data on black bear attacks collected by province personnel.

translocations annually. New Brunswick estimated translocation of 50–60 bears annually whereas Nova Scotia estimated fewer than 15. Only Alberta allows for financial compensation to the landowner affected by damage and nuisance bears.

Educational programs and needs

Most black bear education programs in Canada center on camper safety. Five provinces publish brochures and other information to help reduce the risk of bear encounters in the backcountry. Additionally, Newfoundland is currently implementing a bear safety program for backcountry users. Educational videos and television programs about bears are available from Northwest Territories.

Provincial agencies want to expand existing educational programs about black bears. School and public presentations by wildlife officers are desired in New Brunswick, Newfoundland, Northwest Territories, and Saskatchewan. Also, the promotion of non-consumptive uses is desired in British Columbia, and strategies to help minimize black bear crop depredation are needed in New Brunswick. Finally, all provinces need readily available bear fact sheets and camper safety guidelines.

Management recommendations

Recommended management activities for the Canadian black bear vary widely based on the priorities of individual provinces (Table 8.5). The handling of nuisance bears and increase of nonconsumptive uses seem to be the most needed management actions.

Table 8.5. Future management activities recommended for American black bears in Canada, based on 1993 survey responses.

Recommended management	Alberta	British Columbia	Manitoba	New Brunswick	Newfoundland	Northwest Territories	Nova Scotia	Ontario	Québec	Saskatchewan	Yukon
Develop accurate, inexpensive censusing techniques	X[a]			X	X		X			X	X
Management of nuisance bears	X	X	X	X		X			X		
Research impacts of consumptive and nonconsumptive use	X	X						X	X	X	
Research habitat selection on landscape basis	X			X			X			X	
Research population dynamics			X				X			X	X
Continue/expand public education	X	X			X	X					
Eliminate trade of bear parts		X									X
Improve human waste management	X	X									
Collect better baseline data			X				X				
Protect den sites									X		

[a] X = Need indicated by province personnel.

Table 8.6. American black bear harvest seasons and regulations in the United States of America (1992), based on 1993 survey results.

State	Season(s)	Notes
Alaska	1 Sept.–30 June OPEN 1 Sept.–25 May	Units 1, 2, 3, 5, 6 Units 7, 9, 11–13, 15–26 Unit 14A Dogs and baits require permits, harvesting females with cubs is prohibited, Bears may be killed in defense of life or property, bag limit for non-residents is 1 bear, residents 2 bears, only 1 of which can be glacier bear color phase
Arizona	1 Sept.–7 Sept. 1 Sept.–1 Dec. 1 April–16 April	Management units with small populations; hunting with baits prohibited Management units with large populations; hunting with baits prohibited 3 management units; hunting with baits or dogs prohibited
California	15 August–6 Sept. 10 Oct.–27 Dec.	Archery only; no dogs or bait Archery, rifle, pistol, and dogs allowed; no baiting Harvesting bears ≤ 50 pounds and females with cubs prohibited
Colorado	2 Sept.–30 Sept. ≈ 10 Oct.–10 Nov.	Still hunting with weapon of choice Concurrent with deer and elk season
Florida	30 Nov.–11 Dec. 27 Nov.–24 Jan.	Apalachicola National Forest Baker and Columbia Counties
Georgia	14 Nov.–6 Dec. Last weekend Sept. and 1st 2 weekends Oct. 15 Dec. 19 Sept.–23 Oct.	9 counties N. Georgia; hunting with dogs or baits prohibited 5 counties S. Georgia; Dogs allowed; hunting with baits prohibited Ocmulgee Wildlife Management Area; hunting with dogs or baits prohibited Archery hunting allowed on 9 wildlife management areas; additional bear hunting allowed with firearms on 9 N. Georgia wildlife management areas during 2, 4-day deer hunts
Idaho	15 April ≈ 15 May 15 April ≈ 7 June 15 Sept.–30 Sept. 15 Oct.–31 Oct. 15 Sept. ≈ 15 Oct.	Hounds, baiting, stalking, and still hunting allowed in all seasons
Maine	30 August–25 Sept. 13 Sept.–29 Oct. 30 Oct.–22 Nov.	Baiting, stalking, and still hunting allowed Hunting with dogs allowed Still hunting and stalking allowed
Massachusetts	2nd week Sept. (6 days) 3rd week Nov. (6 days)	Still hunting; dogs allowed Still hunting only
Michigan	10 Sept.–21 Oct.	Firearms, archery, dogs, and baiting allowed
Minnesota	1 Sept.–17 Oct.	Hunting with dogs prohibited; baiting can begin 2 weeks prior to the season
Montana	15 April–31 May 7 Sept.–1 Dec.	No hounds or baiting allowed in either season; archery and firearms allowed with no limitations on caliber
New Hampshire	1 Sept.–9 Nov. 1 Sept.–19 Sept. 20 Sept.–9 Nov. 16 Nov.–5 Dec.	Still hunting and stalking allowed Hunting with bait allowed Hunting with dogs allowed Still hunting and stalking allowed
New Mexico	1 Sept.–30 Oct.	No baiting or trapping
New York	18 Sept.–15 Oct. 23 Oct.–5 Dec. 27 Sept.–22 Oct. 16 Oct.–22 Oct. 27 Nov.–14 Dec. 15 Oct.–21 Nov. 15 Dec.–19 Dec.	Northern New York; all legal hunting implements Northern New York; archery season Northern New York; all legal hunting implements Northern New York; muzzleloading season Southern New York; all legal hunting implements Southern New York; archery season Southern New York; archery season Still hunting, stalking, and driving allowed; hunting with dogs or bait prohibited in all seasons
North Carolina	9 Nov.–1 Jan.	5 seasons in different parts of the state that range in length from 6 days to the entire interval; firearms (including handguns), archery, dogs, and still hunting allowed; Dogs prohibited

Table 8.6 ... continued. American black bear harvest seasons and regulations in the United States of America (1992), based on 1993 survey results.

State	Season(s)	Notes
Oregon	1 Sept.–30 Nov. 15 May–30 June OR	Firearms, archery, dogs, and baiting allowed Controlled spring seasons; firearms, archery, dogs, and baiting allowed 1 April–15 May
South Carolina	3rd week Oct. (6 days) 4th week Oct. (6 days)	Still hunting Dogs allowed
Tennessee	12 Oct.–16 Oct. 2 Dec.–15 Dec.	Dogs allowed Dogs allowed
Utah	28 August–12 Oct. 6 Nov.–30 Nov.	Bait, dogs, and stalking allowed Bait, dogs, and stalking allowed
Vermont	1 Sept. ≈ 17 Nov.	Season closes 5th day of regular deer season; baiting and trapping are not allowed
Virginia	9 Oct.–6 Nov. 29 Nov.–1 Jan. 22 Nov.–1 Jan. 29 Nov.–1 Jan.	Archery Archery Gun season without dogs Gun season with dogs
Washington	1 August–31 Oct. 1 Sept.–25 Oct. 1 August–31 August	Western Washington; any legal big game weapon, bait, and hounds allowed Eastern Washington; any legal big game weapon, bait, and hounds allowed Northeast Washington; pursuit only, no harvest
West Virginia	6 Oct.–20 Nov. 6 Dec.–31 Dec.	Bow hunting (no dogs) Gun hunting (dogs permitted in 11 counties, but prohibited in 5 others)
Wisconsin	11 Sept.–8 Oct. 11 Sept.–1 Oct. 18 Sept.–8 Oct.	Zone C (baiting allowed, but no dogs) Zones A and B, dogs allowed Zones A and B, bait/other The opportunity to hunt first in zones A and B flip-flops annually between dog hunters and bait/other hunters
Wyoming	1 Sept.–15 Nov. 1 May–1 June 1 May–7 June 1 May–15 June 1 May–30 June	Hunt Areas 3–27, 29–31 Hunt Areas 3, 5, 6 Hunt Areas 4, 7–12, 14–22, 24, 30, 31 Hunt Areas 13, 23, 29 Hunt Areas 25–27 Harvesting cubs and females with cubs is prohibited; baiting is allowed

Status and management of the black bear in the United States

Surveys were sent to bear biologists in 40 states. We requested information on distribution and population status, legal status, population and habitat threats, population and habitat management, human-bear interactions, educational programs, and management recommendations. We received responses from 39 states.

Legal status

Black bears are classified as a game species in 33 states, although five of these states have no open hunting season (Alabama, Maryland, Nevada, New Jersey, and Oklahoma). Bears in Louisiana, eastern Texas, and southern Mississippi (*Ursus a. luteolus*) are federally listed as a threatened subspecies under the Endangered Species Act of 1973. Seven states classify black bears as rare, threatened, or endangered. Florida has a dual designation, with two northern populations classified as game and all other populations classified as threatened.

Population and habitat threats

A majority of states regarded habitat loss (n = 35) and fragmentation (n = 32) as threats to the species. Thirteen states considered political constraints on proper management of black bears a threat. Relatively few states considered poaching (n = 11), depredation kills (n = 8), roadkills (n = 6), or overharvest (n = 4) as threats to black bear populations. Kentucky, Missouri, and North Carolina reported limited public knowledge of bear biology and management as a potential threat to black bears. Montana considered the shortage of finances to adequately address species needs a potential threat.

Population management

Hunting levels: Twenty-eight states have black bear hunting seasons. Nineteen states have a bear hunting license, with some also requiring a big game license. In eight states, only a big game license is required to hunt black bears. Nationally, more than 481,500 licenses which allow black bears to be hunted are sold annually.

Harvest limitations: Hunting methods and seasons vary considerably among states and may be complex (Table 8.6). Bear hunting seasons include fall only, spring and fall, or year-round. Spring and year-round seasons are primarily held in western states, where black bear populations are relatively large.

Annual mortality: From 1988–1992, harvests averaged 18,845 bears per year for the entire USA (Table 8.7). Mean

Table 8.7. Population and mortality statistics of American black bears in the United States of America, based on 1993 survey responses.

State	Estimated population size	Population trend	Status	No. of bear licenses	No. of big game licenses	Annual black bear harvest 1988	1989	1990	1991	1992	1988–1992 mean	Mean no. road kills/year
Alabama	<50	=	Game	-	-	-	-	-	-	-	-	1
Alaska	Unknown	=	Game	1,300	84,000	1,705	1,516	1,724	1,751	N/A	1,674	?
Arizona	2,500	=	Game	4,500	0	159	293	165	104	124	169	10
Arkansas	2,200	>	Game	0	4000	14	30	19	102	44	42	1
California	20,000	>	Game	12,000	0	1,359		1,211	1,493	1,266	1,332	?
Colorado	8,000–12,000	Unknown	Game	3,750	0	673	592	401	430	475	514	<10
Connecticut	15–30	>>	Unclass.	-	-	-	-	-	-	-	-	<1
Florida	1,000–2,000	=	Threat./Game	200	700	41	60	39	60	22	44	35
Georgia	1,700	>	Game	0	12,500	103	97	116	100	101	103	-
Idaho	Unknown	<	Game	0	20,000	1,139	1,415	1,567	1,475	N/A	1,399	<5
Kentucky	<200	>>	Protected	-	-	-	-	-	-	-	-	1
Louisiana	200–400	>	Threatened	-	-	-	-	-	-	-	-	<6
Maine	19,500–20,500	=	Game	10,133	0	2,673	2,690	2,088	1,665	2,042	2,232	25
Maryland	175–200	>	Game	-	-	-	-	-	-	-	-	4
Massachusettes	700–750	>	Game	1,345	0	37	29	29	25	68	38	6
Michigan	7,000–10,000	>	Game	5,000	0	1,700	1,200	740	1,100	1,200	1,188	15
Minnesota	15,000	>>	Game	8,300	0	1,509	1,930	2,381	2,143	3,175	2,228	70
Mississippi	<50	>	Endangered	-	-	-	-	-	-	-	-	1
Missouri	50–130	>>	Rare	-	-	-	-	-	-	-	-	1
Montana	15,000–20,000	=	Game	0	13,564	1,241	1,664	1,350	1,153	N/A	1,352	18
Nevada	300	>>	Game	-	-	-	-	-	-	-	-	2
New Hampshire	3,500	>>	Game	9,786	0	198	241	291	123	230	217	17
New Jersey	275–325	>>	Game	-	-	-	-	-	-	-	-	10
New Mexico	3,000	<<	Game	2,430	0	258	230	297	292	228	261	<3
New York	4,000–5,000	>	Game	0	200,000	755	880	660	763	827	777	36
North Carolina	6,100	>>	Game	0	12,000	536	575	764	714	1,059	730	64
Oklahoma	116	>>	Game	-	-	-	-	-	-	-	-	0
Oregon	25,000	>>	Game	20,000	16,000	926	779	1,053	1,363	960	1,016	5
Pennsylvania	7,500	=	Game	?	?	?	?	?	?	?	1,560	?
South Carolina	200	>	Game	0	225	4	10	2	5	9	6	1
South Dakota	Unknown	Unknown	Threatened	-	-	-	-	-	-	-	-	-
Tennessee	750–1,500	>>	Game	0	3,500	76	78	124	66	78	84	5
Texas	Unknown	>>	Threatened	-	-	-	-	-	-	-	-	0
Utah	800–1,000	>	Game	162	0	69	97	22	35	32	51	1
Vermont	2,300	=	Game	0	?	368	311	163	237	337	283	8
Virginia	3,000–3,500	>	Game	0	?	?	?	?	?	?	480	30
Washington	27,000–30,000	>>	Game	13,000	0	864	1,426	?	1,379	1,400	1,267	?
West Virginia	3,500	>>	Game	8,000	9,000	400	510	235	426	455	405	26
Wisconsin	6,200	>	Game	2,110	0	1,123	985	1,247	1,219	1,469	1,209	12
Wyoming	Unknown	=	Game	4,094	0	226	216	222	238	220	224	<10
Total				**106,110**	**375,489**	**18,156**	**17,854**	**16,910**	**18,461**	**15,821**		

Decreasing: <<; slightly decreasing: <; stable: =; slightly increasing: >; increasing: >>.
Data taken from Servheen (1990); mean annual harvest data from 1983–1987.

annual harvests ranged from six bears in South Carolina to 2,232 in Maine over this same five year period. Annual reported mortality due to vehicle collisions ranged from zero (Oklahoma and Texas) to approximately 70 (Minnesota) per state, averaging over 400 bears for the entire USA (Table 8.7).

Habitat management

Ten states conduct habitat management specifically for black bears (Table 8.8). Activities range in scale from protection of den trees (Georgia) to land acquisition (Florida and Louisiana) and involve state and federal agencies and private organizations.

Human-bear interactions

Many states reported black bear damage and nuisance problems related to garbage (n = 27), apiaries (n = 27), and property (n = 21). Additionally, bear damage involving animal depredation and commercial interests (i.e., agricultural crops and timber resources) were reported by several states (n = 14 and n = 12, respectively). Nuisance complaints related to human injury were least common (n = 5).

Educational programs and needs

Twenty-one states provide educational programs related to black bears (Table 8.9). The primary focus of many of these programs involves general life history and management of bears, hunter safety and techniques, prevention of human-bear interactions, bear depredation, and habitat protection. These education programs utilize brochures, slide shows, exhibits, and seminars. Several states indicate needs for public education topics that include black bear biology and co-existing with bears. Additionally, many states considered educating the non-hunting public about black bear management important.

Management recommendations

To better address management of black bears in the future, many states considered population dynamics (n = 18), management of nuisance bear (n = 16), management of fragmented population (n = 14), and habitat management (n = 13) important issues. Several states also reported integrated regional management (n = 8), reliable mortality data (n = 10), and the general lack of data (n = 5) as important issues. Relatively few states reported timber harvest (n = 7) and the role of dispersal (n = 6) as

Table 8.8. Habitat management actions conducted specifically for American black bears in the United States of America, based on 1993 survey responses.

State	Habitat management action	Responsible agencies
Florida	Land Purchase	Florida Dept. of Natural Resources, US Fish and Wildlife Service, US Forest Service, Florida Water Management Districts
Georgia	Den Tree Preservation and Habitat Protection	US Forest Service
Louisiana	Land Acquisition Reforestation and Beneficial Forestry Practices	Louisiana Dept. of Wildlife and Fisheries, US Fish and Wildlife Service Louisiana Dept. of Wildlife and Fisheries, Soil Conservation Service, US Army Corps of Engineers, US Fish and Wildlife Service, Black Bear Conservation Committee
Maine	Management of Beech Stands	Maine Dept. of Inland Fisheries and Wildlife – Cooperative agreements with private landowners
Montana	Protection of Riparian Habitat and Travel Corridors	Montana Dept. of Fish, Wildlife, and Parks
New Hampshire	Forestry Practice Modification	US Forest Service
North Carolina	Timber Management Food Plots, Fruit Trees and Shrubs Permit Review	US Forest Service, North Carolina Wildlife Resources Commission North Carolina Wildlife Resources Commission North Carolina Wildlife Resources Commission
Tennessee	Timber Harvest Prescriptions	US Forest Service, Tennessee Wildlife Resources Agency
Vermont	Protection of Beech Stands	US Forest Service, Vermont Dept. of Fish and Wildlife, Vermont Dept. of Forests, Parks, and Recreation, Timber Companies
Virginia	Land Management Plan	US Forest Service

Table 8.9. Black bear education programs in the United States, based on 1993 survey responses.

State	Education focus	Method of delivery
Colorado	Human safety in bear habitat.	
Connecticut	Population increases, nuisance activities, and management problems.	
Florida	Project Wild.	
Idaho	Differentiating between grizzly and black bears.	
Kentucky	Black bear habits and warning not to feed.	Brochure
Louisiana	Hunter awareness of protected status. Landowner awareness of habitat needs.	
Maine	Population monitoring and harvest management. Ecology, research, and management.	Video Slide programs
Maryland	Habits, biology, and management.	
Massachusetts	Alleviating depredations on farms. Alleviating depredations and nuisance activities. Project Wild. Allow educators to participate in den work.	Brochure Posters for campgrounds
Michigan	Education strategy is being developed, will focus on coexisting with bears and bear management.	
Minnesota	Hunting techniques. Avoiding bear-human conflicts.	 Brochure
Mississippi	Explanation of endangered species status.	Museum of natural science
Missouri	Bear habits, foods. Minimizing nuisance/damage.	In developmental stages
Montana	Bear biology and habitat needs. Living with bears.	
Nevada	Prevention of nuisance complaints.	
New Hampshire	Natural history and management.	Slide presentations
New Jersey	Behavior and nuisance prevention techniques.	
New York	Natural history and management.	
North Carolina	Natural history and management.	
Oklahoma	Minimizing bear-human interactions. Natural history and information on immigration.	
Tennessee	Avoiding bear-human conflicts. Bear restoration in Big South Fork National River and Recreation Area.	
Utah	Project Wild. Public education.	
Vermont	Habitat maps. Management, critical habitat protection, fragmentation, and habitat loss.	 Seminars and articles
Wisconsin	Management and coexisting with bears.	Slide presentations (no organized program)
Wyoming	Avoiding bear-human conflicts. Identification and size estimation. Public attitude surveys.	

important management issues. Sixteen states report other management needs such as education, mapping and protection of critical bear habitats, and management of human growth.

Status and management of the black bear in Mexico

Legal status

The legal status of the Mexican black bear is “endangered,” as considered by the Mexican wildlife agencies, Secretaria de Desarrollo Social, and Secretaria de Agricultura y Recursos Hidraulicos.

Population and habitat threats

An increasing human population and a poor economy are contributing to extensive habitat loss and poaching of unprotected populations of black bears. A weak economy and demands upon government agencies to attend to social problems place wildlife management low on the list of priorities. Enforcement of wildlife laws remains essentially non-existent.

Public lands do not offer protection for wildlife; therefore, most healthy wildlife populations exist on private, isolated ranches. Ranchers are now beginning to manage wildlife for hunting and tourism to supplement decreasing income from cattle ranching.

Habitat is being lost due to overgrazing, land-clearing, and woodcutting. Most of these activities are conducted by “campesinos” (country dwellers or peasants) who have moved from the cities where unemployment is high. Previous governmental policies contributed to land erosion with the expropriation of large land holdings, subdivision, and distribution of these lands to campesinos for food production. Sound land management training, however, was not provided. Campesinos ran cattle or planted crops, and when the land was no longer productive, turned the land back over to the government and petitioned for new lands. A recent ruling by the Mexican president, however, amended the Constitution, giving title to the campesinos, and prohibiting the expropriation of new lands for this purpose.

Management

Black bear hunting seasons have been closed since 1985. Due to minimal law enforcement, however, poaching is uncontrolled and no data are available to indicate the level of poaching. The Mexican government became a signatory to CITES in 1990.

No governmental efforts have been made to manage habitat for black bear conservation. Many ranchers, however, establish watering areas for bears, and sometimes feed bears (syrup and oats) at remote locations during times of low bear food production. Ranchers state that they experience less cattle predation when bears are fed. There is no evidence of habituated bears, as feeding locations are remote and the area is essentially unpopulated by humans. In the Serranias del Burro, there is no indication of poaching by ranchers.

Human-bear interactions

Popular literature has reported cases of human-bear encounters, with most relating to cattle predation. Most problem bears are reported to governmental agencies (n=3; 1993; for the Mexican states of Coahuila and Nuevo Leon) or are tolerated.

Educational programs and needs

Programs need to be developed to educate the public about black bears. Emphasis should be given to the education of children, ranchers, and wildlife managers.

Management recommendations

Managers are not adequately trained for handling bear-related problems, such as cattle predation or habituated bears. Workshops to educate managers can be taught in one to two days, and various agencies could participate. Managers would learn problem-solving for human-bear conflicts, capture techniques with culvert traps, and basic bear biology and ecology. The cost is estimated at US$700 per workshop (travel and lodging for instructor).

Many ranchers are interested in bear conservation, but are unaware of how to co-exist with the species. A guide for ranchers on how to co-exist with the black bear is important. Such a guide would include sections on bear biology, food habits, and ecology, to familiarize the rancher with bears. Problem-solving sections would include how to determine bear predation sign from other species, how to avoid human-bear conflicts, and what to do in the event of human-bear interactions. Water catchment designs will be included to help ranchers avoid cub drownings, and to protect equipment from being destroyed by bears. Suggestions for maintaining healthy bear habitat will also be provided. The guide would include color photographs, stories, and cartoons to motivate readership. The cost of this program is estimated at US$20,800 (includes salary for eight months and printing costs).

Little information is known regarding the present status of the black bear in Mexico, but such information is essential for the establishment of management plans. An updated version of Leopold's (1959) distribution map of the black bear in Mexico could be constructed through information gathered from agency biologists, game wardens, researchers, and ranchers. Although the information would be subjective, assumptions could be made regarding the general health of black bear populations in areas previously observed by Leopold. Such a study should take about four months with an estimated cost of US$15,000.

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Chapter 9

Spectacled Bear Conservation Action Plan

Bernard Peyton

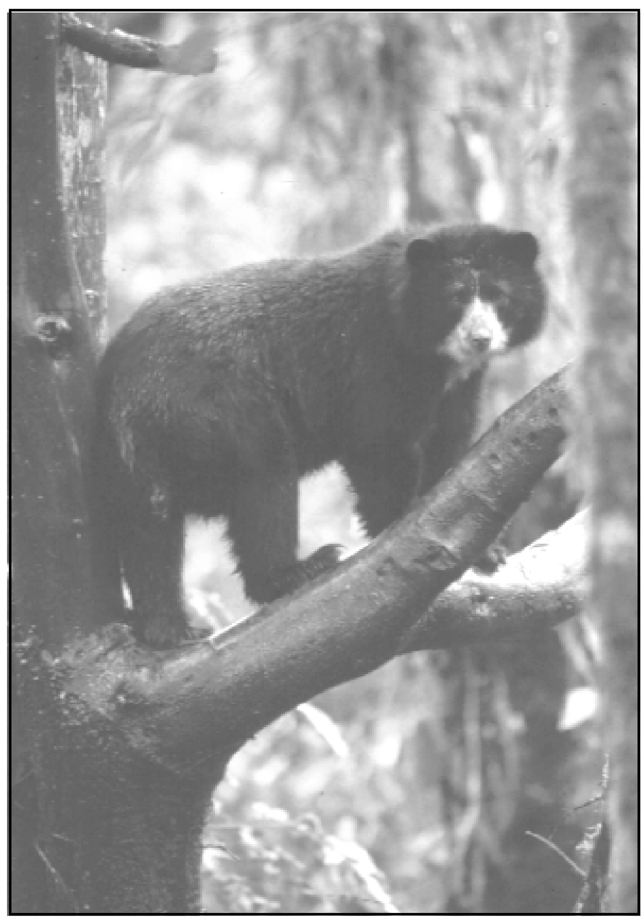
IUCN Category: Vulnerable, A2bc **CITES Listing:** Appendix I
Scientific Name: *Tremarctos ornatus*
Common Names: spectacled bear; Andean bear; *oso de anteojos*, *oso frontino* (spectacled bear); *oso achupayero* (bromeliad eating bear); *oso ganadero* (cow eating bear); *el salvaje*, *oso real*; *manaba*; *meéni*; *ucumari*, *ucucu*, *uco*, *uca* (bear with mystical power); *puca mate* (red fronted bear from eating cows); *yura mateo* (white fronted bear); *yanapuma* (black puma)

Introduction

Between 1991 and 1993, five country reports (for Bolivia, Perú, Ecuador, Colombia, and Venezuela) were written by coordinators who solicited information from more than 60 individuals familiar with spectacled bears. This introduction contains a summary of the main themes addressed in these reports as well as information on the biology of the species, its management needs, and conservation value. The country reports contain detailed information on actions that are needed to counter threats to spectacled bear populations and their habitat.

Physical description: Spectacled bears are an intermediate-sized bear. Adult males measure 1.5 to 2.0m head-body length and weigh between 140 and 175kg (Peyton 1980, Mondolfi 1971). Female bears are 2/3 the size of male bears. Pelage is usually black but can be a dark red brown. The common name "spectacled" refers to the white to light yellow markings that appear on the bridge of the nose, and most often over or around one or both eyes, under the chin, and sometimes extending down to the chest. These markings are individually variant (Roth 1964).

Like all bears, spectacled bears are plantigrade and have longer front limbs than hind limbs. The latter feature enables bears to climb trees, a behavior spectacled bears are especially known for (Peyton 1980). They have stocky bodies, short tails that are often hidden in the fur, short thick necks, small rounded ears, and the shortest relative muzzle length of the extant bears (Mondolfi 1971). Spectacled bears also have the largest zygomaticomandibularis muscle relative to its body size of any bear species (Davis 1955). The last two features, which are shared most similarly with the giant panda (*Ailuropoda melanoleuca*), allow spectacled bears to grind tough fibrous foods, thereby securing its niche against competitors. Unlike the ursid bears whose fourth premolar has a more well-developed protoconid, an adaptation for shearing flesh (Kurtén 1966), the fourth premolar of spectacled bears has blunt lophs (like its other molars and premolars), has three pulp cavities instead of two, and can have three roots instead of the two that characterize ursid bears (Thenius 1976). The musculature and tooth characteristics are designed to support the stresses of grinding and crushing vegetation. Quite possibly spectacled bears are the most herbivorous of all bear species. They share the ursid dental formula of 42 teeth



Spectacled bear (*Tremarctos ornatus*) in Andean forest, Colombia.

L. Mazariegos

(i 3/3, c 1/1, p 4/4, and m 2/3). The chromosome number, 2n=52, is unique among bears (Ewer 1973; Nash and O'Brien 1987).

Reproduction: Presumed mating pairs have been observed together at times of fruit ripening between March and October, indicating that wild spectacled bears may be adapted to breed at various times of the year, as they do in captivity (Dathe 1967). Like all bears, spectacled bears are monestrous. They are probably capable of delayed implantation as evidenced by the variable gestation periods of 160 to 255 days observed in captive bears (Saporiti 1949; Grzimek 1975; Bloxam 1977; Rosenthal 1987a) and wild births that occur "out of season", but appropriately timed for cubs to ingest ripe fruit during years when the El Niño current disrupts normal fruiting phenology. Wild births normally occur several months prior to a time of heavy fruit fall during the rainy season. The timing allows cubs to be old enough to ingest ripe fruits. Parturition for most spectacled bears in captivity (101 of 112 births, Mueller 1989) and the wild (Peyton 1980) occurs between December and February. From one to three young, weighing 300–330g each are born in captivity (Dathe 1967). Litter sizes in the wild range from one to four cubs with two being the most common. Generally reported litter sizes are positively correlated with hunter estimates of female weights, food diversity and abundance, and the degree to which fruiting is temporally predictable. Age of first reproduction in captive bears ranges from four to seven years for both sexes (Weinhardt 1987; Rosenthal 1987b). No data is available on age of first reproduction or litter intervals in the wild.

Social behavior: Spectacled bears are generally solitary, but are reported by farmers and hunters to feed in groups of up to nine individuals in *Opuntia* cactus groves and cornfields. Cubs have been reported to stay with their mothers for up to a year after birth. Spectacled bears are active both day and night in the cloud forest. They bed down under cover during the midday in the Peruvian desert. There is no evidence that spectacled bears hibernate.

Spectacled bears are able to climb vines and understory trees with diameters equal to that of their front paws in order to reach fruit in trees with diameters too large for the animal to embrace. In forest canopies that will not support a bear's weight, the animal employs a destructive foraging technique that results in the creation of platforms of bent branches that have been described as tree nests (Tate 1931; Peyton 1987). The repeated markings of climbing bears on fruit trees, and the prevalence of scats and day beds on inclined trunks and branches are evidence of considerable arboreal activity. When fruit is unavailable, spectacled bears subsist on tough fibrous foods such as leaf petiole bases of bromeliads (*Puya*, *Tillandsia*, and *Guzmania* spp.) and palms, frailejon (*Espeletia* spp.), orchid pseudobulbs, and the meristematic tissue of certain bamboo and desert tree species. Additionally spectacled bears eat insects, rodents, birds, livestock, and carrion (Peyton 1980, 1987; Jorgenson and Rodriguez 1986; Suarez 1988; Brown and Rumiz 1989; Goldstein 1989).

Olfaction is the dominant sense. When disturbed from a day bed, spectacled bears walk several paces in different directions from a spot to which they return, then slowly negotiate steep terrain to escape. The importance of vision is suggested by saplings that are bitten and clawed on the sides facing trail entrances near concentrated food sources or along ridge lines. These signs could advertise territory ownership. The common name "ucucu", when said slowly, approximates a vocalization of the spectacled bear. Low and high pitched trills of captive bears have been postulated to function in keeping cubs and mothers united (Moss 1987).

Benefits of spectacled bear conservation

The arguments to maintain spectacled bear populations apply to all bear species; however, three benefits are particularly important to Andean residents:

Watershed maintenance: The loss of watershed products due to the destruction of bear habitat imperils the existence of Andean civilization as we know it. One half to more than three quarters of the people in the five Andean nations with bears live in highland areas close to spectacled bears (Gonzales 1991). The primary reason that governments established conservation units with spectacled bears was to preserve watershed products for this largely urban population. Their ability to govern depends on it. The trend is further deterioration of watersheds causing shortages in highland food production, drinking water, hydroelectric power, and transport capabilities. The social consequences are massive unemployment leading to anarchy in urban centers. Andean governments increasingly define the deterioration of watersheds as national security issues, sidelining their wildlife and parks officials in favor of their military to control insurgencies in the following bear inhabited areas: the Perija region of Venezuela, the central Andean range in Colombia and Perú, and the middle of the Oriental Andean range in Bolivia (see country reports). The root problem in all these areas was disproportional ownership of land and other resources; conditions which have forced farmers to abandon their fields and cut new ones on steep Andean slopes. Before long-term solutions to these social problems can be implemented, bear habitat must be maintained to prevent further social unrest that resources shortages will exacerbate. Adopting the goal of maintaining bear populations helps humans address their collective interests.

Biodiversity benefits: The spectacled bear is well-qualified to serve as an umbrella species for biodiversity in the Andes and in the world. For example, its range in the Oriental Andes from Venezuela to Bolivia comprises only 3.2% of land area in South America, yet contains 76% of the continent's mammalian species (Mares 1992). On a regional scale diversity of plant species in the northern Andes (30,000–40,000 spp.) is greater than that estimated for the Amazon basin, and far greater than the floristic richness of Europe and North America (Gentry 1982, 1991; Henderson *et al.* 1991). William Duellman (pers. comm. 1995, unpubl. data) found more than 150 species of frogs on one transect through spectacled bear habitat in Cayambe-Coca ER in northern Ecuador. This is roughly twice the number of frog species known to exist in North America (N=81 spp.). Approximately 15% of Perú's vascular plants and vertebrate species are present in 5% of Perú's landmass that is the spectacled bear's range in the cloud forests of the Oriental Andes above 1,500m (Table 9.6 in Perú's country report).

Local endemism is unusually high in the spectacled bear's range. The bear's range in the Oriental Andes from Venezuela to Bolivia contains 63% of South America's endemic mammals (Mares 1992). Typically, endemic woody plants comprise ca. 20% of the floristic richness found in these isolated habitat islands (Gentry 1986). The cloud forest range of the spectacled bear in Perú's Oriental Andes contains 32% of that country's endemic birds, mammals, and anurans combined. The ratio of the number of endemic species per unit area is approximately 5.75 times greater in these cloud forests than it is in Perú's Amazonian forest (Leo 1993). Existing conservation units contain only a small fraction of Andean biodiversity.

Cultural and spiritual reasons: In pre-Colombian mythology, the spectacled bear was worshiped as a grand mediator by which people and their endeavors passed from one condition to another, a role which undoubtedly derived in part from the bear's enormous elevational range (e.g., between the dark forces that inhabited the jungle and light upperworld on the mountain peaks, evil and good, sickness and health, death and rebirth, harvest and planting, and thus one year to the next; Randall 1982). Although increasing competition between bears and people for resources and the adoption of western culture has replaced much of the spiritual awe indigenous land users had for spectacled bears with machoistic values, vestiges of these early beliefs exist throughout the range of the spectacled bear, most notably in Colombia, southern Perú, and northern Bolivia. Everyone that identifies with spectacled bears, whether through humility or machismo, derives strength from this species to combat their deteriorating socio-economic conditions. A lot of hope for self-improvement will die with the extinction of spectacled bears in the wild.

Status and distribution

Spectacled bears occur in all three ranges of the Andes from the Cordillera Merida in Venezuela to the Argentine/ Bolivian border (see country reports for details). The species has been reported to occur in the Darién region of Panama (Jorgenson 1984), and up until very recently in northwestern Argentina where isolated individuals may still exist (Brown and Rumiz 1989).

The altitudinal range of the species on the western Andean slope extends from 250m in the coastal deserts of Perú to 4,750m at the snowline. On the eastern Andean slope the known range extends down to 900m in parts of Ecuador and Perú, and 550m in Amboro, Bolivia. Within these elevational limits, spectacled bears inhabit dry thorn forests, humid to super-saturated rain forests, steppe lands, paramos, and puna grasslands. Before spectacled bear populations became fragmented during the last 500 years, a single spectacled bear population on the border of Perú and Ecuador inhabited as great a range of habitat types (250ml to 4m annual precipitation) as the world's brown bears now occupy. The best habitats are humid to very humid montane forests. These cloud forests typically occupy a 500–1,000m elevational band between 1,000m and 2,700m, depending on latitude. Generally, the wetter these forests are the more food species they support for bears. That is a reason why relative population densities and reported litter sizes are higher in the tropical forests from Colombia to northern Perú than they are in the subtropical forests of Venezuela, southern Perú, and Bolivia. Most of the cloud forests are on the eastern slope of the Oriental Andes where an estimated 85% of the spectacled bear population is found.

Female spectacled bears with cubs occupy areas with concentrated food sources near relatively inaccessible security cover. In the Peruvian desert these areas are centered around water holes flanked by steep cliffs where day beds were found under boulders. Tree canopies provide security cover and fruit for cubs in the cloud forest. Female bears make use of paramo grasslands at the forest edge five to eight months after cubs are born. Security cover here is found in small forest patches on steep slopes. The thick tangle of branches up to 2m from the ground on frost damaged trees were microsites that yielded the most evidence of being occupied by cubs. These bedding sites were within 100m of concentrated sources of food (terrestrial bromeliads), and were generally located at the point where a stream entered the forest from the grasslands. Predators of spectacled bear cubs include mountain lion (*Felis concolor*), and possibly male bears. Spectacled bears appear to avoid jaguar (*Panthera onca*), suggesting that jaguar might be considered a predator. The elevational ranges of these two species in Perú and Bolivia do not overlap on the same mountain slope, but do for 900m of elevation if the entire Cordillera Oriental is considered.

Here, jaguar can occur up to 1,500m in elevation and spectacled bears can descend as low as 600m in elevation (B. Peyton unpubl. data).

Spectacled Bear Specialist Group (SBSG) members are confident that there are at least 18,250 wild spectacled bears. Given the amount of area the bears occupy, there could be several times that amount. Spectacled bears currently occupy at least 50 habitat fragments totaling approximately 260,000km^2 (Figure 9.1, Table 9.1). Four habitat fragments probably contain more than 1,000 adult spectacled bears each. All of these occur on the eastern slope of the Oriental Andes. The largest habitat fragments are in Perú and Bolivia where over two-thirds of the bear's range exists (Peyton *et al.* 1997).

According to the IUCN Red List categories (IUCN 1996), spectacled bear populations are Vulnerable to

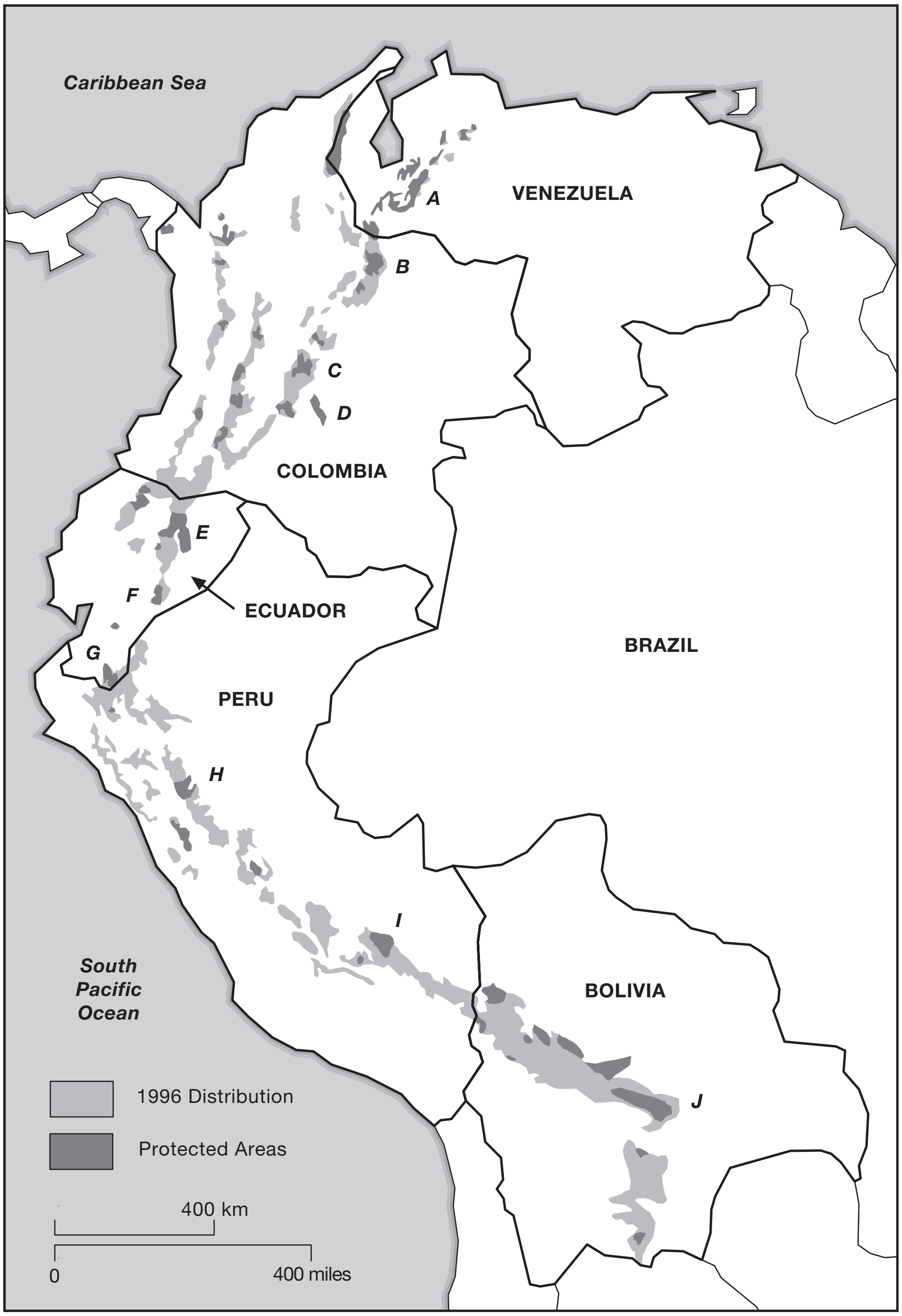


Figure 9.1. **Range of the spectacled bear (*Tremarctos ornatus*) in Latin America's protected (black shaded) and unprotected (gray shaded) parts of the Andes. Letters denote parks or reserves that contain >1,900km^2 of habitat occupied by spectacled bears or that have that potential (areas A–C and G).** Protected areas A–J are: A) Sierra Nevada/Tapo Caparo, B) El Cocuy, C) Sumapaz, D) Sierra de la Macarena, E) Cayambe–Coca/Sumaco–Napo, F) Sangay, G) Podocarpus, H) Rio Abiseo, I) Manu, J) Carrasco/Amboro.

Table 9.1. Amount of spectacled bear range under conservation status (categories I–V of IUCN 1984) and in unprotected wilderness in five Andean nations.
Statistics also include the number of parks containing spectacled bears, their total area, and the total amount of spectacled bear range within a country. Figures in parentheses are the percent of protected land areas occupied by bears.

Country	Number of parks	Park area (km^2)	HABITAT OCCUPIED BY BEARS Park (km^2)		HABITAT OCCUPIED BY BEARS Wilderness (km^2)	Total bear range (km^2)	
Venezuela	13	14,230	1,000	(2.1%)	20,410	21,410	(8.2%)
Colombia	20	32,610	8,250	(17.0%)	21,830	30,080	(11.5%)
Ecuador	10	20,250	8,230	(17.0%)**	20,580	28,810	(11.1%)
Perú	6	23,330	5,760	(11.9%)	76,440	82,200	(31.5%)
Bolivia	9	54,210	25,150	(52.0%)	73,040	98,190	(37.7%)
Total	58	144,630	48,390		212,300	260,690	

* Area does not include the Galápagos Marine Resource Reserve;
** Area does not include Langanates National Park and Illinizas Ecological Reserve because the extent of bear occupied habitat in these two recently created parks is unknown.

extinction. The accelerated pace of habitat conversion to commercial agriculture including drugs, hunting, and the threat of the illegal trade in bear parts all point to a faster rate of decline in both numbers of individuals, populations, and habitat than has existed in the past. Less than 10% of the original tropical montane forest remains in Colombia (Henderson *et al.* 1991), almost none remains in Ecuador's central valley between the Andean ranges, and less than 4% is left on the western Andean slope in Ecuador (Dodson and Gentry 1991). The largest remaining tracts of tropical montane forest exist on the eastern slope of the Oriental Andes south of the Ecuador/Colombia border.

The best measure that has benefited spectacled bears has been the rapid creation, enlargement, and connecting of conservation units during the last 30 years (see country reports for details). Currently there are 58 conservation units that contain spectacled bears that are classified in the first five IUCN management categories (IUCN 1984). All but two of these were established in the last 30 years, and 12 of them were established in this decade. Colombia has the most parks with bears (n = 20) and Bolivia has just over half the area with bears that is protected (25,150km^2 or 52%, Table 9.1, Peyton *et al.* 1997). Counting parks that are adjacent to each other or connected by corridors as one unit, eight protected areas contain over 1,900km^2 of bear occupied habitat (Figure 9.1). This area criteria was the median park size (n=41 parks) that contained a population of spectacled bears that were reported in 1988 to be stable or increasing (Peyton 1988). Until further studies are conducted, the SBSG considers 1,900km^2 to be the minimum size for a park to maintain a viable population of spectacled bears without fairly intensive management.

Legal status

Although hunting of spectacled bears is prohibited under forestry laws in each of the five Andean countries, the laws are not enforced. As a species listed in Appendix I, trade in spectacled bears and their parts is prohibited in these countries under the terms of the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Recently enacted legislation in Bolivia (1990) and Perú (1992 and 1993) threaten both these protective measures by allowing the take of spectacled bears for captive breeding purposes without sufficient background checks on where the bears came from or monitoring what happens to them.

Management

With the exception of productive efforts in Venezuela to manage spectacled bear populations based on mostly anecdotal information, there is no population level management being implemented for spectacled bears in the Andes that has an empirical foundation. The centralized decision-making abilities of Andean governments has allowed them to address the threats of diminishing populations of spectacled bears on theoretical grounds without hard data (e.g., create new parks and significantly enlarge others to connect habitat fragments).

Up until the last 15 years, government authorities have relied on the inaccessibility of cloud forest strongholds to protect spectacled bears. The problems associated with the increased influx of landless peasants into spectacled bear habitat (see country reports) necessitates active management at a time when institutions and their budgets are severely stressed. The consolidation and decentralization of resource management agencies that occurred in Perú in the late 1980s and in Colombia in 1993 has placed severe strains on these countries to implement management on the ground. For example there is only one park guard for every 5,700km^2 of spectacled bear habitat in Perú (Young 1992), and no vehicles for transportation. The situation is similar in Bolivia where only three of 36 parks had guards in 1991 (Marconi and Donosco 1992). Lack of inter-ministerial cooperation has resulted in governments supporting colonization, building of roads and infrastructures, oil extraction, timber harvest, and mining in national parks where such activity was prohibited (notably in Ecuador and Bolivia).

Management styles differ dramatically between Andean nations. Over the past 40 years, Venezuelans have invested oil profits in training technicians in managerial sciences. The strong institutions that resulted from these investments could afford to implement a top-down approach to protecting spectacled bear habitat. This they have done by declaring new national parks that link existing ones and removing villagers within them. The other four nations that lack both the financial and trained human resources have implemented more management sharing operations between government, private industries, and native people to protect spectacled bear habitat (notably Colombia). Proponents of these two approaches have much to teach each other.

One of the reasons why Venezuelans have been successful at implementing conservation action from the top-down is because only 1% of its population are indigenous people. Native people comprise a great deal more of the populations of Ecuador (21.8%), Perú (35.4%), and Bolivia (21.8%, Schwerin 1991) and are the majority of the people who live with spectacled bears in these countries. Policies that encourage formal employment of these people will benefit spectacled bears more than current policies that drive them further into bear habitat.

Human-bear interactions

Spectacled bears are perhaps the least aggressive of all bear species towards humans. During four years of field work throughout Perú, B. Peyton (unpubl.) heard of only one human death caused by a spectacled bear that fell on a hunter after he shot it, and one woman who was bitten on the cheek after a surprise encounter with a bear in a cornfield. The predominant interactions are with bears that eat corn that has replaced their natural food sources. As many as 20% of the cornfields at the forest edge are besieged by spectacled bears. A few bears kill cattle, and many kills are wrongly attributed to spectacled bears. Hunter induced mortality of crop depredating spectacled bears has increased to the point where it is perceived to be as great a problem as habitat destruction (Yerena 1998). There is evidence that spectacled bears reduce both their habitat use and communication with each other following the introduction of cattle in wilderness areas (Downer pers. comm. 1993).

Public education needs

Twenty years ago it was uncommon to find someone from an Andean city who knew spectacled bears existed. Such is not the case today. Leading the way have been hundreds of non-government conservation organizations that do everything from conducting radio talk shows and lobbying legislators to managing nature reserves. The primary needs are to educate Andean residents about their role in preserving watershed products. As the largest resident of these watersheds, the spectacled bear has become symbolic of humanity's future existence.

The target of education should include more rural inhabitants with messages that address their real concerns of land titles and food security (crop depredation included). Lack of education and other means toward upward mobility in rural areas is a major reason why peasants leave farms for overcrowded cities. Latin America now has the most urban population of any continent (75% of total population, WRI 1992), a fact that belies the magnitude of these human migrations over the last 45 years. The predominantly urban population places demands on the spectacled bear habitat to provide resources that are disproportionate to the number of rural inhabitants who live with bears. At the institutional level, administrators need to become more aware of the state-of-the-art theories and practices of managerial sciences.

Specific management recommendations

1. Strengthen institutions

The first ingredient in any bear survival plan are strong institutions at all social levels. Institutions need improvements in policy coordination, training, and funding. The lack of policy coordination between government ministries is evidenced by stronger ministries (e.g., military, those regulating extractive industries, colonization, tourism, etc.) ignoring the sustained resource use policies of the weaker ones. For example oil concessions were granted in Sumaco Napo–Galeras within days of its being established as a national park (Wray and Alvarado 1996), and parts of Amboro have been simultaneously designated national park land as well as land for colonization and timber harvest (see Bolivia's country report). This lack of coordination confirms feelings of distrust that local communities have had about central governments for hundreds of years. Up until the last decade wildlife agencies were powerless to change that situation. Deficits in trained staff and funding severely limited abilities of central governments to enforce policies and monitor their compliance in rural areas. Community institutions were not granted authority over local resource use, and thus were powerless to prevent resources being wasted by outsiders and their own members. Recent partnerships between central government agencies, industry, communities, and private organizations have empowered people at all social levels to preserve resources. An important objective facilitated by private and foreign aid has been the training resource managers have received in practical and theoretical conservation science.

2. Research and monitor distribution, threats, and trends in spectacled bear populations and habitat.

The level of information on spectacled bears and their needs is in its infancy. Geographic distribution of spectacled bears is not known for much of Colombia, most of southern Ecuador, and northern Bolivia. Distribution of bears within national parks, and their seasonal habitat use has only been studied in some detail in five of 58 parks with bears. There is no information to construct a life table, or estimate reproductive parameters to model the trend in a spectacled bear population. Difficulties such as the inaccessibility and complexity of cloud forests make it unlikely that we will soon know detailed information on the needs of females with cubs, litter sizes, when females first reproduce, and seasonal movements of bears or their home range sizes.

Notwithstanding difficulties, research should generate the most useful information with the least capital expenditure and impact on bears (Servheen 1994). Research questions that meet these criteria seek to know: how much habitat spectacled bears occupy or could potentially occupy (both in and outside parks), relative population densities in these habitats, relationships between diet and reproduction in the wild, role of spectacled bears as dispersers of lumber-producing trees, trends in forest cover removal, hunting mortality, economic loss from crop and livestock, and public attitudes towards bears. Land managers thus informed could decide with greater confidence to protect critical habitat, or enact programs to reduce bear mortalities and crop depredation, etc. Research does not need to be expensive, employ high technology, or be lengthy to meet immediate management needs (Servheen 1994).

3. Concentrate management efforts in the 12 largest areas under conservation status (Figure 9.1) and/or in conservation units near large cities. Expand management to the areas between conservation units.

The era of park creation in the Andes is drawing to a close. Andean governments are starting to recognize the colonization and logging that has taken place within national parks such as Sangay (Ecuador) and Amboro (Bolivia) by reclassifying those lands as human use areas. Land in parks will continue to be lost to bears and other wildlife unless parks can become viable institutions of conservation. Management efforts should focus on the 12 largest areas of protected bear habitat (Figure 9.1), and some smaller bear areas near major urban centers such as Chingaza NP. Approximately 20% of Colombia's people (residents of Bogota) depend on Chingaza to provide water and hydroelectric power. Protected bear areas near urban centers also have greater educational and recreational value than areas farther away. Management should expand outward from these core areas to link them together or create buffer zones against further habitat fragmentation. Andean parks with bears are most linked in Venezuela and most fragmented in Perú. Although Perú has 31.5% of the total range of the spectacled bear in Latin America, only 7% of that range is included within park boundaries (Table 9.1). Three parks on the eastern slope of the Oriental Andes have approximately 90% of the protected bear habitat in Perú and are separated from each other by >250km of unprotected wilderness (Peyton *et al.* 1997). In addition to preserving land bridges within Perú, transfrontier corridors should be protected between Ecuador's conservation units and those of its neighbors (El Angel with the Awa NR in Colombia, and Podocarpus with Tabaconas–Namballe in Perú). In addition to protecting bears, these transfrontier parks would promote peace and protect two of the Andean areas of highest species diversity.

4. Create stewardship for bears and their habitat at the local level. Implement government policies that allow local communities security of land tenure. Link benefits facilitated by these policy changes with compliance with forestry law.

The existence of wild spectacled bears is dependent on communities having stewardship for them and their habitat. Land use policies throughout the Andes encourage the mining of cloud forest products without replacement. Communities with unrecognized land ownership rights and without access to credit or technical aid have little ability to thwart the destruction of resources by outsiders, and are encouraged to exploit resources before others do (see Brown and Wyckoff-Baird 1992). The necessary condition for the survival of spectacled bears are the incentives to use resources sustainably. Incentives are created by providing ownership and a shared responsibility for how those resources are used. At least 20% of the spectacled bear's range is occupied by landless peasants who are involved in the production and trafficking of narcotics, informal subsistence farming, mining, and road building. These events are the result of failed policies to initiate land reform and formal employment (Peyton *et al.* 1997).

Policies and programs that increase employment for rural inhabitants should compensate for their reduced use of forest resources and be conditional on their compliance with forestry laws. Andean forests will continue to be cut down and bears will be poached until people perceive it in their best interest to stop these actions. A more decentralized and flexible management style that adapts to regional concerns will be necessary. Alternative employment to shifting agriculture and unsupervised grazing that have benefited rural inhabitants should be expanded upon (e.g., orchid farming, palm oil extraction, pharmaceutical development, tourism, etc.). Biologists can do their part by designing research and monitoring projects to use the existing abilities of local inhabitants.

5. Educate the public, both national and international, about the benefits of preserving watersheds and spectacled bears. Severe shortages of watershed products for urban centers is sufficient evidence for land managers to argue that preserving forests for bears also benefits humans. However, education at all social levels is required before collective action will take place. Heads of government should be made aware of the waste of natural capital (e.g., topsoil, fiber, fuel, etc.) that occurs when bear inhabited forests are converted to pasture. Administrations could more accurately estimate the impact of their policies once these costs are accounted for. The international community must learn that political stability in the Andes is a precondition for maintaining Andean environments and stopping the spread of subversive activities. Current policies of the more developed countries (e.g., trade barriers, domestic subsidies for agricultural produce, control of capital markets, drug eradication programs, etc.) increase political instability in the Andes. Two decades ago few urban residents in the Andes knew spectacled bears existed. Such is not the case today due to the public education efforts of hundreds of local private conservation organizations. These efforts must continue and include more programs that target rural inhabitants. Wildlife and park administrators have little ability to enforce forestry law or mitigate abuses. However, people can be held accountable for destroying bear habitat or poaching bears with pressure from an informed public. The following section contains the lesson that needs to be conveyed.

Status and management of the spectacled bear in Bolivia

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Historic range and current distribution

The oldest records of spectacled bears (*Tremarctos ornatus*) in Bolivia belong to D'Orbigny and Gervais (1847), who reported the presence of this species in Cochabamba and Chuquisaca, and to Arribalzaga (in Salazar and Anderson 1990) who also collected a specimen in Cochabamba for the Museo Argentino de Ciencias Naturales. It is difficult to assess the former distribution of the bear in Bolivia because there are not more than a dozen collecting sites. Based on habitat information from Peru (Peyton 1980), data on the historic presence of the bear in Northern Argentina (Brown and Rumiz 1989), and information

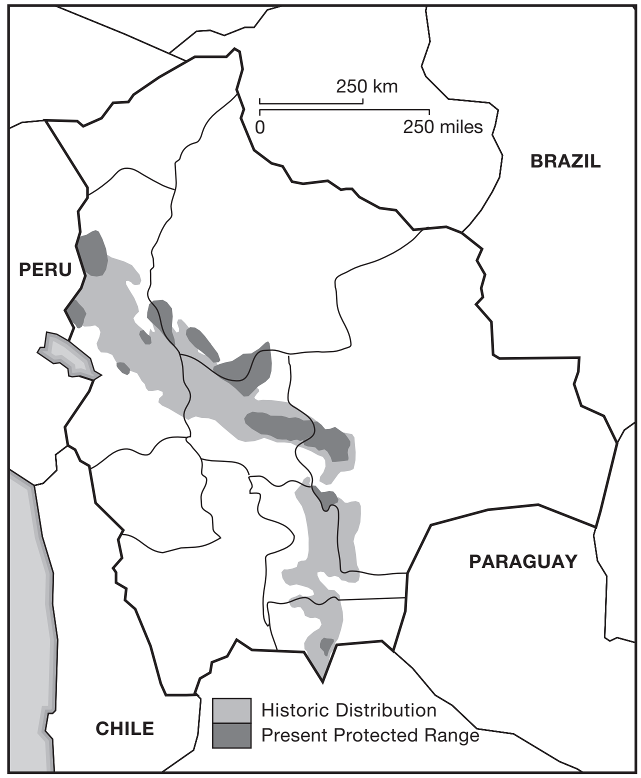

Figure 9.2. Probable historic distribution and present protected range of spectacled bear (*Tremarctos ornatus*) in Bolivia.

available pertaining to Bolivia, it can be assumed that in early 1900, spectacled bears occupied the eastern flank of the Andes, approximately between 500 and 3,000m. A possible exception to this distribution would be the dry valleys on the borders of Cochabamba, Santa Cruz, and Chuquisaca Departments (Figure 9.2).

The current country-wide distribution of the bear cannot be accurately depicted with the available information, except by extrapolating from 40 locations of signs, sightings, and collection sites from several sources (Salazar and Anderson 1990; Eulert 1995; Michel, J.A. pers. comm.) (Figure 9.2). These localities include mountain forest ecosystems between 550 and 3,200m, and a few non-forested slopes above 3,200m. Some localities may encompass areas which represent important bear populations (e.g. sites in Santa Cruz and neighboring Cochabamba, or in Yungas of La Paz), while in other sites the species may have disappeared. Extensive surveys are needed to update the bear distribution.

Status

Spectacled bear population numbers and range in Bolivia are the least known of any of the five South American countries that have bears. There has not been a country-wide survey carried out yet, and potentially important areas remain to be assessed. However, the presence of significant populations in the best known areas of La Paz and Santa Cruz shows the potential within this country for the long-term survival of the species.

Legal status

Bolivian national laws regarding particular wildlife species have existed since the last century, although for the most part, these regulations have had little or no impact on preventing poaching or regulating hunting. Prior to 1967, regulations only established taxes for trade on skins and live animals (Decreto Ley, DL# 04151 of 29/08/55; Decreto Supremo, DS# 05094 of 21/11/58; DL# 07784 of 03/08/66), and the last two laws specifically addressed tax values for spectacled bears, among other species. Hunting and trade of bears was prohibited in 1967 (DS# 08063), and in 1970 (DS# 09328) a fine was set for transgressors. A ban on hunting, transport, and trade of a list of endangered species, which included the spectacled bear, was established in 1979 (DS# 16605). The ban was extended to all wildlife for three years in 1986 (DS# 21312 of 27/06/86), and then it was extended indefinitely in 1987 (DS# 21774 of 26/11/87). In 1990, the government ratified this law and clarified that collections for scientific purposes were excluded from the ban, as long as Bolivian scientific institutions were involved (DS# 22641 of 08/11/90). However, because of lack of enforcement, none of these laws have prevented the killing of bears or their sale to zoos. This lack of law enforcement regarding wildlife issues in general is due to a series of factors, among which the inefficiency and lack of power of local wildlife officials have been the most important.

Population threats

Hunting of bears has been recorded in most parts of its range, and usually occurs when bears frequent either cornfields or grazing pastures. Bears are blamed for any cow killed or lost. Soon after a carcass is found, small hunting groups (2–3 people) are organized to go after any bears present. There are few accounts of people actually seeing a bear taking a cow. One person reported, "... the bear grabbed the animal by the horns, twisted the head towards the cliff and pushed it off. Once the animal is dead in the base of the cliff, then the bear climbs down the cliff and eats the stomach ..." (Salazar and Yañez, unpublished). Also in the Yungas of La Paz, bears are hunted because they raid cornfields, and they can "... easily consume 10 ears of corn every nine meters when alone, but they often come in pairs or with youngsters ..." (Salazar and Yañez, unpublished). These incursions usually happen in June or July (austral winter), a period of the year when it is dry and the forest has no fruit. During this time, the bear preferentially uses the wet puna above the tree line and feeds on bromeliads and other plants. However corn represents a more attractive option for the bears.

There are no general estimates of the number of bears killed in Bolivia, but local reports indicate that bear hunting is widespread. In the Cordillera del Tambillo and Cordillera de Yunga Cruz, an area in the Yungas of La Paz Department, 56 bears were reported killed and six cubs were exported alive in different localities and time periods (Table 9.2).

Restricted data for a nearby region, the Cordillera de Quimsa Cruz (Salazar and Anderson 1990), show about ten adult bears and one youngster killed during a period of about ten years (1979–1989) within an area of 1,000km^2.

Other records of bears killed or captured are available for other parts of the country. In the Cordillera de Tiraque, Department of Cochabamba, an adult male weighing 150kg was killed by personnel of the Forestry Development Office in 1990 because it allegedly attacked cattle. Around the southern border of Amboró NP, in Santa Cruz Department, park guard records accounted for another ten bears killed by local people since the establishment of guard posts two years ago (1991 and 1992). Further to the south, in Huacareta (Department of Chuquisaca) in 1992, a female was killed and her cub was sold to the zoo in La Paz.

The lack of compliance and enforcement of the law regarding the hunting of bears is blatant. This is mostly due to ignorance or purposeful disregard of the law, both by local people and authorities. The situation is aggravated by the remoteness of the areas, the perception that it is justified to kill them because of the damage they do or may do, and the monetary or other return which is obtained from the animals. Bear remains are found in the houses of hunters, and are either used as decorations (paws) or as beds (pelts). Some people mentioned that in some seasons of the year, bear meat can be consumed and the fat is stored for cooking.

Native South Americans had a perception of the bear that was different from that of the cattle-killer or crop-raider. As early as 1600, Huaman Poma de Ayala described the bear as an important member of the religious world of these people. For them, it was a punishing manifestation

Table 9.2. Record of bears killed in the Yungas of La Paz.

Locality	Years	Bears killed	Extra cubs?
Tablería	1980–1992	17	
Santa Bárbara	1980–1992	12	8
Cau-Cau	1990	6	
Curihuati	1980–1992	8	2
Chilkani	1980–1992	10	several
Zorrizani	1990–1992	3	1

of the divinity, or a benign anthropomorphic being. Indeed, several tales currently told by campesinos depict the bear with a protective attitude towards people. Over time, these perceptions have changed, influenced by more secular religions. The old positive attitude towards the bear is loosing ground.

Habitat threats

The most menacing threat to the survival of the spectacled bear in Bolivia is the rapid rate of colonization and habitat clearing. This is particularly problematic, because, in most cases the damage is non-reversible. Liberman (1991) showed that because of high rainfall and steep slopes (60° on average), most of the topsoil in the cloud forest of the eastern Andes tends to be lost immediately after the forest has been cleared. Arce (1988) has identified five major threats to what he called the "ceja de selva" ecosystem in Bolivia. Among them are: expansion of the road system from the highlands to the lowlands, cattle grazing, mining, industrial agriculture, and logging.

Human population densities are higher in the highlands (altiplano) (15/km^2) and lower in the lowlands (5/km^2), although the lowlands produce the majority of goods and services that the populations in the highlands consume. This economic activity has resulted in the improvement of the road system, especially after the Agricultural Reform of 1952. Road improvement fostered the opening and expansion of the land area for cultivation and created the economic circumstances that encouraged the commercialization of agriculture. Since 1952, the size of the road system has increased about 70%, linking production centers with the centers of consumption and fragmenting the bear's ecosystem. In one of the first environmental impact assessments of road construction in the Yungas of La Paz, Liberman (1991) found that even in the early phases of road construction, the area of influence around the road strip increased from an estimated 20m to almost 2km on each side of the road for large mammals. The increase of human population along these roads, and the introduction of high value cash crops such as coca and tea, have raised deforestation rates in the humid Andes of Bolivia.

This situation became aggravated in 1985 when international prices of wolfram and tin fell, and President Paz Estenssoro dismissed 20,000 miners from the non-profitable state mines. In a desperate attempt to solve the problems of unemployment, the central government offered incentives and land to those miners who would move from the highlands to the eastern side of the Andes and the lowlands. With little idea of how to survive in a new environment, the highland miners became farmers. They "slashed and burned" the forest at first to plant chili and tomatoes on a small scale. They then opened up the forest, leaving just a few large trees, and planted coffee, cocoa, and citrus. Most of these became secondary crops to the more profitable tea and coca. Crops which rendered large yields grew rapidly, needed little care, and had large markets (especially coca). Coca cultivation in the Chapare region of Cochabamba totaled 7,000km^2 in 1987 (LIDEMA 1992), affecting bear habitat and bringing associated problems such as chemical contamination, lack of environmental law enforcement, weapons, and violence.

As a result of shifting agriculture, the already high sediment load of rivers flowing down from the Andes increased dramatically. Guyot *et al.* (1988) estimated that the amount of sediments carried out by the Beni river through the canyon "El Bala" reached 550,000tons/day. These data suggest a mechanical erosion of the Andes of ca. 3,000tons/km^2/year. This estimate could double where the effect of the human settlements is higher.

Because rivers that come from the Andes have, in general, traces of gold, some areas are being intensively exploited with the use of heavy machinery. These practices enormously increase the sediment load of the streams, altering their aquatic biology. Worst of all is the use of mercury to extract gold from the sediments, which is later burned and released to the environment. The impact of these operations in the area is completely overlooked.

Logging of cedro (*Cedrela*) in the southern Bolivian-Tucumanian forests of Tarija and Chuquisaca is another cause of habitat destruction in this terrain of deep valleys and high slopes, but its magnitude has not been evaluated.

Protected areas

Salazar and Anderson (1990) listed five conservation areas within the bear's distribution range in Bolivia, but more areas were declared or reviewed by subsequent legislation (Ribera 1996a). That number could be increased to ten potentially important reserves after recent and pending legislation and protected area projects (Table 9.3, Figure 9.2).

Although these conservation areas encompass a considerable area, and potentially harbor relatively large populations of bears, they do not guarantee the long-term survival of the species. People live and make a living in these areas. Thus human pressure on bears and their habitat occurs and may increase

Most of the areas are administered directly by the government (e.g., National System of Protected Areas) or through NGOs and indigenous groups. Their degree of management implementation is still incipient, and varies between the case of Ulla-Ulla, which has a director, park guards, control posts, vehicles, and a management plan under implementation, to the case of Rio Grande-Mascicurí which exists only on paper. Amboró, Carrasco, Pilón Lajas, and Isiboro Sécure have personnel, infrastructure,

Table 9.3. National parks and reserves within the bear range.

Name and category[1]	Department	Total area[2] (km²)	Bear area (km²)
Ulla-Ulla (NR)	La Paz	2,400	300
Cotapata (NP+NAIM)	La Paz	400	400
Alto Madidi (NP)	La Paz	18,960	10,000
Pilón-Lajas (NP+NAIM)	La Paz/Beni	4,000	1,000
Eva-Eva (BPA+IT)	Beni	1,350	1,350
Isiboro-Sécure (NP)	Cochabamba	12,000	3,300
Carrasco (NP+NAIM)	Cochabamba	6,226	3,000
Amboró (NP+NAIM)	Santa Cruz	6,376	4,100
Rio Gde.-Mascicurí (FR)	Santa Cruz	2,420	1,200
Tariquía (NRFF)	Tarija	2,487	1,700
Total		**56,619**	**26,350**

1 BPA Basin Protection Area, FR Forestry Reserve, IT Indigenous Territory, NAIM Natural Area of Integrated Management, NP National Park, NR National Reserve, NRFF National Reserve of Flora and Fauna.
2 Habitat estimated from satellite images. Human settlements in protected areas may decrease potential habitat for bears.

and plans under development, while newer Cotapata, Madidi, and Tariquía do not have official administrations (Ribera 1996a). Recent policy has declared new areas and redefined limits, categories, and zoning. For example, the new and huge Madidi NP and Natural Area of Integrated Management now connects Ulla-Ulla with Pilón Lajas, resulting in a total area of 25,000km² with elevations between 200–6,000m. The connection with Pilón Lajas is too low to be used by bears. Bear reports exist from the three areas but no specific surveys have been carried out. The estimate that at least 10,000km² may represent bear habitat makes this the largest block of bear habitat in Bolivia under some protection, although it is subject to human use in the NAIMs.

The concept of NAIM applies to protected areas which include a mosaic of natural communities of biological importance, together with traditional systems of land use, and areas for multiple resource use. It aims to strike a balance between biodiversity conservation and development of local people by promoting sustainable use of natural resources (Ribera 1996b). Although the approach is theoretically positive, the design and implementation of plans for conservation and sustainable use of resources is just beginning in a few NAIM areas, and it is far from being effective. For example, after Amboró NP was expanded in 1991 to 6,370km², strong conflicts arose between the park management and peasant groups in the higher and lower altitudinal ranges of the park. This led in 1995 to a reduction of the park to 4,425km², and to the creation of a NAIM for the remaining area. For most peasants living in the NAIM, this change of status meant that they were not in the park anymore and park guards could not impose restrictions on their activities. A recently concluded study of bear distribution in Amboró showed that nearly half of the best bear habitat of the area was excluded from the more strict protection of the park (Eulert 1995; Rumiz and Eulert 1996).

National parks such as Carrasco have not been zoned in areas of consumptive use. However, many people support themselves in Carrasco by farming for food crops, planting coca, hunting, and cutting timber. Park guards reported the occurrence of the bear in many sites of the park and a field survey is currently in progress. Despite human presence, Carrasco NP and adjacent Amboró NP and NAIM, constitute a site with great potential for bear conservation.

Other protected areas such as Isiboro Sécure, Pilón Lajas, and Madidi have recent reports on bears (Altamirano 1992; D. Robison pers. comm. 1997; M.O. Ribera pers. comm. 1997) while in Tariquía old accounts of bear presence exist but none were confirmed despite recent field trips (A. Blanco pers. comm. 1997). Potential areas such as Cocapata-Altamachi in Cochabamba, and Serranía Los Milagros and Rio Azero in Chuquisaca should also be evaluated for bear presence. Bella Vista in La Paz seems not to be a viable protected area for bears due to the alteration it has suffered (M.O. Ribera pers. comm. 1997).

Public education needs

It is essential to ratify the prohibition of hunting and capturing wild bears by official communication to the local authorities in the bear's range, and to start friendly education programs with the campesinos. To accomplish these reasonable objectives, priority areas determined by spectacled bear country specialists, as well as through individual initiatives in other areas, should be considered as a starting point. Launching country-wide programs on environmental education at all school levels and through the media would be a more difficult objective to attain due to limited funds and lack of human resources.

Specific conservation recommendations

Priority actions to develop a sound conservation strategy for the spectacled bear in Bolivia fall within the issues of institutional strengthening, research, training, management of protected areas, policy, and conservation education.

1. Strengthen the Bolivian chapter of the Bear Specialist Group. This will provide the base for a group of interested people to coordinate activities within the country and interact with governmental offices to promote compliance with the "no bear hunting" law. It will also help to propose adequate policy, improve education, and provide research results to implement management. Printing and distribution of a poster could be an initial mechanism to address two of these

issues and to advertise the purpose of the group. An institutional diagnostic for Bolivia, evaluating the availability of human resources and potential degree of involvement in bear conservation, should be attained for better planning. An estimated US$20,000/year would support such a group in Bolivia, including part-time secretarial work, computers, communications and travel within the country for a director and assistant, and teaching and advertising material. Larger-scale education programs at primary and secondary schools might need an extra US$20,000/year.

2. Continue field research on ecology and habitat use of bears within and around Amboro NP, and expand the surveys to adjacent Carrasco. Goals should include estimating area used by bears, damage to crops or cattle in surrounding communities, establishing a database of bear records kept by trained park guards, and development of management strategies for bear conservation in both parks and buffer zones. This would be a model project for other parts of Bolivia. Roughly US$60,000 for two years would buy a good, used jeep, salary for a local biologist, maintenance, and field expenses.
3. Survey natural areas within the bear range in Bolivia. Determine the relative importance of protected areas in the north, such as Ulla-Ulla and Madidi, Isiboro Secure, Cotapata, and Eva–Eva. Assess potential conservation areas in the south, such as Rio Grande–Masicurí in Santa Cruz, Rio Azero in Chuquisaca, and Tariquía in Tarija. Around US$100,000 would buy a new jeep, pay the salary for a local biologist and part-time assistants, pay field expenses, and cover travel for the advisor over 2–3 years.
4. Conduct preliminary studies of distribution and damage to crops or cattle in communities that have expressed interest in bear conservation (such as the region of Quime, Provincia Insquisivi, La Paz), or in places where joint efforts with rural development programs could improve the conservation of the bear (such as the area of Lambate, Provincia Sud Yungas, La Paz). These pilot studies with local communities should provide models for education, alternative use of resources, and rural development that could be applied more extensively. Need: US$20,000/yr for two years.
5. Formally train more Bolivian biologists, by implementing programs in Wildlife Biology and incorporating them into the ongoing projects mentioned above. Reinforcing existing programs in Biology in La Paz, Santa Cruz, and Cochabamba is reasonable, and could be accomplished by organizing short-term courses, both in the classroom and in the field. This would need coordination with the local universities to decide a syllabus and to bring in adequate national or external trainers.

Status and management of the spectacled bear in Colombia

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Introduction

Due to a complete restructuring of the Colombian natural resource management system during the writing of this document, it has not been possible to discuss the action plan with all of the appropriate officials. As new officials are appointed and programs are implemented over the next 1–2 years, it will be possible to finalize this plan and incorporate specific research, conservation, and management proposals. During the next few years, it is also anticipated that Colombian conservation NGOs will be able to determine how best to coordinate spectacled bear conservation and management efforts with government officials under the new system.

Historic range and current distribution

Prior to the Spanish conquest that followed the discovery of the New World by Colombus in 1492, Colombia was populated by small groups of indigenous people. While the coastal and Amazonian lowlands were sparsely populated, the Andean highlands were densely populated by the Muisca, Guane, and Loma Cultures (IGAC 1989). Although the highland people cleared large tracts of land for agriculture, due to their limited hunting technology, one can surmise that their impact on bear populations was minimal. Recent human impacts on bear populations, however, are major (see "population and habitat threats").

The historic and present day distribution of spectacled bears reflect the progressive deterioration of Andean ecosystems in Colombia, a change that has come about primarily in the last 100 years, but which has been intensified in the last 50 years. Historically, the spectacled bear ranged throughout the cordilleras and valleys of the central one-third of the country. As a result of population growth and economic development, large parts of the historical range have been converted to agriculture or grazing. Presently, the best remaining bear areas are the western slope of the Western Cordillera, the eastern slope of the Eastern Cordillera, and the southern portions of the three cordilleras, near Ecuador.

With the almost total conversion of the subtropical forest to agricultural uses, mostly for coffee (*Coffea arabica*) fields, the bears have retreated upwards along forested

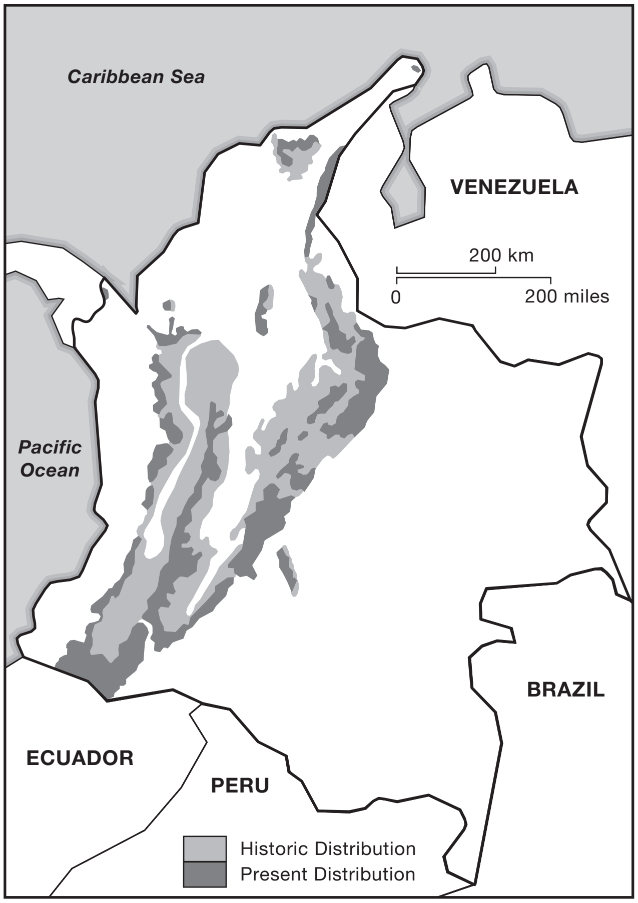

Figure 9.3. Historic and present distribution of the spectacled bear (*Tremarctos ornatus*) in the Colombian Andes.

slopes, and now occupy tracts primarily at 2,000–3,000m elevation (Jorge Hernández C. pers. comm.). Various types of development are taking place in the highlands, however, and provide additional pressures to bears and their habitats. The species is in fact presently "sandwiched" between strong development forces from above and below. This process is most severe in the inter-Andean valleys of the Magdalena and Cauca Rivers where the human population pressures now prevent free movement of bears both within and between mountain ranges.

Spectacled bears occur in the three Andean ranges ("Cordilleras") that occupy the central one-third of the country. These ranges extend from Ecuador in the south to Panama in the northwest and Venezuela in the northeast (Figure 9.3). Perhaps the most stable bear populations in Colombia are situated in the southern half of the Eastern Andean range. This area probably also has the highest population density of spectacled bears, but the northwestern part of Colombia also may have high bear population densities (G.I. Andrade pers. comm.). Spectacled bears, however, are becoming increasingly threatened by human activities, and their populations are decreasing throughout the country.

As a result of social and geological differences in the three ranges, spectacled bear distributions must be viewed in a very local context. The Western Range or Cordillera, geologically quite young compared with the other ranges in Colombia, has an average elevation of 3,000m (IGAC 1989). While the western slope of this range is sparsely populated by humans, the eastern slope is densely inhabited (IGAC 1989). The western slope also retains extensive tracts of montane forest (Cavalier 1993; Figure 9.3). Given the low population density and large extent of forests, the western slope likely has relatively high population densities of spectacled bears in Colombia.

The Central Range, geologically older than the Western Range, has an average elevation of 4,000m (IGAC 1989). While the western slope of this range is densely populated by humans, the eastern slope is less densely populated. The area has a high level of seismic and volcanic activity. Natural vegetation in the Central Range is highly fragmented (G.I. Andrade pers. comm.)

The Eastern Cordillera, geologically the oldest of the three ranges, has an average elevation of 3,500m (IGAC 1989). While the western slope of this range is densely populated by humans, the eastern slope is sparsely inhabited. This range has a high level of seismic activity, but little volcanic activity. The eastern slope also retains extensive tracts of montane forest (Cavalier 1993; Figure 9.3). Given the low population density and large extent of forests, the eastern slope likely has relatively high population densities of spectacled bears in Colombia.

The three ranges of the Andes are separated by two major river valleys. Situated between the Western and Central Ranges, the Cauca River Valley is a major population center. About three million people inhabit the Cauca River Valley. The Magdalena River, situated between the Central and Eastern Ranges, was a major transportation artery to the Caribbean coast, but rarely is used by shippers today due to sedimentation problems caused by deforestation of the adjacent Andean slopes. About three million people inhabit the Magdalena River Valley. The average population density ranges from 10 to 60 people/km^2, but densities up to 100 people/km^2 are attained in the metropolitan areas (IGAC 1989:89). Major highways traverse each of the river valleys. The Cauca and Magdalena Rivers join before reaching the coast.

The present distribution of spectacled bears in Colombia closely corresponds to the distribution of montane forest ≥ 1,200m (Figure 9.3). This region includes about 18 National Parks and several private reserves with spectacled bears Potential bear habitat (31,000km^2) comprises approximately 5.8% of all forested areas of Colombia, and 45% of the estimated 68,400km^2 of forests in the three Andean ranges (Inderena–FEN 1986). We recommend that these areas be managed for conservation purposes. The forests in the Amazon Basin, the Choco, and the Eastern Llanos are not suitable bear habitat due to their low elevation (e.g., ca. 100m) and high temperatures (e.g., 35–40°C).

Three major geographic areas, which correspond to the three Andean ranges in Colombia, can be considered as suitable habitat for spectacled bears. Of a total of 68,400km^2 of Andean forest (Pombo 1989), some 31,000km^2 are highlighted in this report as suitable habitat for spectacled bears, while the 15,000km^2 of cloud forest may be absolutely critical for bear survival. Approximately 30% of the suitable forested habitat are within National Parks that form part of the Colombian System of Protected Areas.

Western Andes Range

Five subunits comprise this area (listed north to south) (Table 9.4):

1. Los Katíos NP and the Darien Region along the border with Panama.
2. Paramillo and Las Orquídeas NPs comprise Area 2 and extend west to the Chocoan lowlands and south to the headwaters of the Atrato River.
3. Macizo de Tatama NP, the area surrounding the Park, and the Cali–Buenaventura road. The Tamana and Cordillera Paraguas regions occur here and have been proposed as national parks.
4. Farallones de Cali and Munchique NPs. These areas contain extensive wilderness areas with a large range in altitude (up to 3,000m) that favor spectacled bears.
5. The southern portion of the Western Andean range includes the watersheds of the Patía, San Juan de Micay, and Mirá (Güiza) Rivers. This area is home to the Emberá, Wuanana, and Awa Indigenous populations (C. Valderrama pers. comm.). A substantial portion of lands in the Güiza area of southern Nariño, a region traditionally used by the Awa people, has been declared by the national government as Indigenous Reserves ("Resguardos").
6. Approximately 14 bears are known to occupy the La Planada NR (32km^2; 1,200–2,100m elevation), about 80km west of Pasto, with additional bears in the surrounding area (C. Valderrama pers. comm.). Since the early 1980s, the reserve has been managed to take into account the needs of bears, as well as those of the local Awa residents.

It is estimated that some 9,000km^2 of the forests of the Western Andes Range are suitable for bears. The region also has an unusually high level of biological diversity (Andrade 1992, 1993). Supporting this diversity are probably some of the largest, best-preserved forests in the Neotropics, including Los Farallones de Cali (1,500km^2). Forty percent of the forests in the Western Andes Range have been designated as National Parks. Additional portions are categorized as Indigenous Reserves or as areas protected for hydroelectricity generation. The immediate prognosis for spectacled bear populations in the Western Andes Range, however, is poor due to poor park management, hydroelectric development (e.g., Micay Project), and road construction (e.g., Cali–Buenaventura, Pereira–Bahía Solano, and Popayán–Guapi).

Central Andes Range

Given its position between two major valleys, the Central Andean Range has the most severe and most extensive habitat degradation. As a result, bear habitat today in this region consists of many small- to medium-sized forest fragments, a few hectares in size. Six general areas can be considered for conservation action in this range (listed south to north):

7. Purace NP and the surrounding Colombian Massif.
8. Nevado de Huila NP and the surrounding wilderness harbor, the largest tract of cloud forest in the range. Large tracts in these areas, however, are being cleared

J. Orejuela

Cloud forest: western Nariño, Colombia.

Table 9.4. Size and amount of spectacled bear habitat in priority research and conservation areas of the Colombian Andes (Inderena pers. comm.)

Area number	Conservation unit name	Year established or expanded	Park area (km²)	Available bear habitat (km²)
Western Andes Range				
1	Los Katíos National Park	1980	720	180
	Darién Wilderness			1000
2	Paramillo National Park	1977	4600	1150
	Las Orquídeas National Park	1974	320	80
	Associated Frontino Wilderness			1500
3	Macizo de Tatamá National Park	1987	519	130
4	Farallones de Cali National Park	1968	1500	380
	Munchique National Park	1989	440	110
	Associated Wilderness			1000
5	Mirá (Güiza), Patía, San Juan de Micay Wilderness			3500
6	Reserva Natural La Planada	1982	32	32
Central Andes Range				
7	Puracé National Park/Colombian Massif	1977	830	210
8	Nevado de Huila National Park	1977	1580	400
9	Las Hermosas National Park	1977	1250	380
10	Los Nevados National Park	1974	380	30
11	Sonsón Wilderness			500
12	San Lucas Range/Nechi Wilderness			3500
Eastern Andes Range				
13	Perija, Los Motilones Wilderness (part)/Catatumbo National Park	1989	1581	1581
14	Tamá National Park	1977	480	120
	El Cocuy National Park	1977	3060	770
15	Guanenta–Alto Río	1993	104	104
	Fonce Sanctuary and associated wilderness		(500)	(500)
16	Pisba National Park	1977	450	110
17	Chingaza National Park	1978	503	133
	Associated Wilderness			500
18	Sumapaz National Park	1977	1540	390
	Cordillera Los Picachos National Park	1988	4390	1100
	Sierra de La Macarena National Park	1987	6293	1580
	Tinigua National Park	1989	2080	500
	Associated Wilderness			800
19	Caguán, Caquetá Putumayo and Associated Wilderness			9000

to plant illegal crops, especially opium poppies between 1,000–2,000m.

9. Las Hermosas NP still contains forested tracts that offer adequate habitat for bears.
10. Los Nevados NP and surrounding wilderness possibly include a small population of bears.
11. An isolated region of cloud forest persists in the southeastern corner of Antioquia Department, near Sonsón, and probably sustains a stable population of bears. The southern part of Antioquia is threatened with development via the Bogotá–Medellin highway and the La Miel hydroelectric project.
12. San Lucas Range, a tropical/subtropical wilderness treasure, located between the Cauca and Magdalena Rivers near the Caribbean Coast, is rapidly being transformed and degraded by a combination of forces, including guerrillas, gold miners, poachers, and wealthy farmers-ranchers who graze cattle and practice agriculture. As a result, spectacled bears there have been subjected to at least 25 years of major human disturbances. Despite these problems, the range is still important for conservation purposes as it reportedly includes a substantial bear population (J. Hernández C. pers. comm.).

About 5,000km^2 of the Central Andes Range offer adequate habitat for bears. These critical wilderness areas are also important for human welfare due to the environmental services they provide. About 4,000km^2 (48% of the total forested area of the range) of this area is already part of the Colombian National Park System. The status of this area is tenuous, however, as large plots of forest are being cleared to plant illegal crops.

Eastern Andes Range

Due to lengthy human occupation, the western slopes of this range generally lack adequate forest cover to sustain bear populations. The eastern slopes, however, contain some of the most extensive bear habitats. Six general areas can be distinguished in the range (listed north to south):

13. The northernmost portion of the Andes, along the border with Venezuela, includes the remaining forests of the Perijá and Los Motilones Ranges and the upper reaches of the Catatumbo–Bari NP. This area includes a wide variety of forest types.
14. Two national parks, Tama and Sierra Nevada del Cocuy, provide ample habitat and a wide altitudinal range for bears (>4,000m). The surrounding wilderness also is extensive, but the former high levels of biodiversity are declining due to human activities (Andrade *et al.* 1991).
15. The Guanenta–Alto Río Fonce Sanctuary (including the Páramo de La Rusia) and the Los Cobardes region (both in the Department of Santander) provide bear habitat in the Magdalena River Valley. The sanctuary and surrounding area include about 500km^2 of páramo and upper montane forest, including small remnants of oak forest (*Quercus humboldtii*), a potential bear food item.
16. Pisba NP, and to a greater extent, Chingaza NP have several forest fragments of importance for bears. Additional forested areas, for example, Carpanta NR (formerly managed by Fundación Natura, but now managed by CorpoGuavio, a regional development agency), occur adjacent to the parks and enhance spectacled bear populations. Compared with other large national parks, the relative proximity of Pisba and Chingaza NPs to Santafé de Bogotá, the national capital (population six million), makes these two areas especially important as research sites and as locations for environmental educational activities.
17. The triangle formed by Sumapaz, Cordillera los Picachos, and Sierra de La Macarena NPs forms one of the largest and most diverse wilderness regions of the world (12,220km^2). The close proximity of this area to Tinigua NP makes it especially important for bear conservation as bears can easily cross the cordillera.
18. The upper reaches of the Caguán, Caquetá, and Putumayo Rivers provide about 9,000km^2 of bear habitat. This region already has been recognized as critical habitat for conservation of the woolly tapir (*Tapirus pinchaque*) and several deer species (C. Downer pers. comm.).

The Eastern Andes Range comprises 17,000km^2 of bear habitat and represents a magnificent conservation area. About 18,800km^2 (61%) of this region already is included in the Colombian National Park System. As in the Central Andes Range, the forests in this range are rapidly are being converted into areas to cultivate illegal crops.

Changes in the distribution of the spectacled bear in Colombia are closely tied to the changes in the distribution of montane forest. The best available data are for forests above 1,200m (Cavelier 1993; Figure 9.4). Recognizing present development trends, the future distribution of the spectacled bear likely will be less than at present. The greatest reduction will occur in the Central Cordillera. Range reductions will be less in the Western and Eastern Cordilleras due to their isolation. Bear populations in the northwest and northeast, however, likely will be greatly reduced to a few national parks and the surrounding wilderness areas. Bear populations between the Ecuadorian border and the cities of Cali (Western Cordillera) and Villavicencio (Eastern Cordillera), have the best long-term prospects for survival.

There are about 30 spectacled bears in captivity in Colombian zoos (C. Valderrama pers comm.; Weinhardt 1994). Additional bears likely are kept as pets by rural farmers and by wealthy individuals in private menageries, but the total number in these two categories probably does not exceed five individuals.

Status

Although already reduced to critical levels, the Colombian population of spectacled bears is second only to that in Peru. While no population estimates for spectacled bears in Colombia have been calculated, a reasonable estimate [based on home range sizes for American black bears (*Ursus americanus*) in prime bear habitat, approximately 0.11 individuals/km^2 (Yerena 1994)], would be a total of about 4,000–5,000 spectacled bears in Colombia.

Legal status

The spectacled bear is protected at the international and national levels. Internationally, the species is listed as Vulnerable by the IUCN Red List of Threatened Animals (IUCN 1996). Colombia also is a signatory to CITES. This treaty regulates international trade in live spectacled bears as well as their parts, products, and derivatives. Colombia also has ratified the World Heritage Convention. Under this convention, the three (two with bear populations) Biosphere Reserves (MAB Program of UNESCO) are managed to conserve resident wildlife and plant populations. Colombia is also a signatory to the 1992 Convention on Biological Diversity. Under this convention, each country must devote full attention to the protection of species. The impact of these international programs on bear conservation has not been evaluated, but probably the benefits have been minimal.

At the national level, the spectacled bear is listed as an endangered species. Under Colombian legislation, it is forbidden to hunt, capture, or kill bears (Código de Recursos Naturales y del Ambiente, Decreto 2811, 1974).

Despite this legislation, spectacled bears frequently are killed or taken as pets, and their habitat continues to be converted to human uses.

Population threats

The distribution of the spectacled bear on mountain slopes at mid-level elevations coincides with the area of greatest socio-economic development of the country. The consequence of this development is large-scale destruction of ecosystems and the restriction of bears to forest habitats fragmented vertically and horizontally. Under these circumstances, spectacled bears are especially vulnerable to local hunters and temporary workers as they move from area to area seeking refuge. Agriculture, livestock grazing, and timber harvest are the main population threats.

Considered together, the factors of agriculture, livestock grazing, timber harvest, and hunting probably result directly in the death of 50 bears and the loss of 300–500km^2 of potential bear habitat annually. Sport hunting also accounts for a small number of bear deaths (perhaps 10 deaths/year), but accurate figures are difficult to obtain since this hunting is illegal. Spectacled bears, given their habitat needs and low reproductive rate, likely cannot sustain such mortality over a long period of time. Based on experience at La Planada, an adult female can produce 1–2 young per year. A female reaches maturity at the age of four years and remains reproductively active for 6–8 years (C. Valderrama pers. comm.).

A new population threat is poaching and illegal international trade of bear parts, particularly claws, teeth, and gall bladders, to supply the demand for traditional east Asian medicine. Although it was not possible to confirm the extent of this trade in Colombia, it probably is not yet a major problem here. This trade, however, is a major problem in Ecuador (L. Suárez pers. comm.).

All of the factors mentioned above are proximate population threats. Spectacled bears, however, also are threatened by the ultimate population threat of a national development model based on economic progress mainly through urban-industrial growth. This model is based on resource exploitation. The opportunities to exploit the natural resources, however, are not equally distributed between the different social and economic groups in Colombia. As a result, severe cultural and environmental problems have developed. Until this ultimate threat is resolved, the proximate threats will continue to reduce spectacled bear populations in Colombia.

Habitat threats

Given the nature and extent of many human activities in Colombia, their negative impact on spectacled bears often is unavoidable. The problem is especially difficult as the region of densest human population (low to middle elevations of mountain slopes) is generally coincident with the distribution of the bears. Competition for space between humans and bears can only increase as humans are now exploiting the last remaining bear refuges, including the cloud forests and "páramos" in the high elevations, for agriculture and cattle grazing. Human impact on cloud forest habitats and on the few remaining subtropical forests in Colombia continues to be severe as the human population (a projected 34 million in 1993) continues to

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"Fermina", female spectacled bear (*Tremarctos ornatus*) in La Planada island habitat, Colombia.

increase at an annual rate of 1.5% (IGAC 1989). Ways must be developed to accommodate bears, as well as humans.

The agricultural/timber harvest frontier is expanding into primary bear habitat. This is due particularly to the planting of tree plantations on former pasturelands and the felling of non-precious trees to meet the pulpwood and minor industrial needs of an expanding human population. The area used for commercial tree plantations is about 1,800km^2 (Pombo 1989; 1984 data). New tree plantations are being planted with alder (*Alnus* spp.), conifer (*Pinus* spp., *Cupressus* spp.) or eucalyptus (*Eucalyptus* spp.). While native forest rarely is used for plantations, the conversion of pastureland is permanent as little or no natural regeneration is undertaken.

Colonization of undeveloped areas by humans also fragments bear habitat. In Colombia, colonization occurs as an independent process when squatters move into unsettled areas, as well as a dependent process as these people follow work camps along new road sites. In either case, colonization contributes to a massive conversion of forests into pastures for agriculture and cattle grazing. About 73,000km^2 are involved in this process in the Andean and Piedmont regions (Pombo 1989). Due to the low fertility of these soils, lands repeatedly are colonized and abandoned. During 1962–1989, about 3,000km^2 of public lands were deeded to colonists annually. Due to jurisdiction problems between government agencies, it has been very difficult to control colonization.

Colonization is an especially pernicious problem because it often is stimulated by wealthy or powerful people in a covert manner. Politicians, for example, often stimulate colonization in the districts they represent in order to concentrate wealth, land tenure, and votes. Land developers also benefit by selling at high profits lands they had previously purchased on speculation. This problem likely will not be resolved soon.

Deforestation is a major problem throughout the country and contributes substantially to the loss of prime bear habitat. Nationally, about 6,000–7,000km^2 of forests are cleared annually (1.7–2.8% annual deforestation rate; Myers 1989; Pombo 1989; WRI 1990). It is estimated that about 600–1,000km^2 of Andean forests are converted each year to other land uses. This loss of forest not only reduces available bear habitat but also limits future opportunities to reintroduce bears, as their former areas no longer exist.

During the past 10 years, economic development and the exploitation of natural resources have increased dramatically in Colombia. Timber harvest, gold mining, mineral extraction, and commercial agriculture, for example, have become widespread throughout the country (Pombo 1989). These activities naturally attract workers and their growing families to previously undeveloped areas. Previously unoccupied areas (prime bear habitat) are converted to agricultural fields, cattle pastures, and house sites. As a result of this development, spectacled bears move into marginal habitats where their survival rates are reduced.

Forest conversion also occurs to promote the illegal drug trade. This conversion can destroy substantial quantities of potential bear habitat. An estimated 500km^2 of Andean forests were cleared, primarily during 1991–1992, to plant opium poppies (*Papaver somniferum*). Additional forests were cleared to plant marijuana (*Cannabis sativa*) and coca (*Erythroxylum coca*) (Anon. 1992b). These products have a high value in the illegal drug market and presently are being used by Colombian farmers and entrepreneurs to substitute for traditional crops that have a low market value. Given the international aspect of this trade and the high potential for profits, farmers engaged in the drug trade are now clearing much more forest than they would have cleared previously for subsistence purposes. Governmental efforts to eradicate these crops rely heavily on massive spraying of herbicides, such as glifosato (Roundup, produced by Monsanto). The potential dangerous ecological consequences of this spraying on plants, insects, and higher vertebrates in the areas surrounding the illegal drug fields have been ignored by government officials. Despite about 10–15 years of concerted efforts by the Governments of Colombia and the United States of America to control drug production, there is no visible end to the annual increase in areas converted to this use.

In the quest for increased economic development, Colombian businessmen are looking west, to the Pacific Basin markets, and east, to the Amazon Basin and its rich mineral and petroleum resources. The construction of roads and oil pipelines to promote this development often degrades potential bear habitat. These roads and pipelines are especially susceptible to attacks by guerrillas (active since about 1975) attempting to destabilize the government. During 1994, about 3–5 attacks per month nationally were reported in the press.

With respect to roads, many routes are being constructed, while other routes are being expanded or rebuilt. In the Western Andes Range, three new routes are being constructed across the cordillera to join major cities of the interior with coastal towns. In addition, a coastal road is being constructed to connect the city of Tumaco with Esmeraldas (Ecuador). Along the Eastern Andes Range, the "Marginal Jungle Highway" (Carretera Marginal de la Selva), a 1,300km-long road between Mocoa, the capital of the Department of Putumayo, and the city of Saravena, in the Department of Arauca, for example, provides increased access by humans to large tracts of potential bear habitat and important conservation areas (especially between La Uribe and San Vicente, Caquetá).

Construction of new roads from the interior of the country to the Pacific Ocean attracts new settlers to the region and is increasing the fragmentation of former large tracts of Andean forests of prime importance to bears. Road construction also is proceeding in the central part of the country (near Las Hermosas NP and between Bogotá and Medellín), as well as in the eastern plains and Amazonia. Road construction also results in the killing of spectacled bears as they wander through work sites.

Roads fragment many previously continuous forest habitats and also degrade bear habitat by providing corridors for the establishment of new settlements by illegal colonists. These colonists frequently derive their subsistence from forest resources, especially timber resources. Large tracts of roadless forest urgently need increased protection by the department and national governments. Bear conservationists need to take into consideration these factors when developing management plans. Government planners, likewise need to take into consideration potential bear habitat when developing their economic plans.

The long-term survival of spectacled bears in Colombia is dependent upon the conservation of large tracts of Andean cloud forests. In turn, the survival of these forests is intimately tied to the provision of ecological services to human populations centers which are generally located at lower elevations. The strategy of ecosystem conservation for human welfare, with continued supply of basic ecological services, such as potable water, soil conservation, and electricity (80% of the energy used in Colombia is derived from hydroelectrical plants), should be linked to the conservation of the spectacled bear and other charismatic wildlife species. In this way it will be possible to show that both humans and bears can benefit from the same conservation practices.

Management

The Colombian National Park System has 45 units which encompass an area of 90,316km^2 (8% of the total land area; Inderena pers. comm.). Of these protected areas, about 18 help to protect spectacled bear populations. This subset of parks has an estimated area of 31,000km^2 (34% of the total area in National Parks).

Natural resource protection and management within National Parks is uneven, being best in the remote units with steep terrain and difficult access. Most of the parks have ongoing problems with residents who were not properly compensated for their land when the area was declared a park. Many of these people continue to reside in their homes as if the park did not exist. In addition, most of the parks have problems with adjacent residents who graze cattle and burn pastures in the parks. Under these circumstances, spectacled bear conservation and management is a secondary concern for many park managers.

Only a few of the 45 parks have management plans. Implementation of these plans often is restricted due to limited funds and poorly-trained park personnel. Thus far, the main accomplishment of the National Park System has been a limited degree of habitat protection.

The benefits of habitat protection through the mechanism of National Parks is becoming more apparent as the demand for drinking water and hydroelectric power exceed the supply in many areas. Where National Parks include major watersheds in close proximity to human populations, their protection is enhanced because the benefits are more obvious to the adjacent residents. For example, Chingaza NP is within 20km of Santafé de Bogotá, the capital, and provides water and electricity for about six million residents. Elsewhere, Los Farallones de Cali NP supplies water to about two million people, while Los Nevados NP supplies water to about 2.5 million people and sustains about 40–60% of the coffee production in the country (total production: US$1,606,000,000 in 1988; Pombo 1989). Given their large size and economic value, these sites increasingly are becoming attractive targets for guerrillas. Due to recent terrorist threats to destroy the dam in Chingaza NP, the military recently began patrols there and has restricted access to the zone. This action shows the extent to which the Government of Colombia will respond when the national security is threatened.

The mechanism that has afforded the best protection of wilderness (National Parks included) and potential bear habitat is to focus on the conservation and management of watersheds. These provide water and energy to the major cities of the country, and indirectly protect potential bear habitat. Colombia is a country of many medium- to large-sized cities, and about 70% of the human population lives in these areas. This relationship should provide bear managers with numerous opportunities to protect forest.

The management of watersheds is under the Regional Development Corporations (36) and the Municipal Utilities Companies ("Empresas Públicas" for major population centers with >100,000 residents). Land use planning in each municipality is the responsibility of the council. There are between 500–600 municipalities in the Andean region. Usually these agencies are well funded and adequately organized to fulfil their mission. The natural areas which are managed by regional corporations and utility companies (excluding national parks under their jurisdiction) is about 25,000km^2. Generally these areas are adequately protected.

Indigenous Reserves often contain large areas of wilderness. While some of these wilderness areas are adequately protected and conserve large tracts of potential bear habitat, others are not. Indigenous Reserves for the Awa (Western Andes); Paez (Central Andes); and the Inga, Ingano, Sibundoy, Kamsa, and Kofan (southeastern Andes) contain large tracts of forest and substantial bear populations. The Paez Indians, however, hunt spectacled bears (G.I. Andrade pers. comm.).

In 1993 a major change occurred in how watersheds and natural resources are managed in Colombia. One element of the change was the establishment of the National Environmental System and the creation of the Ministry of Environment (December 1993) to manage natural resources at the national level. Under “Ley 99,” 36 administrative units were created or modified to manage natural resources at the local level. These regional corporations were given broad powers and adequate funding to meet their responsibilities.

Under the new legislation for environmental matters, the 36 Regional Development Corporations and 1,038 Municipalities now are responsible for developing local management plans for their natural resources. This presents a tremendous opportunity for spectacled bear conservation and management because decisions will be made at the local level by local officials.

This change from national to local administration will retain a broad, national perspective on natural resource management, especially in National Parks. In addition, this change will also focus natural resource management efforts at the local level. Governmental attention to the conservation of watersheds and potential bear habitat will definitely be reinforced because the matter will be treated as a local issue. On matters of joint concern, the Regional Development Corporations will become the implementation arm of the Ministry. The role of the National Park Agency with respect to bear conservation; however, is unclear because park management has been assigned to a Special Administrative Unit within the ministry. (While the wildlife section of Inderena was dissolved in 1994, the parks section still has not been completely terminated.)

The best option for effective management of habitats and species thus far may result from the indirect protection of watersheds and those parks under the jurisdiction of the Regional Corporations. It is anticipated that there will be an increased level of cooperation between the Regional Corporations and NGOs, with both making a more concerted effort to cooperate with the rural communities. This is one of the reasons for waiting 1–2 years to submit the Colombian Action Plan to public comment.

Colombian natural resource officials are in great need of additional field data on which to base their management decisions about spectacled bears. Field studies to date in Colombia have been few in number and short in duration. Manaba and Fundación Natura (two NGOs with interest in spectacled bears), for example, have conducted bear surveys in El Cocuy and Chingaza NPs respectively, and have undertaken environmental education programs with residents adjacent to these sites (Lozada 1989; Lozada nd. *Status of knowledge on the spectacled bear in Colombia: a preliminary report.* Univ. Tennessee, Dep. For., Wildl. and Fish., Knoxville), but neither group has been active in bear conservation for the past several years. Jorgenson and Rodríguez (1986b) conducted a nationwide bear census and identified many key bear areas, but could not visit many of the best sites due to security problems. Rodríguez (1991) conducted a bear distribution and habitat use study at Las Orquídeas NP, but has been unable to extend the research to other areas.

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Spectacled bear (*Tremarctos ornatus*) in enclosure at La Planada Nature Reserve, Colombia.

Formal breeding and conservation programs have been established in three sites. At La Planada NR, Fundación FES has an active captive-breeding program complemented by local environmental education campaigns. During 1989, María Teresa Zequera conducted a study of bear reproductive behavior, but the results have not been published. The Regional Development Corporation of Risaralda (CARDER) recently implemented a captive breeding and education program in the buffer zone around Los Nevados NP. The third site is managed by Fundacion Jaime Duque and consists of two captive bears at a compound at the city of Sopo, just north of Bogota. In addition to these efforts, an animal rescue group at the Universidad Nacional is working on bear rehabilitation. Ecological field studies are urgently needed to complement these studies of captive animals.

Human-bear interactions

The relationship between humans and bears is multifaceted and based on thousands of years of contact. Hate, fear, awe, and respect are some of the terms used to describe the feelings that many humans have for bears. Today, as a result of human incursion into bear habitat, Colombians increasingly are coming into contact with spectacled bears.

In Colombia, the spectacled bear is an important cultural element of many Indigenous groups. This relationship is founded upon respect and admiration for the powerful nature of the bear (Rodríguez *et al.* 1986). By relating myths and legends that focus on bear encounters from one generation to another, these people hope to acquire for themselves the desired properties so revered in the bears. They also hope to transfer these characteristics, such as strength and cunning, to their descendants. Sometimes, the enactment of the legend requires the killing of a bear to collect fat tissue to spread over a newborn baby. Great care is taken, however, not to offend the spirits of the dead bear or over-exploit living bears. These cultural beliefs, thus can have an important conservational benefit to spectacled bears.

While colonists have always killed bears when encountered, many Indigenous peoples exhibited a respectful attitude toward bears. As human encroachment of Indigenous territories increases, however, encounters with bears will become more common and the relationship is changing. Both colonists and Indigenous people kill bears, for example, when they predate crops, especially maize (*Zea mays*). This crop is particularly susceptible to predation for at least two reasons. First, maize gardens are not tended on a daily basis. Second, gardens usually are located in distant forest plots, away from the dwelling and protection of the gardener. Thus, maize gardens are frequently and severely predated by bears. Crop predation is a major economic hardship to a poor farmer who has invested time and money in a maize garden.

Sport hunting of bears is another form of human-bear interaction. For this kind of individual, the hunting process itself is important, rather than for the trophy or meat. Sport hunters frequently collect the paws and skin and give the meat to the local guides or residents. While sport hunting of bears is illegal throughout the country, hunting is usually more severe in areas of human colonization, where enforcement of wildlife laws is difficult. Thus, these hunters usually are not apprehended by the police or wildlife officials. There is also limited hunting of bears for display purposes (for example, circuses, zoological parks, and private collections). Unfortunately, enforcement of Colombian laws protecting endangered species is limited as these activities are frequently carried out by organized criminals who are able to evade these efforts.

During the past 20 years, no bear attacks against humans have been reported in the press (C. Valderrama pers. comm.). Given the timid nature of the spectacled bear, attacks against humans likely will remain rare.

Public education needs

Over the past ten years there has been a growing awareness of conservation issues by government officials as well as by the general public. The creation of the Ministry of the Environment, for example, with strong legislative and economic support, is proof that environmental affairs now are commonly viewed as important. In addition, the cause of the spectacled bear has been featured in numerous venues. Much needs to be accomplished, however, by NGOs as well as government officials.

The action of NGOs has been particularly critical in complementing the efforts of the official natural resource sector. Several organizations and recent events are especially important with respect to spectacled bear conservation and management. In 1991, a meeting of NGOs resulted in the creation of Ecofondo and the identification of more than 500 environmental groups in Colombia. Several institutions interested in spectacled bear research and conservation sent representatives, including:

1. Fundación FES (Fundación para la Educación Superior; active in bear conservation since about 1983), with regional offices in eight cities and a private nature reserve that includes bears (Reserva Natural La Planada);
2. Fundación RenaSer (active since the early 1980s), with a nation-wide environmental education program funded through a World Bank loan;
3. Fundación Natura (active since about 1985), which formerly managed the Carpanta Reserve, administers the Parks in Peril Program in Colombia (grant from USAID to The Nature Conservancy), sponsors environmental education campaigns that often include references to spectacled bears, and jointly manages three national parks with the Ministry of the Environment (formerly INDERENA).
4. Fundación Farallones, which assists in the management of the Los Farallones de Cali NP; and
5. Fundación Herencia Verde (active since about 1983), which likewise assists with the management of wilderness areas surrounding national parks (for example, Los Nevados and Farallones de Cali NPs).

Manaba has been conducting environmental education programs, as well as field research, for approximately ten years.

National Federation of Coffee Growers, which sponsors a program called "The Adventures of Professor Yarumo" on an education television channel [note: the yarumo or cecropia tree (*Cecropia* spp.), a bear food item, is a species that occurs in areas undergoing secondary succession]. This outstanding environmental series recently devoted a program to spectacled bear conservation and captive management activities underway at the La Planada and Ucumari Reserves.

In addition to traditional conservation organizations, new entities have become important in bear conservation and management in Colombia. The press, for example, has recently begun to publish articles on a regular basis in the areas of conservation, environmental education, and ecological tourism. Colombian journalists have traveled to national parks, private reserves, and wilderness areas, for example, in order to prepare special newspaper issues featuring topics such as endangered species and the importance of habitat conservation. Most newspapers, as a result, now have an ecological page and a specialized environmental journalist; and hardly a day goes by without an ecologically important feature article being published. This effort has substantially raised the consciousness of the public in environmental matters.

Efforts to educate the public about environmental matters are not limited to the media. For example, the official education curriculum for public schools also has a strong environmental component. The curriculum, for example, includes sections on ecology and endangered species. In addition, the New School Program ("Escuela Nueva"), a component of the national system, teaches primary-level students about natural resource conservation. Other national programs support environmental projects by local school districts ("Nueva Ley de Educación" and "Proyectos Ambientales Educativos"). While these programs do not deal specifically with spectacled bears, they could be easily modified to introduce bear-related information to youngsters. These kinds of education programs will be important to future bear conservation efforts.

Zoos, especially those at Pereira and Cali, have also become active in the environmental education area. These programs generally focus on endangered species of Colombian fauna, including spectacled bears, and are especially popular with children. The zoos also are attempting to improve animal husbandry methods (G. Corredor pers. comm.).

Despite the recent, nationwide increase in environmental awareness in Colombia, much needs to be accomplished. It is especially important to recognize a growing interest by politicians and government officials at the local and national levels to conduct effectively the necessary habitat and species conservation programs. In this regard, the public and active participation of Ecofondo (in association with about 300 Colombian NGOs) in environmental matters in the political arena is critical.

There is likewise a critical and continuing need in Colombia to develop and air programs that educate the public, particularly those people in areas rich in wildlife. These people, usually the most poor, often do not realize that wild plants and animals in many areas are disappearing. These people also are among those who most use wildlife, especially those who practice subsistence hunting. To accomplish their purpose, these programs also need to consider and complement sustainable, socio-economic development activities, as well as present a conservation message. In this manner, conservation will be tied to the satisfaction of basic human needs, such as food, shelter, and drinking water.

All of the municipalities and departments of Colombia, by law, must prepare a Municipal Development Plan that includes a component for environmental planning. It is a requirement of the planning process to have community participation. Thus, there is now a good opportunity for local people and organizations to plan the present and future of their regions and to make sure that adequate funds are assigned to habitat conservation and environmental education programs.

Given the present opportunities, it is absolutely essential for individuals and organizations interested in spectacled bear conservation and management to assist rural communities as they organize themselves and begin to participate in programs which seek autonomous integrated development. By working together, bear biologists and an organized and educated populace can achieve their common goals.

Specific conservation recommendations

1. Promote ecological and behavioral research of spectacled bears and their habitat in Colombia in order to understand the factors that affect bear survival. This research should be undertaken in parks as well as on private lands and should include the following elements:
   a. Status surveys to determine the distribution and abundance of bears throughout the country.
   b. Field research to determine bear food habits, habitat use, and daily activity cycles. This research should include the use of radio telemetry as well as ground surveys in areas used by bears.
   c. Studies to determine the impact of human activities on the ecology and behavior of bears. These activities include hunting, agriculture, cattle grazing, selective logging, fuel wood harvest, and the construction of roads, oil pipelines, and hydro-electric plants.
   d. Research on the reproductive biology of captive as well as free-ranging bears to determine basic life history parameters, such as: age at first reproduction, number of young per year, age at last reproduction, and timing and duration of gestation.
   e. Studies to determine minimal and optimal values for size, composition, and structure of bear habitat. These studies should take into account seasonal differences as well as variations due to bear densities and the nature and extent of human activities in the area.

   Based on our knowledge of Colombia, we suggest the following potential research sites: Reserva Natural La

Planada/Awa Indigenous Reserve (Nariño), Guanenta–Alto Río Fonce Sanctuary (Santander), Farallones de Cali NP (Valle), Puracé NP (Cauca and Huila), Los Nevados NP (Caldas, Quindío, Risaralda, Tolima), Chingaza NP (Cundinamarca and Meta), and Sierra Nevada de Cocuy NP (Boyacá and Arauca). These recommendations are based on the known occurrence of spectacled bears at the sites, local support for bear research and conservation activities, and a relatively large potential study area (protected zone plus surrounding area).

We propose that these studies be undertaken by university level researchers, biologists from conservation NGOs, and university-level students doing thesis research. In this regard, Jorgenson has submitted for funding a proposal to conduct three short-term field studies at Guanenta–Alto Río Fonce Sanctuary. Additional funding will be sought in cooperation with Fundación FES to conduct similar studies at Reserva Natural La Planada. These studies will serve as the basis for a long-term study at each site to investigate bear ecology and behavior using radio telemetry.

2. Develop a conservation strategy for spectacled bears in Colombia. This strategy should be undertaken in parks as well as on private lands and should be based on the following elements:
   a. Environmental education programs to inform the public as well as government officials at the local and national levels about bears, their role in the montane ecosystem and potential public benefits of maintaining these ecosystems.
   b. Effective legislation designed to protect the species and its habitat from direct population threats as well as indirect threats through regional economic development programs that focus on resource exploitation.
   c. Strengthen park management and infrastructure to meet the needs of park visitors, researchers, the included flora and fauna, and teachers involved in environmental education programs. Cooperative programs with conservation NGOs should be promoted until adequate financial support is available from the local and national governments.
   d. Promote habitat restoration and the construction of corridors between fragmented forest areas to increase the amount and quality of habitat available to spectacled bears.

Based on our knowledge of Colombia, we suggest the following activities and organizations: production of educational materials for schools and community groups, promotion of visits to local national parks and protected areas, local campaigns to plant trees and restore degraded areas, and conducting local public hearings to discuss proposed legislation and natural resource management policy. Several NGOs already are engaged in these activities or would have an interest in participating, including: Fundación FES, Fundación Natura, Ecofondo, Proyecto BioPacífico, and Herencia Verde. These activities will have to be coordinated with other programs already underway, including: Parks in Peril (Fundación Natura and The Nature Conservancy), the World Bank/Global Environmental Facility (Ecofondo), and protected areas management in the Chocó (BioPacífico).

3. Support community development programs that either improve local socio-economic conditions without depleting local natural resources or increase the role of the public in determining local policies for natural resource management. These programs need to be cooperative in nature in order to benefit from resources and expertise at the national level and local interest in implementing efficient projects.

To evaluate these three objectives and identify specific projects, we suggest that a national meeting be held to set priorities and establish evaluation criteria for the various activities undertaken under this action plan. The following organizations should be invited to attend: a) Ministry of the Environment (parks and wildlife officials), b) representatives of the Alexander von Humboldt and John von Neumann Institutes (national research centers), c) university professors and researchers (including Universidad Nacional, Universidad del Valle, Pontificia Universidad Javeriana – Biology and PUJ/Ideade, and Universidad de los Andes), d) representatives of the appropriate regional development corporations and municipalities, e) representatives of conservation NGOs (including IUCN, WPSA, Manaba, Fundación FES, Fundación Natura, Proyecto BioPacífico, Herencia Verde, and Fundación Pro-Sierra Nevada de Santa Marta), and f) representatives of zoos (including Santa Cruz, Cali, and Medellín).

Status and management of the spectacled bear in Ecuador

Luis Suárez

Status and distribution

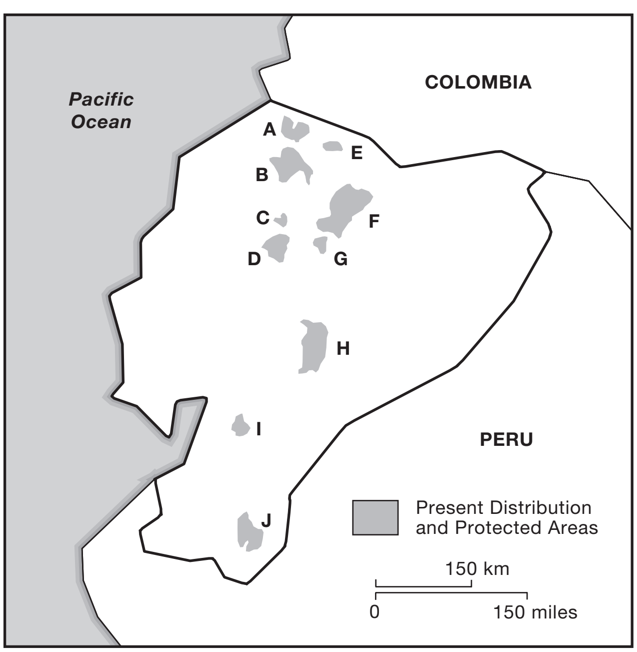
Spectacled bears in Ecuador occur in the cloud forests and páramo habitats, from 900 to 4,250m, in the western and eastern ranges of the Andes (Peyton 1985; Suárez 1985, 1989). The majority of bears reside on the eastern slopes from the border of Colombia to Perú. The areas where bears occur are broken intermittently by settlements along the roads that descend to the Amazonian region. On the western slopes, bear populations are fragmented and isolated. Bears are absent from the inter-Andean region that separates the two Andean ranges in Ecuador.

Spectacled bears are present in at least 15 protected areas throughout the country. Bear survival however, is threatened due to habitat loss in the areas surrounding the reserves and on the reserves themselves (Suárez and García 1986; Downer 1993). The rapidly increasing human population in the inter-Andean valleys, which are already densely settled, is producing a mobile population of landless farmers who seize every opportunity to colonize the Andean slopes where bears occur. Government policies still favor the expansion of the agricultural frontier (Southgate *et al.* 1989). As a result, most of the forested areas of the country are being threatened. In addition, agriculture in bear habitat has resulted in increasing crop predation by bears, which has increased hunting (Adams and Mazariegos 1994; Suárez, unpubl. data).

Although no population estimates are available for the spectacled bear in Ecuador, this species is found in the following areas (Figure 9.4):

1. The largest spectacled bear populations are found along the eastern slope of the Eastern Range of the Andes. Bears are relatively abundant at Cayambe-Coca Ecological Reserve (ER) (4,031km^2), Antisana ER (1,200km^2), and Sangay NP (5,177km^2). These areas are also the most suited to protect the endangered woolly tapir (*Tapirus pinchaque*), and the Andean condor (*Vultur gryphus*) (Peyton 1985, 1986; Downer 1993). Bears have also been reported in the highlands of Sumaco Napo–Galeras NP (2,052km^2) and Llanganates NP (2,197km^2), where difficult terrain and harsh weather conditions limit human occupation (Downer 1993).
2. In western Ecuador, spectacled bears occur in three ecological reserves: Cotacachi–Cayapas ER (2,044km^2), El Angel ER (300km^2), and Illinizas ER (1,499km^2). Bears also have been recorded at Mindo Protected Forest (192km^2) on the western slopes of the Pichincha volcanoes, and at both Toachi–Pilatón Protected Forest (2,120km^2) and Río Zarapullo Protected Forest (216km^2, Mauricio Castillo, Fundación Antisana, pers. comm. 1993). Also, bears probably occur in the Awá Ethnic Forest Reserve (1,010km^2) located on the northwestern slopes of the Andes on the border between Ecuador and Colombia.
3. In southern Ecuador, the largest bear reserve is Podocarpus NP (1,463km^2). A small population of bears probably inhabits the western forests of Cajas NP (288km^2) and Molleturo–Mullopungo Protected Forest (380km^2).

Figure 9.4. Present distribution in protected areas of the spectacled bear (*Tremarctos ornatus*) in Ecuador. Protected areas A–J are: A) Awa Ethnic Forest, B) Cotacachi-Cayapas Ecological Reserve, C) Mindo Reserve, D) Toachi-Pilaton and Rio Zarapullo Protected Forests, E) El Angel Natural Monument, F) Cayembe-Coca Ecological Reserve, G) Antizana Ecological Reserve, H) Sangay National Park, I) Molleturo-Mullopungo Protected Forest and Cajas National Recreation Area, and J) Podocarpus National Park.



Population and habitat threats

The main threat to the long-term survival of the spectacled bear is the conversion of cloud forests to other land uses. Bear habitats are becoming fragmented by the construction of roads and the establishment of human settlements on the Andean slopes (Peyton 1985, 1986; Suárez and García 1986).

Increasingly, agricultural activities are reducing suitable habitats and forcing bears to predate crops, such as corn, to survive. Crop predation is increasing the hunting pressure of farmers. Many farmers now consider the spectacled bear as a pest (Suárez, unpubl. data).

Sport hunting and the use of bear parts in traditional medicine also threaten bear populations in Ecuador (Adams and Mazariegos 1994; Romero and Suárez in prep.). Although hunting is prohibited, bear parts are openly sold in rural markets throughout the country. The fat is used to heal bruises and broken bones. The meat and baculi are used to enhance health and vigor. Skulls, claws, and hides are sold too. Adams and Mazariegos (1994) gathered reports of 15 bears being killed in 1993 to supply the demand for grease in two communities adjacent to protected areas. They estimated an annual kill rate of 70–120 bears on a national scale. This figure does not include cubs, some of which are killed along with their mothers. Hunting of spectacled bears is also increasing due to the international trade of bear gall bladders. Recently, farmers living adjacent to Cotacachi–Cayapas and Cayambe–Coca reported that Asian merchants offered economic rewards for bear gall bladders (Mauricio Castillo, Fundación Antisana, pers comm. 1993; Suárez unpublished data). In December 1992, a Korean offered farmers US$150 (five times the minimum monthly salary in Ecuador) for a bear gallbladder and US$10–15 for each paw (Adams and Mazariegos 1994).

This combination of increasing habitat destruction and poaching makes the spectacled bear's future bleak. It is likely that long-term conservation of bears in Ecuador must be based on large protected areas, where rugged terrain and dense cover can provide protection against human activities.

Western Ecuador

On the Pacific slopes of the Andes, between approximately 1,300m and 3,500m, montane cloud forests still exist, especially in the extreme north. The páramo vegetation, above 3,500m, has been extensively modified by human activities, particularly by seasonal burning and grazing. The main conservation problem is the loss of cloud forests as a result of uncontrolled shifting cultivation, which occurs even inside protected areas (Cifuentes *et al.* 1989). Bear habitats are becoming fragmented and predation of cornfields by bears is increasing in areas bordering nature reserves, such as Cotacachi–Cayapas and Mindo.

Eastern Ecuador

The eastern cloud forests are relatively contiguous, but colonists are now moving into these areas along the expanding network of roads which are being constructed to give access to the Amazon Basin. The habitat available to the bear is shrinking annually by the establishment of human settlements on the Andean slopes and overgrazing by cattle in the highlands. Bears are also threatened by habitat destruction from gold mining activities. In addition, crop predation by bears is increasing along the borders of Cayambe–Coca, Antisana, and Sangay. Bears also are poached inside these reserves (Peyton 1985, 1986; Cifuentes *et al.* 1989; Downer 1993).

Southern Ecuador

The main conservation problems in southern Ecuador are habitat fragmentation and poaching. Bear habitat is being fragmented by the construction of roads and the conversion of montane forests to agricultural uses. Gold mining operations, timber extraction, and poaching are reducing bear populations within nature reserves. Crop predation by bears is also a serious problem along the western border of the Podocarpus NP (Romero and Suárez *in prep*.). In the Cordillera del Condor, spectacled bears are harmed by cloud forest destruction and hunting (Downer 1993).

Management

Actions to protect Ecuador's wildlands started in 1936 when the government set aside several islands of the Galápagos Archipelago as the first National Park (Figueroa 1983). The first National Strategy for the Conservation of Outstanding Natural Areas was completed in 1976. It identified priority areas and provided guidelines for their management (Putney 1976). The adoption of this strategy was a milestone in Ecuador's conservation efforts. Currently, the National System of Protected Areas includes 24 reserves, managed by the Division of Natural Areas and Wildlife of the National Forestry Institute. Not counting the Galápagos, about 49,190km^2 are now legally protected (approximately 17% of the national territory).

Two treaties are relevant to bear conservation in Ecuador. Ecuador has ratified CITES and the World Heritage Convention. An important bear reserve, Sangay NP, was included on the World Heritage List in 1983.

Recent domestic measures have improved bear conservation in Ecuador. First, Sangay NP was extended from 2,719 to 5,177km^2 to protect the headwaters of the Paute River, a critical water source for the country. Also in 1992, El Angel ER was established, which protects bear ranges in northern Ecuador. In 1993 the government created the Antisana ER, which protects bear habitat on the eastern slopes of this volcano. More recently, the government established three protected areas with substantial amount of bear occupied habitat: Sumaco Napo – Galeras and Llanganates NPs on the eastern slope of the Andes, and the Illinizas ER on the western slope.

Unfortunately, Ecuadorian conservation areas are severely threatened and poorly managed. Although the parks and reserves are legally protected, the conservation legislation often conflicts directly with other Ecuadorian legislation, such as the mining and hydrocarbon laws, under which mining and oil concessions have been granted access inside national parks and other protected areas. The Departments of Defense and Public Works, as well as other government agencies, also develop infrastructure inside nature reserves without consultation with the Division of Natural Areas and Wildlife. The problems are compounded by the invasion of protected areas by colonists, the extraction of wood and fauna, the pasturing of livestock, and deliberate burning. These conflicts are the result of inadequate funding, insufficient protection and management, poorly conceived and contradictory legislation, minimal coordination between public and private institutions, and lack of trained park personnel and suitable infrastructure (Cifuentes *et al.* 1989).

A number of local NGOs are actively campaigning for the conservation of spectacled bears. EcoCiencia is developing research and education projects in collaboration with WCS, in Podocarpus, Cayambe-Coca, and Cotacachi-

Cayapas. Fundación Natura is supporting the Division of Natural Areas and Wildlife by assisting with the establishment of boundaries and the provision of critical infrastructure and equipment for several protected areas, through a debt-for-nature swap sponsored by WWF-US and The Nature Conservancy. Fundación Natura is also promoting conservation activities in several areas on the western slopes of the Andes where bears occur (Oswaldo Báez, Fundación Natura pers. comm. 1994). Other local organizations, such as Fundación ArcoIris and Fundación Ecológica Mazán, are actively involved in conservation projects in Loja and Cuenca, respectively. Likewise, Fundación Antisana is developing conservation activities at Antisana and Cayambe-Coca ERs.

Specific conservation recommendations

1. The integrity of present reserves containing spectacled bears should be maintained and their areas extended where possible. It may be possible to combine bear conservation with watershed protection. A large proportion of the bear's geographic distribution in Ecuador coincides with critical water catchment areas which determine the yield and quality of water supplies for much of Ecuador. Highest priority should be given to the conservation of the most important watersheds: Cotacachi-Cayapas, Cayambe-Coca, Antisana, Sangay, and Podocarpus.
2. A long-term ecological research project using radio marked bears should be implemented to generate data on bear behavior, reproduction, space requirements, and diet. This would provide basic information needed to assure the continued existence of this species. According to Peyton (1986), Antisana and Cayambe–Coca have the best mix of accessibility, good bear and woolly tapir populations, competent human resources, and potential for large mammal protection in Ecuador.
3. Forest corridors should be established to link the Cayambe-Coca reserve to the cloud forests of Antisana and Llanganates. This would create the largest reserve for spectacled bears in Ecuador.
4. A detailed survey and long-term monitoring of all protected areas with spectacled bears should be conducted to assess their conservation status. The survey should also include the highlands near the Colombian border, the eastern side of Cotopaxi volcano, the eastern Andes of Azuay, and the southern cloud forests near the Peruvian border. The long-term monitoring, using geographical information systems (GIS), would generate basic data on habitat availability as well as habitat loss due to human encroachment. This information can be used to avoid or reduce the negative impacts of population isolation.
5. The impact of crop predation by bears should be evaluated to design compensation mechanisms or land management alternatives for local farmers.
6. Resources, including better legislation and additional park rangers, should be provided to improve anti-poaching measures, especially within nature reserves and the surrounding areas. Law enforcement is especially needed to control poaching activities that supply bear body parts.
7. Educational programs should be designed to promote the conservation of Andean forests. These programs could use the spectacled bear as a flagship species.
8. Training programs should be established to strengthen local research capacity and conservation programs.

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Status and management of the spectacled bear in Perú

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Status

The number of bears in Perú is unknown. Albert Erickson (1966), after a six week survey in 1965, estimated there were 2,500 spectacled bears in Perú. Grimwood (1969), who traveled throughout Perú, estimated that there were 800–2,000 spectacled bears in 1968. Peyton (1981), after a more extensive survey in 1977–1979, placed the population at 2,000–2,400 bears. These numbers probably underestimate Perú's bear population. Surveys in the southern half of Perú's bear range from 1980–1990 revealed Perú had more bear occupied habitat than previously thought. Perú has approximately 82,200km^2 of bear occupied habitat, or 1/3 of the species' range in the Andes (Peyton *et al.* 1997). If population densities of spectacled bears are as low as the least dense North American black bear population (low=seven adult bears/100km^2, Garshelis 1994), then the area bears occupy in Perú would translate to a minimum population of 5,750 adult bears. These statistics should be used with extreme caution.

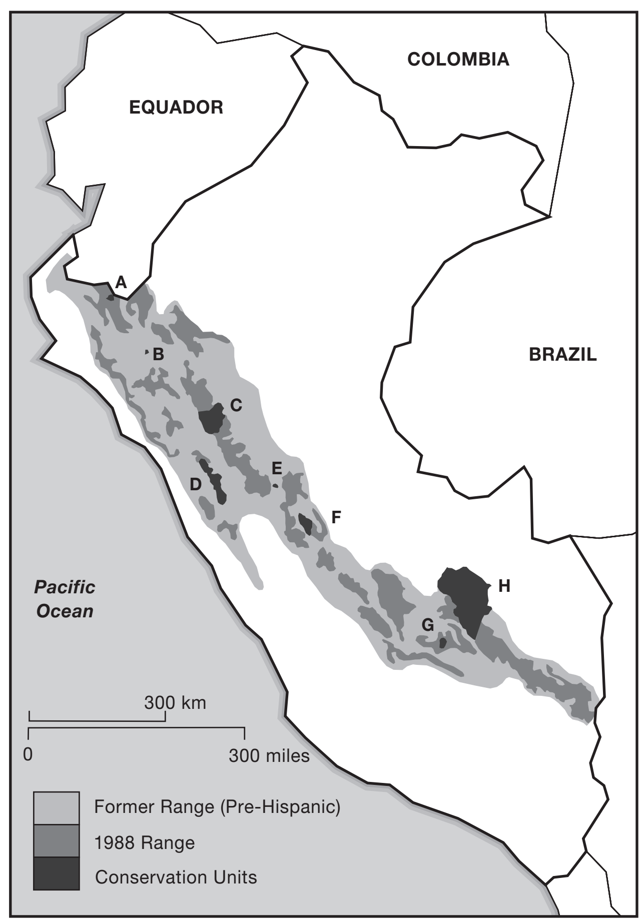
Historic range and current distribution

The spectacled bear inhabits the greatest range of habitat types and elevations in Perú of any bear species found in any other country. Bears in Perú are found in all three Andean ranges from 250m in the coastal deserts to just below permanent snow at 4,750m. Between these elevations spectacled bears inhabit steppe lands, subtropical dry forests to tropical montane rain forests, elfin forests, and high elevation grasslands. Bears are not permanent residents of low mountain tropical forests where they are rarely found at elevations as low as 650m on the eastern slopes of the Cordillera Oriental (Peyton 1980).

Given the range of habitat the species can exploit, it is a safe assumption that at some point before Colonial times spectacled bears occupied the entire Coastal Range down to 250m and as far south as Lima, the Central Andes to the headwaters of the Santo Tomas River, and the entire Oriental Range (Figure 9.5). Cities have been present in Perú for at least the past 7,700 years (New York Times, 28 April, 1981). From then until the Spanish conquest of the Incan Empire in the 1530s, bears probably did not compete with humans for food or threaten their survival. The evidence for this is the lack of bear imagery in the tapestries and ceramic vessels of Perú's pre-Hispanic cultures (Peyton 1981, 1987b). The change in land ethic and ownership from the 1550s to 1790 set the stage for the bear's future population decline. The mestizo descendants of the Spaniards acquired large land holdings, made only larger by the depopulation of vast highland areas due to wars, introduced disease, and poisoning of native Peruvians in silver mines. The inequitable land ownership (0.2% of farmers owned 69% of the farmland in 1960) forced farmers to abandon land that could no longer support their families. Thus by 1961, 23% of Perú's population was migrant (2.28 million people, see Eckstein 1983). Most migrants went to Lima, and other large cities where they tried to enter the industrial class. A smaller proportion traveled over the Andes in search of land they could farm informally. Their efforts were facilitated by new roads built over the Andes by President Fernando Belaunde Terry (1963–1968) with the help of foreign aid. His goal was to relieve the overcrowded urban environment and provide labor to develop jungle resources. The Agrarian Reform he initiated failed to redistribute more than 4% of the farmland. The road building and exodus of farmers to the montane forests continued during the military regime (1968–1980) that followed. Although the generals managed to redistribute almost all of the privately held land, only 28% of the peasant population received it (Eckstein 1983). Many of the 860,000 families left to fend for themselves had no other choice but to join the throngs that had previously migrated into cities and over the Andes toward the jungle. Bear habitat that was once protected by impenetrable cloud forests was now under attack by shifting cultivars. The combined effect of lack of land, increased access, deforestation, and hunting promises to eradicate wild bear populations in Perú unless a range of solutions are initiated (see Specific Conservation Recommendations below). Nobody knows the exact cumulative impact of these threats, but it is believed to be severe. Hunters interviewed during field surveys of 1977–97 claim bear populations have declined to a third of their former level since the 1960s.

Spectacled bear populations are now very small, fragmented, and disappearing in the Coastal or Occidental

Figure 9.5. Present and estimated pre-Hispanic range of the spectacled bear (*Tremarctos ornatus*) in Perú. The estimated range is a map of the habitat types that presently are known to support spectacled bear populations. Location of National Parks (NP) and Historic Sanctuaries (HS) that now contain bears (within present range), or formerly had bears (outside present range), are indicated by letters: A) Tabaconas-Namballe NS, B) Cutervo NP, C) Rio Abiseo NP, D) Huascaran NP, E) Tingo Maria NP, F) Yanachaga-Chemillen NP, G) Machu Picchu HS, H) Manu NP



Andean Range, where there are probably less than 300 bears. The best Occidental bear population occupies montane forest and paramos north of the towns of Huancabamba and Ayabaca to the Ecuador border where the Occidental and Central Andean Ranges converge. Included in this area is the recently established National Sanctuary of Tabaconas–Namballe (1988, Figure 9.5). The Cutervo NP (Figure 9.5) and humid forests south of Porculla pass to the town of Chota are not large enough to contain viable populations of spectacled bears. These areas are also home to drug traffickers which has curtailed forestry and wildlife management for the past two decades. An estimated 10–20 bears occupy the humid forests and paramos in each of the populations south of Chota. Fewer than 100 bears inhabit the coastal deserts and thorn forests from Pativilca River (10°42'S) to the town of Canchaque (5°24'S). The upper elevational limit to these populations is where annual precipitation is high enough (e.g., > 500mm) to support permanent human settlement. Agriculture and villages occur in a broad band from 2,750–4,400m elevation in the south and 1,675–2,300m in the north, thereby separating the desert bear populations from bears that occupy humid forests. Desert bear populations are further isolated from each other by human settlements along the major river valleys that descend to the Pacific Ocean. The largest of these bear populations are on steep topography that prevent human access along the rivers Pativilca, Huarmey, Santa, Viru, and La Leche. Bears infrequently use the subalpine paramo and steppe habitat above 4,000m on the northern boundary of Huascaran NP (Figure 9.5) between Nevado Champarra and Cerro Alto Santa Cruz.

Spectacled bears live above 1,800m elevation in montane forests on both sides of the Marañon River north of 10°S latitude and between 1,675 and 2,900m in the provinces of Tarma, Satipo, and Huanta. The high annual precipitation of 2–7m makes this the wettest and consequently the most species-rich bear habitat in Perú. For example, the spectacled bear's range in Río Abiseo NP in the northern central Andes (Figure 9.5) is home to 36 endemic vertebrates. This is 9% of Perú's endemic vertebrates (n=272) and 29% of those that live in Perú's montane forests (n=126, Leo 1993). Undisturbed parts of the range have the highest density bear populations found in Perú as evidenced by copious amounts of fresh spoor seen throughout the year. Local reports of litter sizes were consistently two or more cubs with litters of four cubs occasionally reported (Peyton unpubl. data). Population numbers in these regions are unknown.

A small population of perhaps fewer than 50 bears inhabit the thorn forests and deserts between the towns of Ocros and Chulpi along the Pampas–Apurimac–Santo Tomas drainage. The near vertical habitat and the unstable political situation has prevented land managers and researchers from entering bear habitat here since 1979. The Sendero Luminoso terrorist movement that has crippled the economy of Perú for the past decade had its origin in Ayacucho above the Apurimac River. The highlands south of Chulpi in the Central Andean Range has been farmed since pre-Hispanic times. Consequently the southern end of the range is unsuitable for spectacled bears. Human settlement along the Maraon and Apurimac Rivers form effective barriers to bear movement between the Central and Oriental Andean Ranges.

Spectacled bears have their largest and most contiguous populations on the eastern slopes of the Oriental Andean Range. Some areas offer bears over 3,500m of elevation from high elevation paramos to lowland forests. Extensive agricultural areas exist on the western slope of the Carabaya Range; below 1,750m in the Vilcanota Range, and along the Urubamba, Huallaga, Perene, and Apurimac Rivers. These areas are unsuitable to bears and fragment the eastern slope bear population into at least seven subpopulations. Population numbers are also unknown for these areas.

Status of protected areas

Although Perú has 31.5% of the total range of the spectacled bear in Latin America, only 7% of that range is included within park boundaries. The Tabaconas–Namballe National Sanctuary might sustain a bear population if its 295km^2 area and the adjacent forest of El Chaupe (490km^2) were placed under strict management. Both areas have tall forests of commercial grade lumber (*Podocarpus* sp.) that have been cut down on the Ecuadorian side of the border. Local communities stopped a Peruvian lumber company from logging an area adjacent to the sanctuary in 1992 (A. Luscombe *pers. comm* 1993). The Huascarán, Cutervo, and Tingo Maria NPs (Figure 9.5) are not important conservation units for bears. The latter two parks are surrounded and impacted by coca fields (Young 1992). Four conservation units with bears exist on the eastern slopes of the Oriental Andes (Figure 9.5). Three of these give the spectacled bear their best chance of survival in Perú: the Río Abiseo NP in the north, Yanachaga-Chemillén NP in central Perú, and Manú NP in the south. All have over 1,200km^2 of bear occupied habitat which was found to be the minimum necessary to contain a spectacled bear population that was reported to be stable by hunters (Peyton 1989, Table 9.5). Only 5% of the spectacled bear range above 1,500m on the eastern Oriental slope is included within the boundaries of these three parks (Young 1992). The parks are separated from each other by >250km of unprotected wilderness. More of eastern slope of the Oriental Andes needs to be preserved. Protected land bridges that connect parks and forest reserves should be established even though initially they will not be functioning institutions. Forested corridors

Table 9.5. Size and amount of spectacled bear habitat in national parks (NP) and historical sanctuaries (NS) in Perú.

Conservation unit	Year established	Total area (km^2)	Bear occupied area (km^2)
Cutervo NP	1961	25	0
Tingo Maria NP	1965	180	0
Manú NP	1973	15,328	2,300
Huascarán NP	1975	3,400	150
Machu Picchu HS	1981	326	89
Río Abiseo NP	1983	2,745	1,920
Yanachaga-Chemillén NP	1986	1,220	1,000
Tabaconas-Namballe NS	1988	295	295
Total		**23,314**	**5,754**

adjacent to these parks extend for >3,000m of elevation and >200km along the Oriental Andes. Recently Río Abiseo NP and areas adjacent to Yanachaga–Chemillén NP (Bosque de Protección San Matías–San Carlos and the Cordillera El Sira) are experiencing incursions by coca growers, the plant from which cocaine is derived (Dr. Antonio Brack-Egg pers. comm. 1994). This development is threatening to both parks and their management. The fourth conservation unit, the Historical Sanctuary of Machu Picchu is too small to protect bears without intensive management of adjacent land. Of its 326km^2, only 89km^2 was found by Peyton (1987a) to be of good quality for the species. However, its status as one of the most prominent tourist attractions in the world make it too important to ignore for bears.

The spectacled bear is one of a few species that can serve as an umbrella under which conservation can affect the greatest number of conspecifics. This is especially true in Perú which is considered to be one of the 12 most diverse countries in the world (UNEP 1991). Perú's Andean taxa are characterized by unusually high endemism (Table 9.6) and high turnover rates in species composition. The cloud forest above 1,500m in Perú where bears live contain an estimated 15% of vertebrates and vascular plants, and 32% of Perú's endemic species in only 5% of Perú's landmass. On a unit area basis that level of endemism is 5.75 times greater than it is in Perú's Amazonian forests (Leo 1993).

Under optimal management the three largest national parks in Perú's Oriental Andes would preserve only a fraction of that diversity because of the high turnover rates in flora and fauna between them. For example, half the flowering plants found in Río Abiseo NP have not been found in Yanachaga–Chemillén or Manú (Young 1988). If these three parks become habitat islands in a human altered landscape, many or possibly most of the species they contain would be unreplicated anywhere in the world. Management is far from ideal for these three parks to exist in the future, let alone the 250–400km of land between them. Perú's government currently employs approximately 35 forestry guards to protect the entire eastern slope of the Oriental Andes. The level of protection translates to 5,700km^2 of spectacled bear habitat/park guard (Young 1992).

Legal status

On the basis of Albert Erickson's 1965 survey, the spectacled bear was listed as Vulnerable in the IUCN Red Data Book (Peyton 1987b). Hunting and other forms of take of spectacled bears are prohibited in Perú by the Forestry and Wildlife Law (Decree Law No. 21147, 1975). Perú ratified CITES in 1975. The spectacled bear is listed on Appendix I of CITES which further prohibits the trade in spectacled bears and its parts by signatory nations. Both legal instruments were weakened by subsequent legislation. On 30 May, 1992 the Peruvian government enacted legislation that defined conditions for the take of endangered species from the wild for captive breeding (D.S. 018-92-AG). A Ministerial Resolution on 18 May, 1993 (R.M. 0164-93-AG) established fees the government would collect for each animal taken under the former provision. The eligible list included spectacled bears and other Appendix I and II species of CITES (K. Young pers comm. 1993). Take of a spectacled bear under this provision would cost US$1,000 (Daniel Aguilar 1993, pers. comm.). Although the Director of Wildlife confirmed that fees would be paid only by zoos (Mariella Leo Luna pers. comm. 5 April, 1994), the legal provisions do not prevent the commercialization of endangered wildlife by either the recipient or the government. The exploitable loopholes in

Table 9.6. Biodiversity (number of species) of various taxa in Perú as a whole and that portion contained in Peruvian cloud forests above 1,500m elevation in the Oriental Andes (OA). Percentages of species totals appear in brackets.

	All species		Endemic species		
Taxa	**Perú**	**OA**	**Perú**	**OA**	**References**
Vascular plants	20,000	>3,000 (15)			Gentry 1980, Young 1991
Anurans	295		110	42 (38)	Leo 1993 and references therein
Mammals	460		52	17 (33)	Leo 1993, Pacheco *et al*. 1995
Birds	1,702	930 (55)	112	29 (26)	Parker *et al*. 1982, O'Neill 1992

the provisions include the lack of restrictions on how bears and other wildlife are caught and how "registering and marking" captive offspring (article 4c of D.S. 018-92-AG) will guarantee wild bears will not be taken. Lacking are provisions requiring sufficient background checks on recipients and monitoring what happens to transferred wildlife. These laws enable the government to partake in the illegal sale of wildlife, whether intentional or not.

Perú ratified the World Heritage Convention in 1982. Four sites with spectacled bears were inscribed: Machu Picchu Historical Sanctuary (1983), Huascarán NP (1985), Manú NP (1987), and Río Abiseo NP (1990). In 1977, Perú had three biosphere reserves accepted in the UNESCO Man and the Biosphere Programme, among them the Huascarán and Manú NPs. The Biodiversity Convention signed by Perú in 1992 was ratified a year later by the Peruvian National Congress.

Population and habitat threats

The combination of rural population growth, lack of land ownership, and increased road access through bear habitat is the most serious threat to bears in Perú. Currently an estimated 1.5 million people (< 10% of Perú's population) live in the montane forests of the Oriental Andes where the best bear populations are found (Young 1992). Their ranks are augmented yearly by people fleeing from terrorism or meager employment in the coastal cities and highland Departments of Cajamarca, Junin, Ayacucho, Cusco, Pasco, and Puno. These migrants cause more damage than residents because they are unfamiliar with the fragile ecological conditions that discourage permanent agriculture in montane environments.

Roads are the axes that define the major breaks in the spectacled bear population. Coastal desert bear populations are isolated from one another by the settlements along roads built to exploit the Amazon basin. Settlements and agriculture now occupy most of the inter-Andean valleys. Bears are thus prevented from crossing between the three Andean ranges and populations are increasingly fragmented within ranges. The economic pressure to build roads has threatened the integrity of the largest national parks with bears. Within the past 15 years conservationists have brought enough pressure on politicians to halt the construction of roads that would bisect both Río Abiseo and Manú NPs. Huascarán NP had a road built through it in the early 1980s along the southern end of its bear habitat. The nearly absent regulatory presence in national parks to protect bears (discussed below) is another reason why road access is such a severe threat. Parks with bears offer only passive protection against the encroachment of humans that roads allow.

Of the products of increased access, habitat loss has had a more significant impact on Peruvian bear populations than has hunting. The two impacts are related. Spectacled bears increasingly adapt to feeding on crops that replace their natural foods. The reliability of finding bears in cornfields has made them easy targets for hunters. Peruvian farmers compensate for their lack of weapons by bringing in professional hunters to eradicate depredating bears. Until now, hunting has been an additive source of mortality to bears. The trend in Perú is for hunting to have a more significant impact on spectacled bear populations than habitat loss. This is evidenced by the disappearance of bear sign over the last three decades in the Occidental and Central Andean Ranges where good quality habitat remains. The most severely impacted areas are where

B. Peyton

Rare photograph of a spectacled bear (*Tremarctos ornatus*) at a water hole in the Peruvian desert of Cerro Chaparri, Department of Lambayeque. Once easily lassoed and clubbed by mestizo hunters on horseback, these desert bears are rarely seen by local inhabitants if at all. They are now the most endangered spectacled bear population in South America.

people have reduced the core habitat for bears to less than 500km^2. Another indication of the severity of hunting has been the recent improvement of bear populations in the central and southeastern parts of the Andes since 1985. Less bear hunting occurred because people were inhibited from carrying firearms that might increase their chance of being killed by Sendero Luminoso guerrillas or the Peruvian army sent to combat terrorism (A. Begazo, R. Marin, and A. Luscombe pers. comm. 1993).

The most severe habitat threat to spectacled bear populations in Perú is their restriction to poor quality habitat. Montane forest is being replaced with cornfields and pasture in the lower elevations (600–2,000m) of the bear's range. Livestock are also grazed in the highlands (above 3,000–3,500m). The net effect is to limit the spectacled bear to poor quality habitat in between. The elevations of 2,700–3,300m are choked with bamboo species (*Chusquea* spp.) the bear does not eat. Preferred fruit sources are rare to nonexistent. Trees with their associated bear foods of epiphytic bromeliads and orchids are also less abundant. And finally the energetics of moving in the environment is higher due to increased slope inclination and higher vegetation density in heights above the ground occupied by the bear's body (Peyton 1987c). It is not known whether bears can survive if limited to these elevations. They might not because there are no known bear populations in the bamboo forests of the Andes that do not have access to fruit sources either above or below. Most of the bear habitat below 1,800m has been replaced by cropland in all three Andean ranges in Perú except on the east slopes of the Oriental Range.

The removal of seasonally available fruit from the spectacled bear diet could severely impact recruitment. The timing of ripe fruit coincides with the time of cub rearing and may be important in bringing potential mating pairs of bears together. These effects are expected to be most pronounced in the Apurimac valley where for most of the year bears have little to eat other than terrestrial bromeliads (*Puya* spp.). People occupy elevations above the bears (2,700–3,000m) where precipitation is sufficient for agriculture. The boundary area between bears and humans support cactus groves (*Opuntia ficus indica*, *Trichocereus* spp.) which provide bears with fruit. As many as nine bears have been seen feeding in close proximity to one another in cactus groves (Peyton 1981). Increased cattle and goat grazing in this habitat has trampled the cactus and caused bears to avoid the habitat. Poor nutrition may be one reason why adult female bears here weigh approximately 35kg and are reported to have only 1 young (Peyton 1981, unpubl. data). Genetic effects due to inbreeding could be another factor to explain the apparent low viability of Apurimac bears. If so, the near vertical topography of the elevations below 3,000m to the Apurimac River that prevents human access may not be sufficient to save the species here.

Food is not nearly so limiting for bears in the coastal desert. Bears here have been seen with two young and killed in excess of 100kg in weight. Unlike the Apurimac situation, human encroachment is proceeding from the lower elevations as well. Bears, particularly sows with cubs, make extensive use of riparian and cliff habitat in the desert for food, water, and day bedding (Peyton 1980). Habitat threats here include the cutting of forests in riparian areas to make crates for agricultural produce, housing, and firewood. The loss of tree cover causes year-round water sources to evaporate which may limit the bear's ability to exploit nearby areas.

Fires set in the dry season by farmers to fertilize and clear fields for crops or cattle can alter bear habitat kilometers from where they are set. A fire set by railroad employees in the Machu Picchu Historical Sanctuary in 1988 raged over 34km^2 of bear inhabited wilderness (Diaz 1989). The long-term effect is not known, but the short-term effect was to reduce the quality to bears of approximately 40% of their best habitat. The increase of smoke in all valleys has reduced the scenic value tourists place on Perú to the point of arousing concern by local and central government officials. In the past two decades 5–9% of Perú's gross national product was derived from tourism. Most of the tourists went to the Historical Sanctuary of Machu Picchu where every year the ruins and mountains become harder to see through the haze.

Management

Management focused on the needs of bears is lacking in Perú, but progress has been substantial given the young age of the national park system and its governing institutions. Resource management in Perú during the past four decades can be divided into three time periods. During the first period (1950s–1977) the Ministry of Agriculture established its authority over natural resource use (1956), and defined three management categories of forest reserves and four of protected areas (Forestry and Wildlife Law, Decree Law No. 21147, 1975). Collectively the protected areas comprise the National System of Conservation Units (Sistema Nacional de Unidades de Conservación) (SINUC). Policy formation and administration of SINUC was given to the General Directorate of Forestry and Fauna (Dirección General Forestal y de Fauna) (DGFF) a division within the Ministry of Agriculture. Since the establishment of the first conservation unit in 1961, SINUC today comprises 25 units totaling 4.29% of Perú's landmass (IUCN 1992). Six of these units contain bears and approximately 5,750km^2 of bear habitat (Table 9.5).

During the second period (1977–1987) policies originating from the central administration split the authority over conservation units between the DGFF and the National Forestry and Fauna Institute (INFOR, Instituto Nacional Forestal y de Fauna), a public institution that conducted agroforestry research. The ill-defined hierarchy left Perú without an autonomous institute to manage protected areas and enforce forestry law (Injoque *et al.* 1991). Consequently, human encroachment occurred in all conservation units by both landless peasants and by the more powerful development interests of the Ministries of Transport, Fisheries, Mining, and Tourism (Ferreyros 1988). The Cutervo, Tingo Maria, and Huascarán NPs lost their conservation value for spectacled bears during this period.

Consolidation and decentralization of administrative bodies has occurred since 1987 when INFOR was dissolved. Its responsibilities and those of the DGFF were incorporated into a National Institute of Natural Resources (INRENA, Instituto Nacional de Recursos Naturales). District forestry units (distritos forestales) and forestry development centers (centros de desarollo forestal) were integrated into 12 Agrarian Units, now the sole regional offices with greater autonomy. The SINUC and all other state controlled lands such as national forests were incorporated under one organization, the National System of State Protected Natural Areas (SINANPE, Sistema Nacional de Areas Naturales Protegidas por el Estado). Perhaps most critically important to bears, an Environment and Natural Resources Code (Legislative Decree No. 613 of 1990) was passed which consolidated all previous legislation into a cohesive document. Among the provisions was one that recognized the rights of native communities to own land, and one that repealed the Law for the Basis of Rural Development of the Peruvian Amazon (No. 24994 of 1989). The latter had promoted extensive agricultural development in the Amazon basin (IUCN 1992). Together these measures allowed authorities to implement "sustainable yield" principles, without which forests where bears lived would be continually mined without replacement. Subsequent revisions of the Peruvian Penal Code included for the first time sections that specified penalties for violations of laws dealing with wildlife and natural resources (T. Luscombe pers. comm. 1993).

The act of consolidation and decentralization coupled with declining economic conditions in the country at large had severely reduced the staff in the DGFF. For example in the two years from 1991 to 1993, the number of park guards employed by SINANPE fell from 143 to 93. Most of the conservation units within SINUC were not fulfilling their management objectives. The NGOs Asociación de Ecología y Conservación, Asociación Perúana para la Conservación, and Fundación Perúana para Conservación de la Naturaleza did their best to fill the management need by providing conservation units of SINUC with equipment, personnel, and research projects. SINUC and SINANPE have continued to receive little support by the government which results in inadequate salaries and training (Ferreyros 1988). Conservation of bears and habitat both in and outside management units will continue to decline unless this infrastructure is supported.

Two conservation units are too small to maintain viable bear populations without bear use of adjacent land (i.e. Machu Picchu HS and Tabaconas–Namballe NS). The rest are becoming that way. Most of the spectacled bear range in Perú (93%, Peyton *et al.* 1997) exists outside parks where the interests of local communities prevail and enforcement of forestry laws is weak. Therefore, the future existence of bears in Perú depends on the support bears receive at the local level. Central authorities must grant community institutions greater authority to manage resources in return for their cooperation in maintaining bear populations and the watershed resources they share with bears. Management authorities have just begun to seriously address this issue.

Human-bear interactions

In pre-Colombian time, the spectacled bear was worshiped as a vehicle for change. Everything from the passage of sickness to health, of the underworld to heaven, of dark into light, and passage of time (one year to the next, adolescence to adulthood) was attributed to the powers of spectacled bears (Randall 1982). The Incas likewise considered the bear to have spiritual value, and sometimes let bears go after capturing them in predator roundups designed to protect their camelid herds from mountain lions (Tschudi 1844). By 1850, the influence of Spanish culture had supplanted these beliefs with one that viewed the bear as a symbol of machismo. The descendants of the Spanish Conquistadores lassoed and clubbed bears from horseback when the latter fed on shrub fruits (*Capparis* spp.) in the open desert (Peyton 1981). During the latter half of the 19th century, dogs were used by hunters, enabling hunters to kill bears in their forest refuges (Osgood 1914). Machoistic identification in the bear is now widespread among local farmers. Like their ancestors they drink the blood of bears as a communion to being more bear-like. Fat, which was once used by the Incas as a salve for tumors, (Baumann 1963) is now used to cure rheumatism and acne (Brack-Egg 1961). Baculums and paws fetch more than a month's salary to a farmer. Bear scats are fed to cattle (Ricciuti 1983) and smeared on newborns to make them strong. A bear with 10 litres of fat could be worth more than US$115 to a farmer, or half his annual income. On average between 1–3 bears are killed per year in most valleys of the Cordillera Oriental. Fortunately, the international trade in bears and bear parts has not impacted Perú's bear population. That is likely to change due to the high presence of Asian companies doing business in Perú.

In addition to the lure of prestige and income from killing bears, the loss of crops and livestock to depredating bears further motivates farmers to kill them. Of 25 cornfields with bear feeding sign examined by Peyton (1980), five of the fields were half consumed by bears and three were totally consumed. It is common in Perú to hear farmers complain of bears killing their entire herd of livestock. Farmers without guns either make arrangements to have bears shot by the military, police, or sport hunters; or poison them with parathion in baits (Peyton 1987b). There still remains a vestige of the ancestral spiritual belief about bears, but that is likely to disappear with the passing of the current generation. Therefore, policies to save bears in Perú must include means of compensating farmers for losses due to agricultural depredation, reduced use of bear habitat, and loss of income generated by the sale of bear parts. Alternative employment for farmers include tourism, orchid farming, development of hydroelectric power and pharmaceutical products, and preservation of genetic diversity in important food crops. The latter includes more than 3,000 varieties of the potato, a food that originated in Perú. Spectacled bears may be the principle dispersal agent of one of the three most important timber sources in the cloud forest, members of the Lauraceae family (Peyton 1987c).

Public education needs

The most important aspect of a public education program is that it recognizes bear conservation is affected by all sectors of society. The target groups to receive education on environmental issues that affect bears are: policy makers (government officials, law makers), policy implementors (park guards), monitors and educators (NGOs, teachers), students, resource developers (corporations, lending institutions), and resource users (farmers, urbanites). The message to all groups is the maintenance of bear habitat and civilization in Andean nations as we have known it are inseparably intertwined. Spectacled bears by virtue of their cosmopolitan use of the Peruvian Andes are a good thermometer for the health of the environment as well as a flagship representative of it. Their cultural status as a symbol of renewal and endurance provides hope and heritage to Perú's lower classes.

Public education must promote a dialogue between target groups to solve problems together. For example, resource users are rarely consulted by policy makers and don't often become project implementors. Policy makers and developers have as much need to understand the concepts of sustained yield and how to apply it to bear habitat as NGOs need to understand that resource users can not be prohibited from using resources without being compensated. The infrastructure for public education is well developed in Perú. There are more than 80 environmental NGOs in Perú. The projects listed in the next section address specific needs of target groups.

Specific conservation recommendations

These recommendations are organized under the four factors Kellert and Clark (1991) proposed were important for natural resource policies and listed under the social group that would implement them. Varying institutional strength, costs, and time scales over which projects occur make it difficult to prioritize these steps. Generally, steps mentioned first within an outline level have more importance or are pre-conditions for later steps to occur. The overall goal is to reduce negative human impact on bears both in and outside protected areas, and wherever possible improve welfare of people who share resources with bears in return for their stewardship of these national treasures.

Biological

1. *International*: Link Podocarpus NP in Ecuador to Tabaconas–Namballe National Sanctuary in Perú with protected corridors that would additionally extend for another 200km to the northeast to include the Cordillera del Condor.
2. *Central/Regional Government*: a) Discourage new road access through cloud forests; b) Increase the number and size of protected areas with bears on the eastern Oriental slope. Establish buffer zones around significant bear areas and corridors of protected habitat between them; c) Improve conditions for bears within existing parks. Create incentives and pressure to remove miners, settlers, and livestock from core and buffer areas. Deploy park guards, preferably chosen from local communities (target at least one guard/300km^2 of park); d) Implement policies designed to reduce agricultural damage due to bears (e.g., legislation that allows removal of problem bears, passive and active deterrence, compensation program, etc.); e) Research indicators of ecosystem health in both relatively pristine and severely degraded Andean habitat. Use comparisons to argue for preserving habitat.
3. *Community*: a) Research and monitor bear populations and threats to them. Provide local knowledge to researchers and project planners; b) Improve and maintain bear habitat, especially in buffer areas and corridors, through: removal of livestock, trail closure, prohibition of logging trees bears feed in, controlled burns to improve food abundance and diversity, etc.; c) Reduce bear depredation of crops and livestock by improving yields on land further from the forest refuges of bears and employing crop guards in the fields at the forest edge.
4. *NGO*: a) Research the impact of bears and humans on each other and on shared resources. Identify what behaviors should be changed in both man and bear and risks local people take to benefit bears. Research topics include: bear depredation on agriculture, bear use of

habitat, bear population estimates and status, habitat conversion/loss, hunting, and commercialization of bears and bear parts; b) Provide training and standardize methods to apply them in other areas and draw comparisons.

Social

1. *Central Government*: a) Implement policies that provide land tenure for residents of bear habitat. Build it on informal systems wherever possible. Use arguments generated from pilot projects that demonstrate local capacity, and use comparative studies that shoe the relationship between degree of resource ownership and ability of Andean areas to provide resources; b) Support private property laws and uphold domestic food prices; c) Encourage agricultural extension, technical support, and facilitate credit on favorable terms to owners of small farms (<$0.10km^2$).
2. *Regional Government*: a) Improve the welfare of those who live near bears (e.g., develop markets and agricultural extension services; improve educational opportunities, transportation, access to credit institutions, and health facilities) in return for community cooperation in sustained resource use; b) Develop and maintain more intensive use of existing land under cultivation around bear areas (e.g., repair and create irrigation systems, terracing, raised crop beds; encouraging multi-cropping and longer fallow periods; plant leguminous crops and shade trees for soil enrichment, vaccinate livestock, etc.); c) promote education to improve the public perception of both protected and unprotected areas.
3. *Community*: a) Research and monitor resource use and the acceptance of goals by the community to improve bear populations; b) Increase public awareness through education programs that build on cultural traditions that teach respect for the environment.
4. *NGOs*: a) Improve community welfare (extend credit on favorable terms, etc.); b) Research aspirations of local communities. Identify incentives or benefits that will compensate changes in their behavior. Research topics include: resource ownership and use patterns, political processes, impact of outside influences, bear depredation on agriculture, sources of livelyhood including commercialization of bears and bear parts, labor organization, and agricultural yield per unit effort).

Institutional

1. *International*: a) Foreign governments must cease to support measures that obligate Perú to mine resources without replacement and encourage the spread of informal economies further into bear habitat (e.g., cease support for coca field erradication, control of capital markets, domestic agricultural subsidies, and unfair tariffs on imports); b) Reduce, write-off, and/or reschedule foreign debt payments; c) Increase foreign aid and technical support; d) Uphold legislation that makes domestic and multinational companies accountable for their activities that degrade the environment within Perú's borders.
2. *Central Government*: a) Promote vertical and horizontal coordination of policies between and within ministries; b) Decentralize authority to manage resources. Form partnerships with indigenous groups, community institutions, NGOs, industry, regional utility coorporations, and lending institutions to cooperatively manage resources. Provide regional and community government bodies with a principal role in the decision making process and the authority to prevent misuse of resources. Make these authorizations accountable to the national interest; c) Promote cooperative relationships with Bolivia and Ecuador to cooperatively manage border bear areas; d) Share information and provide technical support; e) Close the loopholes of recently enacted legislation (D.S. 018-92-AG, R.M. 0164-93-AG).
3. *Regional Government*: a) Improve institutional cooperation to maintain parks; b) Revise park management plans to incorporate bear needs (e.g., zone large bear areas by establishing 500–800km^2 core areas of no human use, establish six kilometer-wide buffers around cores with limited use, etc.); c) Increase park management staff, preferably with employees hired from local communities.
4. *Community*: a) Strengthen local institutional ability to control resource use by community members and outsiders; b) Improve communication between communities, government agencies, and NGOs.
5. *NGOs*: a) Improve role as a neutral interface between communities, government, industry, and other outside interests; b) Broaden the base of financial support for bears both domestically and abroad. Develop alternative sources of capital (e.g., tourism, orchid farming, cottage industry, etc.); c) Improve skills at all social levels to adapt and manage their own development.

Valuational

1. *All levels of social organization*: Establish the spectacled bear as a flagship for the preservation of biological and cultural resources in the Andes.
2. *Regional/Community*: Reduce hunting of spectacled bears by creating an interest in bear protection on the part of local stewards through targeting the military and police, developing a compensation program to reduce the financial loss from crop depredation, using proceeds from alternative and new developments to create employment in resource management sectors, and create educational resources.

3. *NGOs*: a) Research and improve public attitudes towards bears; b) Develop projects based on existing cultural values.

Specific projects

Rio Abiseo National Park

a. *Public awareness campaign, Río Abiseo National Park* (submitted by Mariella Leo, Biologist):
The Río Abiseo NP (RANP) is the most significant conservation unit that protects montane habitats in northern Perú. Residents of the park include the spectacled bear, an animal that makes extensive use of the cloud forest, and the taruka (*Hippocamelus antisensis*), a large deer that inhabits high elevation grasslands above the forest. Although classified in Perú as vulnerable, both species have seriously declined in numbers to the point where remaining populations should be considered endangered. Park guards reduce hunting of these species inside the park. However, they are unable to exert any control on the hunting of these species outside the park boundaries where their natural ranges extend. Here, spectacled bears are killed primarily as revenge for their depredation on crops and cattle. Taruka are killed for meat. A decrease in hunting pressure on these species in adjacent areas to the park would help prevent the extinction of these park residents in several ways. The park populations would be maintained by increased emigration from outside areas and possibly by increased genetic diversity. Also hunting inside the park would be easier to control if it were controlled in the surrounding areas.

   Action: Identify people's attitudes towards these species and estimate hunting impact. A questionnaire survey will be conducted to this end in the five districts adjacent to the western border of RANP (Provinces of Pataz and Condormarca). Low cost printing material will be produced and basic information and training will be provided to the park guards to place them on the front end of the campaign to help save these species. Talks and presentations will be given in the rural towns close to the park and to the seven families settled inside the park. Information will be provided to the local police and army. Their support will be requested to avoid illegal hunting by their peers, and to help enforce the hunting prohibition in the area.
   Estimated budget: US$8,000.
   Time period: 6 Months
   Participating institutions: RANP administration, APECO, APECO-Trujillo, and INRENA

   Action: Develop awareness among rural school children, through environmental education programs conducted by local school teachers with NGO technical support when needed. Rural school teachers have little knowledge about the importance of endangered species and their needs for conservation. Information and adequate materials on wildlife is always lacking. A pilot project that targets school teachers from neighboring towns to the western border of RANP will be started to change this situation. A short workshop will be developed with 20 teachers from different schools to examine the current information about spectacled bears and taruka in the region and the country at large. Products from the workshop will include an outline of a teaching guide and material to be distributed among students. Final production of the material will be done in Lima where official recognition of the efforts of the participants will be requested from the Education Ministry and INRENA. The educational material will be distributed among schools by the RANP administration. An annual prize will be established for the best monograph on these species and awarded after a school contest promoted by the RANP administration.
   Estimated budget: US$ 10,000.
   Time period: 1 year
   Participating institutions: RANP administration, APECO, APECO-Trujillo, INRENA, and USE-Pataz (local Education Service Unit from the Education Ministry).

b. *Monitor the impact of depredations by spectacled bears in neighboring areas* (submitted by Mariella Leo, Biologist):
Farmers and cattle owners from the Province of Pataz (west of RANP) complain that spectacled bears are harmful animals. The argument is used to justify killing bears in the areas adjacent to park boundaries. The real impact bears have on agriculture is unknown here as it is for most areas in Perú. The information is needed locally to strengthen public awareness and the environmental education process, and nationally to formulate a policy on the problems of depredating bears.

   Action: Monitor level of depredation. A survey will be conducted to determine the level of impact spectacled bears have on agriculture. The survey will include interviews with farmers and cattle owners and visits to the sites of crop damage and livestock kills. These monitoring activities will be developed with the support of APECO researchers and the park guards who will receive training on gathering and recording data. The park guards will implement the survey with fieldwork expenses covered through this project. APECO researchers will continue to support the process with two visits per year and will analyze the data. The goal will be to have a clear picture of the economic and social impact of bears on human welfare. Annual

reports of the research will supplement information for the public awareness and educational activities.
Estimated budget: US$10,000.
Time period: 2 years
Participating institutions: RANP administration and APECO

c. *Resettlement of seven families from the RANP* (submitted by Mariella Leo, Biologist):
A few months prior to the establishment of the RANP in 1983, a local farmer set up a farm in the Abiseo River valley. Relatives came to the area during the following years and settled without knowing they were inside a national park. In 1985 an aerial survey of the RANP failed to locate their small village. After the park administration was established in 1986, the Park Chief contacted the settlers and initiated some attempts for their resettlement. Although their impact in the park is unknown, their presence is a constant source for potential violations of park laws (hunting, burning, etc.) and their presence could stimulate other migrant farmers to settle in the park.

Action: Negotiate the resettlement of families who currently reside in RANP on a case by case basis. Alternatives other than cash compensation will be offered to these families. Agreements will be devised according to current laws. APECO staff will monitor the process and facilitate coordination among government organizations and with the farmers.
Estimated budget: US$10,000.
Time period: 2 years
Participating institutions: RANP administration, INRENA, Dirección Regional Agraria-La Libertad, and APECO.

Tabaconas/Namballe

a. *Human influence on spectacled bear populations in "El Chaupe," an adjacent forest to Tabaconas-Namballe NS* (submitted by Juan Jose Rodriguez, Oscar Hernandez, and Anthony Luscombe, ECCO):
Stable or increasing spectactled bear populations have not been found in areas less than 1,000km^2 in size. The 290km^2 of Tabaconas–Namballe NS are too small to maintain spectacled bears without intensive management; management that might prove too expensive for future budgets and too restrictive of resources that local communities depend on. Without local support for the park it will be overrun by settlements and agriculture. A management model that works well is to create a multiple use zone in areas that surround or buffer a core area where human use is prohibited. Tabaconas–Namballe is too small to include these buffer zones within its boundaries. If the 490km^2 of adjacent forest known as "El Chaupe" were included in a park master plan, the combined area would be large enough to preserve watershed products and its species for benefit of both man and bear. The additional land would reduce the cost of sustaining bears exponentially, as well as preserve the greatest number of options for future use of the park.

Action: Research the effect humans and bears have on each other in "El Chaupe."

The biggest threat to spectacled bear populations is the rapidly expanding human migration into prime bear habitat. Tabaconas–Namballe National Sanctuary has the most promise to sustain bears of any area in the western Andean range in Perú, provided that the forest in the sanctuary and adjacent areas remains intact. The future of these forests depend on their ability to provide benefits for the local communities. For the past two years staff of ECCO have been helping local farming communities stop a logging company from removing trees from "El Chaupe," a 490km^2 forest adjacent to the sanctuary. The local communities received no payments or jobs from the logging and thus were against it. There is no guarantee that the forests are safe from future logging. The expanding human populations surrounding these forests will eventually cut them down without replacement unless alternative employment and methods to preserve them can be found. As a first step, field work is needed to learn about how bears and humans use resources in the park. The process of learning the effect each has on the other has many human benefits. Among these are building rapport and capacity with local communities (e.g. training of future park staff, project or industry managers), and identifying resources that can finance the restricted use of enough area to preserve the watersheds and their species. Beside the spectacled bear, the forests on the border with Ecuador that include Tabaconas–Namballe are the only areas in Perú that have the woolly tapir (*Tapirus pinchaque*). The information gathered will be used to convince the Peruvian government of the need to include adjacent forested areas such as "El Chaupe" in a park management plan.
Estimated budget: US $8,245.
Time period: 1 year
Participating institutions: ECCO and its Bear Working Group, and the Univ. of Cajamarca.

b. *Research bear/human interactions as a first step to maintaining a dispersal corridor for bears between Manú NP., HS Machu Picchu, and the Apurimac Valley* (submitted by Constantino Aucca, ECCO):
At the present rate of human population expansion, the spectacled bear in southern Perú will be reduced

to two separate populations within the next 20–30 years: the largest in Manú NP of at least several hundred, and a very small population of under 50 bears in the HS of Machu Picchu. Citing either demographic or genetic causes of decline, no biologist gives either population much chance of surviving. The existence of spectacled bears in southern Perú depends on preserving enough habitat between and adjacent to these parks. In most of the valleys outside parks, local farmers remove the tall forest on the lower slopes for their cornfields at the rate of 100m of elevation every three years. As the best food producing habitat is replaced by corn and cattle, bear depredation on agriculture and the subsequent ire of local farmers increases. In the vacuum of alternative resources or ways to exploit them, farmers will destroy their own livelihood on these slopes if the current use continues. Before that happens, enough habitat will be removed and enough bears will be killed in cornfields to reduce the bear population in southern Perú to a level it cannot recover from. What is needed is a program to teach people to conserve their environment for themselves as well as bears.

Action: Research status of bear and human use around and between the HS of Machu Picchu and Manú NP with the objective of preserving a corridor for dispersal between these parks.

A field team, made up of ECCO coordinator Constantino Aucca and biology students from the University of Cusco, will research the status of bear habitat and its use by bears and humans in the areas between and surrounding Manú and Machu Picchu. Included in the study area are the valleys between the junction of the Pachachaca River and the Apurimac River and the Salcantay range, and the valleys accessed from the Marcapata to Shintuyo road that runs along the eastern boundary of Manú NP. The main objective will be to create a map of bear and human use areas. Agriculture and bear depredation will be thoroughly researched, including estimates of effort, yield, actual damage, and perceived loss to pests that include bears. The products of the study will include capacity building for future managers and technicians in both the university and the local communities. The research results will be used to strengthen arguments to add adjacent land to park management plans, and empower local communities to manage lands between the parks for the combined benefit of both man and bear. The principle interest for bears will be to preserve a corridor between parks and to prevent further isolation of bears in southern Perú.
Estimated budget: US $10,725.
Time period: 1 year
Participating institutions: ECCO, Univ. of Cusco.

Status and management of the spectacled bear in Venezuela

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Historic range and current distribution

Historical accounts from the 16th to 18th centuries suggest a wider bear distribution than exists today. Past distribution could have extended to mountainous and forested regions adjacent to the southern margin of the Orinoco river and perhaps, although with less probability, to the Interior range of eastern Venezuela (E. Yerena, *Distribución pasada y contemporánea de los úrsidos en América del Sur.* Informe de Seminario EA–7154, Dep.Estudios Ambientales, Univ. Simón Bolívar, Caracas, 1987). Most accounts correspond to animals whose descriptions could resemble those of spectacled bear. Humboldt and Bonpland (1814) and Codazzi (1970) are the first naturalists who refer specifically to the presence of bears (without specifying the species) at the beginning of the 19th century, particularly in the region of Guayana, south of the Orinoco river. Based on the evidence of unconfirmed reports of bear presence, spectacled bears may have existed in the mountain ranges of San Luís (Falcón State) and Aroa (Yaracuy State). Although these regions have Andean biogeographical affinity, it is not likely that areas such as these that are outside the Andean region have bears today.

Present spectacled bear distribution is discontinuous but encompasses humid forests and páramos with little to no human impacts in the Andes mountain range of western Venezuela (Mondolfi 1989, Figure 9.6). This range splits from the Colombian Oriental mountain range into two divergent and isolated branches, the Perijá and Mérida ranges. The Perijá Range heads north and has nearly 8,000km^2 of forested mountain habitat for bears (Yerena and Torres 1994). The Mérida Range heads northeast. Its 13,300km^2 of forested mountain slopes are broken into

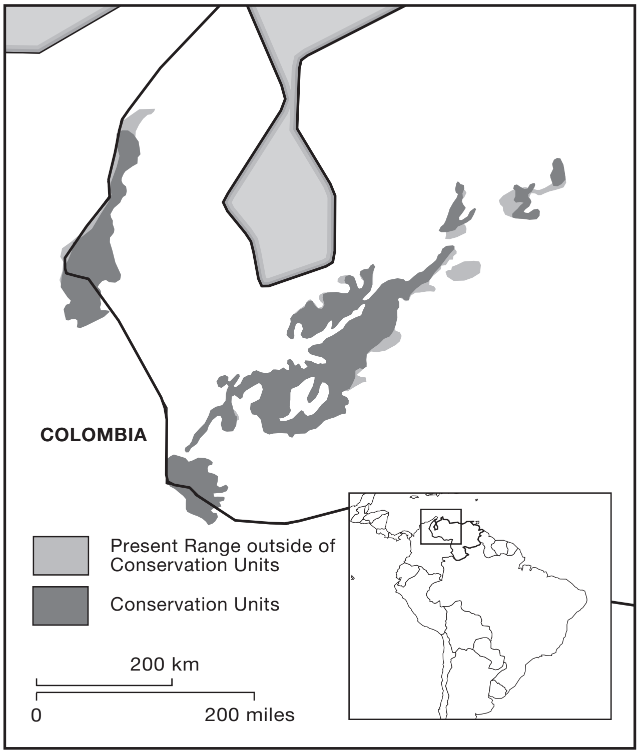


Figure 9.6. Present range of spectacled bears (*Tremarctos ornatus*) in Venezuela and conservation areas.

four wilderness fragments: Tamá, Central, Dinira and Portuguese (Yerena and Torres 1994).

The Perijá distribution is almost exclusively in Venezuela along the eastern slopes of the range. Wilderness areas with bears are scarce on the western slopes in Colombian territory, and more prevailent south of the Venezuelan border in the Catatumbo river basin. The latter region supports a bear population whose range is mostly to the north in Venezuela. The Tamá massif where Colombia's Oriental range terminates, is the starting point of the Mérida range. There the distribution is restricted to the wilderness areas of the massif, from the foothills up to the summit and extending toward the Colombian portion. The distribution becomes discontinuous along the altitudinal depression that separates Tamá from Chorro El Indio NP. From then on to the end of the Mérida range the topography is steeper and higher in elevation. Here wilderness areas (up to Guaramacal NP) are relatively continuous and restricted to the higher portions of the range. These areas have difficult access and are not ecologically favorable for agriculture. The replacement of wilderness by coffee plantations fragment the spectacled bear's distribution at the end of the Mérida range, between Guaramacal and Terepaima NPs (Portuguesa range). In spite of the local extinction of bear populations due to agriculture, bears are reported to seasonally use semi-isolated cloud forest tracts as small as 70km^2 (Yerena 1992; Goldstein 1990).

The altitudinal range of bears in Venezuela is from 400 to 4,300m. The areas where bears are most often observed at low altitude are in Perijá, Sierra Nevada, and Tamá (Goldstein 1990; Yerena 1988). As in other Andean countries, most bear locations are reported above 1,000m. (E. Yerena, Distribución pasada y contemporánea de los úrsidos en América del Sur. Informe de Seminario EA–7154, Dep.Estudios Ambientales, Univ. Simón Bolívar, Caracas, 1987).

Most high altitude vegetation formations are bear habitat. The Venezuelan Andes have two fundamental natural vegetation formations: woody (predominance of shrubs and arboreal life forms) and non-woody (predominance of rosette-like life forms). The latter are alpine meadows above and around timberline called páramos (Vareschi 1970) which generally do not share the same space with woody formations. Most paramos are used by bears (graminoid páramos and Andean páramo). Forest (woody formations with predominance of trees) that support bears are: evergreen dry forest, submontane forest, montane seasonal forest, cloud forest (characterized by scarce sunlight and frequent fogs), páramo forest, and high Andean forest (Yerena 1992, using habitat classification by Beard 1946, 1955; Monasterio 1980; Sarmiento,G., M. Monasterio, A. Azocar, E. Castellano, and J. Silva, *Vegetación Natural: Estudio Integral de la Cuenca de los Rios Chama y Capazón.* Subproyecto III. Facultad de Ciencias, Universidad de Los Andes. Mérida, 1971). Seasonal and semi-arid formations such as dry deciduous forest and thorny scrubs have not been sufficiently studied in Venezuela to determine if they support bears or have that potential. Desert páramo and periglacial desert (Monasterio 1980) are seasonally traversed by bears, but do not support bears year-round. The timberline at around 3,000m is an important habitat for bears (Goldstein 1990). This ecotone is characterized by interspersed forest/shrub/páramos. Its location on mountain slopes is mostly affected by climate, however fire and other human interventions play a key role (Monasterio and Reyes 1980).

In the short term we do not foresee a significant reduction of bear distribution area, except in the Portuguesa range. Here, it is possible bears will go extinct in Terepaima NP, whose forests are isolated from the rest of the forested Mérida range. This process may be caused by a combined effect of poaching and deforestation for agricultural purposes. The low altitude and lack of steep slopes of this relatively small region allow human access. The available habitat to bears may decrease in the northern end of the Perijá range due to coal mining, timber extraction, and agriculture (legal and illegal crops), as well as in the foothills of its eastern slope due to cattle ranching and agriculture. The long-term future of bear populations at Tamá and Perijá NPs relies on the maintenance of bear populations in adjacent territory under Colombia authority. Both national parks have counterparts in Colombia, but the possibility of maintaining wilderness continuity with other areas in Colombian is unknown. The eventual isolation of these transfrontier populations is worrysome.

Status

Our best estimate is that there are probably no more than 1,000 bears in Venezuela. There is no empirical data on bear population numbers in Venezuela, and direct field estimates have been made (Goldstein 1990). However some densities have been estimated in the central block of the Mérida range, based on the number of hunted bears in relatively confined areas, and on information provided by hunters. The average of these estimates was 0.04 individuals/km^2 or 1/25km^2 (Yerena 1992). This density is low considering estimates by Peyton in Perú and comparable data of *Ursus americanus* (Peyton 1984). Extrapolation of this density over the total amount of forested habitat in the central block of the mountain range (approximately 4,600km^2 in the states of Trujillo, Barinas, Mérida and part of Táchira yeilds a population estimate of 180 individuals (Yerena 1992). Further extension to include all bear habitat in Venezuela (around 21,400km^2, Goldstein 1990) results in a population estimate of 1,000 bears.

Legal status

In Venezuela there is no specific legislation regarding conservation and management of spectacled bears. Nevertheless the Wildlife Protection Act of 1970 listed the spectacled bear as a species for which hunting, poaching, and commercial harvesting were prohibited. Bear hunting for any reason has been prohibited indefinitely since 1980 (ministerial resolution/ DGAA-95 of Jan., 1980). Venezuela subscribed to CITES in 1976, and thus has protected spectacled bears as an endangered species under Appendix I resolutions.

Population threats and human interactions

The main threat to bear populations is poaching. An estimated 2.47 bears/year have been poached during the last 70 years in the surroundings of the city of Mérida situated in the central tract of the Mérida range. This might be an underestimation (Yerena 1992). If this loss is representational of the entire Mérida range, it would be multiplied 10–13 times, a significant impact on the viability of what probably amounts to no more than a few hundred bears. Notwithstanding the lack of data on illegal kills, poaching undoubtedly is exerting deleterious effects on wild populations. The main reasons for hunting are cultural and economic (Yerena 1988; Mondolfi 1989; Herrera *et al.* 1992; I. Goldstein pers. comm). Manhood is achieved by poachers who kill bears. This could be linked to the fear that the bear's strength inspires. Also bear parts (e.g., fat, bones, baculum, and blood) are valued for healing or magic purposes. In all studied cases poaching has met a double purpose: providing meat and hunting trophies. Bear hunting is most often opportunistic, and thus not planned. Skin and claws are generally conserved as hunting trophies. The main economic incentive that justifies poaching is to eliminate nuisance bears blamed for cattle losses, and not the commercialization of bear parts. Cattle losses encourage organized bear hunting, mainly in páramo habitat (Goldstein 1991).

Habitat threats

Habitat loss is the second largest threat to bear populations in Venezuela. At risk are the remaining wilderness areas (Yerena 1992; I. Goldstein pers. comm.). After European settlers arrived at the beginning of the 16th century, wilderness areas were reduced, especially those located on internal mountain valleys and plateaus. Generally these were areas with moderate and seasonal climates (corresponding to semidecidous and evergreen forests). Agricultural expansion reached its maximum limit during the first decades of the present century. Although the affected areas generally started to recover since the 1940s, large portions of the bear's range did not. The humid forests that were probably bear strongholds above Lake Maracaibo were rapidly transformed into plantations and cattle fields during the 1950s. During the same period an estimated 12,890km^2 of forest was lost on the Llanos foothills (Orinoco river basin), or 67.5% of the original forest (Veillon 1977). Now agriculture is expanding again, especially in paramo lands. This is occuring due to its profitability in both wilderness areas and formerly abandoned fields. The effect of these agricultural interventions is the fragmentation and isolation of forest tracts.

This is particularly characteristic of the Portuguesa mountain range, and around Dinira and Tamá NPs. Habitat in the Perijá range is not yet fragmented. Thus this range is the most important block of bear habitat in Venezuela (Yerena and Torres 1994).

Management

Up to November 1996, Venezuela had 43 national parks and 23 natural monuments, that represent around 15% (150,000km^2) of the national territory. By 1986 there were five national parks with bears in the Venezuelan Andes (Table 9.7). The number of protected areas dramatically increased following field studies on bear ecology and conservation by Venezuelans in the 1980s, and due to efforts by Venezuelan members of the IUCN/SSC SBSG. Presently 13 national parks and natural monuments exist within the spectacled bear's range (Table 9.7). The new protected areas were designed to not include significant rural populations. The following factors explains this surprising increment in the number of protected areas: a) politicians' need to be popular; b) pressure exerted by environmentalist organizations at the regional level; c) presence of technicians in government institutions with scientific training in conservation; d) a significant increase of geographical and ecological studies in the Andes undertaken mainly by university students, and e) the importance of watershed preservation in the higher river basins. The fact that rivers with origins in protected areas produce more than eight million m^3 of water per year that generate 17% of the hydroelectric potential of Venezuela (Maraven 1993) was a powerful argument to justify the creation and management of all these protected areas. The combined effect of these five factors was especially positive between 1986 and 1992. Since then, government officials consider that too much protected area exists in the Andean region. Consequently these factors are not expected to exert as much influence as they had.

Within the bear's range approximately 14,000km^2 is protected, an area equivalent to 9.36% of all land in the national parks system. The amount of available bear habitat in protected areas was estimated by subtracting non-wilderness areas from the total park size (Table 9.7). Upon doing so it was apparent to land managers in the mid-1980s that the there was not enough suitable habitat within most parks to maintain viable bear populations given the needs of bears for large areas, security cover, and sufficient genetic interchange against inbreeding depression (Yerena 1992; Yerena and Torres 1994). Consequently several national parks were conjugated or linked to newly created protected areas generating the following large conservation units (Figure 9.6):

a. Tapo Caparo, Sierra Nevada, La Culata, Guirigay, Páramos del Batallón y La Negra, and Chorro El Indio (total 8,730km^2; areas 12, 1, 10, 13, 8, 9 of Table 9.7);
b. Yacambú, El Guache (total 345km^2, areas 2 and 11 of Table 9.7).

Also, two national parks share borders with two other national parks of Colombia, generating two key transfrontier conservation units:

c. Perijá (area 4 of Table 9.7, Venezuela) and Catatumbo Barí (Colombia), totaling 4,530km^2; and
d. Tamá (area 5 of Table 9.7, Venezuela) and Tamá (Colombia), totaling 1,870km^2.

The creation of a second dispersal corridor has been proposed between Sierra Nevada and Páramos del Batallón, along the uppermost ridge of the mountain range. Another proposed corridor would link Guirigay with Guaramacal, thus expanding the largest conservation unit (a). These corridors would add 1,500km^2 to regional subsystem of interlinked protected areas that would embrace approximately 10,230km^2. Similarly some degree of wilderness connection could be maintained between Terepaima and Yacambú, and between these areas and conservation unit (b). Peasant relocation programs have taken place in these latter two parks which have helped park consolidation. Although Sierra Nevada and Tamá NPs contain the largest human populations, these people did not pose a significant threat to wilderness areas. Dinira is the only protected area whose bears may be genetically isolated.

Table 9.7. Protected natural areas in the Venezuelan Andes. All are national parks except the Natural Monument of Teta de Niquitao/Guirigay

Protected area	Size (km2)	Non-wilderness habitat (km^2)	Elevation (m)	Year
Before 1986				
1. Sierra Nevada	2,765	86	300–5,007	1952
2. Yacambu	145.8	60.2	1,400–2,160	1962
3. Terepaima	186.5	58.7	300–1,675	1976
4. Perijá	2,952.8	80	200–3,500	1978
5. Tamá	1,390	250	320–3,500	1978
After 1986				
6. Guaramacal	214	1.3	1,500–3,100	1988
7. Dinira	420	20	1,400–3,500	1988
8. Páramos del Batallón and La Negra	952	180	1,200–3,900	1989
9. Chorro El Indio	108	7.4	800–2,600	1989
10. Sierra de La Culata	2,004	100	800–4,700	1989
11. El Guache	200	20	800–1,700	1992
12. Tapo Caparo	2,704	100	400–2,800	1993
13. Teta de Niquitao/Guirigay	200	30	2,000–4,000	1993

The Ministry of the Environment oversees the National Institute of Parks (Inparques) which manages national parks and natural monuments, and the Wildlife Service (Profauna) which manages wildlife refuges and reservations and is responsible for wildlife species conservation outside parks and monuments. Up until now there have been no refuges or reserves established in the Andean region. Management of Andean protected areas is performed by Inparques with a minimum of field personnel. Personnel and management programs have so far been sufficient to prevent major loss of wilderness habitat but insufficient to enforce regulations against poaching. Perijá is the conservation unit that has the most critical management situation because of the presence of Colombian guerrillas, illegal crops, conflicts among Creole cattlemen and Indian communities, coal mining, and the advancement of the agricultural frontier. The latter three issues are prevalent in land adjacent to the national park. These conflicts could be alleviated and/or solved if a buffer zone could be established around the park where Indian communities had property rights, and the whole area managed as a biosphere reserve (Yerena, E., La reserva de biosfera de la Sierra de Perijá. IV Seminario Regional para la Conservación del Lago de Maracaibo. San Cristobal, Venezuela, 1994).

Eighteen (12: 6) spectacled bears have been kept in six zoos during the last 30 years (Pernalete 1991; Torres 1992). Captive breeding efforts had not been reported until very recently, due mainly to the lack of females and poor breeding facilities. Now only two institutions have captive spectacled bears: Gustavo Rivera Zoo (Punto Fijo) and Miguel Romero Antoni Zoo (Barquisimeto City). Gustavo Rivera has a breeding program in cooperation with Lincoln Park Zoo of Chicago. Miguel Romero has just begun another breeding program with an imported female from Lima's Las Leyendas Zoo. They also have imported a captive-born spectacled bear from Leipzig (Germany), and recently got a confiscated circus bear. An ambitious breeding and re-stocking program has been proposed as a joint effort by these zoos, Inparques, and Fundacondor, a private NGO, (see Specific Projects below). These zoos are competent in captivity management, but research is sporadic and somehow restricted to veterinary needs.

Public education needs

The spectacled bear has become a symbol of conservation in just the last eight years. Previously few people know of its existence in Venezuela. Now it has become a flagship species, even named with some frequency by politicians. This has been achieved with modest but effective efforts of government organizations like Inparques, Los Andes University, Venezuelan oil companies, State of Mérida, and NGOs such as ProVita, Fudena, Banco Andino, Fundacondor, Boy Scouts Association, Polar Brewery, Brigada Conservacionista Tremarctos Ornatus, CREE, FAPAS, and others. Support has been received from international organizations such as the Lincoln Park Zoological Society, New York Zoological Society and Jersey Wildlife Preservation Trust. The environmental education programs that resulted from this support included the use of posters, pamphlets, graffiti, T-shirts, handicrafts, participation in radio and TV programs, forums, and conferences. This has generated a snowball effect that has encouraged many companies, unions, conservationists, sport event promoters, etc., to diffuse the spectacled bear image and name. Spectacled bears have been featured in special television and radio programs, commercials, and press deliveries. Although the effect of these media have not been quantitatively monitored and evaluated, it is obvious that this kind of promotion should continue due to its positive impact on public opinion of bears and all wildlife.

Specific conservation recommendations

1. Reduce poaching

Vast improvements are needed in the abilities of law enforcement officers in the field to combat poaching, both to reinforce mechanisms and field operational capacities. This should be carried out by specially trained and equipped personnel with aptitude to work in remote and difficult areas. It should also be accomplished with the cooperation of regional and community institutions. Protected area management programs should give high priority to anti-poaching activities. Such activities should be accompanied by extension programs that promote sustained use of alternative resources such as ecotourism, captive breeding of game species, honey farming, handicrafts, etc. Local inhabitants should derive real and tangible profits from sustainable natural resource use, and from a conservationist attitude toward wildlife. Policies should diminish bear/people conflicts, especially those associated with extensive cattle grazing on pàramo land. More intensive and higher tech grazing techniques might reduce extensive cattle presence on pàramos, and thus the competition between cattle and wild herbivores. Compensation programs should be considered for confirmed livestock kills caused by bears or felines.

2. Address habitat needs for the maintenance of viable bear populations

Habitat availability for bears should be met within a legal frame of protected areas. It is necessary to use other management categories different from national parks such as wildlife refuges and reservations. The search for the maintenance of habitat continuity should continue, implementing management of dispersal corridors and redesigning some boundaries of already existing conservation units. It is important to coordinate with Colombian authorities and institutions to apply these same measures in transfrontier wilderness areas. Also it is important to achieve adequate planning and integral management of already established protected areas. In peripheral areas of parks, sustainable resource use programs should be implemented to prevent habitat fragmentation and create buffer zones. Forest use policies outside protected areas should be revised to stop the advancing agriculture frontier, and promote more intensive and profitable land use.

3. Increase scientific research

Presently lacking is detailed knowledge of the bear's geographical distribution and all other aspects of its biology, and how this knowledge can be applied to conservation training and support for new professionals and students from different technical and scientific disciplines is needed. Also lacking are tools to analyze information such as a permanent monitoring system that includes sighting locations and data processing. Cooperation with researchers and students of the other Andean countries is another need. An experimental reintroduction or restocking program could be a vehicle to increase understanding of bear behavior, reproductive biology, population genetics, and ecology. Such a program, although polemic, should be discussed thoroughly.

4. Increase public awareness

Venezuelans of all social backgrounds should appreciate and support initiatives for the conservation of this species, with full awareness of all tangible benefits that are derived from it: conservation of cloud forests, biodiversity, and watershed products such as drinking water and hydroelectric energy; alternative industries such as tourism, and regional planning and development. All available resources for massive and selective diffusion, with special emphasis on radio mass media, should be used. The educational forum should be both formal and informal and especially be directed toward peasants who live inside and around bear habitat. These programs should reinforce the achievement of the first two objectives of this action plan. The achievement of the conservation of this species is important for the Andean identity of Venezuelans and their country. Such identity requires a shared objective of ecological integration with the neighboring Andean countries, one that could be very fruitful in terms of technical and scientific cooperation.

5. Develop capacities for integral captive population management

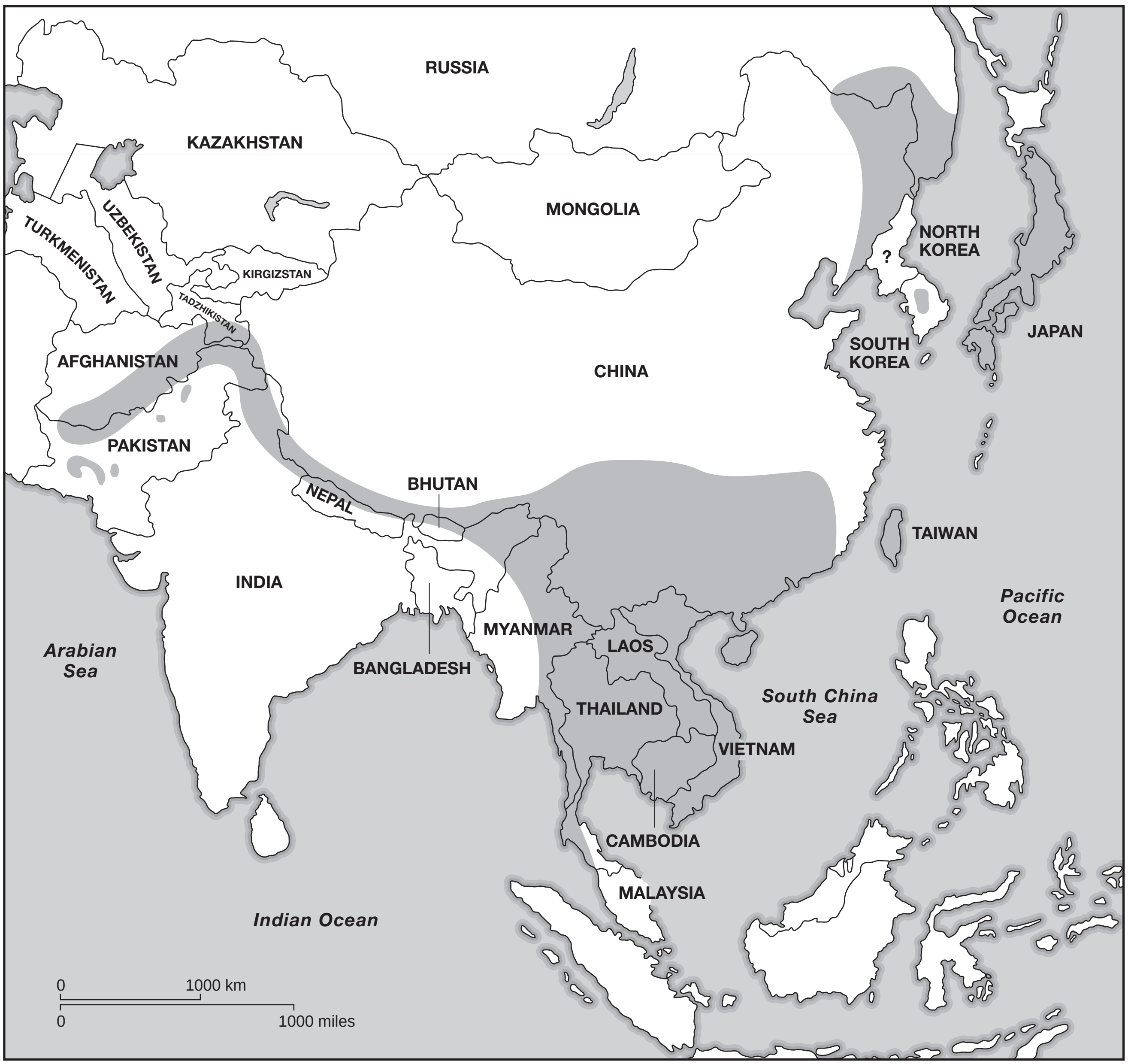
This objective has a double purpose: to integrate *in situ* and *ex situ* conservation strategies, and contribute to the achievement of the educational objective. A National Plan of Captive Management must first be established, endorsed, and accepted by all zoos. In connection with efforts of maintaining wild populations, a captive breeding stock should be established, and techniques developed to replenish diminished wild populations with captive-raised animals. This is a medium to long-range plan. Zoos should play a more active role in promoting awareness about this species; particularly in their local regions. Coordination should be strengthened between Venezuelan and international *ex situ* management institutions.

Chapter 10

Asiatic Black Bear Conservation Action Plan

IUCN Category: Vulnerable, A1cd; Critically Endangered, B1+2abc,C2A (Iran, Pakistan)
CITES Listing: Appendix I
Scientific Names: *Ursus thibetanus, Ursus thibetanus ussuricus, Ursus thibetanus japonicus*, *Ursus thibetanus formosus*
Common Names: Asiatic black bear; Formosan black bear; Japan: *tsukinowa-guma*; Russia: *gimalayskiy medved, belogrudiy medved*, or *cherniy medved,* Himalayan, white-chested or black bear

Figure 10.1. General distribution of the Asiatic black bear (*Ursus thibetanus*).



Introduction

The Asiatic black bear (*Ursus thibetanus*) is distributed through much of southern Asia, northeastern China, far eastern Russia and Japan (Servheen 1990), see Figure 10.1.
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Status and management of the Asiatic black bear in China

Ma Yiqing and Li Xiaomin

Distribution and status

According to 1994 statistics the number of Asiatic black bears (*Ursus thibetanus*) in China is less than 20,000 individuals. They are endangered now, and urgently must be protected.

The Asiatic black bear is widely distributed in broad-leaf and theropencedrymion forests. Tropical rainforests and oak forests are its ideal habitats. In the past, there were large areas of forests and substantial numbers of black bears in northern China. Forests have disappeared quickly in this region since the Ming Dynasty (1368–1644), and especially during this century. According to historical materials, the number of bears in China has decreased yearly and its distribution range is continuously being reduced. The wild population numbers are declining in areas, even in regions of northeast and southwest China. The bear no longer exists in many provinces and Autonomous Regions. Black bears are now extinct in the northern region.

Because of the rapid increase of human population and development, the extent of black bear habitat has gradually decreased over recent years. For example, the human population in Heilongjiang Province, a black bear stronghold (see page 123), has increased by a multiple of five in the past 30 years. Farmland area has increased 30,000km^2, decreasing the forest area from 480,000km^2 to 240,000km^2. Forests have become fragmented by highways and towns.

The black bear is widely distributed in China (Figure 10.2), but mainly occurs in southwest China. Most recordings are from Xizhang Autonomous Region, Sichuan, Yunnan, and Heilongjiang provinces, etc. The distribution of the black bear in China can be divided into four large regions:

1. East Mountainous regions of northeast China: extends southward from the Xiaoxinganling, Zhagguangcailing, Laoyeling, and Changbaishan mountain regions, and towards the northeast of Liaoning Province (Huairen County).
2. Southern part of the Qinling Mountains: extends from the Yushu area of Qinghai Province through southern Ganshu Province to the Qinling Mountains and Daba Mountains of southern Shaanxi Province.
3. Central-southern areas: the junction of three provinces, Anhui, Zhejiang, and Jiangxi, the Wuyi mountains, the west of Hubei Province, the north of Guangdong

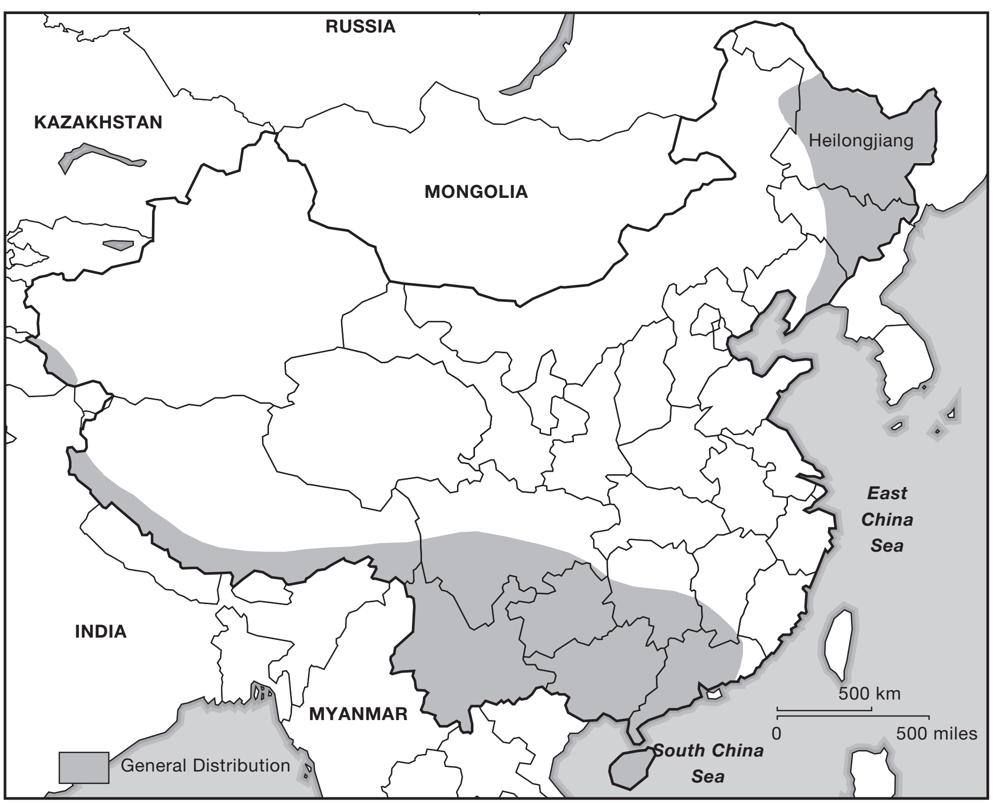

Figure 10.2. Distribution of the Asiatic black bear (*Ursus thibetanus*) in China.

Province and the mountainous regions of the Wuling hills (the northwest forest areas of Guangxi Province).
4. Southwestern China: Himalayan mountain forest areas of southern Tibet, the Hangduan Mountains of eastern Tibet, hilly areas around the Basin of Sichuan Province, high mountain and deep valley regions of southwestern Sichuan, forest area of Yungui Plateaus, etc.

According to the present estimates, the total population of the Asiatic black bear in China is about 15,000–20,000 individuals.Through recent survey data and comparing relevant data, the numerical distribution of the black bear in China is as follows:
1. **Northeastern China:** Heilongjiang Province, an estimated 1,000–2,000; Jilin 350–400; and Liaoning, about 50. Total number is 2,300–2,850.
2. **Southern part of Qinling mountains:** Southern Qinghai Province, about 100; southern Shaanxi Province, about 250–300. The total number is about 450–550.
3. **Central-southern area of China:** Southern Anhui Province, 30–40; western and southern Zhejiang Province, 20–30; northern Fujian Province, 50–80; northern Guangdong Province, 40–50. The population in western Hubei Province is relatively larger than other regions, and the density is 1–1.5/100km^2, or 350–400 individuals. In the forest region of northwestern Guangxi Province, the density is 1.5–2.0/100km^2, and 200–260 individuals. The total population is about 1,020–1,250 in the whole region (the integer is 1,000–1,200).
4. **Southwestern China:** Density and populations are; Tibet, 1/150–200km^2 and 3,500–4,500; Sichuan Province, 1/100–150km^2 and 5,000 – 6,000; northern Guizhou Province, 1–1.5/100km^2 and 360–460; Yunnan Province, 1/100km^2 and 2,000–3,000. The total population is about 10,860–13,960 (the integer is 11,000–14,000).

The black bear occurred on Hainan Island until recently but research on whether the black bear still survives on the island is needed.

Legal status

According to the National Protection Wildlife Law, the black bear is listed as a "protected animal". The People's Republic of China's Wildlife Protection Law stipulates that anyone who catches or hunts bears without permits from the national wildlife authorities will be severely punished. If the case is serious and violates the law, the responsibility for the case must be investigated and prosecuted according to the laws. These national laws and regulations provide a reliable basis for the protection of bears, while each Province or Autonomous Region has reinforced protection, such as: "Wildlife Protection Propaganda Month" activities, putting "Wildlife Protection Act" into effect, and carrying out these "Implemental Detailed Rules and Regulations" of each Province or Region. It is common knowledge that the black bears are protected animals.

Population and habitat threats

Habitat loss is due to over-cutting of forests and some other logging practices. Over the last 40 years, the human population has increased to over 430,000 in regions where bears are distributed, in Shaanxi, Ganshu, and Sichuan provinces. In this area, 27 forestry enterprises were built between 1950 and 1985 (excluding the lumbering units belonging to the county). The deforested area is verified at 42,256km^2. This reduced the habitat by 73%, from 51,103km^2 in the early 1950s to 13,832km^2 in the 1980s. By the early 1990s, the distribution area was reduced to only one-fifth of the area that existed before the 1940s.

Increasing human population, expansion of residential areas, and roadway networks in forest areas not only cause reduction and fragmentation of bear, but also degrades the environment within habitats, and food sources are destroyed and lost. These big mammals face environmental and genetic stress which occurs in isolated sub-populations.

Over-hunting has been a great threat to the population of black bears and is one of the most important reasons for their decrease. Bears are glamorous mammals, their skins,

Asiatic black bear (*Ursus thibetanus*) at a bear farm, China.

C. Servheen

paws, gall bladders, and even young cubs have direct and large economic values. In autumn, bears harm the crops, orchards, and bee farms, so bear harvest has been maintained at a high level in China. In Heilongjiang Province, the annual harvest of bears was over 1,000 during the 1950s to 1960s, but purchased furs were reduced by 4/5, even by 9/10 yearly in the late 1970s to the early 1980s. In Dehong Dai and Jingpo Nations Autonomous Prefecture, Yunnan Province, bear resources were very abundant in past years, but according to investigations, bear resources have declined recently. For example, the Prefecture's amount of purchased bear skins was: 188 skins in 1986, 142 in 1987, 123 in 1988, 72 in 1989, 45 in 1990, and 27 in 1991. This shows that the wild bear numbers are declining every year, and the yield of furs was only 1/7 of that in 1986.

Raising bears in captivity became popular throughout China, owing especially to the successful milking of bile from gall bladders, and bear raising became an easy way to quick prosperity. Many black bears were captured from the wild.

Management

There has been a rapid development of natural reserves in China: 415 natural reserves were set up by the end of 1993 in order to protect forests and wildlife. The total area of natural reserves is about 460,000km^2, 4.7 % of the total area of China. There are bears in most of these reserves where they are more protected. Protection of forests and fire prevention in each forest region throughout the country provides protection to big mammals such as the black bear. Also, punishing poachers and confiscating illegal hunting tools and live animals are all active measures to protect bears.

In recent years, the Forestry Ministry of China has organized surveys on bear resources throughout the country, and the data is presently being collected and analysed. This advances protection of, and research on, bears.

The following problems occur in China: 1) Hunting young bears in some areas is not prohibited; 2) The management level of each bear farm is different; 3) The illegal border trade and smuggling of live bears and its products are serious problems; 4) As the bear is a big, dangerous beast, the lack of funds and research teams limit field studies. This leads to the lack of data on bear resources and informed scientific judgment.

Specific conservation recommendations

1. The wildlife protection law and the relevant detailed rules and regulations must be strictly enforced. It is necessary to educate people regarding such laws, and people who illegally capture and/or kill wildlife should be punished in due time.
2. It is necessary to establish a resource data bank for black bears, monitor trends of black bear population and their habitats, and establish a research and monitoring center.
3. Rectify bear raising farms and set a unified management method. Enforce management of bear farms for better economic effectiveness. Set up artificial breeding centers in appropriate bear farms.
4. Establish natural reserves in overlapping areas of black bear distribution. Strengthen management of natural reserves. Set up black bear field research centers in natural reserves.
5. Strengthen scientific research and international cooperation. Develop research on black bear trade, habitat conservation, and captive raising and breeding.
6. Formulate a plan for black bear reintroduction in areas where black bears have become extinct, and organize and enforce the plan effectively.

Status and management of the Asiatic black bear in India

S. Sathyakumar

Status

The Asiatic black bear is threatened in India due to poaching for gall bladders (medicine) and skin (ornamental), killing bears to reduce agricultural crop depredation, large scale destruction of its habitat due to illegal logging, developmental activities (hydroelectric projects and road construction), and pressures from humans and livestock. The potential Asiatic black bear habitat in India is about 14,474km^2 of which only <5% is protected under the existing network of protected areas (WIINWDB 1995). There are no estimates of Asiatic black bear population numbers or densities in India.

Historic range and current distribution

The Asiatic black bear was once continuously distributed from west to east through Baluchistan, India, Nepal, China, Japan, and south into Myanmar and the Malayan peninsula. In India, it is now found in the states of Jammu and Kashmir (not Ladakh), Himachal Pradesh, Uttar Pradesh, Sikkim, Arunachal Pradesh, and in the hills of West Bengal and northeastern states (Figure 10.3).

The Greater Himalayan ranges cover 233,800km^2 (7.38%) of India's geographical region (Rodgers and Panwar 1988) and supports perhaps the largest population of Asiatic black bears in Asia. This population is largely confined to the western, northwestern and eastern

Himalayan ranges in India (Figure 10.3). The Asiatic black bear inhabits forested hills ranging from 1,200m to 3,300m (Prater 1980). Its range overlaps with that of the sloth bear below 1,200m and the Himalayan brown bear above 3,000m. Schaller (1977) mentioned that it is distributed in the forests of Himalaya below 3,750m. At present, the distribution of the Asiatic black bear in India is continuous. This is largely due to the fact that the black bear manages to make use of plantations, orchards, cultivated areas, scrublands, and even villages for its movement between forested areas.

A small population exists in the central Himalayan regions of India in the states of Sikkim and West Bengal (WIINWDB 1995). This species is also present in a few areas in the hills of the other northeastern states. In total, 56 Protected Areas (PAs) in India have black bear populations.

It is likely that the increasing human population and its resultant pressures will have an adverse impact on the status and distribution of the India's Asiatic black bears. The long-term conservation of this species lies in adequate protection within and outside of PAs, protection of forested areas adjacent to PAs and forest corridors, minimization of other habitat destruction, and strict controls on illegal trade of bear gall bladders and pelts.

The following is the distribution and status of Asiatic black bears in India, presented state by state with reference to the network of PAs, major valleys, Reserved Forests (RFs) and Forest Divisions (FDs). Information on black bear occurrence presented here, where no citation is given, is from personal communications with scientists familiar with the areas. Though black bears are reported to occur in RFs and FDs and in areas outside PAs, the information on their status and distribution in such areas is scanty.

Jammu and Kashmir

The best known populations of Asiatic black bears in India are in this state. The Dachigam NP, Overa WS, Overa-Aru WS, Limber-Lachipora WS, and Kistwar NP are the PAs with populations of Asiatic black bears. The species is also reported to occur in fairly good numbers in Pahalgam and Pinjore Punjab Forest Divisions (FD), Naranag-Wangat FD, Tral, and Shikargarh, Shar, and Dakrum areas in the Islamabad District.

Saberwal (1989) reported that Asiatic black bear density estimates ranged from 1.3 to 1.8 bear/km^2 in lower Dachigam during high fruit abundance periods. About 25 to 40 bears were estimated to use lower Dachigam between late June and October (times of high fruit abundance). Manjrekar (1989) had over 250 black bear sightings in 140 days of study in Dachigam NP. The total black bear population for Dachigam may be about 50. Schaller (1977) reported that black bears in Dachigam were abundant in 1969. According to Gruisen (pers. comm.) at least seven black bears could be sighted per day in Dachigam NP during the years 1981–82. The present status of black bears in Dachigam is not known.

In Overa WS, Price (pers. comm.), based on his observations every spring and summer from 1985 to 1991, reported that Asiatic black bear populations seem to be decreasing. More females with cubs were sighted in 1985–86, but no cubs were sighted during 1987–1990, and in 1991 there were no sightings of bears. It appears that they were breeding well in 1985–87 and may not have been breeding in 1988–91. Although the Asiatic black bear is reported to occur in Kistwar NP, its status is not known. Similarly, in other PAs and FDs, the Asiatic black bear populations are either decreasing or their present status is not known.

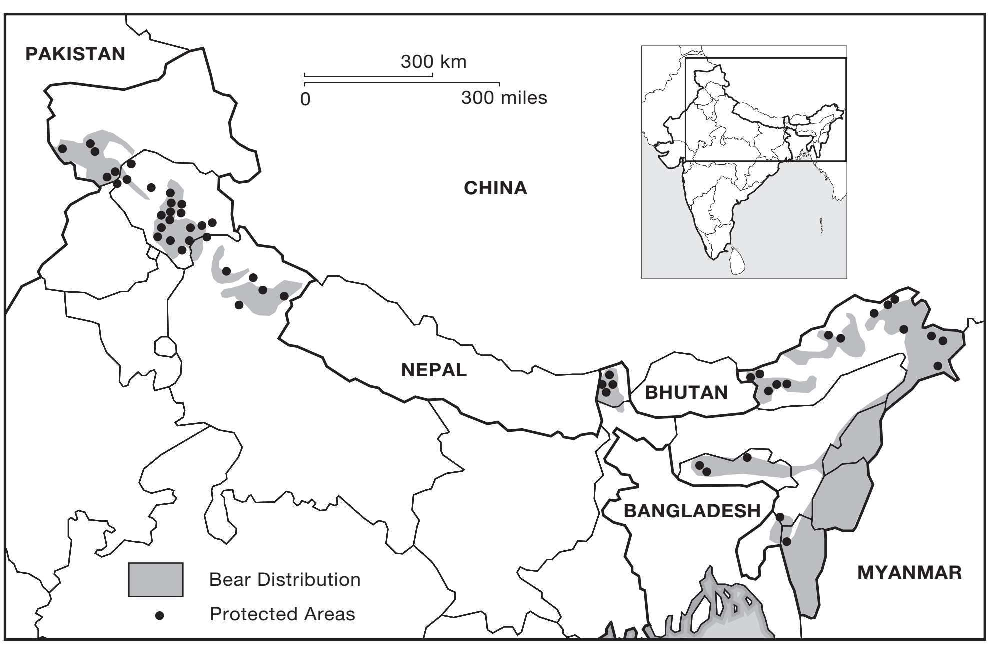

Figure 10.3. Present Asiatic black bear (*Ursus thibetanus*) distribution and protected areas in India.

Himachal Pradesh

Asiatic black bears exist in and adjacent to 21 PAs (Table 10.1) (Singh *et al.* 1990; Green 1993; WIINWDB 1995), and within some forested valleys. It is reported to be in fairly good numbers in Great Himalayan NP, Rupi Bhaba WS, Tundah WS, Kugti WS, Dharangati WS, Sangla WS, Kanawar WS, Kalatop-Khajjiar WS and Kais WS.

Black bears occur in the forested areas of Pangi (Chenab catchment) and Bharmaur valleys (Ravi catchment) in Chamba District; in the Dhaula Dhar range (Beas catchment), Bara Bangal, Chota Bangal, and Bir in Kangra District; in the Parbati Valley, Pandrabis, Bashleo Pass (Sutlej catchment), Solang, and Jagatsukh nallas in Kullu District; in the upper catchments of Bata and Giri in Solan and Simla Districts; in Sutlej and Yamuna catchments, Pandrabis, Simla ridge, Karsog, Shali, Kandyali, Hatu, and Moral Kanda areas in Simla District; and in the Ropa Valley, Kalpa, and Kaksthal areas in Kinnaur District.

Black bears are reported to be in fairly good numbers in the forested areas of the Dhaula Dhar range, Chota Bangal, Parbati Valley, Bashleo Pass, and Kalpa areas.

The species was once abundant in the Shimla Ridge and Moral Kanda areas but is now very rare. It is reported to be rare or becoming rarer in PAs such as Shikari Devi WS and Manali WS, and its status is not known in the rest of its range.

Uttar Pradesh

Asiatic black bear populations are present in and around PAs such as Nanda Devi NP and Biosphere Reserve (BR), Kedarnath WS, Valley of Flowers NP, Govind WS, Askot WS (Table 10.1); in Yamunotri and Gangotri valleys; forested areas in and around Mussorie, Chakrata, Uttar Kashi, Tehri, Bura kedar, Bageshwar, Dharamghar, Binsar, the upper catchments of Ram ganga, Ladhiya Valley, and in parts of Pithoragarh District (WIINWDB

Table 10.1. Asiatic black bear (*Ursus thibetanus*) populations and their status in Indian Protected Areas.

Name of the State and Protected Area	Area (km²)	Past status	Recent status
Jammu and Kashmir			
Dachigam NP	141	AB (1969)	UK (1995)
Kistwar NP	400	UK	UK (1995)
Limber-Lachipora WS	106	FC (1986)	UK (1994)
Overa WS and Overa-Aru WS	457	VC (1990)	NC (1991)
Himachal Pradesh			
Bandli WS	41	UK	UK (1995)
Chail WS	46	UK	UK (1995)
Churdar WS	56	UK	UK (1995)
Daranghati WS	42	UK	FC (1994)
Gamgul Siahbehi WS	109	RR (1991)	UK (1994)
Great Himalayan NP	620	UK	UK (1995)
Kais WS	14	FC (?)	FC (1994)
Kalatop-Khajjiar WS	69	RR (1991)	FC (1994)
Kanawar WS	54	FC (?)	FC (1994)
Khokhan WS	14	UK	UK (1995)
Kugti WS	379	FC (1992)	FC (1993)
Lippa Asrang WS	31	UK	CM (1993)
Majhatal WS	92	UK	UK (1995)
Manali WS	30	CM (1987)	RR (1991)
Nargu WS	278	UK	UK (1995)
Rupi Bhaba WS	125	VC (1992)	CM (1994)
Sangla WS	650	CM (?)	VC (1994)
Sechu Tuan Nala WS	103	UK	UK (1995)
Shikari Devi WS	214	UK	RR (1994)
Talra WS	26	UK	UK (1995)
Tundah WS	64	CM (1992)	VC (1993)
Uttar Pradesh			
Askot WS	600	FC (1988)	UK (1995)
Corbett NP	521	UK	RR (1993)
Govind WS	953	FC (1988)	NC (1992)
Kedarnath WS	975	FC (1981)	FC (1995)
Nanda Devi BR	2,237	FC (1983)	FC (1993)
Valley of Flowers NP	88	UK	FC (1995)
West Bengal			
Buxa TR	759	UK	UK (1995)
Neora NP	88	UK	UK (1995)
Senchal WS	39	UK	UK (1995)
Singalila NP	78	UK	UK (1995)
Sikkim			
Dzongri WS*	468	UK	UK (1995)
Fambong WS*	51	UK	UK (1995)
Khangchendzonga NP	850	UK	UK (1995)
Pangola NP*	108	UK	UK (1995)
Tolung WS*	230	UK	UK (1995)
Arunachal Pradesh			
Dibang Valley WS and NP*	500	UK	UK (1995)
Eagle's Nest WS	217	UK	UK (1995)
Mehao WS	282	UK	UK (1995)
Mouling NP	483	UK	UK (1995)
Namdapha NP	1,985	RR (1990)	UK (1995)
Pakhui WS and NP*	862	UK	UK (1995)
Palin WS*	250	UK	UK (1995)
Sessa Orchid WS	100	UK	UK (1995)
Tale Valley WS*	25	UK	UK (1995)
Tawang WS* and NP*	300	UK	UK (1995)
Walong WS* and NP*	300	UK	UK (1995)
Meghalaya			
Balphakram NP	220	UK	UK (1995)
Nokrek BR	-	UK	UK (1995)
Nongkhyllem WS	29	UK	UK (1995)
Mizoram			
Dampa WS and NP*	580	UK	UK (1995)
Tripura			
Rao WS	1	UK	UK (1995)

WS – Wildlife Sanctuary; NP – National Park; TR – Tiger Reserve; * – Proposed PA.
RR – Rare; CM – Common; FC – Fairly Common; VC – Very Common; UK – Unknown.

1995; Sathyakumar 1993 and 1994; Rawat, Samant, Mohan and Kaul pers. comm.; Tiwari undated). This species has been reported in Corbett NP, and on the banks of the River Ganges in Chilla, Rajaji NP.

The Asiatic black bear is reported to be in fairly good numbers in and around Nanda Devi BR (Lamba 1987, Tewari undated), Kedarnath WS (Green 1985, Sathyakumar 1994), and Valley of Flowers NP. The status is not known in other areas.

West Bengal and Sikkim

According to Rodgers and Panwar (1988), the central Himalayan region is represented in northern West Bengal and Sikkim. The Asiatic black bear is reported to be present in and around four PAs in West Bengal, including Buxa TR, Singalila NP, Neora NP, Senchal WS (Table 10.1) (WIINWDB 1995), and in the forested areas of Darjeeling and the Kalimpong hills.

In Sikkim, it is present in Kanchendzonga NP, Pangola NP, Dzongiri WS, Tolung WS, Yaksom, Rathong Valley, Lepcha Reserve and in other undisturbed forested areas between 1,200 and 3,000m elevations. Of these, Dzongiri, Pangola, and Lepcha areas have black bear populations in fairly good numbers. The past and the present status of this species in these two states is not known.

Arunachal Pradesh

With over 80% of the its geographical area under forest cover, Arunachal Pradesh has a continuous distribution of Asiatic black bear populations, but these populations are seriously threatened by heavy poaching pressures. The species is reported to be present in suitable undisturbed habitats throughout Arunachal Pradesh, but this northeastern state of India is yet to be scientifically explored.

Asiatic black bear populations are reported to be present in 14 PAs (WIINWDB 1995). Its presence has been confirmed in and around PAs such as Mehao WS (Katti *et al.* 1990), Dibang Valley WS, Eagle's Nest WS, Tale Valley WS, Namdapha, and in Hot Spring, Ditchu (Lohit District), Tale Valley, Anini Social FD, Mayodia Pass, and Siang areas (pers. comms. and Katti *et al.* 1990). Undoubtedly, PAs such as Pakhui WS, Sessa Orchid WS, the proposed Palin WS, and Walong WS and NP have Asiatic black bear populations due to their contiguity with PAs or forested areas in which black bears have been reported. The past and present status of the species in Arunachal Pradesh is not known.

Mizoram, Meghalaya, and Tripura

Asiatic black bear distribution extends into the states of Mizoram, Meghalaya, Tripura, Manipur, and Nagaland (Figure 10.3). There are no confirmed reports on the presence of Asiatic black bears in Manipur and Nagaland.

Asiatic black bear populations in Mizoram are present in Dampa WS (Green 1993), Murlen NP and WS, and in some undisturbed forested areas in the Mizo hills. There is no information on the past and present status of the black bear in Mizoram.

In Meghalaya, the black bear is present in and around Balphakram NP, Nokrek BR (Green 1993), and in some undisturbed forested areas in the Garo, Khasi, and Jaintia hills. It is also reported to be present in Nongkhyllem WS, Saipung RF, and Narpah RF areas. The black bear populations in this state are seriously threatened due to unabated poaching and the shortening of "jhumming" (shifting cultivation) cycles.

The hills of Tripura hold small scattered Asiatic black bear populations which are present due to the contiguity to the hills of Mizoram. It is present in Kailashahar FD, Manu, Kanchanpur FD, Longthorai RF, Deo RF, and is probably present in Rao WS. There is no information on the past and present status of Asiatic black bears in Tripura.

Captive Populations

As of June 1994, at least 123 individual Asiatic black bears were known to be in captivity in 32 zoological parks/ facilities in India. Of these captive bears, 52 were males, 44 were females, 20 were young, and seven were of unknown age and sex. Data on numbers in captivity in the past, breeding success, survival, and mortality rates are not available.

Legal status

The Asiatic black bear is listed as Vulnerable in the Red Data Book (IUCN 1974); in Appendix I of CITES in India (Anon. 1992a); and in Schedule I of the Indian Wildlife (Protection) Act (Anon 1972) and its 1991 amendment. Though this species is protected in India due to the above mentioned laws, usually it has been difficult to prosecute the accused in poaching cases because of lack of *prima facie* evidences in the courts and also due to lack of Wildlife Forensic Labs to detect the originality of the confiscated animal part/product. Moreover, poaching and subsequent smuggling through international borders is rampant. As India has large stretches of its boundary with neighboring nations such as Pakistan, Tibet, China, Nepal, Bhutan, Bangladesh and Myanmar, it is difficult to police the borders which in most cases are remote, rugged mountainous terrain. The policy of issuing license for possessing 'crop protection guns' to people living in and around PAs for preventing crop raiding by wildlife has serious impact on black bear and other wildlife. In Meghalaya, shooting permits were issued in the recent past by the State administration (Appendix I) which includes the Asiatic black bear, a Schedule I species of the

Indian Wildlife (Protection) Act. The Meghalaya State Forest Dept. has initiated procedures to stop this practice.

Population threats

Black bear populations in India are largely threatened due to poaching for gall bladder and skin. While the former is believed to be of medicinal value, the latter is for trophy or ornamental purposes. The medicinal value of gall bladder is yet to be scientifically established, but tribes and local villagers strongly believe in its medicinal properties. In Arunachal Pradesh and the northeast states, indigenous people hunt black bear for its skin. Even today, every local's hut has a display of wild animal skulls and skin including black bear.

Human-bear interactions

The serious limiting factor for black bear conservation in India is human-black bear conflict. Reports of black bears killing livestock, attacking humans, and subsequent public backlash are regular, largely in the northwestern and western Himalayan region. These reports are on the increase in recent years. For instance, in Chamba District of Himachal Pradesh, the number of black bear attacks on humans have gradually increased from 10 in 1988–89 to 21 in 1991–92. For the same period, livestock killed by black bears also increased from 29 to 45 (P. Thapliyal pers. comm.) Similarly, in Chamoli District of Uttar Pradesh the number of such cases increased from one in 1990–91 to 16 in 1992–93 (Tewari undated). Reasons for the increased incidence of livestock depredation and attack of humans by black bears may be due to: a) shrinkage of black bear habitat due to extension of agricultural lands, encroachment, and habitat destruction; b) increasing human population in and around PAs and forested areas and subsequent dependence on forests for daily needs; and c) increasing awareness by local people regarding compensation paid by the Government for damages caused to humans and livestock by wildlife and hence the increase in number of cases reported.

Habitat threats

Potential Asiatic black bear habitat range in India is about 14,474km^2 of which only <5% is protected under the existing network of PAs in India (Rodgers and Panwar 1988; WIINWDB 1995). In Jammu and Kashmir, the major threat to black bear habitat is mainly due to the militants and their activities in the forested areas, and consequently lack of protection. In Himachal Pradesh and Uttar Pradesh, habitat destruction is largely by human dependency on forests for fuelwood, fodder, and other forest produce such as montane bamboo. In Arunachal Pradesh, habitat loss is mainly due to illegal timber extraction, jhumming, and development activities such as construction of roads in pristine forested areas. In Sikkim, activities of the Indian Army, mountaineering institutes, and trekking clubs has led to large scale destruction of black bear habitat. Moreover, construction of a dam on Rathong river has caused serious damage to black bear habitat in the Rathong River valley (G.Tewari pers. comm.). In the northeast states, jhumming has led to serious impact on black bear habitat. In the State of Meghalaya, about 95% of the land belongs to the people and the State Government does not have any mandate to protect wildlife and their habitats.

Management

The Indian Wildlife (Protection) Act, 1972 and its amendment in 1991 help protect the Asiatic black bear. In Jammu and Kashmir State, wildlife legislation by the state affords protection to this species. India ratified the CITES in 1976 and the black bear is listed in Appendix I, which bans international trade in its products (Anon 1992). TRAFFIC-India also keeps a check on trade of this species and its products. NGOs such as WWF-India apart from their public awareness programs also play a crucial role in wildlife poaching cases as a third party prosecutor. Forest Departments have started paying compensation when livestock is killed or humans are injured or killed by black bears.

The Forest Conservation Act 1980 was designed to curb habitat loss due to deforestation. In all NPs and in the core area of WSs, all forestry operations, human use, and livestock use have been stopped. There is a shift from commercially-oriented forest management to conservation-oriented management. The National Wildlife Action Plan was launched in 1983 to establish a network of PAs, management of PAs, and habitat restoration and wildlife protection in multiple-use areas.

The number of PAs in India has risen from 131 in 1975 to 497 in 1994 and today ca. 144,791km^2 of area is protected and managed (WIINWBD 1995).

Conservation recommendations

1. Poaching and smuggling need to be controlled. The basic infrastructure for protection and management is yet to be improved. There is a need for more trained wildlife staff to protect and manage PAs in India. Adequate facilities, incentives, remote area allowances, equipment, and motivation are required for wildlife staff in all areas. The Indian defense forces and the border police can be of great help in this effort.

Neighboring countries such as Pakistan, Tibet, China, Nepal, Bhutan, Myanmar, and Bangladesh also need to help and cooperate in preventing poaching and subsequent smuggling of wildlife products.

2. There is a need for large PAs to maintain viable populations of black bear and other large mammals. Most of the PAs in Himachal Pradesh are small and suffer from human and biotic pressures from within and without. Identifying forested areas adjacent to PAs, and forest corridors between PAs is crucial. For instance; the panthrabis, Chota and Bara Bangal areas in Himachal Pradesh; Reserved Forest areas adjacent to Kedarnath WS and Valley of Flowers NP; and forested areas adjacent to Sangla WS in Himachal Pradesh and Govind WS in Uttar Pradesh.
3. The proposal for declaring new PAs (Rodgers and Panwar 1988) has to be executed by concerned State Forest Depts. as soon as possible.
4. Some large PAs such as Nanda Devi NP and BR, Kedarnath WS, Govind WS, and Great Himalayan NP can be brought under the proposed Snow Leopard Recovery Program (Project Snow leopard) to enable improvement in infrastructure and management.
5. All developmental activities such as dam and road construction in Sikkim and Arunachal Pradesh need to controlled by the Government by ensuring completion of Environmental Impact Assessment studies prior to clearance of projects.
6. The short cycle of jhumming practices in northeastern states needs to be replaced with longer cycles.
7. State Forest Departments should initiate procedures to procure rights for protection of wildlife and their habitats in areas which are not under their control, as in the case of Meghalaya.
8. The policy of issuing crop protection guns needs to be scrapped and replaced by other means of protection such as use of fire crackers to scare away crop raiding bears or other wildlife. Speedier ways to pay compensation for livestock killed and humans injured must be implemented to gain general public confidence and cooperation.
9. Ecodevelopment projects to meet the needs of the human population in and around important black bear areas are necessary. Awareness programs for the Indian Army, border police personnel, and the general public are needed.
10. Status surveys for black bears must be conducted for most parts of Sikkim, West Bengal, Arunachal Pradesh and other northeastern states. Even basic information on presence/absence of black bear in different parts of India is not available.
11. Monitoring of black bear status and numbers based on direct and indirect evidence in different PAs has to be initiated. Scientific research on ecology of black bears is necessary as information on food and feeding habits, habitat utilization, and ranging patterns are crucial for the long-term conservation and management of this species.

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Status and management of the Asiatic black bear in Japan

Toshihiro Hazumi

Introduction

Japan consists of four major islands, and was separated from the Eurasian Continent early in the Pleistocene. Most wild animals in Japan are subspecies of continental species. The Japanese black bear (*Ursus thibetanus japonicus*) is popularly called "Tsukinowa-guma," meaning

Asiatic black bear (*Ursus thibetanus japonicus*) in Japan.

K. Maita

crescent bear in Japanese, as it usually has a white patch like a new moon on its chest.

The average weight of the Japanese black bear ranges between 60–120kg in the adult male and 40–100kg in the adult female. The average body length is 110–140cm. The size of the annual home range varies and averages 66.06km^2 in males (N=8) and 26.37km^2 in females (N=11). Total home range size for the lifetime of an adult male reaches 180km^2 (Hazumi unpublished). Grasses, sedges, herbs, and buds are the preferred foods in spring, and berries and nuts in summer and fall. Because of the varied vegetation types in Japan, key diet items for each local population may be different. The acorns of *Fagus* or *Quercus* are usually eaten in the pre-denning season (Nozaki *et al.* 1983). One characteristic behavior of this smaller bear species is to make seats, which resemble bird nests, with broken branches in tree tops, and with *Sasa* bamboo on steep slopes. They may rest and eat while sitting on these seats. The denning period lasts for five or six months between November and April. Black bears den in hollow trees, under large rocks, or in the ground. In areas with little snow, bears like steep ravines so as to avoid men and dogs in the hunting season.

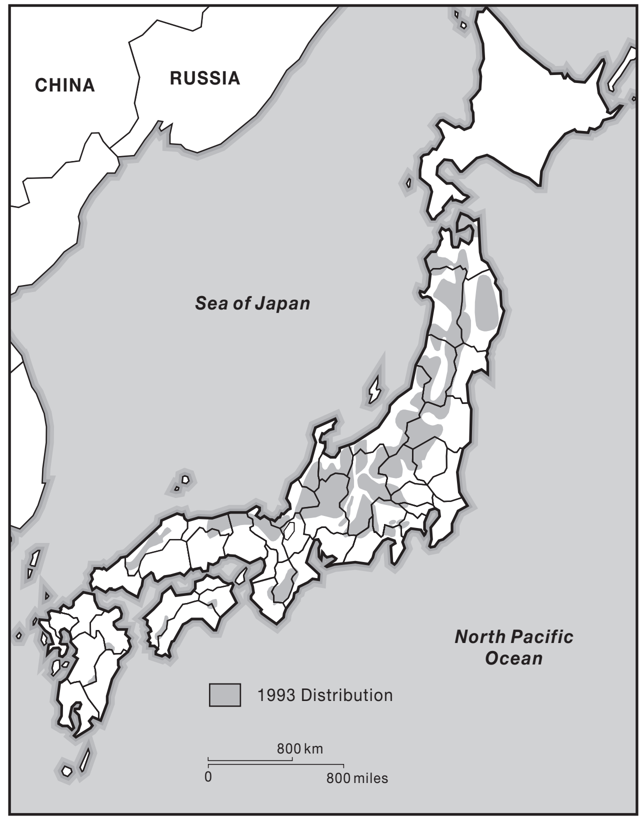


Figure 10.4. Distribution of Asiatic black bears (*Ursus thibetanus japonicus*) in Japan, 1993.

Historic range and current distribution

In the early 1900s, black bears were widely distributed throughout the three main islands in Japan, away from human settlements. At that time, the human population was rather small and had only minor influences on the bear population. While there have been no records of black bears on Hokkaido, brown bears (*Ursus arctos yesoensis*) occur on this island (see Tsutomu, this volume).

Undeveloped bear habitats were also abundant at the turn of the century. Mountainous areas occupy 70% of the total land area of Japan, where the steep topography and heavy snow make cultivation and logging activities difficult at high altitudes. Hunting pressure on the bear population was also low at the time, owing to simple and traditional hunting methods such as the use of spears, snares with fiber ropes, and traps which crushed animals with the weight of stones.

Human disturbance in many bear habitats by forestry activities started in the 1940s. Between 1939 and 1945, during World War II, Japan needed an enormous amount of timber resources. Since the 1960s, Japan has been reconstructing its industries. At a time of high economic growth, mobilization and mechanization enabled development in mountainous areas, and new traffic accessibility allowed logging and cultivating to spread rapidly. Large-scale plantations of coniferous trees have changed bear habitats, especially in areas of low snowfall. Bears cause damage to plantations by stripping bark. Box traps have been used all year round to protect plantation areas since 1970, reducing the population size of black bears in southwestern Japan. They are now considered endangered on Kyushu and Shikoku islands, and threatened in the Chugoku and Kii regions of Honshu island. Isolation of local bear populations and increasing nuisance kills have become serious in other areas of northeastern Japan. Figure 10.4 shows the distribution of Japanese black bears today.

Status

Steep topography and dense *Sasa* bamboo makes research on bears in their natural habitat very difficult. The six prefectures of northeastern Japan (Yamagata, Akita, Niigata, Toyama, Iwate, and Aomori Prefectures) count the number of bears in the post-denning season. In spring, much of the snow is firm enough to walk on, making searches for bears easy. The estimated population density is 0.11–0.18 bears/km^2 in these areas. On the other hand, direct counts are impossible due to minimal snow cover in southwestern Japan. A capture-recapture method will be experimented with on Mt. Tanzawa and Mt. Hyonosen for census purposes.

The annual statistical harvest of black bears is more than 2,000 individuals, half of which is by nuisance kill.

Based on this information, 10,000–15,000 black bears are estimated to live in Japan (Env. Agency unpubl.)

Legal status

In the Japanese Red Data Book (1991), the Environmental Agency has estimated each local population of black bears in Japan. Five populations (in Kyushu, Shikoku, West-Chugoku, East-Chugoku and Kii areas) have been listed as endangered. This list is to be reviewed every five years. Small isolated populations in Tanzawa and Shimokita areas of mainland Honshu were listed as endangered in 1995.

There is still a lack of efficient conservation measures for the bears beyond recognizing these endangered populations. Present laws and systems for wildlife conservation and management are still insufficient. With only limited legal restraint on land development projects, bear habitats continue to be degraded. The Japanese Forest Agency, which owns most public areas, and many private land owners have traditionally shown little tolerance towards the bear. Serious damage to crops and fear of human-bear confrontations prevent people from understanding the need to limit nuisance kills.

Population threats

Bear harvest is not controlled according to biological data on the species. Nuisance bear killing is practiced year-round, and the harvest numbers have been increasing. Since 1970, box traps have been used widely to capture bears that cause damage.

During the sports hunting season from 15 November to 14 February, it is estimated that the number of bears shot each year will gradually decrease (Statistical Year Book of Hunting of the Env. Agency). One reason for this is that the old traditional hunters will retire and that younger generations are not keen on hunting. In addition, traditional techniques such as shooting bears in their dens may disappear with the retirement of elder hunters.

Although bear poaching is a well-known practice throughout Japan (Hazumi 1992), authorities have made few attempts to control the situation.

Habitat threats

The Japanese Forest Agency has expanded plantation areas throughout Japan since 1945. The total area of tree plantations has reached more than 40% of the total forest area (252,100km^2) in Japan. The logging areas are penetrating the more remote forests today, destroying core areas of bear habitat.

At the same time, imports of inexpensive timber from virgin forests abroad have caused many Japanese timber forests to be abandoned without proper maintenance, since the authorities cannot afford to pay the high wages for timber workers. This economic failure of forestry has caused depopulation in many towns and villages in forest areas, and rural communities have made great efforts to reactivate local economies. However, this has led to construction works with public investment such as roads, dams, pastures for livestock, and resort facilities, causing further decrease and isolation of bear habitats.

Although several protected areas, including national parks and other forms of reserves, have been established by government laws, many types of land use practice still have priority over wildlife conservation. Unfortunately, developers and land use planners show little concern for wildlife habitat management.

Management

Today, the population of Japanese black bear is facing a crisis (Hazumi 1992). The main reasons for this crisis


K. Maita

Asiatic black bear (*Ursus thibetanus japonicus*) in Japan.

are habitat destruction and uncontrolled harvesting. Diminishing habitats and fluctuations in annual food supply for this species have increased human/bear encounters. Japanese authorities considered control killing as the only feasible measure to solve this problem (Hanai 1990; Azuma and Torii 1978; Watanabe 1980). Referring to the manner of the control kill practice as an example, some wildlife experts have said there is no effective policy or law for wildlife conservation and management in Japan. There is no efficient management system, based on biological theories to secure wildlife and its habitats. Technical arguments for wildlife conservation have only just started in Japan with insufficient biological studies to support them.

The increasing number of close encounters with bears have stimulated concern triggering some initiatives for bear conservation since 1990. Symposiums and forums on bear conservation have been organized by researchers, NGOs, and the government every year. In 1991, five local bear populations were listed as endangered in the Japanese Red Data Book edited by the Environment Agency. One of the positive results of such endeavors is that since 1992, the Japanese Association of Hunters has decided to prohibit bear hunting in those five areas, and limit it for three years in another area. Although this self-control of hunters has had little actual effect (Asoshina 1994), they have become more sensitive to bear conservation.

The 1992 CITES Conference held in Kyoto, Japan, stimulated the Japanese public, increasing the awareness towards the environment and the conservation of wildlife and natural resources. However, there are still two major and urgent themes: 1) limiting bear harvest, and 2) conserving their habitats. This will require the understanding and approval of rural residents around and within bear habitats. There is still a long way to go to achieve these challenging goals.

Human-bear interactions

As mentioned previously, Japanese black bears cause significant damage to coniferous plantations by stripping bark. This is a serious problem, especially in southwestern bear habitats where plantations occupy a large percentage of the total forest area (40–60%) (Japanese Wildlife Research Center 1987). Since few effective measures have been introduced to prevent such damage caused by bears, excessive use of box traps poses a serious threat the bear population in such areas.

Black bears have caused damage to crops, apiaries, fish-farms, livestock, and have sometimes caused human casualties. Such damage and accidents with people usually occur between late summer and autumn. Physical countermeasures such as electric fences are rarely introduced. Bears have almost always been considered as pests, and have been killed by shooting, snaring, and trapping. Since the 1980s, many more bears have been observed in and around human residential areas than before. One reason for these increasing encounters may be that the combination of logging expansion and failure of mast crops in many areas has reduced the carrying capacity of bear habitats.

Public education needs

Japan has no laws regarding the ownership of wildlife, therefore no one is responsible for wildlife management. This can be considered the main reason for the inadequate state of general wildlife conservation in Japan. This situation has been reinforced during the period of reconstruction of the Japanese economy after World War II, as economic development rather than nature conservation has been given priority.

In universities and natural history museums, basic ecological studies, especially on large mammal species including bears, have been almost totally neglected. Such lack of attention to wildlife ecology could lead to insufficient information and lack of guidelines for wildlife conservation. It can be said that pest control, not only of bears but also of other mammal species, has been the dominant concept guiding wildlife administration systems this century.

National and local governments have only recently begun to consider wildlife conservation problems. Small Japanese NGOs confront a public with only limited awareness of the country's wildlife and challenges to its conservation. Insufficient research on wildlife, little information on wildlife in education, and no public consensus on wildlife conservation creates a frustrating cycle.

Specific conservation recommendations

General wildlife policy

Basic concepts of wildlife conservation and management should be reviewed. A coherent system for wildlife management must be established by law within administrative authorities. Current conservation movements by Japanese NGOs are opportunistic and in many cases not constructive. Therefore, there is an urgent need to establish cooperation between all government sectors concerned.

Basic wildlife management systems

1. Monitoring of wildlife populations including bears should be carried out using comprehensive biological methods throughout Japan.
2. Specialists should be trained for posts in general wildlife management within administrative authorities.
3. Trained staff should be stationed in each area within the bear distribution range.
4. Adequate budgets should be allocated for general wildlife management.

Harvest control
1. The total bear harvest should be limited to a sustainable level, which may be under 5% of each population.
2. Killing females with cubs, shooting of denning bears and use of snaring should be prohibited immediately.

Depredation control
1. Crops and timber should be protected by physical methods, such as electric fences. Other countermeasures should be developed.
2. Bears causing damage should not be killed, but translocated.

Habitat management
1. The habitat size and type of each population should be evaluated. Core areas and corridors should be delineated on maps.
2. Core deciduous forests should be protected as a priority, as the most essential bear habitats.
3. Contiguous forests should be kept as corridors especially between a large/major population and other small isolated populations.

Development of biological studies
1. Courses on wildlife biology should be established in more universities. A more efficient system for wildlife management should be established, which will require many trained wildlife biologists.
2. The function of local museums as research stations should be expanded. Monitoring and research on local fauna should be one of the most important tasks of natural history museums.
3. A network of researchers should support wildlife managers for bear population monitoring.

Public education
1. The most up-to-date information on bears should be presented to rural residents. This is the most important way to remove fear of wild bears. This fear is the main reason for the increase in bears killed as pests.
2. Wildlife education should be included as an integral part of environmental education in curricula for schools and other institutions.

Status and management of the Asiatic black bear in Russia

Igor Chestin and Victor Yudin

Biology

Reproduction: The only information available on reproduction is that given by Bromley (1956). The breeding season starts a bit earlier than that of brown bears, in late May–early June. Females first give birth when they are three years old, but do not become pregnant every year. Pregnant females generally make up 14% of populations. Similar to brown bears, Asian black bears have delayed implantation. Litters usually consist of two, or more rarely of one or three cubs. Lactation lasts 1–1.5 months after leaving a den. Cubs usually spend two summers and one (rarely two) winters with the sow.

Social behavior: According to Abramov (1972), Bromley (1956, 1965), and Kucherenko (1973), Asian black bears are less mobile than brown bears. Kucherenko (1973) mentioned that if food is abundant Asian black bears can remain in an area of roughly 1–2km^2, and sometimes even as little as 0.5–1km^2. Asian black bears spend half of their life in trees (Kucherenko 1972, 1973; Khramtsov 1983). When feeding in trees, Asian black bears break branches and twigs to place under themselves. As a result, many trees have something like 'nests' in the tops, and this provides evidence of the presence of Asian black bears in an area.

Habitat preference: All experts (Bromley 1956, 1965; Abramov 1972; Abramov, Pikunov, and Bazylnikov 1979; Kucherenko 1972, 1973, 1985; Pikunov, Fomenko, and Kovalenok 1991; Pikunov 1991) agree that Asian black bear range coincides with the range of mixed Siberian pine/broad-leaved forests. There does not seem to be any data on encounters in other ecosystems. Table 10.2, from Pikunov (1991), considers preference of den sites.

Historic range and current distribution

Asiatic black bears occur over the limited territory of Primorye and Priamurye in the very extreme north of the

Table 10.2. Preference of den sites by geographic region and habitat type (Pikunov 1991).

Geographic region	No. of dens	% dens in *Tilia amurensis* habitat	% dens in *Pinus koreensis* habitat	% dens in *Populus maximow* habitat	Reference
Khabarovsk province	30	53	30	10	Sysoyev 1952
Eastern Sikhote-Alin	39	31	8	46	Bromley 1965
Amur-Ussuri region	80	40	25	20	Kucherenko 1974
Primorsky kray	164	40	13	33	Abramov *et al.* 1977
Western Sikhote-Alin	31	55	39	6	original data 1988

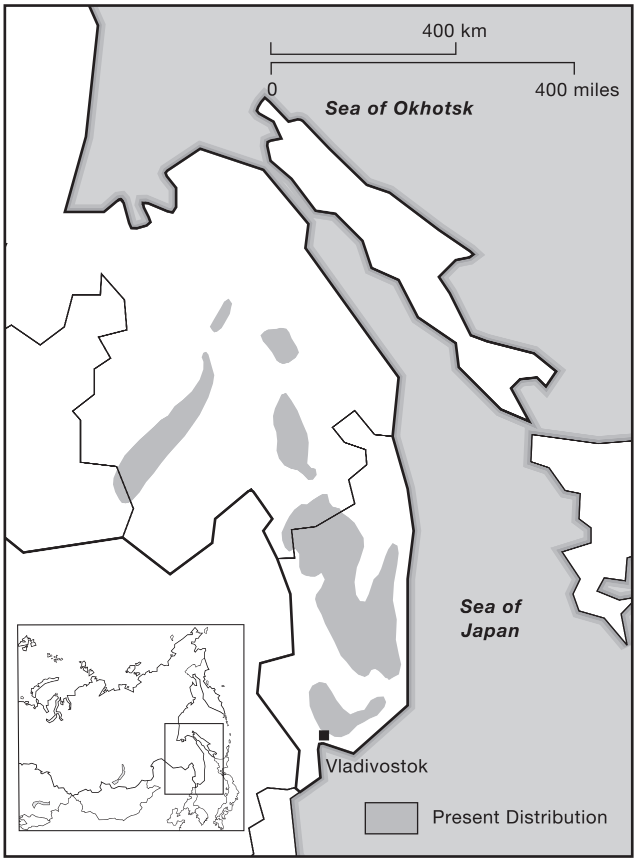


Figure 10.5. Estimated present distribution of Asiatic black bears (*Ursus thibetanus*) in Far East Russia (Yudin 1994).

species' range (see Figure 10.5). Distribution of this bear in this region is closely connected with mixed broad-leaf and Korean pine (*Pinus koreensis*) forests. The geographical distribution of the Asiatic black bear is gradually decreasing. Presumably, in the beginning of the 19th century the bear occurred throughout the mixed forests as well as the plains. By the end of the century, bear population were isolated in the Sikhote-Alin region and only single individuals were observed on the plains.

The range occupied by Asiatic black bears is stable in some areas and decreasing in others. Overall range is likely decreasing and subpopulations becoming increasingly isolated, but specific distribution data is lacking. Population densities still vary from 1.1 to 4.0 individuals per 10km^2, but total numbers continue to decline. In the beginning of the 19th century the number of Asiatic black bears was not less than 25,000–35,000 individuals while today 4,000–5,000 remain. By the year 2000 the Sikhote-Alin region may become completely isolated from the territory situated on the west bank of the Amur River. Presumably a section of the range on Pogranichny ridge will also disappear. Distribution may become even more limited to the mountains, especially on the eastern slopes of the Sikhote-Alin and the Sea of Japan coast.

Legal status

The Asiatic black bear is listed in the Red Data Book of the USSR (which is now obsolete) and as an infrequent species in the Red Data Book of Russia. Thus it falls under special protection and hunting is prohibited. The presence of Asian black bears in an area theoretically can be an argument in favor of creating a new reserve. However, nowadays there is strong movement to legalize hunting of this species, and this is supported by the local scientific community (Kucherenko 1985), with the notable exception of Dr. D. Pikunov (1991). Those people believe that the species in Russia is not endangered. Kucherenko (1985) mentioned that in 1970 there were 6–8,000 Asian black bears, and in 1985, 4,600–5,400. Density in the best habitats can reach 1.5–2.0/ 10km^2.

Population and habitat threats

The major threat to the population itself is greatly increased poaching. Up until 1983 when the Asiatic black bear was listed in the Red Data Book of USSR, 300–400 individuals were shot every year. Recently the hunting of the bear was forbidden, but many cases of illegal shooting occur. This is done by local people and foreigners responding to perestroika, and is fueled by the growing demand for bear parts. The whole Far East of Russia represents a huge source of bear parts for Asian markets. Many Chinese and Korean (both South and North) workers in Russia, who are supposed to be employed in the timber industry, are in fact engaged in the trade. Many Russian sailors purchase bear parts from local hunters and sell them in Japan and Southeast Asia. Unfortunately there are no estimates of the effect international trade has on populations of brown and Asian black bears.

The main habitat threat to Asian black bear populations in Russia comes from a rapidly growing timber industry. This was mentioned by Bromley (1965) and Abramov (1972) almost 30 years ago. Both the above authors, as well as Kucherenko (1973), Kostoglod (1981), and Khramtsov and Zhivotchenko (1981), reported that the cutting of trees containing cavities, which Asian black bears use for their dens, was a grave threat to the species. Facing a lack of hollow trees, Asian black bears must den on the ground or in the rocks and thus become vulnerable to predators like tigers, brown bears, and hunters. Pikunov (1991) mentioned that Siberian pine/ broad-leaved forests have experienced a two-fold decrease in area during the last 70–80 years. The speed at which these forests are cut is much higher now than it was 5–10 years ago. Many joint ventures (Russian-Chinese, Russian-South Korean) are developing logging operations in Russia. The timber harvested mainly goes to Japan and Southeast Asia.

In addition the development of land for agriculture and building of settlements reduces the area of forests, and consequently the range of the Asiatic black bear. Logging roads make the most remote forest sites accessible to hunters, while logging equipment itself interferes with bears, and leads to the death of individual bears.

Management

Each oblast or kray (Russian administrative units, similar to provinces) has two governmental structures that are responsible for wildlife management. First, there are the territorial divisions of the Russian Game Department (Glavokhota). The staff of this organization provides control over game users, like professional and amateur hunters, united in game societies. Game Departments also issue hunting licenses. The other local structure is the territorial division of Ministry of Nature Protection. This division is responsible only for the control of specially protected species. Thus, since Asian black bear range in Russia covers the whole of Primorskiy kray (with Vladivostok at the center) part of Khabarovsk kray (with Khabarovsk at the center) and a small piece of Amur oblast (with Blagoveshchensk at the center), there are three territorial Game Departments and three territorial Departments of Nature Protection assigned to manage this species. However, none of them have performed even simple population censusing, not to mention other investigations.

Management of the Asiatic black bear population is accomplished by means of habitat protection and a ban on hunting. In 1991, the government enacted a law forbidding the cutting of Korean pine throughout the bear's range.

There are eight nature reserves, where hunting, tourism, and any kind of development are prohibited. Annual censusing is usually conducted. The area of these reserves is 7,880km^2, or approximately 2.3% of the species' range in Russia.

Human-bear interactions

There are occasional conflicts caused by black bears, like damaging beehives and preying on livestock (very rare), but damage from brown bears is much more serious and prevalent. There are no records of predation on humans by Asiatic black bears. Attacks on people are very rare and are usually provoked by the person(s) involved.

Public education needs

Japanese companies must be encouraged not to buy Russian timber. Local people and local authorities recognize the problems they will face when the forests are gone, but economic disaster and short-term political interests force them to sell everything they can. It is necessary to inform the public more frequently in the media about current laws and measures taken to protect rare mammals.

Specific conservation recommendations

Since there is almost no information on Asian black bear numbers and biology, it seems crucially important to initiate research projects. In order to preserve habitat, it is probably worth considering establishment of compensation for non-development of areas important to local populations. Regarding the economic situation in Russia, international organizations would likely be the only source for such compensation.

Conservation of the Asiatic black bear would be enhanced if we fulfil the following requirements:

1. Expansion of the areas of the Sikhote-Alin, Komsomolsk, Rhingan, Ussuri, and "Kedrovaya Pad" reserves.
2. Stopping of any cutting in the broad-leaved and Korean pine forests.
3. Strengthening of protection and increase in penalties for illegal killing of the Asiatic black bear.

Status and management of the Formosan black bear in Taiwan

Ying Wang

Historic range and current distribution

The Formosan black bear (*Ursus thibetanus formosus*), an endemic subspecies to Taiwan, was probably distributed island-wide in historical times. According to Japanese police records of the aborigines (1937), 78 bears were sold by the aboriginal people of Atayal, Bunun, Tsou, and Paiwan in 1933. These people lived in the mountainous areas from the northernmost to the southernmost tip of Taiwan. That each of these tribes had its own distinct hunting territory implies that bears at that time were distributed from the north to the south end of the island. Kano (1940) reported during his expedition in the Tsugitaka mountains (Snow Mountain range) that bears were still common in the area and were roughly distributed between 600 and 2,700m. Chen (1956) recorded that the species was found between 100 and 2,000m in the mountains of Suao, Lotung, Hwalien, Shihtoushan (Lion Head mountain), Yushan, and Alishan. According to our surveys, bears were caught in the Coastal Mountain range in the eastern part of Taiwan 20 years ago. From those records, it is suggested that except in areas heavily populated by man, such as the western plain which had long ago been converted to agricultural land, the rest of

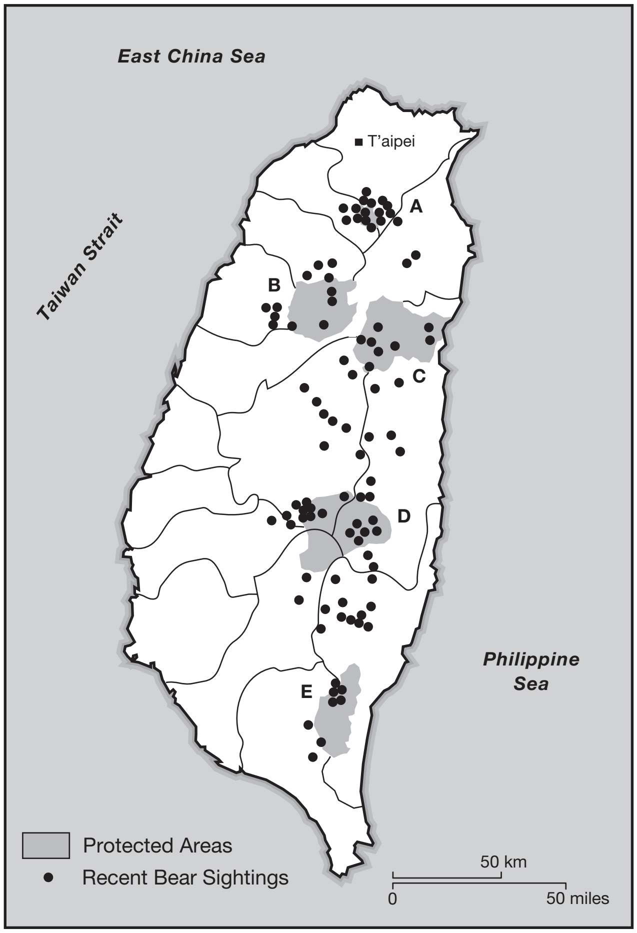


Figure 10.6. Protected areas and recent bear sightings within Formosan black bear (*Ursus thibetanus formosus*) range in Taiwan.
Protected areas A–E are: A) Chatienshan Reserve, B) Sheipa NP, C) Taroko NP, D) Yushan NP, E) Tawushan Reserve.

Taiwan could have been occupied bear habitat less than 100 years ago.

According to Wang (1990), among three mountain ranges in Taiwan excluding the Coastal Mountain range, bears were found on the slopes of the Central and Snow Mountain ranges. During recent surveys (Wang and Chen 1991; unpublished data 1991–1993, 1993–1994) bear distribution has remained basically unchanged. Combining sighting reports from these surveys with information obtained by the Forest Bureau from 1991 to 1993, we found that bears were distributed along the Central Mountain range from the Hapan area (north of Lala mountain) south to Tawu and Snow mountains in the Snow Mountain range. Several concentrated sites of bear activity were identified, particularly in the vicinity of three national parks and two reserves which included: Lala Mountain (Chatienshan Reserve), Snow Mountain area (Sheipa NP), Taroko NP, Yushan NP, Tawushan Reserve, the area between Taroko and Yushan, and the area between Yushan and Tawushan (Figure 10.6).

Status

The Formosan black bear was, according to early records, distributed in both low and high elevations island wide. However, due to habitat destruction and persistent hunting, it's distribution has decreased (Lin and Lin 1983; McCullough 1974; Wang 1988, 1986; Wang *et al.* 1989; Wang and Chen 1991; Wang and Lin 1987; Wang and Wang 1990; Yen 1979). According to sighting records with known elevation (n=135), the range of bear sightings occurred between 200–3,600m in elevation with nearly 90% of the sightings occurring over 1,000m. In 1989, after the enactment of the Wildlife Conservation Law, this species was listed as endangered with full protection. Poaching persisted due to the bear's high commercial value on the black market. However, in 1994 a revision to the Wildlife Conservation Law that increases fines and penalties for people who commit a crime against wildlife seems to have some effect in discouraging poaching activities on bears.

Legal status

The Formosan black bear was listed as an endangered species under the Natural and Cultural Heritage Act on January 30, 1989, and was later listed as a Conserved Species Category I (similar to CITES Appendix I species) under the Wildlife Conservation law.

Population threats

People do not actively pursue the bear now. However, the Chinese treat it as a highly prized animal because of the medicinal properties of its gall bladder and the rare culinary value of its paws. Using a steel jawed traps to capture the boar is still a common practice over vast areas. Occasionally, bears may become victim to steel jawed traps set for wild boar, a very popular quarry for aborigines. Two bears were known to have been captured in steel jawed traps recently at Haituan. They were killed and probably sold on the black market. The wide use of steel traps by aborigines to capture boars creates a substantial threat the native bear population.

Habitat threats

Timber harvest used to be a major threat to habitat in bear country. In 1992, a ban of timber harvesting from the natural forest was undertaken. This came about as a result of the Forest Bureau's changing policy from focusing solely on timber harvest to multiple use of forest resources. For the next ten years, existing prime habitat for bears will be quite safe. However, a new policy concerning the transfer of ownership of hill land from the government to private interests will potentially affect some lowland habitat, especially in the eastern part of Taiwan where some of the land is still quite undeveloped. Furthermore, highway construction will pose a great potential threat to the integrity of bear habitat. Within the next decade the government is planning to build two cross island highways from west to east, one in the central part of Taiwan and another in the southern part. Both pass through remote areas of the central mountain range that is considered prime bear habitat.

Management

The Department of Health launched a survey on the consumption of bear gall bladders in traditional Chinese medicine (Chang *et al.* 1995). A joint meeting of representatives from Chinese medicinal shops, doctors, government agents, NGOs, and scientists was held for the first time to discuss controlling and phasing out the use of bear gall bladders in the traditional market. Further meetings will be held to discuss the protection of all bears, including our native species, in the near future.

Keeping bears as pets may sometimes provide a method of circumventing restrictions on the possession of wild captive bears. Bears are under the strict control of the Wildlife Conservation Law, so no import or export of any bear species for pets is allowed subsequent to the enactment of the Law. People who own bears as pets are now required to register them with local governments. A minimum living standard for all captive animals including bears is now being produced by the government. Hopefully this will encourage some bear owners to give up their pets. According to a survey (Wang and Chen 1991), 41 Asiatic black bears (including 16 Formosan bears) were kept either in zoos for exhibition or by private individuals as pets. No breeding record has ever been documented. An end to keeping bears as pets will be accomplished either when presently captive bears die or when the government takes quick action to solve the problem.

Human-bear interactions

Very few sightings of bears raiding agricultural areas have been recorded. During the past three years, bears were sighted feeding in orchards and corn fields, but no conflicts with humans have been documented. However, in late 1993 at Walami area in Yushan NP, a bear was reported trying to get into a shelter. It stayed in the vicinity for a few months, probably attracted by garbage from human camping activities.

Public education needs

Though the sale of bear parts and meat has been ended officially, it still exists on the black market. Educating the public about the consequences of using bear parts for food or medicine is urgent. First, the reality that one can only acquire bear paws for a delicacy by killing the animal needs to be clarified. Second, the traditional use of the bear gall bladder in Chinese medicine should be stopped at best, or strictly controlled at least. People who use these products need to be informed and educated that their conduct could endanger the bear population. On the other hand, alternatives or substitutes for bear gall bladder need to be addressed and developed. The goal should be to provide good educational material to help users change their behavior.

Rearing wild animals as pets has become very popular recently. With the enactment of the Wildlife Conservation Law, pet bears will probably not be seen in the public in the years to come, yet education is the ultimate means to stop the inhumane keeping of bears as pets. Humane ways to keep pets need to be stressed as well. Furthermore, it needs to be stressed that bears living in the wild are far better off than those living in captivity.

Finally, bear threat to human life has not been a concern up to now; however, it will become more of a concern as more hikers swarm into the mountains and leave their food and trash where bears can access it. As a consequence, human-bear interactions will increase. Education on the appropriate way to behave in bear country is needed. First, workshops could be held to educate professionals such as foresters and managers of parks or protected areas about human-bear interactions. Hikers and mountain climbers, who get into the back country and have a higher chance of encountering bears, also need to be educated.

Conservation recommendations

1. Steel jawed traps used to capture wild boar need to be strictly controlled in designated areas and completely banned in bear country.
2. Control or phase out the use of bear gall bladders in the traditional market and find alternatives or substitutes for bear gall bladder in Chinese medicine.
3. Stop the use of bear paws as a traditional delicacy and end the keeping of bears as pets.
4. More research needs to be done in order to learn the basic biology of this species in the field and in captivity.
5. Highway construction and land use policies need to be modified to protect suitable bear habitat.
6. Professionals and the general public, especially hikers and mountain climbers in bear country, need to be educated to avoid unnecessary negative impacts caused by bear-human conflict that may affect the momentum of protecting the species.

Status and management of the Asiatic black bear and sun bear in Vietnam

Do Dinh Sam

Introduction

Currently, there are no individuals or groups specializing in bear research in Vietnam, but several overseas authors have done general research on Vietnamese carnivores and mammals: Brousmiche in 1887; Pavie in 1904; Menegaux in 1905–1906; Thomas in 1909–1925; Bourret in 1927–1942–1944; Delacour in 1925–1930; and Osgood in 1932. From 1945 to 1954, research projects were interrupted due to the war against the French colonialists. After 1954, research was resumed by native authors within the country such as Dao Van Tien, Vo Quy, Le Hien Hao, Le Vu Khoi, Vu Thanh Tinh, Pham Trong A'nh, Dang Huy Huynh, Cao Van Sung, Do Tuoc, and Hoang Cuong.

Biology

There are two species of bear in Vietnam: the Asiatic black bear (*Ursus thibetanus*) and sun bear (*Helarctos malayanus*). The Asiatic black bear is a large bear weighing up to 200kg. This species is black in color. The majority have two stripes of white or occasionally yellow hair in a V shape on the chest. The head is relatively large, and there often is a thick mane on the upper part of the neck. The ears have two bushy tufts of long hair. The sun bear is a smaller bear, weighing only about 80kg. The shape is different from that of *U. thibetanus*, especially the head, which is smaller, similar to that of a dog. The neck has no mane, the ears do not have tufts, and the body hair is also less thick. There are also two stripes of white (or yellow) hair on their breast making a V shape.

Both bear species in Vietnam are active all year round, and no hibernation is observed. They eat starchy seeds such as *Quercus*, *Castanopsis*, and *Gnetum*; fleshy seeds such as *Canarium*, *Livistoma*; succulent fruit like *Ficus*, *Garcinia*, *Nepheliuum*, *Baccaurea*, *Syzygium*, *Dracontomelum*; various types of tubers such as *Dioseorea bulbifera*; the trunk of *Arenga saccharifera*, and *Rhapislaosesis* buds. In total, bears have been known to feed on 100 plant species. They seem to like honey very much. They also feed on the carcasses of animals, eggs and young birds, frogs, insects, crabs, and snails.

Little is known about reproductive season of bears in Vietnam, in part because mothers and their young can be hunted throughout the year. Scientific literature includes no information on the length of pregnancy, but it is believed to last 6–7 months, with 2–4 offspring at each birth.

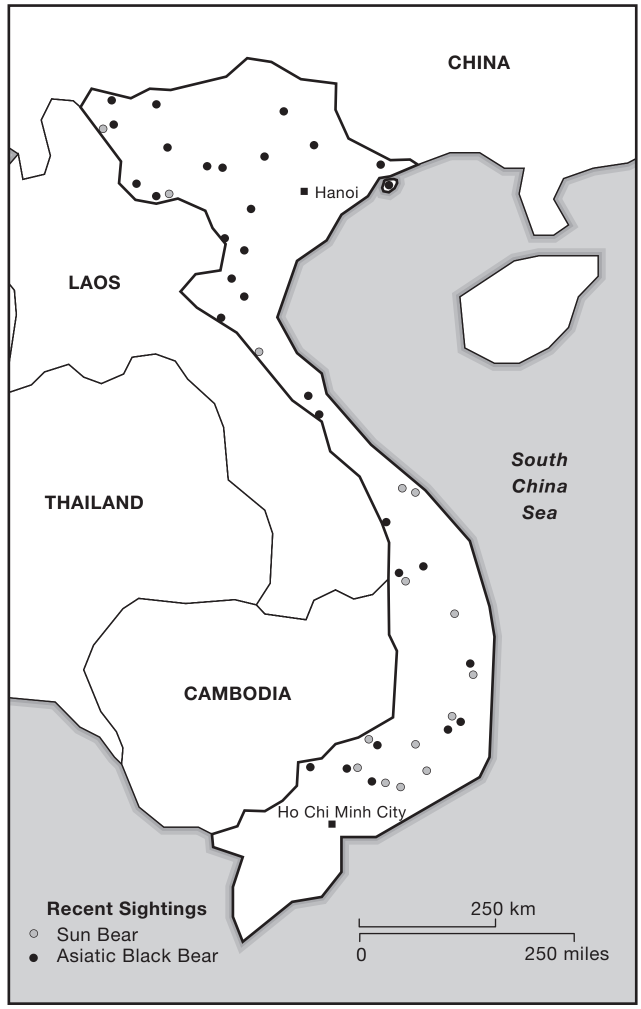


Figure 10.7. Recent Asiatic black bear (*Ursus thibetanus*) and sun bear (*Helarctos malayanus*) sightings in Vietnam.

Status and distribution

The population of Asiatic black bears is rather large: it is more common than other carnivorous mammals. They are distributed in all altitudinal ranges: mountainous regions, hill forests, limestone forests, and mangrove forests. They have been seen at certain times near the seashore and swimming from one island to another. Bears have also been seen at altitudes over 1,000m.

These bears also occur in Laos and Cambodia. The accompanying map (Figure 10.7) gives information on the distribution of the two bear species in Vietnam.

Legal status

The Government issued Decision 276/QD, 276/1989 with an attached regulation on management, protection and wildlife import and export. The decision includes a list of wildlife species of which the hunting and export are prohibited, including *H. malayanus*. In the Red Book of Vietnam which was recently prepared, *U. thibetanus* and *H. malayanus* were listed as endangered.

Population and habitat threats

Due to the pressures of human population growth and unstable settlement, the forests of Vietnam have been steadily cleared. Of the 87,000km^2 of natural forests, about 1,000km^2 disappear every year. In addition, hunting pressure has increased, while awareness of wildlife, habitat needs, and the status of bears remains low. As a result, bear population numbers have declined quickly. There are places where many bears (both species) occurred in the past, such as Ba Vi mountain (now NP), Tam Dao mountain (now NR), Cat Ba Island (now NP) but now have no bears. In other provinces where there were many bears in the past such as Quang Ninh and Hoa Binh, now only a few remain. In Vinh Phu, Lang Son, and Bac Thai provinces, bears are now extinct or nearly extinct.

Asiatic black bear cub (*Ursus thibetanus*) for sale in Laos.

C. Servheen

Management

There are few reliable records of annual bear harvests in Vietnam. According to a document by Le Hien Hao in 1973, in the provinces of North Vietnam (from latitude 17° northward) 6,000 bears were captured annually. According to a Do Tuoc document in 1981, in the northwestern part of North Vietnam alone (Moc Chau, Thuan Chau, Muong Te, Mu Cang Chai, Tram Tau, and Bac Yen districts), each village in these districts (about 15 villages in a district) annually captured about 4–5 bears. In rare cases a village can capture up to 10–15 bears a year.

Presently in Vietnam, the numbers of bears captured annually are estimated to amount to several thousand, most of which are Asiatic black bears, taken mainly in central highland provinces, central Vietnam, and northwestern part of North Vietnam.

In 1963, the State of Vietnam issued the "Temporary Regulation on Wildlife Hunting" in which hunting of 16 mammal species and four bird species was prohibited, but the regulation did not include the two bear species.

Beginning with the establishment of the first Natural Reserve, Cuc Phuong, in 1964, a system of 87 Natural Reserves has now been established with the total area of over 10,000km^2 (compared with 87,000km^2 of natural forests). In the natural reserves, strict measures have been applied to prohibit wildlife hunting.

Human-bear interactions

Bears have high economic value in Vietnam. The bear's bile is the most appreciated because it cures many diseases, effectively treats the accumulation of blood below the skin, and counters toxic effects. Bear bone glue is used as a tonic, and bear fat is also a medicine and a tonic. Finally, each bear provides a large quantity of edible meat. Because of high value of these products, people hunt bears despite their perceived fierce nature. At present, each bear is worth about 20–30 million dong (US$1,500–2,250 equivalent).

Many people keep bears because they are easily fed and cared for, especially as cubs. They quickly become tame domestic animals, feeding on many kinds of food such as rice, maize, sweet potato, cassava, pumpkin, and ripe fruit. They also like to eat animal fat and sweet foods. Bears eat a lot and grow quickly. A rather young bear satisfactorily fed would gain 10–20kg/month.

Public education needs

Wildlife protection is a topic for lectures, posters, postage stamps, match box labels, and school children's text books. However, the animals usually chosen for this type of education are the large, precious, and rare mammals such as the rhinoceros (*Dicerorhinus sumatrensis, Rhinoceros sondaicus*), elephant (*Elephas maximus*), guar (*Bos frontalis*), kouprey (*B. sauveli*), and banteng (*B. javanicus*). Bear protection is still only given attention in the natural reserves. Little research on bears is conducted.

Specific conservation recommendations

In order to proceed with the protection of bears in Vietnam, in cooperation with the activities of the IUCN/SSC Bear Specialist Group, we would like to suggest a number of topics worthy of consideration and research in Vietnam:

1. Research on the status of black bear in Vietnam with the following specifics: a) collecting literature on bears; b) surveys throughout the country for distribution and population of bears, especially *H. malayanus*; c) evaluation of the hunting situation (numbers of bears killed for flesh and export annually); d) a survey of people keeping bears and the number of bears in captivity; e) studies of biological and ecological characteristics of each bear species, and f) predictions of population trends for the two bear species in Vietnam. **Estimated budget: US$30,000.**
2. Public information on bear protection, including: a) writing of books, printing of posters, and organizing lectures on bear protection, and b) making a video tape of a bear's life. **Estimated budget: US$5,000.**
3. Because the Vietnamese customarily use the products of bears (flesh, fat, bones, bile), bear farming is needed if hunting is to be limited. This needs to be organised and: a) establishing a bear farm to produce young bears supplied to the people for rearing (the initial scale of the farm is 20 female bears and five male bears); b) organizing a demonstration course for families that desire to rear bears (initial number of trainees to be 100 persons). **Estimated budget: US$50,000.**

Chapter 11

Sun Bear Conservation Action Plan

Christopher Servheen

IUCN Category: Data Deficient **CITES Listing:** Appendix I
Scientific Name: *Helarctos malayanus*
Common Name: sun bear, honey bear

Introduction

The sun bear (*Helarctos malayanus*) is the smallest of the eight bear species and the only tropical bear species inhabiting lowland tropical rain forests throughout much of Southeast Asia. Body size is small for the Ursidae with weight between 50–65kg, body length between 1.1 and 1.4m, and an average shoulder height of 70cm. Lekagul and McNeely (1977), describing Thailand's sun bears, stated that sun bears rarely weighed more than 50kg. The pelage of the sun bear is usually black, but can vary from reddish to grey (Payne *et al*. 1985). Almost every sun bear has a chest patch of white to reddish hair shaped usually in the form of a "U", but variations from circles to spots have been reported (Pocock 1941; Meijaard 1997). Hair length is the shortest of any bear species and is consistent with the hot tropical environment of the species.

Sun bear (*Helarctos malayanus*).

C. Servheen

The body form is unique among the Ursidae. The front feet are turned inward to a great degree. The claws on the front feet are long and heavy. The head is large, broad and heavy in proportion to the body (Pocock 1941). The teeth are massive, especially the canines, for the size of the animal. The palate is broad in proportion to the skull. The tongue of the animal is extremely long and can be extended during feeding up to 20–25cm (Meijaard 1997). The chest is flattened ventrally. A superficial conclusion of the habits of this bear based on its morphology would indicate that it is adapted to climbing trees, using its strong jaws and claws to tear into trees or other structures, and using its long tongue to extract food such as insects, larvae, or honey from cavities.

Historic range and current distribution

It is presumed that the historic distribution of the sun bear was throughout much of the lowland tropical forest habitat within its range. The extent of this forest has been extensively reduced by human activities and population increase. This has resulted in assumed reduction in numbers and range for sun bears and other species. Meijaard (1997) has compiled an excellent summary of the historic distribution records for the sun bear. Of interest are the historic records for sun bears in places like eastern Tibet and Sichuan, China (Lydekker 1906), Manipur state and Assam (Higgins 1932) and the upper Chitwan district in India (Wroughton 1916), places where the species is now extinct. There were old published reports of sun bears on the island of Java (Greve 1894; Cuvier 1834; Fischer 1829), but there was apparently never any evidence to document the species from this island in historical time, only fossil evidence from the Pleistocene (Erdbrink 1953).

The sun bear is now found in Southeast Asia from Burma, eastward through Laos, Thailand, Cambodia, Vietnam, and Malaysia. It is also found on the islands of Sumatra and Borneo in the countries of Indonesia, Malaysia, and Brunei. Current distribution is shown in Figure 11.1 (Servheen 1991). There are also persistent

Figure 11.1. Present estimated distribution of the sun bear (*Helarctos malayanus*) in Southeast Asia.

reports of sun bears in parts of southern China, especially in Yunan province and it seems likely that small numbers of sun bears still exist in this area. The occurrence of sun bears in Bangladesh is questionable with no recent confirmed records available. The sun bear may now be extinct in India (A. Johnsingh pers. comm.).

Status

The habitat of the sun bear is the lowland tropical rain forest, usually below 500m. Davies and Payne (1982) report the species is found throughout dipterocarp and lower montane forests of Sabah, Malaysia from 0 to 1,350m but is common nowhere. As lowland forest habitats become fragmented due to resource extraction and human settlement, it is reasonable to assume that sun bear populations in much of their remaining ranges are now fragmented and in many cases isolated due to human activity. Future range will be determined by the extent of lowland forest habitat. As forests, especially lowland forests, are permanently converted to other uses such as plantation agriculture and human settlement, these areas are eliminated as suitable sun bear habitat. Given the levels of human activity within the range of the sun bear, it seems reasonable to assume that sun bear range will continue to decline and become more fragmented.

Legal status

The sun bear is listed under CITES Appendix I as a species in danger of extinction which is or may be affected by international trade. The sun bear is protected in Kalimantan and Sumatra in Indonesia and this protection prohibits killing, trade in dead or live animals, and keeping of bears as pets, although permits could be issued to allow pet keeping (Meijaard 1997). In Sabah, Malaysia the sun bear is listed as a game species. It may not be killed without a license and killing in forest reserve areas is limited.

Hunting is also permitted in Sarawak where sun bears are threatened by unregulated hunting (Caldecott 1988).

The effectiveness of legal protection varies greatly. While legislation exists in many countries within the range of the sun bear, sun bear parts and live bears are seen openly for sale in most areas where the species exists. In settled areas where oil palm plantations exist or where agricultural crops are planted in bear habitat, sun bears are regularly shot for depredations on such cultivated lands. In many areas, adult females are shot as depredating animals and their cubs are captured for pets and eventually sold, killed, or given to sanctuaries.

Population threats

Lack of knowledge about numbers of bears, distribution, population fragmentation, and mortality rates threaten sun bears throughout their range. The combination of lack of knowledge about numbers of bears and ongoing and unregulated mortality creates an ominous situation. Many sun bear populations have already gone extinct due to a combination of habitat loss and excessive human-caused mortality. It is likely that populations in many areas are now fragmented and isolated into small subpopulations that are sustaining increasing mortality. In many areas of sun bear range such as Burma, Laos, Cambodia, and Vietnam poaching of bears for sale or for food is unregulated and increasing (Mills and Servheen, 1991). Market economies and opening of borders now allow free trade of bears and parts of bears, thereby accelerating killing of bears. Judging from habitat loss alone, it is possible that sun bear numbers are less than 25% of the historic levels of 100 years ago. Given the lack of knowledge of the sun bear throughout its range, it is likely that the species will disappear from many areas before their existence there has been documented.

Habitat threats

The habitat of the sun bear is the lowland tropical hardwood forests of Southeast Asia, Sumatra, and Borneo. These forests are highly valued for timber production and are rapidly being converted to second growth, plantation agriculture and human settlement. Logging activities now affect many lowland forest areas. Malaysia and Indonesia are the world's leading exporters of tropical hardwoods, and most of these tropical hardwoods originate in sun bear habitat.

The effect of secondary growth plant communities occurring after timber harvest on sun bear habitat use is unknown. Impacts of timber harvest on bear distribution, density, and food supply are unknown. Several types of silvicultural systems are in use throughout sun bear habitat and the impacts of each system on resident wildlife depend on the food habits and resource use strategies of each species (Johns 1985, 1986). The lack of knowledge of sun bear ecology makes understanding the effects of forest harvest on habitat use, food habits, and behavior impossible at this time.

Development of plantation agriculture for oil palm and rubber convert lowland tropical forest into habitat of limited value to sun bears. In addition, palm plantations present conflict opportunities for sun bears who may feed on the palm heart and destroy the palms in doing so. Such depredating bears are persecuted and destroyed by landowners.

C. Servheen

Forest cleared for plantation development in sun bear habitat, Borneo.

Management

Little management of sun bears occurs anywhere in their range. Animals depredating in agricultural areas are regularly killed by landowners. No population estimates exist nor is there any good information on the range of the species. No records of human-caused mortality are kept and since no population estimates exist, there is no mortality management nor level of sustainable mortality for any population unit. No habitat management exists for sun bears anywhere in the range of the species. Nothing is known about the impacts of timber harvest or other human activities on the food habits, habitat, or ecology of the species, so habitat management related to such activities is not possible.

Human-bear interactions

Human-bear interactions are characterized by depredation in agricultural areas with subsequent elimination of offending bears, hunting for consumption, sale of bears captured as young, sale of bear parts originating from illegal hunting and depredation kills, and effects of human resource extraction activities such as timber harvest on bears. Sale of sun bear gall bladders for use in traditional Chinese medicine occurs throughout the range of the species (Mills and Servheen 1991). Hunting of sun bears for food, for sale of parts, and for sale of young captured when the mothers are killed is ongoing throughout the range of the species and is unregulated. Meijaard (1997) reports that sale of bear parts such as gall bladders in Kalimantan, Indonesia accelerated with an influx of foreign users of traditional medicine. Local people had little demand for such parts but would kill bears to satisfy demands if such markets were available as foreign timber workers entered sun bear habitat.

Sun bears are known as fierce animals when surprised in the forest. Local people interviewed by Meijaard (1997) stated that the sun bear was the most fierce of tropical forest animals in its range and would attack humans and inflict serious wounds if surprised. Bears are feared because of this aggressive tendency.

Public education needs

In general there is little knowledge or concern about the status of sun bears in most countries within their range. This is due in large part to the fact that in Southeast Asia, wildlife conservation is concentrated on species of higher local and international concern such as tigers, elephants, and rhinos. Human coexistence with sun bears will depend upon basic knowledge being communicated to local people and government officials about the natural history of the bears and their response to human activities. Given the lack of knowledge about the species, it is understandable that minimal information and effort is available to devote to education and public outreach efforts.


C. Servheen

Sun bear gall bladders for sale in Malaysia.

Specific conservation recommendations

The sun bear is the least known of the world's bears. Basic research on the sun bear is the highest priority research need. Basic information on the status, ecology, food habits, and distribution of the sun bear is needed everywhere in its range in Southeast Asia.

Methodologies to assess the distribution of many large mammal species in tropical forests are limited. It is especially difficult for nocturnal, solitary, non-vocal, and/or elusive species like sun bears. There are no readily available measure of changes in density of sun bears in tropical habitats. Results of transect surveys are often difficult to reproduce in different areas in order to gain comparative data. A method to quantify presence/absence and encounter frequency would be a useful not only for sun bears but for many other tropical forest mammals such as the Felidae. Such a method would allow assessment of distribution and the relative abundance of species in undisturbed and logged habitats.

Local scientists and managers in the countries within sun bear range need assistance in developing methods to survey nocturnal, solitary carnivores such as sun bears. There is a need for site-specific application of methods to assess distribution, density and the impacts of forest harvest on sun bear populations in representative habitats throughout the range of the species. These surveys would be useful to forest managers so they may better judge the impacts of timber harvest on native species and use the results in future forest management.

Timber harvest of lowland tropical rain forests of Southeast Asia produces second-growth forests and changes the distribution and abundance of sun bear foods. Plantation development converts diverse forest ecosystems into monocultures. This changes the carrying capacity of ecosystems for wildlife, many of which are of value to local people and to biodiversity. Information on how large carnivores like sun bears adapt to this land conversion is minimal. Research on the basic life-history of the sun bear is needed to assess the impacts of forest conversion on biodiversity and carnivore survival. This information is also needed to develop management and conservation plans that address the needs of resident wildlife while allowing sustainable resource extraction to sustain local economies.

Research data about the status and biology of the sun bear should be made available to local people through development of informational presentation in schools, posters and brochures.

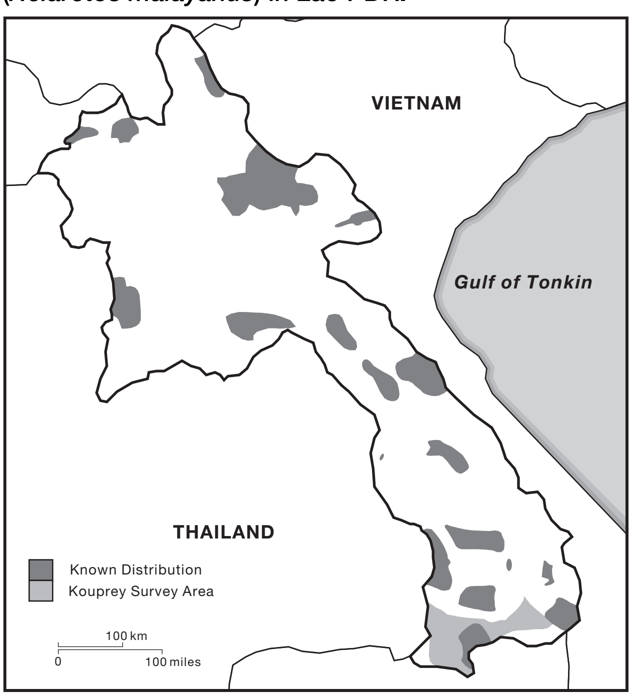
Status and management of the sun bear in Lao PDR

Richard E. Salter

Historic range and current distribution

Sun bears (*Helarctos malayanus*) were reported by Deuve (1972) to occur in all provinces of Laos. The regional range map in Lekagul and McNeely (1977), which presumably represents the historic range of the species, shows sun bears as occurring throughout Laos, with the possible exception of the extreme northeastern corner of the country (Figure 11.2). Current distribution is shown in Figure 11.2.

Figure 11.2. Present distribution of sun bears (*Helarctos malayanus*) in Lao PDR.



Status

Sun bears are widely distributed throughout the country, with the probable exception of the most heavily settled and cultivated portions of the Mekong Plain. Population levels are unknown but the frequency of reports during village interviews (90.4%, n=324) suggests that this species is still relatively abundant. Sun bears reportedly occur in all major proposed protected areas surveyed to date (see current distribution map), although it should be noted that the location of these areas is biased towards heavily forested and hilly parts of the country.

Legal status

Hunting of sun bears is prohibited throughout Laos and in all seasons, except with permission of the Council of Ministers, by Decree No. 118/PCM dated 5 October 1989 (Decree of the Council of Ministers on the Management and Protection of Aquatic Animals and Wildlife and Hunting and Fishing) and by subsequent instructions on the execution of the decree. Individual animals can be killed in self-defense or in defense of property but remain the property of the State. Extraction and export taxes of US$200 for whole animals, US$0.70/g for bile, US$18/kg for skins, and US$10.50/kg for feet are payable under Decree of the Council of Ministers No. 47/CCM, on the State Tax System (dated 26 June, 1989), although transporting, possessing, or trading bears or bear parts without authorization is prohibited. Penalties for violations of hunting and trade regulations are specified in the 1989 Penal Code. However, hunting and trade are very difficult to control and there is very little enforcement capacity.

Population threats

Firearms and subsistence hunting are very widespread in rural Laos, and it is likely that sun bears are killed or wounded whenever opportunity permits. There is some trade in bear gall bladders, paws, skins, and live cubs, both internally and to neighboring China and Thailand (Salter pers. obs. 1988–93; Chazee 1990; Martin 1992; Srikosamarata *et al.* 1992), although as virtually all of this is unregulated, the volume and value of trade has not been determined.

Habitat threats

Threats to sun bear habitat include degradation and loss of dense forest cover as a result of logging, shifting cultivation, locally intensive grazing, and annual fires over large areas. These factors often occur in combination and can result in rapid degradation of previously forested areas. At present, closed forest covers an estimated 47% of the country, mainly in the center and the south.

Management

No specific management actions have been taken, other than as indicated under Legal Status.

Human-bear interactions

Bears are fairly commonly reported as crop pests and occasionally as livestock predators (Forest Resources Conservation Project unpublished interview data), but whether this primarily involves Asiatic black bears or sun bears is unknown. As elsewhere in Southeast Asia, villagers recognize close encounters with sun bears to be potentially or extremely dangerous.

Public education needs

Broad educational measures are needed to raise the general level of conservation awareness among rural and urban populations. Measures in rural areas should focus on the need to protect sun bears and other protected or otherwise vulnerable species from hunting. In urban areas, protection measures should focus on discouraging the keeping of bears for pets and the purchase of bear parts for medicine or trophies. There is also a need for educational material and displays at entry and exit points to discourage tourists from purchasing wildlife souvenirs.

Specific conservation recommendations

1. Strengthen and enforce existing hunting and trade regulations, including training and equipping of enforcement and customs staff, and ensuring that government staff at all levels are aware of existing regulations.
2. Accession to CITES.
3. Develop public education measures as above.
4. Develop a monitoring system to track and assist in controlling the sale of bear parts.
5. Complete a national system of protected areas, buffer zones, and forested corridors, and develop other habitat protection measures as appropriate.

Status and management of the sun bear in Vietnam

See Status and management of the Asiatic black bear and sun bear in Vietnam (Chapter 10, page 216) and Figure 10.7.

Chapter 12

Sloth Bear Conservation Action Plan

David L. Garshelis, Anup R. Joshi, James L. D. Smith, and Clifford G. Rice

IUCN Category: Vulnerable, A2cd **CITES Listing:** Appendix I
Scientific Names: *Melursus ursinus* (occasionally *Ursus ursinus*); *Melursus ursinus ursinus* in India, Nepal, Bhutan, and Bangladesh; *Melursus ursinus inornatus* in Sri Lanka
Common Names: sloth bear; Northern India and Nepal: *bhalu*; India: *rinch*, *reech*, *richwa*, *asval*, *karadi*, *puni karadi*, *elugu bunti*; Sri Lanka: *walaha* (male), *waelahinna* (female), *karadi*; Bhutan: *doni*; Bangladesh: *bhaluk*

Introduction

Physical description: Sloth bears have a distinctively long shaggy coat, with no underfur. The hair is especially long around the neck and the back of the head (hair length up to 15cm). It is the only bear with long hair on its ears. Sloth bears are typically black, although brown or reddish individuals have been observed (Brander 1982; Phillips 1984), as have albinos (Bharos 1988). Like sun bears and Asiatic black bears, sloth bears have a broad, white chest blaze, but unlike these other species, their muzzle is whitish. They have long (6–8cm), slightly curved, ivory-colored front claws, for digging, and shorter claws in the rear. The front feet are turned inward, also probably an adaptation for digging. They have a broad palate, protrusible lips, and they lack the upper two middle incisors, all specializations for eating ants and termites. Weights vary by area and by sex. Adult males generally weigh 80–145kg, and adult females weigh 55–95kg. However, a 192kg male and a 124kg female have been reported (Brander 1982).

D. Garshelis

LEFT: Sloth bear (*Melursus ursinus*) in a tree, showing characteristic white muzzle and chest blaze. Sloth bears climb trees mainly to obtain honey from beehives. Otherwise, they spend little time in trees.

BELOW: Front teeth of a sloth bear showing the gap where the upper incisors are missing, presumably an adaptation for sucking in termites and ants. The large canines may aid in defense against other large predators, like tigers and leopards.

D. Garshelis

Reproduction: Sloth bears typically breed during June–July, and cubs are born during November–January (Jacobi 1975; Laurie and Seidensticker 1977; Iswariah 1984; Joshi 1996), after a period of delayed implantation (Puschmann *et al.*1977). However, breeding and birthing may occur at other times of the year (Laurie and Seidensticker 1977; Gopal 1991). Phillips (1984) indicated that there was no conspicuous breeding season in Sri Lanka, although Norris (1969) thought that young cubs were most prevalent during August and September, suggesting most births occurring in mid-summer and breeding during the winter. If true, this would be exactly opposite of the predominant pattern observed elsewhere.

Cubs are born in protected dens (e.g., excavated holes or natural hollows). Females remain in dens for 2–3 months, and during this period rarely come out to eat (Jacobi 1975; Joshi 1996). A litter size of two is most common (Laurie and Seidensticker 1977; Phillips 1984; Gopal 1991; Joshi 1996); litters of one have been observed, although some may represent two cub litters with early mortality (Joshi 1996). Litters of three are rare (Norris 1969; Brander 1982; Heath and Mellon 1983; Iswariah 1984), possibly because three cubs cannot ride well on the mother's back. Cubs are routinely carried on the mother's back from the time they leave the den until they are about nine months old (Heath and Mellon 1983; Joshi 1996). Cubs can climb trees to feed (e.g., on honey or fruits), but do not use trees as a means of escape. Carrying by mothers seems to be the main defense for cubs against attacks by other predators, such as tigers and leopards (Laurie and Seidensticker 1977; Gopal 1991), and also against attacks from other bears.

Cubs stay with their mothers for 1.5 or two years, splitting up just before the breeding season (Joshi 1996). Thus, females breed at either two or three year intervals. Females may breed first when four years old, but do not necessarily produce cubs following their first breeding season.

Social behavior: Detailed information on social behavior of sloth bears is available only for Royal Chitwan NP (Laurie and Seidensticker 1977; Joshi 1996). Extensive home range overlap (mean home range size = 9 and 14km^2 for females and males, respectively, in Chitwan) and nonaggressive behaviors toward other bears indicate that, in this area at least, they are not territorial. However, they have been observed to mark trees with their teeth and claws, a behavior that may be linked to social spacing. Temporal avoidance may be more pronounced than spatial avoidance. Females with cubs and subadults of both sexes are rarely active at night, whereas adult males and lone adult females are at least as active at night as during the day. The shift to diurnal activity by females with cubs and subadults may be related to avoidance of nocturnal predators as well as potentially aggressive encounters with other bears; intra-specific killing of juveniles has been observed (Joshi 1996).

During the breeding season, groups of 3–4 males congregate near estrus females. All may breed, apparently in rank order, as the same order of breeding may occur among the same group of males with different females. Aggressive behavior among males appears to be uncommon, although serious and even fatal injuries from fighting sometimes occur (Joshi 1996). Large canines (in both sexes), relative to their body size and to other bears of equal size, may be a defense against aggressive interactions with conspecifics and/or between sloth bears and other predators. Sloth bears rely on their aggressive

D. Garshelis

Den of a sloth bear dug into the bank of a dry riverbed. Dens are used only by cub-bearing females. In Royal Chitwan National Park, Nepal, parturient females entered dens in early-mid November, came out periodically to feed beginning in late December or early January (after cubs were born), and exited dens in mid-January (Joshi 1996). Bears also sometimes rested in dens during other times of year.

Table 12.1. Comparison of diets of sloth bears based on composition of scats from national parks (NP) and wildlife sanctuaries (WS) in Nepal and India.

Location	Time of year	*n* scats	% Composition Insects	Fruits	Other	Reference
Nepal						
Royal Chitwan NP						
1990–1993	Year-round	627	83	14	3	Joshi *et al*. in press
	Fruiting season	249	58	38	4	Joshi *et al*. in press
	Nonfruiting season	378	95	2	3	Joshi *et al*. in press
Royal Chitwan NP						
1973–1975	Year-round	139	52	42	7	Laurie and Seidensticker 1977
India						
Kanha NP (Central India)	Year-round	92	39	61	0	Schaller 1967
Bandipur NP (South India)	Year-round	95	53	37	10	Johnsingh 1981
Mudumalai WS (South India)	Fruiting season	350	8	90	2	Baskaran 1990
Mundanthurai WS (South India)	Nonfruiting season	111	75	25	1	Gokula *et al*. 1995

nature in interactions with large dangerous species like tigers, leopards, elephants, and rhinoceros. This disposition also makes them a danger to people.

Aside from the breeding season, sloth bears have been observed in brief, generally passive aggregations (up to 5–7 individuals of mixed sex-age classes). In some instances individuals were congregated near a dense clump of fruit or flowers (Prater 1971; Brander 1982; Baskaran 1990), whereas in other cases a concentrated food source was not apparent (Joshi 1996). More stable associations have been observed among pairs of subadults (siblings independent of the mother as well as unrelated individuals) (Laurie and Seidensticker 1977; Iswariah 1984; Joshi 1996). These associations, which may persist for several weeks to over a year, may function as defensive coalitions against other sloth bears and predators. Some evidence exists that subadults may be excluded from prime habitats and forced to occupy less favorable areas (Joshi 1996).

Habitat preferences: Sloth bears inhabit a wide variety of habitats, including grasslands, thorn scrub, sal (*Shorea robusta*) forest and moist evergreen forest. Current information about their use of habitat is scant. Consequently, generalizations about habitat use must be considered provisional, pending further detailed and widespread studies.

In Royal Chitwan NP, Nepal, sloth bears preferred alluvial grasslands during the dry season, apparently because of a high density of termites, their principal prey during this season (Joshi *et al.* 1995; Joshi *et al.* in press). However, during the wet season, males moved to upland sal forest (Laurie and Seidensticker 1977; Sunquist 1982; Joshi *et al.* 1995). Fruiting corresponded with the wet season, but diets of sloth bears that moved to the uplands did not contain more fruit than those that remained in the lowlands (Joshi *et al.* in press). The shift to the uplands by some sloth bears appeared to facilitate foraging on termites, which was difficult in the flooded lowlands, whereas the shift back to the lowlands occurred when soils dried, possibly hampering the excavation of termite colonies in the uplands (Davidar 1983).

Studies in India indicated a lower reliance on termites and other insects, and a greater reliance on fruits than in Chitwan, probably due to a longer fruiting season further south (Schaller 1967; Johnsingh 1981; Iswariah 1984; Baskaran 1990; Gopal 1991; Gokula *et al.* 1995) (Table 12.1). Extensive grasslands in Chitwan also seemed to promote a diet more reliant on ants and their larvae (Joshi *et al.* in press). In Parambikulam WS, Kerala (southern India), just as in Chitwan, sloth bear sign was more common in grasslands than in deciduous forest (which had more sign than evergreen forest or plantations) (Balakrishnan and Easa 1986). In nearby Mudumalai WS, Tamil Nadu, fruits composed >90% of the diet and most sloth bear sign was found in dry deciduous tall grass forest (compared to deciduous forests with shorter and less-dense grasses) (Baskaran 1990). The dry deciduous forest in this area had greater fruit abundance, more cover, and less human disturbance than other habitats. A thorn (*Acacia* spp.) forest at Mudumalai had the greatest abundance of termite mounds, but sloth bears were likely deterred from this area by heavy grazing of livestock and other human use. A survey across the lowlands of Nepal indicated that sloth bears were either absent or occurred at low densities in areas with high human use, despite high termite densities (Joshi *et al.* unpublished data). That is, habitat quality may be related as much to human disturbance as to the abundance of food.

General distribution

Sloth bears are restricted to the Indian subcontinent: India, Sri Lanka, Nepal, Bhutan, and Bangladesh. At the turn of the century, sloth bears were found throughout Sri Lanka, but due to wide scale conversion of upland forests to coffee and tea, they are now found only in the northern and eastern lowlands (Phillips 1984; Santiapillai and Santiapillai 1990; C. Santiapillai *in litt*. 1994). The most current range map for Sri Lanka (Figure 12.1), however, includes areas where forests are highly degraded or absent (IUCN, WCMC database), and where bears probably no longer occur. In India, sloth bears have a patchy distribution corresponding with remaining forest cover; they are absent in the high mountains of Himachal Pradesh and Jammu and Kashmir, the northwestern deserts of Rajasthan, and a broad non-forested swath in the south (Figure 12.1). Northward they extend through the lowlands of Nepal and into the Siwalik Hills; the population in Nepal is no longer continuous with that of India. Eastward, the range stretches through southern Bhutan, and into the Indian states of Assam, Manipur, and Arunachal Pradesh. Some sloth bears may still exist in remnant, mixed-evergreen forests of the Chittagong and Sylhet regions of eastern Bangladesh, but by the early 1970s they had been extirpated from the sal forests of central Bangladesh (Khan 1982, 1984; R. Khan *in litt*. to C. Servheen 1988). There is no data indicating that sloth bears ever occurred as far east as present day Myanmar, although it is not clear what would have prevented their spread there from the adjoining portion of southeastern Bangladesh.

Populations and status

New IUCN criteria for categorizing species by degree of threat rely on estimates of abundance (total numbers and rate of decline), distribution (total occupied area and degree of fragmentation), and probability of extinction (IUCN 1996). Under these criteria, the sloth bear is listed as Vulnerable (IUCN 1996), although much of these data are not available for sloth bears, and it is questionable

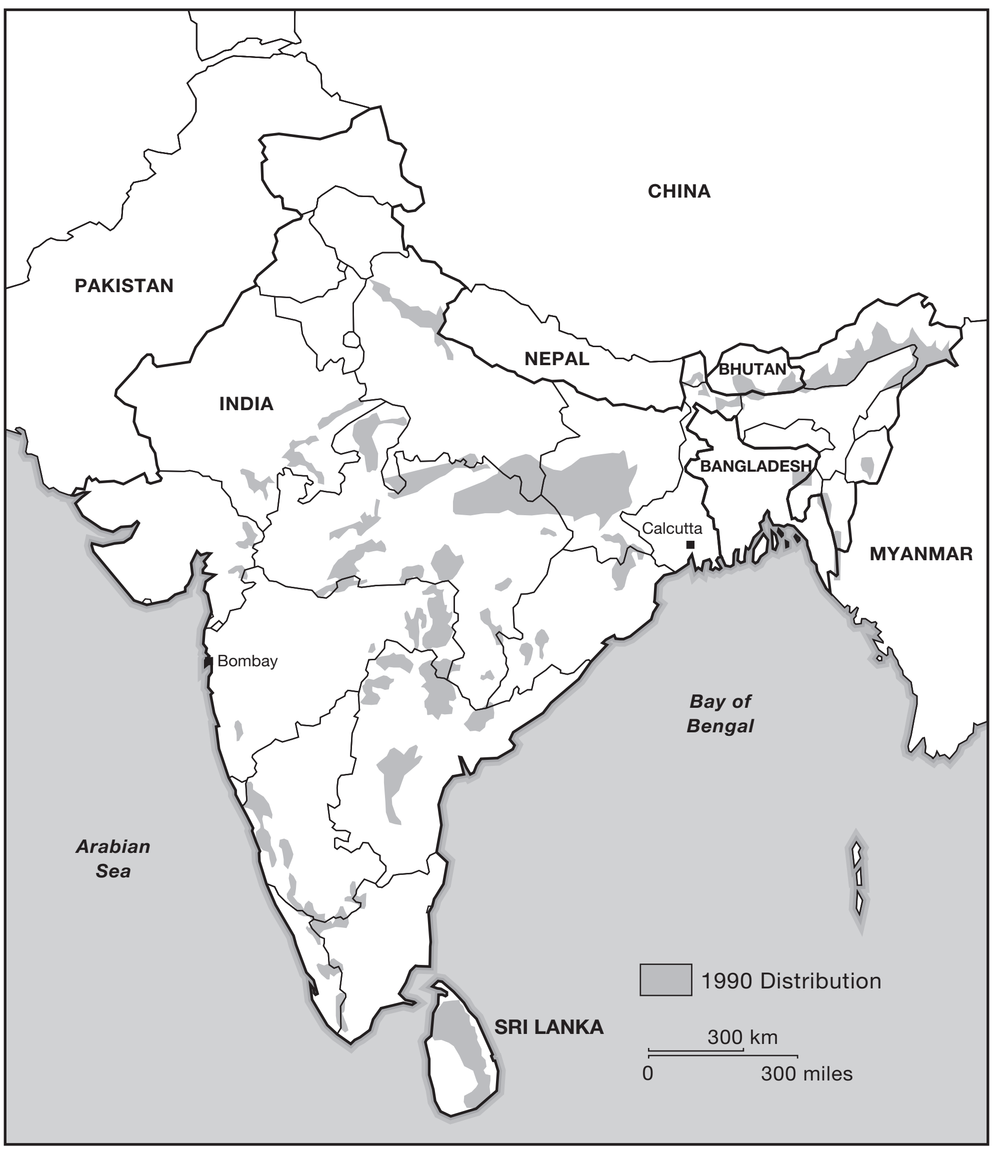


Figure 12.1. Estimated sloth bear (*Melursus ursinus*) range in India, Bangladesh, Bhutan, and Sri Lanka.

whether "ballpark" guesses are of any value. Protected areas with sloth bears encompass 56,000km^2 (45,000 in India, 2,400 in Nepal, 5,800 in Sri Lanka, 3,000km^2 in Bhutan), and the range outside the protected areas may be 200–300,000km^2. The total world population of sloth bears is probably between 10,000 and 25,000, but good estimates of abundance, even for small areas, are lacking, so an overall estimate for the species, given present information, is virtually meaningless. There are also no good estimates of rates of population change, and in most areas even trends in population size are unknown. Respondents to a 1993–94 survey by the authors indicated that the prospect for persistence of sloth bears in India is fair (not good, not poor), due to continued habitat loss and degradation. Most sloth bear populations outside protected areas are likely decreasing. The same appears to be true for Nepal (Joshi *et al.* unpubl. data) and Sri Lanka (Santiapillai and Santiapillai 1990). The status of sloth bears in Bangladesh is precarious at best, if they even still exist there (Khan 1982, 1984; R. Khan *in litt.* to C. Servheen 1988); protected areas are still heavily encroached upon by people, due to high human density and underfunded, understaffed forest departments (Chivers 1986). The outlook for this species in Bhutan appears to be more promising, due to a commitment to its protection by the Royal government; they appear to be fairly common in protected areas along the southern border and are likely present in adjacent forests (S. Langchuk, head Nature Conservation Section, Forestry Services Division, Gasa *in litt*., 1994; T.S. Namgyal, WWF pers. comm. 1996). In general, it is difficult to assess the overall status of this species across its range, due to a paucity of information on abundance and distribution, especially outside the protected areas.

Status and management of the sloth bear in India

Historic range and current distribution

Historically the range of sloth bears in India extended, virtually uninterrupted, from the southern tip north to the border with Nepal and east to the Myanmar border. They did not inhabit the desert along the border with Pakistan or the mountainous areas of the far north. Sloth bears were once so common throughout the Indian peninsula that they could be speared from horseback (Brander 1982). Due to overhunting, populations began to decline by the late 1800s, as rail lines increased access to previously remote areas (Gilbert 1896). During the 1940s and 1950s, many naturalists began to notice a sharp decrease in sloth bear sightings, as well as a decrease in performing bears on the streets (Seshadri 1969; Krishnan 1972; Singh 1973). This decline was related to loss of forest habitat, which was instigated by the British in the 1800s, and continued at a particularly rapid rate after Indian independence in 1947.

Sloth bears are the most widespread species of bear in India (Figure 12.1). Along the northern part of this range they overlap the range of the Asiatic black bear. These two species coexist in some national parks and wildlife sanctuaries, such as Corbett, Jaldapara, and Kaziranga. In eastern India, in the hills south of the Brahmaputra River (states of Assam, Manipur, and Mizoram) they also overlap the westernmost range of the sun bear (Higgins 1932; Gee 1967). In fact, sloth bears, Asiatic black bears, and sun bears all coexist in parts of this area (Choudhury 1993; S.D. Roy *in litt.* 1996), the only places in the world occupied by three species of bears. Sloth bears are not sympatric with brown bears, which live in the highlands of Himachal Pradesh and Jammu and Kashmir. Sloth bears are basically a lowland species, although they are found in the Siwaliks, low hills bordering the outer range of the Himalayas from Punjab to Arunachal Pradesh; however, they are no longer found as far west as Punjab.

Status

Jaffeson (1975) made the first real attempt to assess the nationwide status of sloth bears. He surveyed 20 forest officers and wildlife wardens from five Indian states (although half of the responses were from Tamil Nadu). Nine respondents estimated sloth bear numbers in their areas. Totaling these yielded 487 sloth bears on 8,067km^2, or a rough average density of 6 bears/100km^2. Individual density estimates ranged from 40/100km^2 in Mudumalai WS to 3/100km^2 in Kanha NP. A regression equation, taking into account human density in the vicinity (which, curiously, was positively related to bear density) was then used to extrapolate sloth bear density throughout the 260–290,000km^2 of forested range to produce a total estimated population of 7,300–8,000 sloth bears in India. Most respondents (67%) indicated that numbers were declining; 20% thought sloth bear populations in their area were stable.

We conducted a similar survey during 1993–94. We interviewed five Indian Forest Service officers at a tiger workshop in New Delhi and mailed 41 questionnaires to officials from throughout India, of which seven were completed (sources listed in Table 12.2). Data from this survey were combined with information from the Wildlife Institute of India's National Wildlife Database, the India Proposal to CITES (1989), and various printed sources to generate a list of parks and reserves occupied by sloth bears (Table 12.2; electronic database [Lotus file] available from authors). The quality of the information in this database thus varies from that obtained directly from our interviews and questionnaires (some first-hand, some second-hand), to a government document and database

Table 12.2. Indian National Parks (NP) and Wildlife Sanctuaries (WS) (including Tiger Reserves) with sloth bears, based on 1980–96 data. Population and density estimates are less exact than they appear (see text).

Protected area	State	Area (km^2)	Population estimate	Bears/ $100km^2$	Source(s)[a]
1 Anaimalai WS	TNA	842			2a,4d
2 Anshi NP	KAR	250	rare		1a
3 Arabithittu WS	KAR	14			4b
4 Badalkhol WS	MPR	104			1g
5 Bandh Baratha WS	RAJ	192			4b
6 Bandhavgarh NP	MPR	448			1gi,2a,4a
7 Bandipur NP	KAR	874	32	4	1ai,2ab,4cd
8 Bannerghatta NP	KAR	104	rare		1a,4ac
9 Barnawapara WS	MPR	245			4b
10 Bassi WS	RAJ	150	rare		1b
11 Bhadra WS	KAR	492	common		1a,4c
12 Bhagwan Mahavir NP – Molem WS	GOA	362			4ab
13 Bhairamgarh WS	MPR	139	common		2a
14 Bhensrodgarh WS	RAJ	229			4a
15 Bhimbandh WS	BIH	682			4ab
16 Bilgiri R. Temple WS	KAR	540	common		1a,4c
17 Bor WS	MAH	61			4c
18 Brahmagiri WS	KAR	181			4c
19 Buxa Tiger Reserve	WBL	759			2a,4a
20 Chandaka WS	ORI	176			2a,4c
21 Chandoli WS	MAH	309			4b
22 Chandra prabha WS	MPR	78			4cd
23 Chandrapur WS	ORI	109			2a
24 Chendurang WS	KER	100			4b
25 Chimnony WS	KER	90			4b
26 Chinnar WS	KER	90	rare		1d,4b
27 Corbett NP	UPR	1,400	27	5	1gm,2ab,4cd
28 Cotigoa WS	GOA	105			1e,4a
29 Dalma WS	BIH	193	40	21	1i,4c
30 Dampha WS	MIZ	340			1h
31 Dandeli WS	KAR	843	common		1ae,4c
32 Darrah WS	RAJ	266	18	7	1b,2b,4a
33 Dudhwa NP	UPR	490	80	16	2ab,4acd
34 Eturnagaram WS	APR	803			3d,4ad
35 Fossil NP	MPR	0.3			2a
36 Gautala WS	MAH	261			4b
37 Gautaum Budha WS	BIH	260			4ab
38 Gorumara WS	WBL	9			4b
39 Hazaribagh WS	BIH	186			2a,4d
40 Idukki WS	KER	70	extirpated		1dki,4ac
41 Indravati NP	MPR	1,258	87	7	1gi,2ab,4a
42 Itanagar WS	ARU	141			2a
43 Jaldapara WS	WBL	116	10	9	1ih,2a,4d
44 Jawahar Sagar WS	RAJ	100	23	23	1b
45 Jessore WS	GUJ	181	225	124	2ab,3c,4ab
46 Kalakad-Mundanthurai WS	TNA	900	common		1km,2b,4ab
47 Kanger Valley NP	MPR	200			2a
48 Kanha NP	MPR	940	70	7	1gi,2a,4cd
49 Karlapat WS	ORI	255			2a,4b
50 Katepurna WS	MAH	74			4b
51 Kawal WS	APR	893			2a,4ac
52 Kaziranga NP	ASS	430			1fh,2a,4d
53 Keibul-Lamjao NP	MAN	40			1h
54 Kela Devi WS	RAJ	676	82	12	1b,2ab
55 Khalasuni WS	ORI	116			4c
56 Kheoni WS	MPR	123			2a
57 Kinnersani WS	APR	635			2a,4ac
58 Kinwat WS	MAH	138			2a,4c
59 Kishanpur WS	UPR	227			4c

Table 12.2 ... continued. Indian National Parks (NP) and Wildlife Sanctuaries (WS) (including Tiger Reserves) with sloth bears, based on 1980–96 data. Population and density estimates are less exact than they appear (see text).

Protected area	State	Area (km^2)	Population estimate	Bears/ 100km^2	Source(s)[a]
60 Koderma WS	BIH	178			4bc
61 Kotagarh WS	ORI	400			2a,4b
62 Kumbhalgarh WS	RAJ	578	105	18	1bj,2ab,4ad
63 Lanjamadagu Siwar. WS	APR	30			2a,4c
64 Manas NP	ASS	391			1h,2a
65 Melghat WS	MAH	1,620	common		1m,2a,4cd
66 Melkote Temple WS	KAR	50			4bc
67 Mookambika WS	KAR	247			4ab
68 Mount Abu WS	RAJ	289	20	7	1bj,2b,4a
69 Mudumalai WS	TNA	321	common		1em,2a,4acd
70 Murlen WS	MIZ	45			1h
71 Nagarahole NP	KAR	643	common		1ae,2a,4cd
72 Nagarjunasagar (S) WS	APR	1,347	300	22	2ab,3d,4ac
73 Nagzira WS	MAH	153			4bc
74 Namdafa WS	ARU	1,985			4c
75 National Chambal WS	MPR	320			1g,2a
76 Nawegaon NP	MAH	134			2a,4c
77 Neora NP	WBL	88			4b
78 Neyyar WS	KER	128	rare		1dm
79 Nugu WS	KAR	30			4c
80 Pachmari WS	MPR	462			2a
81 Painganga WS	MAH	325			4b
82 Pakhal WS	APR	878			2a,3d
83 Pakhui WS	ARU	862			4ab
84 Palamau WS	BIH	748	46	6	1i,2ab,4d
85 Panna NP	MPR	543	common		1gm,2a,4a
86 Panpatha WS	MPR	246			4b
87 Papikonda WS	APR	590			4b
88 Parambikulam WS	KER	285	common		1dk,4c
89 Pench NP	MAH	257			4c
90 Pench NP	MPR	293	rare		1c,2a,4a
91 Peppara WS	KER	53			4b
92 Periyar WS	KER	777	common		1dk,2a,4c
93 Pocharam WS	APR	136			3d,4b
94 Pranhita WS	APR	136			2a,3d,4a
95 Rajaji NP	UPR	820			4ac
96 Rajgir WS	BIH	36			4b
97 Ramgarh Vishdhari WS	RAJ	301	3	1	1b,2a
98 Ranthambore NP	RAJ	392	57	15	1b,2ab,4ad
99 Ratanmahal WS	GUJ	56	43	77	2b,3c,4b
100 Ratapani WS	MPR	689			4b
101 Sardarpur WS	MPR	348			4b
102 Satpura NP	MPR	524			1g,2a
103 Sawai Man Singh WS	RAJ	103			4b
104 Sharavathi WS	KAR	431			4abc
105 Shettyhalli WS	KAR	396	common		1a,4c
106 Shivpuri NP	MPR	156			4cd
107 Shoolpaneswar WS	GUJ	608	35	6	2ab,3c,4b
108 Silent Valley WS	KER	90	50	56	1d,3a
109 Simlipal NP	ORI	846			2a
110 Singhori WS	MPR	288			1g
111 Someshwara WS	KAR	845			1e,4c
112 Sonai-Rupai WS	ASS	175			4c
113 Tadoba NP	MAH	117	35	30	2a,3b,4cd
114 Tamor Pingla WS	MPR	609			4b
115 Todgarh Rawali WS	RAJ	495	40	8	1b
116 Topchanchi WS	BIH	12			4b
117 Udanti WS	MPR	248			2a

Table 12.2 ... continued. Indian National Parks (NP) and Wildlife Sanctuaries (WS) (including Tiger Reserves) with sloth bears, based on 1980–96 data. Population and density estimates are less exact than they appear (see text).

Protected area	State	Area (km^2)	Population estimate	Bears/ $100km^2$	Source(s)[a]
118 Valmiki NP	BIH	336			2a,4a
119 Van Vihar WS	RAJ	60	20	33	1b,2a
120 Wynaad WS	KER	344	common		1d,2a,4a
121 Yawal WS	MAH	178			4b
Total		**45,290**	**mean**	**22**	
			median	**12**	

[a] **Sources**

1. Information obtained from completed questionnaires (1993) and/or interviews with some participants of a 1993 tiger workshop in New Delhi:
   a. Appayya, M.K., Chief Conservator of Forest, Bangalore, Karnataka
   b. Bhandari, R.S., Chief Wildlife Warden, Van Bhawan, Vanikipath, Jaipur, Rajasthan
   c. Dongaonkar, K.R., Director, Pench National Park, Seoni, Madhya Pradesh
   d. Easa, P.S., Head, Division of Wildlife Biology, Kerala Forest Institute, Peechi, Kerala
   e. Karanth, U., Center for Wildlife Studies, Kevempu Nagar, Mysore
   f. Mathur, Wildlife Institute of India, Dehradun
   g. Pabla, H.S., Joint Director, Wildlife Institute of India, Dehradun, Uttar Pradesh
   h. Roy, S.D., 209 Masjid Moth, New Delhi
   i. Sathyendra, C., Project Officer, WWF-India, Data Center for Natural Resources, Bangalore
   j. Sharma, I.K., Ecologist. Bhagwati Bhavan, Jodhpur, Rajasthan
   k. Shrivastav, K.K.
   m. Johnsingh, A.J.T., Joint Director, Wildlife Institute of India, Dehradun, Uttar Pradesh
2. Official government documents and databases:
   a. Wildlife Institute of India: National Wildlife Database (confirmed locations only)
   b. India Proposal to CITES (1989)
3. Technical papers (with bears mentioned peripherally):
   a. Balakrishnan (1984)
   b. Choudhary (1987)
   c. Java (1991)
   d. Krishna Raju *et al*. (1987)
4. Handbooks:
   a. Israel and Sinclair (1987)
   b. Negi (1991)
   c. Saharia (1982)
   d. Seshadri (1986)

(for which the source of the data are not indicated, but the standards for incorporation are probably high), to printed materials ranging from peer-reviewed publications (none directly concerning sloth bears), to handbooks about parks and reserves of India (where the information might be out-dated, misinterpreted, or assumed). The database presented here includes 120 reportedly occupied protected areas of which 42 (35%) were gleaned solely from handbooks and the remainder from more solid sources.

Survey respondents indicated that sizable numbers of sloth bears also exist outside many of the protected areas. We used a 1996 WCMC database of forest cover of India (based on visual interpretation of Thematic Mapper satellite data) to create a map of "hypothesized" sloth bear range, which we overlaid with points representing occupied protected areas (from Table 12.2) (Figure 12.1; electronic database [ArcView file] available from authors). This range map undoubtedly has major inaccuracies, as some of the forest may be incorrectly mapped, sloth bears may be absent from large parts of the remaining forest (due to poaching or degradation of the understory), and bears may inhabit some unforested areas (e.g., grass-covered, rugged hills near Bangalore) (U. Karanth, Center for Wildlife Studies, Kuvempu Nagar, Mysore, *in litt.* 1993). Despite these problems, we feel that this map is a better depiction of current sloth bear distribution than would be represented by a single block of contiguous range encompassing the extreme locations.

Several estimates of sloth bear abundance in protected areas have been generated, all from results of surveys of bear sign. The difficulties associated with converting prevalence of sign or sightings to estimates of abundance, especially for a species like a sloth bear, are well known (Wesley 1977; Saharia 1980). However, such estimates are routinely made in several Indian parks and wildlife sanctuaries, and the same procedures have been used in Sri Lanka. An example may be instructive for assessing the value of such estimates. Eisenberg and Lockhart (1972) conducted a reconnaissance of Wilpattu NP in Sri Lanka. Sloth bears were encountered 24 times in a $583km^2$ search area. Assuming no sloth bears were seen twice, Jaffeson (1975) converted these data to a density of 4 bears/$100km^2$. However, from Eisenberg and Lockhart's (1972) report, it is clear that at least five of the sightings were of the same female with a cub (for which they plotted the home range), and another 12 sightings clustered in a small area also may have represented a single individual. Nevertheless, using these data, Eisenberg (*in litt*., cited in Cowan 1972) estimated a crude density of five bears/100km^2. Santiapillai and Santiapillai (1990) then extrapolated this density estimate (and that of Laurie and Seidensticker [1977], who used the same approach in Royal Chitwan NP, Nepal) to all protected areas in Sri Lanka to obtain an estimate of 300–600 sloth bears nationwide.

With these caveats in mind, we compiled recent (1980–94) population estimates (and calculated corresponding densities) for various parks and sanctuaries in India, mainly to investigate the perceived degree of variation among areas. Two sanctuaries in Gujarat that were established especially for sloth bears had the highest reported densities (77–124 bears/100km^2). These were comparable to densities estimated from mark-recapture/resight data on radio-collared sloth bears in preferred habitat in Royal Chitwan NP, Nepal (Joshi 1996). Most other density estimates were about an order of magnitude less. The median density (which is more appropriate than the mean, due to the skewed distribution) for 23 protected areas was 12 bears/100km^2, which is about half the average estimated density for all of Chitwan, but twice the average density estimated from Jaffeson's (1975) survey. Applying this median density to the 45,000km^2 of parks and reserves with sloth bears yields a population estimate of about 5,000 sloth bears within protected areas. However, we estimate that there are >250,000km^2 of potential sloth bear range outside the protected areas. We do not know how much of this area is occupied by sloth bears, nor can we make defensible estimates of sloth bear density in this area; thus it is not possible to produce a meaningful population estimate for all of India. If the density outside the protected areas is the same as inside, the total Indian population of sloth bears would be >30,000. The only density estimate that we are aware of for an area outside a park or sanctuary is that of Iswariah (1984), who conducted a study in Ramnagaram Taluk, Karnataka, where sloth bears subsist in a "few rocky pockets of scrub" intermixed with cultivated crops and plantations. Even in this relatively poor habitat she estimated a density of 12 bears/100km^2, the same as the median of the estimates from the various protected areas. Nevertheless, it is probably reasonable to assume that over the entire range, sloth bear density is somewhat less outside than inside the protected areas. If outside density averages half the estimated median of the protected areas, the total sloth bear population in India would be near 20,000. If it is a tenth, the total population would be about 8,000. These values may bracket the actual population, although our intent is not to pose an estimate, but rather to emphasize the large degree of variation and uncertainty in these numbers.

Legal status

Sloth bears are completely protected under Schedule I of the Indian Wildlife Protection Act of 1972 (as amended in 1986). They cannot be hunted, but can be killed in self defense or in special circumstances where they have caused damage. All trade and export is illegal. Sloth bears are listed under Appendix I of CITES.

Population threats

Sloth bear populations in India appear to be significantly threatened by poaching. Gall bladders and other parts from poached bears are typically exported to Singapore, Bangkok, Hong Kong, or other intermediary ports, and eventually to Japan, South Korea, or Taiwan. Respondents to our survey indicated that poaching was unimportant. However, based on records obtained by TRAFFIC (Japan), parts from an estimated 700–1,500 bears per year were shipped from India to Japan during the late 1970s through the 1980s (Servheen 1990), and the Wildlife Protection Society of India (New Delhi *in litt.* 1996) found that poaching and trade in sloth bear parts is still "fairly common in the hills of the northern States of Uttar Pradesh, Himachal Pradesh and West Bengal, and the central State of Madhya Pradesh." S.D. Roy (New Delhi *in litt*. 1996) indicated that local villagers as well as transgressors from Myanmar also routinely poach bears in eastern India (Mizoram, Manipur, Tripura, and Assam). Some poaching is a result of superstitious beliefs, rather than for sale of parts (A.J.T. Johnsingh, Joint Director of the Wildlife Institute of India, Dehra Dun, Uttar Pradesh, *in litt*. 1996)

Other threats include the capture of live bears (mainly cubs, after the mother is killed) and some killing of nuisance bears. Like the trade in parts, the extent of these activities varies regionally. H.S. Pabla (Joint Director of the Wildlife Institute of India, Dehra Dun, Uttar Pradesh, *in litt*. 1993) indicated that capture of sloth bears for street shows is still a concern in Madhya Pradesh. Likewise, the Wildlife Protection Society of India (*in litt*. 1996) reported a "thriving business in captive street entertainment bears" in a heavy tourist area of Uttar Pradesh, as well as some export of live sloth bears to Pakistan for bear baiting (fights with dogs). There are no records of how many sloth bears are killed as nuisances, although Johnsingh (*in litt*. 1996) indicated that the total is probably low. Crop depredations vary from virtually none to moderate, or even severe in parts of Karnataka (M.K. Appayya, Chief Conservator of Forests, Bangalore, *in litt*. 1993) and Rajasthan (I.K. Sharma, ecologist, Bhagwati Bhavan, Jhodpur, *in litt*. 1993), where sloth bears seek out honeycombs and fruit trees.

Habitat threats

Loss of forested areas outside parks and reserves poses a major threat to sloth bears because it causes population fragmentation, thereby leaving small, nonviable populations within the parks. A high degree of dispersion among protected areas with sloth bears is evident (Figure 12.1). Furthermore, habitat degradation outside the parks, caused by overgrazing, overharvest of forest products (cutting timber, lopping branches, collecting fruits and honey), establishment of monoculture plantations (e.g., tea, rubber, teak, eucalyptus), expansion of agricultural areas, and settlement of refugees, diminishes natural food supplies for sloth bears and may result in reduced reproduction. Poor food supplies also may increase the likelihood of sloth bears seeking human-related foods, like sugarcane and peanuts, outside the forest, where they become more vulnerable to being killed as a nuisance.

Ramnagaram Taluk (50km southwest of Bangalore City, Karnataka) provides an example of the consequences of habitat degradation. This area was once famous among shikaris for a large population of sloth bears. However, the natural forests have degraded into scrub, with scant food supplies for bears. As a result, sloth bears have become more reliant on cultivated crops, which now compose 50% of their diet (Iswariah 1984). Bear damage to crops incurs a substantial loss to villagers, who attempt to scare the bears away by building machans in their fields and maintaining nightly watches. Because of their dependence on crops in proximity to humans, sloth bears seem to have become more nocturnal, making it more dangerous for people to enter their fields at night, and incidence of maulings have increased. This, in turn, has caused local people to fear and dislike sloth bears, prompting greater killing of crop-raiding individuals. Bears were recently extirpated from one small wildlife sanctuary (Idukki, Table 12.2), apparently due to habitat degradation (P. S. Easa, Division of Wildlife Biology, Kerala Forest Institute, Peechi, Kerala, *in litt*. 1993). Some replanting of forests has occurred, but in states like Karnataka, Gujarat, and Haryana, these "forest farms" are comprised overwhelmingly of eucalyptus (Gadgil and Guha 1992), which is of little value to sloth bears or other wildlife.

Management

Three sanctuaries in Gujarat have been established specifically to protect sloth bears along the western edge of their range: Jessore, Ratanmahal (also called Rajanmal), and Shoolpaneshwar (also called Dumkhal) sloth bear sanctuaries (Java 1991; India Proposal to CITES 1989). Sloth bears are also protected by a series of parks and reserves that were established as part of Project Tiger, which was initiated in 1972. Some notable tiger sanctuaries that also harbor sloth bears include Corbett and Ranthambore, along the northwestern edge of the sloth bear's range; Kahna, near the center of the range; Buxa, in West Bengal; Manas, in neighboring Assam (and also in Bhutan); Bandipur, part of a cluster of reserves in the southern part of the country; and Periyar, a reserve surrounded by high human density near the southern tip of the peninsula. Aside from the protection afforded by these various parks and reserves, there is little direct management for sloth bears.

Human-bear interactions

Sloth bears are known for their aggressiveness, both towards humans and towards other large mammals. They seem to avoid human contact, when possible, but may encounter humans when they are enticed into croplands or when people enter the forest. Sloth bears seem to have a low tolerance toward people when they inadvertently meet. Many old accounts of Indian wildlife lore describe incidents of maulings by sloth bears. Krishna Raju *et al.* (1987) indicated that there are still 20–30 maulings by sloth bears each year in the Indian state of Andhra Pradesh. Phillips (1984) commented that sloth bears are second only to rogue elephants as the most feared animal among jungle-villagers of Sri Lanka. Fear of sloth bears makes it difficult to stimulate support for measures to maintain nearby bear populations.

Public education needs

Education should emphasize the importance of maintaining entire forest ecosystems of which sloth bears and other large mammals are a part. Charismatic megafauna like tigers, rhinos, and elephants naturally garner the most attention. In developing a conservation ethic that protects these species against habitat degradation and poaching, sloth bears will gain protection as well. However, sloth bear conservation should not just be incidental to conservation strategies designed for other species. Sloth bear biology is in many ways unique, because of their peculiar predilection for ant and termite-eating (myrmecophagy), and this uniqueness could be a focal point for interesting classroom lessons and television programs about habitat needs and conservation.

Specific conservation recommendations

Mapping

1. Expand and update information on the distribution of sloth bears across their range. We obtained evidence of the presence of sloth bears in a large number of protected

areas, but our sources of information were often based on secondary information or past knowledge. It is likely that we missed some areas and possibly included some areas where sloth bears are no longer present. We obtained little information on protected areas where sloth bears formerly occurred but have since been extirpated. We also obtained little information about the presence or absence of sloth bears in forested areas outside reserves. Thus, the range map presented here is very general, and of little use in monitoring range expansion or shrinkage. An updated range map should have a corresponding database (e.g. Table 12.2) that includes information (i.e. metadata) about the date and source of all location points where sloth bears were recorded to be present or absent.
2. Map sloth bear distribution in relation to forest cover and boundaries of protected areas, and thereby delineate discrete population units. These larger population units, rather than individual reserves, should be the basis of management. The size and separation of these management units will dictate conservation strategies, such as the inclusion of additional protected areas, corridors between areas, or buffer zones around areas.
3. Compile information on land use and land conditions for areas outside reserves to determine the potential to support viable sloth bear populations. Sloth bears occur on sparsely-forested hills outside reserves in southwestern India, and probably other hilly, remote areas as well (U. Karanth *in litt*. 1993; I. Sharma *in litt*. 1993). These areas may serve as corridors between population centers, and/or as sites that may attract dispersers or seasonal migrants. The use of these areas, both by sloth bears and by people, needs greater study to assess their importance in maintaining sloth bear populations.

Monitoring abundance

1. Develop and implement a more reliable and consistent means of assessing relative sloth bear densities across their range. Estimates of sloth bear numbers are available for a number of protected areas (Table 12.2), but they are of dubious quality and usefulness because there is no evidence that sign and sightings can be reliably converted to estimates of abundance. Unsubstantiated abundance estimates provide a false sense of assurance in population assessment, and may confer little or no warning for populations in jeopardy. A standardized, quantitative *index*, such as transect routes to measure density of sloth bear sign (e.g., holes in termite colonies), would be far more useful in comparing relative abundance across areas and years. This kind of labor-intensive monitoring program may not be feasible in all areas (although it was recently accomplished for the whole state of Kerala) (Easa *in litt*. 1993). However, we suggest that monitoring abundance is probably less important than mapping sloth bear distribution and identifying and dealing with site-specific threats to their existence.

Habitat improvement

1. Promote community-based forestry projects. As forested lands outside the reserves continue to shrink and decline in quality due to human activities, more land needs to be protected. Less than 10% of the land area of India is under good forest cover (Poffenberger 1994), and <5% is contained within parks and reserves (WCMC 1992). However, establishment of more parks is not the primary means by which to conserve sizable chunks of habitat for sloth bears. In India, as in many other places, more lands potentially inhabitable for a variety of wildlife species exist beyond the boundaries of current reserves, and regeneration of forests in these areas may be at least as critical to species survival as protection within reserves (Western 1989). Parks and reserves can act as core areas for populations within larger ecosystems in which humans and multiple-use lands are critical elements (Grumbine 1994). Establishment of more parks often entails a trade-off, as displacement of local people may cause resentment not only toward the government officials responsible for the action, but also for the whole conservation concept. It is now well understood that an effort to provide for the resource needs of local people is an essential component of a successful conservation strategy (Poffenberger 1990; Western *et al.* 1994).

   Community-based forestry programs could significantly expand habitat for sloth bears. This approach is new to India. Colonial forest policies of the last century were upheld after Indian independence. The national forest policy of 1952 reinforced the right of the state, not the local community, to control management and protection of forested land (Gadgil and Guha 1992). Recently, however, policies in states in eastern peninsula India (e.g., West Bengal, Bihar, Orissa) have changed to allow a new emergence of community forestry practices. The success of one community-based forestry project in Orissa was marked by the recent sighting of a sloth bear (Poffenberger 1994). Numerous villages in this part of India have been involved in patrolling and protecting hundreds of thousands of hectares of degraded sal forest, and the results, in terms of forest regeneration, have been remarkable. Moreover, this community-based approach might stimulate an atmosphere whereby local disdain for those who poach community-owned forestry products serves to protect all forest resources, including resident wildlife (i.e. community-based anti-poaching activities). The benefits of this community-based approach to maintaining ecosystem integrity thus extends well beyond sloth bears. However, state and national support for these activities (including joint management policies providing local empowerment) are essential for their success (Poffenberger 1994).

Human-bear interactions

1. Establish a database documenting incidents of sloth bear-human conflict. Trends in bear-human problems (especially crop depredations and maulings) may reflect the condition of adjacent forested areas (i.e. its ability to support bears). Moreover, if conflicts between sloth bears and people increase, local support for bear conservation measures, like poaching patrols and community forestry programs, will decrease. Currently, data on nuisance activity and bear-inflicted injuries are based mainly on anecdotal information from a small number of areas. A more quantitative system of recording is needed.
2. Recognize that poaching of sloth bears is a critical problem deserving more attention. Trade records indicate that bears in India are still being poached in significant numbers. Although the level of poaching (i.e. number taken in any one area) is probably low, small populations, like those of many protected areas (Table 12.2) (and in the forests outside these areas) are vulnerable to eventual extirpation. Low-level poaching is difficult to detect and control, as evidenced from the lack of knowledge of poaching activities by respondents to our survey. Documentation of the extent of poaching may be obtained from trade reports, although these probably yield considerable underestimates. Nevertheless, it is important to recognize that poaching occurs and is likely to seriously impact sloth bear populations, despite being locally undetectable over the short term. Reduction in poaching will require greater enforcement efforts as well as an educational program to gain community support for anti-poaching endeavors.

Status and management of the sloth bear in Nepal

Historic range and current distribution

Sloth bears formerly ranged across the full length of the Nepal Terai, continuous with their range in India. Historically, this area was sparsely inhabited by Tharus, an indigenous group of people that were resistant to malaria. However, with the advent of malaria control in 1954, and prompted by the government's resettling program, many hill people from central Nepal abandoned their terraced slopes to clear the arable, flat land of the Terai. As they did, much of the forest was cleared, and with that, sloth bears were relegated to a narrower and

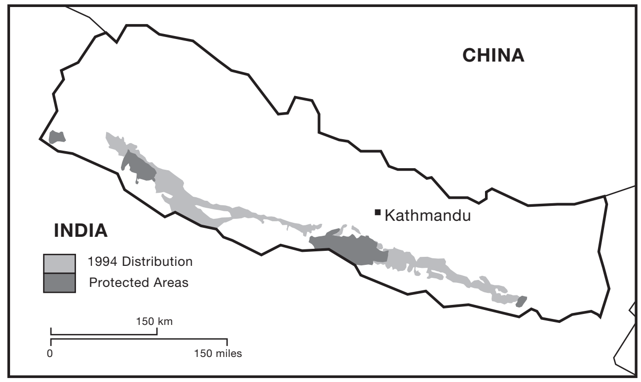


Figure 12.2. Sloth bear (*Melursus ursinus*) range in Nepal, based on data collected by the authors during a 1993–94 survey across the Terai. A map showing forested areas, generated from satellite data and produced by the National Remote Censusing Center of Nepal, was used to outline the area encompassing the points where bears were documented to occur during our field survey.

narrower strip of remnant forest, which has become progressively more degraded. From the early 1960s to the early 1980s, the human population of the Terai nearly tripled and about half the forest, especially along major rivers, was converted to agriculture (Gurung 1984; Ghimire 1992).

Sloth bear range in Nepal is limited mainly to the Terai, the southern strip of lowland forest and grasslands bordering India. However, the connection with India is now broken by uninhabitable agricultural lands. Northward sloth bears range into the Siwalik Hills, which rise to 750–1,500m. There is no information indicating how high in the Siwaliks sloth bears reach, but in Sri Lanka sloth bears have been observed at elevations of 1,200m (Phillips 1984) and in the Western Ghats of India up to 2,000m (Johnsingh *in litt*. 1996).

Three areas with sloth bears have been protected: Royal Chitwan NP and the adjacent Parsa WR (total 1431km^2), located near the center of the sloth bear's range, and Royal Bardia NP (968km^2), near the western edge of the bear's present range (Figure 12.2). During 1990–94 we conducted an intensive study of sloth bears in Chitwan. In the dry season, when sloth bears concentrated in the alluvial grasslands (Joshi *et al.* 1995), density (based on mark-recapture/resight of radio-marked individuals) exceeded 70 bears/100km^2 (Joshi 1996). Laurie and Seidensticker (1977) estimated a density of 50 bears/100km^2 in roughly the same area in 1974. However, 70% of the park is upland, dominated by sal forest, and used by sloth bears mainly during the wet season. Thus, overall density for the park is lower. Joshi (1996) estimated a parkwide population of 200–250 sloth bears, or about 25 bears/100km^2. This estimate is substantially higher than Laurie and Seidensticker's (1977) parkwide estimate of 55 bears (10/100km^2); the difference, though, is due to methodology not population change. A high density of sloth bears in Chitwan is apparent from a high prevalence of diggings in termite mounds.

Status

During 1993–94, the authors conducted a survey across the entire length of the Nepal Terai to assess the distribution and relative abundance of sloth bears. We outlined the potential range (forested areas) using a map produced by the National Remote Censusing Center, Nepal, which was based on 1984 Thematic Mapper satellite data. Then we interviewed villagers residing in or near forested areas, and if they indicated that bears were present in the area, we conducted transects to verify and quantify sloth bear sign. Our data indicated that the range is continuous from Chitwan west to Bardia (Figure 12.2). However, in many stretches where the forest has been eliminated or highly degraded in the lowlands, sloth bears remain only in the Siwalik Hills, where human use has been far less. Asiatic black bears live in the higher elevation range north of the Siwaliks (Mahabharat Lekh or Middle Hills), which are separated from the Siwaliks in places by dun valleys of the inner Terai. As far as we could determine, there is little or no overlap between sloth bears and black bears in Nepal.

In all areas across the Terai, sloth bear density (assessed from sign) appears to be much lower than in Royal Chitwan NP. However, sightings of sloth bears with cubs as well as our observation of a den with a female and cubs indicated that reproduction still occurs outside the park. Sloth bear density is also conspicuously lower in Royal Bardia NP than in Chitwan, possibly because Bardia does not contain extensive alluvial grasslands like Chitwan. Evidence of sloth bears dwindles west of Bardia, and we found no indication that they exist in Royal Suklaphanta WR, at the western edge of the Terai; sloth bears occurred in Suklaphanta until at least 1977 (Spillet and Tamang 1967; C. Rice pers. observ.). East of Chitwan sloth bear range extends up to just short of Kosi Tappu Wildlife Reserve (Figure 12.2). These data are insufficient to provide a population estimate for the country, especially because we could not adequately survey the Siwalik Hills, which, based on interviews with villagers, seemed to harbor the greatest numbers of sloth bears outside the protected areas. However, given the stark contrast between densities in and out of Chitwan, and the fragmentation and narrowness of the remaining range, totaling roughly 17,000km^2, it seems doubtful that the population exceeds 1,000 sloth bears, and may be <500.

Legal status

The National Parks and Wildlife Conservation Act 2029 protects Asiatic black bears but not sloth bears. Sloth bears can be legally killed to protect people or property. Hunting is legal, with a license, but very few sloth bears are hunted. Villagers that were interviewed during our survey of the Terai were aware of only one incident of known legal hunting in the recent past.

C. Rice

Sloth bear in Suklaphanta Wildlife Reserve at the western edge of the Nepal Terai, December, 1976. A survey of this reserve by the authors in 1994 revealed that sloth bears have since been extirpated, apparently resulting from poaching. Grasslands in the reserve are burned annually. This photograph was taken shortly after burning and harvesting of the grass. Such burning is necessary to maintain this habitat, which in Royal Chitwan National Park supports a high density of sloth bears.

Population threats

Loss of habitat and increasing human use of remaining habitat appear to be the greatest population threats to sloth bears in Nepal. Some poaching also occurs, although its severity is difficult to ascertain. On 12 of 42 interviews that we conducted across the Terai, villagers indicated some knowledge of poaching in the area (although not necessarily of bears); 18 indicated no poaching, and the remainder did not know. Very few people were aware of a market for bear parts. Outside Chitwan, low bear densities may not attract poachers. However, given such sparse numbers, even a low level of poaching could be highly detrimental to population viability. Moreover, with recently increased poaching of rhinos and tigers in both Chitwan and Bardia, sloth bears in these areas are also subject to greater risk. Mills and Servheen (1991) were told by merchants in Kathmandu that bear gall was available in villages around Chitwan, although this could not be confirmed. However, trade records indicate that during 1990–93, Nepal was the second-largest source of gall bladders (about 25 bears/year) for South Korea (Mills 1995). Some of these gall bladders were certainly from Asiatic black bears (which are preferred by the recipients), but it is likely that trade in sloth bear parts also occurs, especially given that until recently, CITES prohibitions on trade of parts of sloth bears was much less restrictive than for Asiatic black bears.

Habitat threats

Much of the remaining forest in the Terai is severely degraded from grazing, cutting, lopping, and other human activities. Bears are absent from these areas, and in many stretches have been relegated to the hills bordering the lowlands. People gathering wood, fodder, mushrooms, and such in the hills occasionally encounter sloth bears, but human use of the hills is far less intense than in the lowlands. Some large patches of remnant forest in the lowlands have high densities of termite mounds, seemingly sufficient to sustain sloth bears, but in most of these areas we found no evidence of bears, and surmised that they had been driven off by heavy human activity. Likewise, habitat appears suitable at both the eastern and western ends of the Terai, but sloth bears are absent. A low level of poaching combined with the apparent intolerance of sloth bears to high human use of the forest may have caused their local extirpation.

Management

Protected areas with sloth bears (Chitwan/Parsa and Bardia) exist today because of their former status as hunting reserves. For over a hundred years (1846–1950), when Nepal was ruled by Rana prime ministers, the ruling class guarded these areas for lavish hunts, often involving royalty from India and Europe. Although these hunts were spaced at intervals of several years, the kill was often enormous. During the last large hunt in Chitwan during 1938–39, 15 sloth bears were killed (incidentally to 120 tigers). The size of this harvest probably reflects the high density of sloth bears that existed there (as well as the efficiency and size of the hunting party). In order to preserve the wildlife of Chitwan, especially rhinos and tigers, it was designated as Nepal's first National Park in 1973. In doing so, many of the people that had settled there were forced to move. Similarly, Bardia was made a wildlife reserve in 1976, and reclassified as a National Park in 1988.

There are five protected areas in the Terai: Royal Chitwan NP, adjoining Parsa WR, Royal Bardia NP, Suklaphanta WR, and Kosi Tappu WR. However, sloth bears currently exist only in Chitwan, Parsa, and Bardia. There is no specific management for sloth bears, but in these three parks and reserves they receive greater protection from habitat degradation and poaching than outside. Moreover, there is active habitat management in Chitwan that may be beneficial to sloth bears. For centuries local Tharu people burned and cut grasses for building materials. A few years after establishment of the park this practice was permitted again, although under certain constraints (i.e., specific dates, no vehicles or bullock carts, and a small fee). This yearly disturbance not only maintains the grasslands and encourages new growth for grazing herbivores (Mishra 1982), but may enhance habitat conditions for termites, and hence sloth bears; this is speculative, as data are not available, but the sloth bears' preference for the grasslands, apparently due to a high abundance of termites, is evident (Joshi *et al.* 1995; Joshi *et al.* in press).

Human-bear interactions

Bears occasionally raided crops (maize, potatoes, yams, guavas, mangos, and pawpaws) in cultivated fields adjacent to Chitwan during the mid-1970s, just after it was designated a national park (Laurie and Seidensticker 1977). At the time, a large number of people and their 20,000+ head of cattle had just been removed from the new park (Mishra and Jeffries 1991). Now, 20 years later, sloth bears rarely leave the park to raid crops (although several other species do) (Joshi *et al.* 1995). One explanation is that the habitat in the park has recovered from previous human exploitation to the extent that it now provides sloth bears with adequate food (termites, ants and various fruits), and they are no longer tempted to supplement their diet with human-related foods (Joshi *et al.* in press). Additionally, contact between sloth bears and people inside the current park may have been more frequent before restrictions on human use of this area were imposed, so in the past, bears may have been more accustomed to people and thus less wary of venturing into their fields. Presently, sloth bears in Chitwan may encounter occasional park visitors, but large numbers of people enter the park only during the brief period in January and February when villagers burn and cut grass. During this annual grass harvest, several maulings by sloth bears have occurred.

We also heard reports of maulings in areas outside the park. Three residents of one village in western Nepal were mauled by sloth bears during the past 6–10 years, and in a village in eastern Nepal a man was recently killed by a sloth bear. These incidents occurred in the forest after people apparently stumbled across a bear. We found no evidence, in any village, that sloth bears raided crops or that people encountered sloth bears other than in the forest.

Public education needs

Royal Chitwan NP, the site of the first major study of sloth bears, could serve as the cornerstone for lessons in conservation to school children in Nepal. The history of the park provides a prime case not only for the necessity of protecting forest habitats in order to ensure the survival of some of the world's most magnificent species of wildlife, but also for highlighting the benefits to people in protecting and managing valuable resources like the alluvial grasslands. Moreover, the uniqueness of sloth bears, related to their feeding on ants and termites, make them a powerful example not only of how animals adapt to and exploit their environment, but also of how reliance on specific foods and habitat types makes them vulnerable to extirpation. It is important to emphasize that these bears do not kill livestock, and rarely damage crops, when provided adequate habitat with good supplies of natural food. Conservation education should be developed around the theme of maintaining large forest ecosystems that protect many species and simultaneously provide benefits to local people (Grumbine 1994).

Specific conservation recommendations

Mapping

Collect data on distribution of sloth bears in the hills along the northern edge of the Terai. We found that sloth bears were absent in large expanses of the Terai, but local people informed us, and we subsequently verified with direct evidence, that they still inhabit the Siwalik Hills. These hills are steep, dry, and much less conducive to growing crops, and thus have a lower human density than the Terai, which explains the continued presence of sloth bears there. However, it is uncertain whether the sloth bears that presently live in the Siwaliks represent a viable population that would persist. In this case, the status of sloth bears in Nepal is much more tenuous, as the range in the lowlands is very fragmented.

Monitoring abundance

Periodically resurvey the range to monitor changes in population status. Standardized transects to quantify sloth bear diggings for termites can be used to compare areas and to assess changes in abundance over time. These transects could be established in a few key places throughout the range, and conducted at recurrent intervals. Additionally, interviews with local villagers would be helpful in verifying the presence or absence (especially the recent disappearance) of bears in an area.

Habitat improvement

Restore habitat through community-based forestry projects. Remaining blocks of unprotected forest are heavily used by local people, and it seems probable that this continued use, combined with low-level poaching, is causing gradual declines in sloth bear numbers. Chitwan, Parsa, and Bardia can act as population centers within larger ecosystems of multiple-use lands. However, it is likely that no additional reserves will be established. Thus, it is necessary to focus on land-use outside these protected areas. Before the Forest Nationalization Act of 1957, forests were viewed as a common community resource. After the act, these forests were declared government property, but because these lands could not be adequately protected and because individuals had no stake in their protection, they were overexploited. Moreover, the government resettlement program in the Terai directly led to clearing or severe degradation of forested lands. However, a national forestry plan was reformulated in 1976 and again in 1989, allowing, and even encouraging community-owned forests.

Community forestry programs, wherein local people learn the value of planting and protecting trees, could expand habitat for sloth bears, and could also reduce poaching. As villagers guard their community-owned forests from wood poachers, their vigilance might also serve as a deterrent against poaching of wildlife. The strength of this approach is that it is instigated from the bottom up (i.e., people do it because it benefits them, rather than because it is mandated), but it also must be supported from the top down (Poffenberger 1990; Western *et al.* 1994). A significant obstacle, which requires top-down policy, is the large number of landless people in the Terai. Only through land tenure can people be expected to undertake land improvement (Ghimire 1992).

Human-bear interactions

Investigate and instigate more protection against poaching. Wildlife officials in Nepal are already aware of poaching-related problems with a number of wildlife species, most notably rhinos and tigers, but seem not to recognize a problem with sloth bears. Our survey indicated that although poaching is not prevalent, its occurrence is probably sufficient to affect population viability. Poaching was probably responsible for the extirpation of sloth bears from Suklaphanta WR within the past 20 years, and if it can decimate a population in a protected area, then it can certainly depress and eventually eliminate sloth bears in a number of other, more vulnerable places throughout the range. This problem will not be solved easily, as anti-poaching efforts are not adequate even to protect the parks, no less the lands outside the parks. Community support will be necessary, and an active educational program, in schools and in local communities, is needed to garner such support. If the apparent poaching situation near Suklaphanta can be controlled, it might be feasible to eventually restore the sloth bear population there through reintroduction.

Chapter 13

Giant Panda Conservation Action Plan

Donald G. Reid and Jien Gong

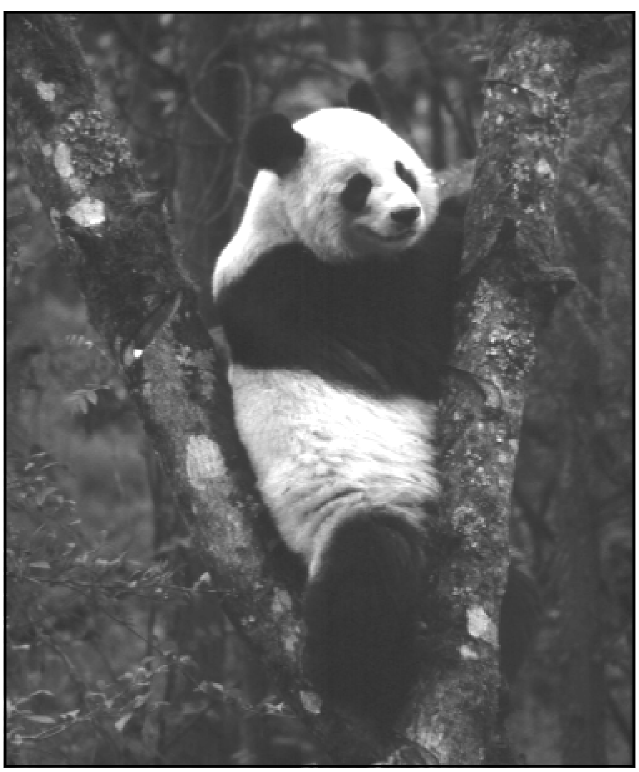
IUCN Category: Endangered, B1+2c, C2a **CITES Listing:** Appendix I
Scientific Name: *Ailuropoda melanoleuca*
Common Names: giant panda; *Mo* (ancient Chinese); *Pixiu* (ancient Chinese); *Daxiongmao* ("giant bear-cat"; contemporary Chinese); *Baixiong* ("white-bear"; contemporary Chinese)

Overview of the giant panda

Physical description: The giant panda (*Ailuropoda melanoleuca*) is a medium-sized terrestrial mammal with adults ranging in body length from 160 to 190cm, adult males weighing 85 to 125kg, and adult females weighing 70 to 100kg. Pandas have the typical stocky, barrel-shaped body of a bear, with a short tail (10–15cm) (Schaller *et al.* 1985). However, they have proportionally larger heads and shorter legs than most bears. Pandas are quadripedal and plantigrade with a diagonal gait. Their forequarters are more massive than their hindquarters reflecting their ability to climb trees, and their reliance on forelimbs for manipulating bamboo, their almost exclusive food.

Giant pandas are most easily recognized by their black and white pelage. The white hair of most of the body and belly, is abruptly contrasted by black, erect ears (7–10cm), oval black patches around and particularly below the eyes, black forelimbs with a band extending over the shoulder, and black hindlimbs. Guard hairs are coarse, oily and quite long (4–10cm) being shortest on back and rump. The underfur is moderately developed, but rather sparse on the belly (Schaller *et al.* 1985).

The animal has some obvious adaptations for ingesting bamboo, a fiber-rich food. A wrist bone, the radial sesamoid, is greatly enlarged and supplied with muscular attachments, allowing it to act as an opposable "thumb" to the first of the five regular digits of the forepaw. With the enhanced dexterity of this "sixth digit", pandas can more readily grasp bamboo stems and orient them for efficient ingestion. The relatively large head is formed by massive zygomatic arches that spread widely, and a well



S.A. Mainka

LEFT: Giant panda (*Ailuropoda melanoleuca*) in its temperate montane broadleaved forest habitat of which bamboo, 99% of the panda's diet, is the dominant understory species.

BELOW: Panda foot with five digits and "thumb", an adaption for grasping and orienting bamboo stems for easy ingestion. Wolong Natural Reserve, Sichuan, China.

WWF/Don Reid

developed sagittal crest. The jawbones themselves are quite massive. Giant panda dentition (I33 C11 P44 M23 = 42, with P1 sometimes absent) is similar to ursids. However, none of the cheek teeth are carnassial. All molars, and even posterior premolars, are wide, flat-topped and heavily cusped. Taken together, these features of the skull are clearly adaptations for stronger crushing and grinding of food (Davis 1964; Schaller *et al.* 1985).

The giant panda's pupils are vertical slits, as in cats, suggesting that the eye may be adapted for nocturnal vision. In the anogenital area there is a naked patch with glandular tissue and two anal sacs. These are used for scent marking. Giant pandas typically sit on their rump to feed, freeing their forelimbs. When resting they also frequently sit, often against a large tree, but also lie on virtually all aspects of their body at various times (Kleiman 1983; Schaller *et al.* 1985).

Reproduction: Giant pandas have a polygynous or promiscuous mating system; males compete for access to more than one adult female. The mating season is principally from mid-March to mid-May. Females without young may also come into heat in autumn (September and October) and very occasionally in winter (January and February). During mating, pandas leave their essentially solitary existence and become somewhat more social. The focus of sociality is an estrusoestrus female (Kleiman 1983; Schaller *et al.* 1985).

Females communicate receptivity with increased scent marking and vocalizations, including moans, bleats, and barks. Males, especially dominant ones that are ready to mate, also vocalize with barks and roars (Kleiman 1983; Schaller *et al.* 1985). Vocalizations by either sex may serve to heighten receptivity of nearby members of the opposite sex. They often attract other males, leading to a competitive situation. Females are monoestrus (Kleiman 1983), so competition among males for copulations is intense. Females often retreat up a tree to avoid combative males (Schaller *et al.* 1985).

Peak female receptivity lasts only two to seven days, and is immediately preceded by a period of elevated urinary estrogen levels (Bonney *et al.* 1982; Hodges *et al.* 1984; Schaller *et al.* 1985). Urinary androgen levels peak in successfully copulating males at the time of female receptivity (Bonney *et al.* 1982), emphasizing the need for the opposite sexes to synchronize reproductive behaviors. Dominant males apparently achieve the majority of copulations, which are numerous and short, but they do not always guard females for long after copulation (Schaller *et al.* 1985). Prior compatibility of a pair seems essential for successful mating (Kleiman 1983). Some subordinate males may achieve copulation. Females appear to be spontaneous ovulators. Not all matings are contested (Schaller *et al.* 1985). Female giant pandas have been artificially inseminated using electroejaculated sperm (Moore *et al.* 1984; Schaller *et al.* 1985; Masui *et al.* 1989).

The gestation period in giant pandas is highly variable ranging from 97 to 181 days. Since neo-natesneonates are so altricial, weighing only about 100g and being only 15–17cm long, pandas evidently have a delay in implantation of the blastocyst (a gestation of 45 days would be sufficient for the observed development of the neonate) (Schaller *et al.* 1985). Temporal changes in concentrations of various hormone and steroid conjugates in the urine also indicate delayed implantation (Hodges *et al.* 1984; Chaudhuri *et al.* 1988; Monfort *et al.* 1989). There is some evidence that females can experience spontaneous pseudopregnancy during the period prior to implantation (Monfort *et al.* 1989; Mainka *et al.* 1990). Females most commonly give birth from July through September, but the ecological and physiological cues for implantation are unknown (Schaller *et al.* 1985).

Females give birth to one or two young, but very rarely attempt to raise more than one. Since neo-natesneonates are essentially helpless, the female's choice of natal site is important. Females generally give birth in a rock cave or a tree with a hollow base. Such natal den sites may be limiting, since suitable trees, generally conifers, are likely a few hundred years old. The female leaves the young in the den for short periods during its first four to six weeks of life, while she feeds and drinks. At this time it may be particularly vulnerable to thermal stress and predation by yellow-throated marten (*Martes flavigula*), golden cats (*Felis temmincki*), or other predators. Females abandon maternity dens and start travelling with their young four to seven weeks after birth. The young one is still uncoordinated and must be carried by its mother. Not until is it five or six months old can it move independently. Even then it is still dependent on its mother for food, and they travel together until the juvenile is about eighteen months old (Schaller *et al.* 1985).

When the young survives its first year, the female will not mate the subsequent year or even two years, so the inter-birth interval is at least two years (Schaller *et al.* 1985; Lu 1993). However, females losing young as late as early March may come into estrusoestrus the following May (Reid *et al.* 1989). Pandas do not reach sexual maturity until they are at least 4.5 years, and perhaps not until 7.5 years old (Schaller *et al.* 1985; Wei *et al.* 1989).

Life span in the wild has not been well documented but is expected, based on captive animals and allometry, to be from 25 to 30 years (Schaller *et al.* 1985). The oldest in a series of skulls found in the wild was 26 years (Wei *et al.* 1989). Subadults up to 50 kg may be susceptible to predation by leopards (*Panthera pardus*) (Schaller *et al.* 1985), and may be the subject of infanticide by males (Catton 1987).

Social behavior: Giant pandas are solitary for most of their lives. The longest lasting social group is that of mother and young, lasting from birth until the juvenile is about eighteen months old, and able to forage on its own. Subadult pandas sometimes forage, rest and move quite close together, even for weeks on end. Otherwise giant pandas only associate in groups during courtship and mating, when males and females attract mates through concerted vocalization (Schaller *et al.* 1985).

Outside courtship, giant pandas vocalize rarely, except when meeting one another. On such occasions they use a variety of moans, honks, yips and barks to communicate intent. However, it appears that giant pandas do not often meet one another outside the mating season (Schaller *et al.* 1985). They use olfactory cues to communicate in all seasons. These are principally scent marks formed by rubbing the anal glandular area on prominent objects such as conifer tree trunks, spraying urine, and clawing bark. The information being transferred probably includes individual identification, time of passage, and reproductive condition. Scent trees are located along travel routes, such as ridge tops, much more than along home range boundaries. Males scent mark more frequently than females especially outside the mating season. The primary function of marking seems to be the maintenance of physical distance between individuals whose ranges overlap, and not the outright defence of exclusive range (Schaller *et al.* 1985). Adult male home ranges overlap those of a number of females, and those of adjacent males (Lu Zhi 1992).

Although female ranges overlap each other to some extent, in Wolong Reserve females have fairly exclusive, repeatedly-used, core ranges of 0.3 to 0.4km^2. Females are fairly sedentary, and may not visit portions of their range for many months. Although not strictly territorial, male pandas move more frequently through their ranges, which lack discrete heavily used core areas. Male home ranges tend to be somewhat larger than those of females (Schaller *et al.* 1985; Johnson *et al.* 1988; Reid *et al.* 1989).

Home range sizes for females appear to vary in response to changing bamboo availability while for males home range sizes are determined by the number and availability of reproductive females (Lu Zhi, 1992). In Wolong Reserve, animals confined their annual activities within 3.9 to 6.4km^2 before the dominant bamboo flowered and died in 1983 (Schaller *et al.* 1985), and increased these to 6.6 to 9.8km^2 within a few years of the die-back (Johnson *et al.* 1988). In Tangjiahe Reserve, where many bamboo stands were immature and regenerating from a die-back, one male used 23.1km^2 in a year (Schaller *et al.* 1989).

Habitat selection: The panda is omnivorous. However, bamboo represents 99% of their diet. The giant panda's existence revolves around its almost exclusive diet of bamboo. With a gastro-intestinal tract typical of the Carnivora, single stomach, short intestine, and no caecum, the panda only digests on average 17% of the dry matter of its bamboo diet (Dierenfeld *et al.*, 1982, Schaller *et al.*, 1985, Mainka *et al.*, 1989). Cell contents provide most of the digestible nutrients, and pandas digest relatively little of the structural carbohydrates of cell walls. Therefore pandas must ingest large amounts (10–18kg) of bamboo daily. Feeding takes most of their waking time (Dierenfeld *et al.* 1982; Schaller *et al.* 1985). Consequently the factors most strongly influencing habitat selection are likely to be food availability and quality.

Bamboos are common and even dominant plants in the understory of the temperate montane broad-leaved forests, the temperate montane broad-leaved and conifer mixed forests, and the subalpine conifer forests to which pandas are now limited. These bamboos are typically small or dwarf species, rarely exceeding 3cm in culm diameter and 5m in height. Up to 33 bamboo species grow in these forests, and many have limited ranges (Qiu 1989). Only about 15 species are widespread and most preferred by the pandas. Between one and four species grow within a panda's home range. Mountain bamboos grow within fairly clear altitudinal limits, and being clonal, grow in large patches which intergrade relatively little. Pandas can choose habitats for feeding on two obvious scales: between bamboo species, and within a species.

Selection between bamboos: Pandas select certain bamboo species on a seasonal basis, and consequently undergo altitudinal migration in certain seasons. Key factors inducing these movements are availability of bamboo shoots (the annual crop of asexually produced, fast-growing new culms growing from clonal rhizomes), and severity of winter weather.

For example, in Wolong Reserve, giant pandas spend most of the year feeding on leaves and stems of Bashania fangiana bamboo, from 2,600 to 3,400m in the subalpine conifer forest. In May most pandas move downslope to feed almost exclusively on emerging shoots of *Fargesia robusta*, which only grows below 2,600m under a mixed canopy forest. By late June, when shoots are fully grown and fibrous, pandas move back upslope to feed on Bashania again (Schaller *et al.* 1985). Apart from the shoot season, pandas only use *F. robusta* when winter snow makes foraging more difficult in the conifer forests (Schaller *et al.* 1985), or soon after a die-back of the dominant *B. fangiana* (Reid *et al.* 1989).

In the Qinling Mountains pandas move to lower elevations in winter apparently to avoid more severe conditions higher on the mountain (Pan and Lu 1989).

Selection within bamboos: Giant pandas consume different parts of the bamboo plant seasonally. They eat new shoots when available, concentrate on leaves in summer when these are most numerous, and eat more stems in winter when many leaves are dead. The details of these selections have been quantified for few bamboos, so care must be taken in extrapolating the following discussion. However, it holds for *Bashania fangiana*, and likely for other dwarf subalpine species. Pandas discriminate amongst *B. fangiana* stems in winter, preferring those less than one-year old (Schaller *et al.* 1985, 1989; Johnson *et al.* 1988; Reid *et al.* 1989). They avoid very short and thin culms which provide little energetic return per unit effort in search and handling (Reid *et al.* 1989). They select the thickest and tallest culms (Schaller *et al.* 1985; Reid *et al.* 1991).

Bashania fangiana dominates the understory vegetation in subalpine fir, hemlock, and birch forests of the Qionglai Mountains, and competes with tree seedlings (Taylor and Qin 1988a, 1992). The critical resource for forest floor plants is light. Canopy gaps, resulting from windfall or landslip, allow more light to reach the forest floor, thereby promoting tree seedling regeneration, initially dominated by wind-dispersed birch species (Taylor and Qin 1988a, 1988c, 1989a). Such gaps also enhance bamboo growth as evidenced by increasing culm height, diameter and density (Reid *et al.* 1991).

In Wolong Reserve, pandas prefer to feed on *B. fangiana* under a mixed fir and birch canopy (selectively cut forty or fifty years previously), rather than under homogeneous fir (uncut) or birch (forty year-old clearcut), and rather than in recent clearcuts (Reid and Hu 1991; Reid *et al.* 1991). The selective cutting in effect produced numerous canopy gaps, and maintained sufficient conifers as seed sources for regeneration and as shade trees. The resulting intermediate light levels allowed optimal bamboo growth for pandas (Taylor and Qin 1989a; Reid *et al.* 1991). Gao and Pan (1989) report that pandas also prefer selectively cut forests in the Qinling Mountains.

Subalpine dwarf bamboos reach their upper elevational limit close to the treeline. Culms are shorter and more sparsely distributed in the upper few hundred meters of their range (Schaller *et al.* 1985; Reid *et al.* 1991). Giant pandas tend to avoid this bamboo (Schaller *et al.* 1985; Johnson *et al.* 1988; Reid and Hu 1991).

Other important habitat features: Giant pandas select habitats for feeding, and other functions, based on factors other than bamboo growth form. They show strong preference for relatively level terrain when feeding, probably to facilitate their need to sit while manipulating bamboo, and to minimize the energetic costs of moving on steep slopes (Reid and Hu 1991). The repeatedly used core areas of females' home ranges are on relatively level terrain (Schaller *et al.* 1985).

Pandas must drink water in all seasons except spring when they eat water-rich shoots (Schaller *et al.* 1985). Streams are generally common in most parts of the species' range, especially during the monsoon. However, the need for water may preclude use of some slopes in drier seasons such as winter, and may induce pandas to use valley bottoms more heavily.

Unlike alpine bears, pandas do not hibernate. Pandas do not use particular habitats for resting in contrast to those used for feeding. They feed during dark and light periods. They tend to have peaks of activity around 0500 and 1700 hours irrespective of season, and generally sleep for periods of one to six hours within the bamboo stands in which they forage. Occasionally they use hollow trees or rock overhangs for shelter from rain or snow (Schaller *et al.* 1985).

Maternity or natal dens are a critical resource. Females need rock caves or trees with hollow bases in which to keep neonates warm and dry for the first month or so of life. Ideally these sites should be near stands of bamboo, and close to a water source. Only mature forests can provide the necessary trees. Clearcutting completely removes all maternity den trees (Schaller *et al.* 1985).

Status and distribution

Wild giant pandas exist today only in three provinces of the Peoples Republic of China: Sichuan, Shaanxi, and Gansu. The species is endangered because: 1) populations and habitats have declined dramatically within the last century and especially in the past few decades, 2) the total population is estimated to be quite low, and 3) the current distribution is fragmented into habitat islands surrounded by habitats drastically altered by humans.

Fossil records indicate that the Pleistocene range of giant pandas included most of southern and eastern China, east of the Himalayan uplift and south of present-day Beijing (Figure 13.1). Fossil giant pandas have also been found in 12 sites in Vietnam from Vinh northwards and one site in Burma (Zhu and Long 1983).

Panda range has shrunk remarkably in recent history. By 1800 the species was likely found only in two mountain regions fairly well isolated from one another: 1) the east slope of the Tibetan plateau in central Sichuan and southern Gansu, stretching east to the Qinling Mountains of south-central Shaanxi; and 2) hilly country covering southern Shaanxi, eastern Sichuan, western Hubei, and northwestern Hunan provinces. This latter block was separated from the Qinling by the Hanshui River, from the pandas of the Tibetan uplift by the well-populated Sichuan basin, and was itself divided in two by the Yangtze River (Chang Jiang) (Figure 13.1) (Zhu and Long 1983).

By 1900 pandas were apparently extinct in this easterly block, and remained only in the Qinling Mountains and along the edge of the Tibetan uplift (Figure 13.1). Soon after 1900, the expansion of agriculture upstream along principal river valleys had separated this distribution into six mountain ranges almost completely isolated from one another. Along with the Qinling, these are the Min, Qionglai, Daxiangling, Xiaoxiangling, and Liang Mountains (Schaller *et al.* 1985).

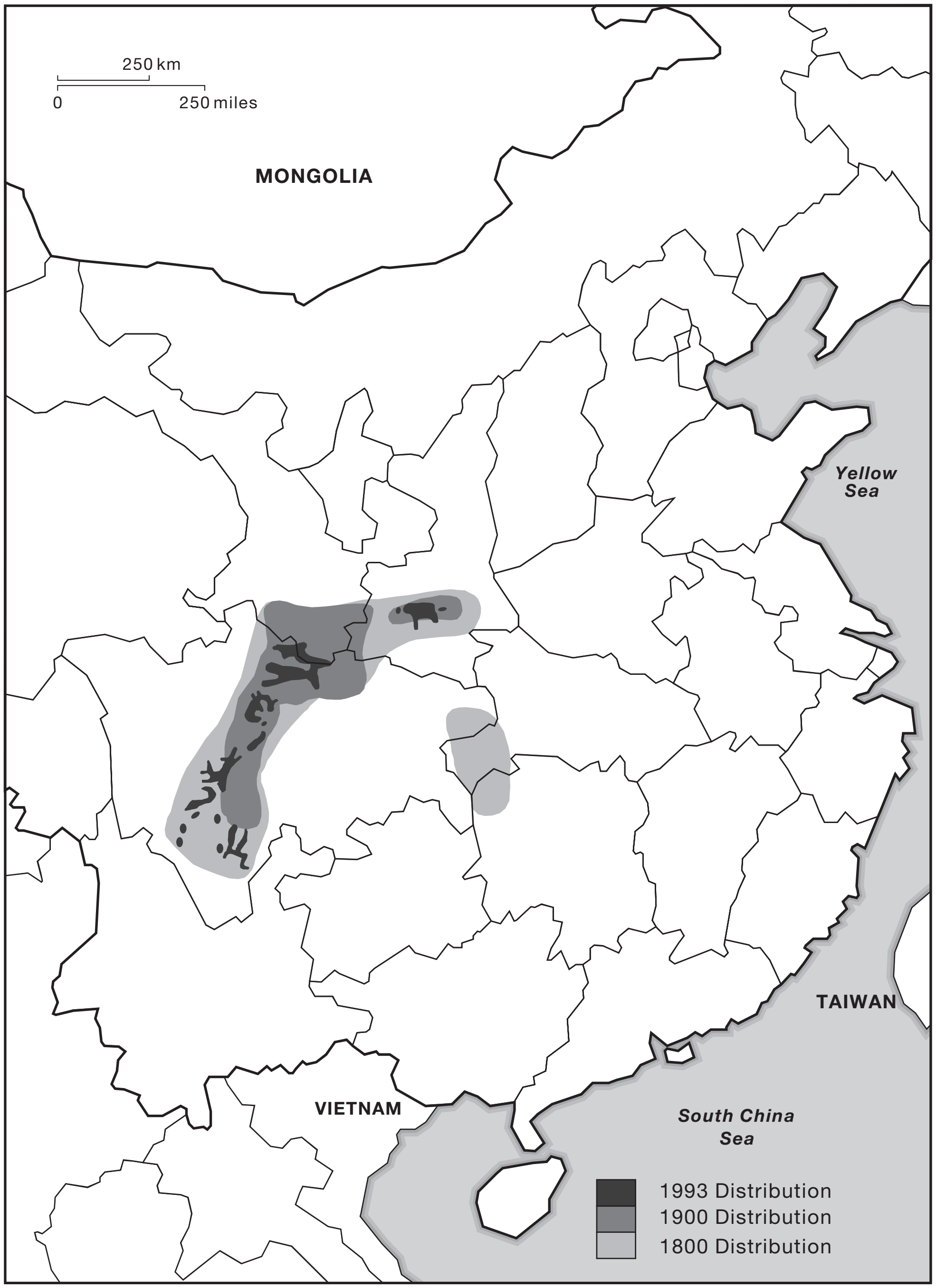


Figure 13.1. Distribution of the giant panda (*Ailuropoda melanoleuca*) in China during 1800, 1900, and 1993.

At present pandas occupy portions of these six mountain ranges. However, within none of these ranges is the remaining habitat and distribution totally contiguous. Information on the current distributions of pandas and habitats was collected by a large-scale panda survey jointly organized by WWF and the Ministry of Forestry (MoF) of China from 1985 to 1988. The total population of wild pandas is estimated to be about 1,000 individuals. About 81.5%, are in Sichuan distributed in 28 counties in the Minshan, Qionglaishan, Xiangling and Liangshan Mountains. 10% are in 5 counties in the Qinling Mountains in Shaanxi and 8.5% in one county in the Minshan Mountains in Gansu. These are distributed in 25 fragments of continuous bamboo-forest habitat totalling about 14,000km^2 (Figure 13.1) (MoF 1992; Johnson pers comm.). Habitat fragments within a mountain range are sufficiently isolated that pandas rarely move between them. Some of these isolated populations seem particularly vulnerable to extinction (Figure 13.1). However, they are frequently separated by only short distances of lowland that have relatively recently been alienated as panda habitat.

Captive populations of giant pandas are substantial. In 1953 Chengdu zoo became the first in China to hold and exhibit the giant panda. Beijing zoo was the first zoo to breed pandas in captivity in 1963 and later the first zoo to breed pandas by means of artificial insemination in 1978. Right now, Approximately 104 are held in China, in numerous zoos, and in research and holding stations associated with the Ministry of Forestry Reserves. However, the captive population is not self-sustaining (MoF 1992). About half of the currently held pandas were rescued from the wild following bamboo dieback in the late 1970s and the 1980s. Outside China, zoos in Paris (1); Berlin (2); Tokyo (3); Pyongyang (1); Mexico City (5); San Diego, California (2); and Washington, DC (1) hold a few captive pandas.

Legal status

Giant pandas have been considered a threatened and precious species since the mid-1900s. An act of the Third National Peoples Congress (1957) initiated the establishment of forest Reserves. A directive of the State Council in 1962 urging protection of wildlife resources, resulted in the establishment of Reserves specifically for giant pandas, starting in 1963. By 1990, a total of 13 nature reserves have been set up in the major distribution areas of the giant panda in Minshan, Qionglai, Liangshan, and Qinling mountain ranges, with a total area of 6,000km^2 and giant panda habitat area of 3751km^2. About 35% of the wild giant pandas live in these reserves. These reserves have played an important part in the protection of the giant panda. They have become the refuge areas for the giant pandas from areas of high human disturbance. These declarations constituted a major sacrifice of forestry production and local revenue in an effort to save the panda. Big timber extraction units had to be withdraw in several cases, resulting in the loss of many years of investment in buildings, roads, and plantations.

Under the Chinese Wildlife Conservation Law of 1988 the giant panda is listed as a Category 1 species, receiving the highest possible level of protection (Zhu, 1989). Although hunting of pandas has been illegal since the 1960s, a proclamation of the Supreme Court in 1987 increased the maximum sentence from two years in prison to life imprisonment and even the death penalty (Schaller 1993).

The Ministry of Forestry, which has changed and is now called the State Forestry Administration, has responsibility for terrestrial wildlife resources and forest Reserves in China and, therefore, for giant panda conservation. The Ministry of Urban and Rural Construction has control of zoos, and therefore the majority of captive pandas. In addition each province has its own Forestry Bureau, with immediate control of provincial Reserves, and the enforcement of state and provincial legislation. Bureaucracies are large and often poorly coordinated. Mechanisms for better interdepartmental communication and policy implementation are required (Zhu 1989).

Population threats

Poaching: Poaching is a very potent threat to persistence of giant panda populations, principally because the species has such a slow potential rate of population growth. Replacement of breeding adults lost to poaching can take many years, and will be completely forestalled by repeated poaching. Although pandas were often killed historically for use of their pelts as sleeping mats, their body parts have not been used to any large extent in traditional Chinese medicine (Schaller *et al.* 1985). Pandas are caught in snares set for other wildlife, mainly musk deer (Schaller *et al.* 1985). Poaching aimed directly at giant pandas, and using mostly snares and firearms, increased substantially in the mid-1980s (Qiu 1990; Schaller 1993). It was apparently stimulated by an international demand for panda pelts in richer nations, principally Japan, but also Hong Kong and Taiwan (Schaller 1993). Such an international commodity exchange was greatly facilitated when the Chinese economy changed in the 1980s from a state-run to a more free market system. Markets for common property resources such as wildlife have flourished (Schaller 1993). The number of panda poaching cases for which arrests were made increased from seven in 1983 to 21 in 1987 (Qiu 1990), and probably as many as 400 pandas may have been poached in the 1970s and 1980s (Hu 1989 in Qiu 1990).

The magnitude of the problem spurred the increased penalties for offenders in 1987, and improved enforcement. At least three offenders have been sentenced to death so far. Poaching intensity has dropped off, and is not now considered a major problem in substantial portions of the range (Mainka pers. comm.). Although convicted poachers are receiving heavy penalties, the incentive to poach is still enormous. The value of a panda pelt to a rural peasant can be at least two or three times the average annual income (Schaller 1993). Sustained and improved patrolling and enforcement are essential to reduce and eliminate poaching. Undercover work has allowed authorities to break some trading rings (Schaller 1993). Such efforts must be increased in China, and in nations where the demand originates, and where enforcement of CITES regulations can be improved. There is need for public awareness and education campaigns in countries receiving pelts, urging moral revulsion at possession of panda parts.

In addition to deliberate poaching, some pandas get killed accidentally in snares set for other animals, such as musk deer. Many hunters set snares in the forests for deer and other animals. Musk deer, especially, can fetch a great deal of money for a farmer. Although illegal, snaring is commonplace outside the reserve system and still occurs inside reserves. This problem is especially serious during the winter as pandas move to lower elevations. Also, farmers do not work much on their lands in winter and tend to work more in the forests.

Population size and isolation: The small size of most of the remaining 25 giant panda populations puts them at substantial risk of extinction through demographic and genetic stochasticity alone (Schaffer 1981), quite apart from the ongoing threats to their numbers and habitats. Some such extinctions have recently occurred as there are areas of suitable habitat unoccupied by pandas (MacKinnon *et al.* 1989)

Active management is essential to reduce the extinction risks faced by most panda populations. Such management could include habitat restoration, translocation, and reintroduction (MacKinnon *et al.* 1989). Habitat restoration should take priority because it can best insure an increasing effective population size, thereby enabling pandas to re-establish original patterns and functions of dispersal, mate choice, gene flow, and habitat selection on their own terms. Habitat restoration should focus on lower elevation lands, especially where restoration of these can join presently disjunct habitat distributions, as corridors. Pandas can then better disperse between higher elevation ranges, reoccupy unfilled habitats, and increase gene flow between demes potentially suffering from drift and inbreeding (MacKinnon *et al.* 1989). This approach requires resettlement of farmers, so is politically difficult. It requires growth of trees and bamboos over a fairly long period of time. Despite these difficulties, it is the approach with fewest ecological uncertainties and possible causes for error, and so must be given highest priority.

Although translocation and reintroduction are designed to combat low effective population size and population isolation, their successful use depends on substantial amounts of information about the age, sex, and genetic structure of wild and captive populations. This information is very difficult to gather with certainty. It is not at all clear that we will ever know enough about the genetic makeup and demography of a wild population to adequately combat drift, inbreeding and lack of mating opportunities with planned introductions of pandas. The cost-effectiveness of such persistent, planned interventions is therefore unclear. Their utility is also dubious until captive populations are producing surplus individuals.

Translocation and reintroduction have certain potential risks: 1) outbreeding depression through dilution of genomes adapted to one mountain range or another; 2) spread of parasite or disease organisms from one population to another where they are absent; 3) inability of naïve, captive-reared individuals to behave adequately for survival in a natural environment; and 4) unoccupied habitats lacking certain habitat requisites for pandas (Mainka and Qiu 1992). The first of these is least likely, judging by historically larger contiguous habitats, but needs to be assessed using data on genetic variation and heterozygosity within and between various mountain ranges.

Survey information on parasite and disease distributions should be compiled, and captive individuals screened for disease load before release. Mainka *et al.* (1994) have made progress in assessing incidence and threats of viral diseases in one captive population. Causes of death differ between captive and wild pandas (Qiu and Mainka 1993), suggesting that the agents and etiologies of certain intestinal, respiratory, and genito-urinary diseases, more prevalent in captive pandas, need to be revealed and screened before translocations take place.

Introduction of captive pandas to the wild should be attempted in a closely monitored, experimental fashion, perhaps with habituated individuals. Habitats can be assessed for suitability, particularly in terms of food availability, maternity den availability, and lack of immediate anthropogenic threats to panda survival.

Any management should include long-term monitoring of each population for trends in relative abundance and reproduction, and for extent of habitat change associated with bamboo diebacks and vulnerability of pandas to other human intrusions (Schaller *et al.* 1985; MacKinnon *et al.* 1989; Reid *et al.* 1989).

In September 1997, a Giant Panda re-introduction feasibility workshop jointly organized by WWF and the Ministry of Forestry was held in Wolong, China involving both Chinese and foreign experts. After reviewing the current knowledge about the giant panda and its status, the workshop concluded that given the current situation reintroduction, could not be recommended and the most important activities to promote panda conservation are habitat conservation and research into wild panda populations and habitat. Major suggestions for further activities include: 1) implementing a national survey and trend analysis, including causes of panda decline, of wild panda populations, panda habitat, and potential panda habitat; 2) emphasizing research on panda captive breeding and improve collaboration and co-operation both nationally and internationally among all institutions holding giant pandas to achieve the goal of a self-sustaining captive population; 3) completing sufficient research to establish target population goals for the panda recovery program; 4) initiating more long-term detailed studies of panda populations and panda habitat at selected potential release sites; 5) expanding research on development of social communities in captivity in order to ensure captive-born pandas are properly socialised; and 6) conducting research including release site evaluation and selection,

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Though enormous investment has been made in panda breeding centers, captive pandas suffer low pregnancy rates and high rates of neo-natal mortality. More successful breeding in captive populations is essential to the survival of the species.

source animal evaluation and selection, and source animal training.

Reproduction: Captive giant pandas suffer from low pregnancy rates, and high rates of neo-natal mortality, resulting in an inability of the captive population to sustain itself (O'Brien and Knight 1987; Mainka and Qiu 1992). Such depressed population viability could result from inbreeding, and from inappropriate husbandry (O'Brien and Knight 1987; Mainka and Qiu 1992). Captive management should benefit from: 1) improved understanding of husbandry and behavioral factors influencing mate compatibility and mate choice; 2) improved records of behavioral compatibility and physiological receptivity at time of attempted mating; 3) genetic profiles of captives for pedigree analysis; and 4) improved information on captive diet and care for improving milk quality. Progress is being made, with current research on genetic profiles of captive pandas, successful use of a low-lactose formula food supplement (Mainka pers. comm.), and improved understanding of causes of death (Qiu and Mainka 1993). In China, there are some captive breeding successes in several zoos, such as Beijing, Chengdu, Fuzhou, and Chongqing, and the Giant Panda Research Center in Wolong. However, the survival rate is generally low.

There is some limited evidence that pregnancy rates in the wild are likewise lower than maximal, and that juvenile mortality is high (Reid 1992). Most of these data are from a period of relative food scarcity following a bamboo dieback in Wolong Reserve, and may directly reflect such stress on females. Such population parameters are likely to vary with chance environmental and demographic events, emphasizing the need for continuous monitoring of population age-class composition.

Habitat threats

The primary reason for giant panda population declines in the past few hundred years is the outright loss of habitat and degradation of habitat, principally through agriculture, but also through timber harvesting and inappropriate silviculture. Major surveys of the entire giant panda distribution area in 1974–77 and again in 1985–88, together with detailed mapping of forest cover from satellite photographs show that the area of suitable habitat occupied by giant pandas has shrunk from over 25,000km^2 in the mid-1970s to less than 14,000km^2. Giant pandas were only found in 34 counties during the 1985–88 survey, compared to 45 counties in the 1970s. Areas within panda Reserves are not immune; Wolong Reserve lost about 35km^2 in the late 1970s and early 1980s (De Wulf *et al.* 1988).

Agriculture: Habitat is lost to agriculture through forest clearance, bamboo cutting, and subsequent cultivation. There are more than 570,000 people living in the giant panda distribution area. As a large portion of these people are national minorities and are partly exempt from the Chinese one-child policy, the human population growth is higher than the national average. As the human population grows, resource competition between human and panda intensifies. Larger and larger areas of giant panda habitat are converted to farmland. Because the crop productivity

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Wolong Nature Reserve. A primary threat to giant panda forest habitat has been its conversion to agricultural use. Though fossil records show panda range to have included most of southern and eastern China, its range is currently limited to six isolated mountain ranges that are now threatened by human encroachment.

in these mountainous areas is relatively low, a large area of land is needed for human subsistence and people push very high up the mountain slopes.

If the land is not arable, it is often opened to livestock grazing and browsing which is incompatible with panda habitat since bamboo and canopy trees do not regenerate. Seasonal use of forest and alpine meadows by grazing livestock can severely impact bamboo growth and degrade its quality for pandas. Giant pandas may continue normal activities in mature forests as close as 100m to established agricultural land, but are less tolerant of the noise and activity of forest cutting.

Legislation and regulations for controlling agricultural land clearance, and grazing livestock, are lacking outside Reserves. This situation must be remedied. Only with the establishment of Reserve boundaries is there any clear possibility of habitat protection. However, several reserves include considerable human settlement and farmland within their borders. Farms in the narrow mountain valleys, which were previously panda habitat, are generally unmechanized and merely subsistence. The farmers are mostly members of National Minority tribes. Reserve managers often ignore illegal habitat destruction, because they are required to improve the living standards of local people (Schaller 1993). Reserves will be ineffective until these people are resettled, or their technologies and lifestyles changed from a reliance on continued wood cutting and land clearance. Reserves must step up enforcement of regulations making land clearance illegal (MacKinnon *et al.* 1989). Resettlement is possible; approximately 300 people were resettled out of Tangjiahe Reserve in 1986. Abandoned farmland and degraded forests are now available for restoration as panda habitat (MacKinnon *et al.* 1989).

Timber harvest: Habitat continues to be degraded and completely lost as a result of timber harvesting outside Reserves. There are more than 20 timber-logging units, big and small, operating and cutting trees in the giant panda distribution area. The most common technique is clearcutting. The forest cutting and associated road building activities result in severe adverse impacts on giant pandas. As the forest-cutting practices progress, more and more logging roads are constructed and extend into the giant panda areas, which opens up habitat to other forms of human encroachment. These roads allow farmers to clear fields deeper into the mountainous giant panda area, and also make it easier for people to get into the giant panda area to poach, dig herbal medicines and gather forest products. Timber harvesting is strictly prohibited within Reserves. However, in several Reserves with farmers living in them, forest cutting for firewood and building material is still a serious threat.

Clearcutting of subalpine forests is detrimental to giant pandas, because of the effects on bamboo growth. Without shade, bamboo clones face unusually high isolation and are likely stressed by elevated evapotranspiration (Taylor *et al.* 1991b). Culms are stunted and very dense, and therefore little selected by pandas for feeding most of the year (Schaller *et al.* 1985; Reid and Hu 1991). Being so densely packed, they preclude any canopy tree regeneration (Taylor and Qin 1988a, 1988c). The stresses appear to diminish the clones' ability to sequester sufficient resources for flowering (Taylor *et al.* 1991b). For those clones that do manage to flower, elevated isolation reduces survival of young seedlings such that virtually none reach the age of seven (Taylor and Qin 1988b, 1993b). As a result there is a complete loss of bamboo, and therefore panda habitat, from substantial areas of clearcuts.

Clearcutting also results in increased soil loss to erosion, and instability of local and regional hydrology. Clearcutting should be made illegal (MacKinnon *et al.* 1989). Current regulations require replanting, but this has not always been attempted. Some reforestation with closely spaced conifers has precluded understory plant growth, and resulted in complete habitat alienation. Restoration of panda habitat in clearcuts will be costly, and must start with planting of conifers, whose seed sources are too sparse for natural regeneration. These tree seedlings will be spared the competition from bamboos. When trees are well established, bamboos can be planted under them (Taylor and Qin 1989b; Taylor *et al.* 1991a).

After the serious flooding of the Yangtze River in the summer of 1998, the Chinese government banned all timber cutting in the areas of the upper reaches of the Yangtze River, especially in Sichuan, in order to protect the forests for flood-control. All the timber-companies in the panda distribution areas were transferred to tree-planting or other kinds of business. This could have a very positive role in protecting and recovering the panda habitat.

However, most farmers living close to panda habitat rely on wood for energy and shelter. Their perpetual cutting gradually alienates habitat. Although it is selective cutting at first, its repetition results in a clearcut. This process has sped up in the last decade with increased poaching of timber for sale on an expanding free market. Such timber harvesting occurs in Reserves, where it is illegal (Forestry Law 1984); enforcement must be improved.

Fire: Fire has the potential to destroy large areas of panda habitat quickly, especially if it should catch on the extensive fuel provided by a bamboo dieback (MacKinnon *et al.* 1989). Lightning strikes are rare in panda range, and natural wild fire does not seem to be a prominent ecological process. However, in some areas fires are set to clear land and encourage new growth. Such burning should be illegal (MacKinnon *et al.* 1989).

Bamboo dieback: Bamboos rarely reproduce sexually, but most years they reproduce vegetatively with rapidly growing shoots from clonal rhizomes (Janzen 1976; Taylor and Qin 1993a). The time interval between periodic sexual reproduction varies from species to species, and can be from 15 to 120 years. Within a species this period is fairly fixed, and the majority of clones flower synchronously. Following such mass flowering, mature culms die ("dieback"), and the standing crop must regenerate slowly from seedlings (Janzen 1976). This takes at least 10 years, and generally more than 15 (Taylor and Qin 1993b). Consequently, a bamboo dieback results in a major loss of food for the local giant panda population.

In the mid-1970s four species of *Fargesia* bamboo flowered and died within a few years of one another in overlapping ranges in the Min Mountains. All major food species of pandas occur in this mountain range. In total, flowering occurred over about 5000km^2. The standing crops of virtually all bamboos available to local pandas declined. Bamboos died after flowering and this was followed by a heavy die-off of giant pandas. A total of 138 dead giant pandas were found in the Min Mountains by the local rescue team members patrolling the area. Where there was only one bamboo, between 30 and 80% of pandas died. Where there were two or more bamboos, few died (Schaller *et al.* 1985). Where a species flowers only in part of its altitudinal range, pandas may concentrate in the areas where bamboo has not flowered and can assume unusual concentrations.

Between 1981 and 1984, and mainly in 1983, *B. fangiana*, the preferred subalpine bamboo in the Qionglai Mountains, mass flowered. Between 80 and 90% of the standing crop died (Reid *et al.* 1989). Approximately 2000km^2 of prime panda habitat was affected. Panda rescue efforts between 1983 and 1987 found 62 dead pandas, but not all of these would have died from starvation (Schaller 1988). For a short period pandas cropped more culms from the remaining unflowered clones than these clones replaced with new shoots (Reid *et al.* 1989). After a few years they changed their winter food habits, and began to eat more of the alternative lower elevation bamboo (Johnson *et al.* 1988; Reid *et al.* 1989). In Qinling Mountains *B. chungii* and *F. aurita* had flowered since the 1970s. A survey in 1987 found out that about 30 percent of the total area of the giant panda distribution range of this mountain range had flowered.

Bamboo dieback can be a major threat to a panda population. When a substantial standing crop of at least one alternative bamboo is available, the threat is much reduced. Managers should quantify the standing crop of each bamboo species available to local pandas, assess the potential impact of a dieback of each species, and survey bamboos annually for sign of flowering.

In evolutionary time, panda populations have obviously survived thousands of flowering events without any help from humans. Rescuing pandas in the face of such food shortages may be justified today in a few areas because human activity has compromised the ability of some populations to accommodate a dieback: alternative bamboos are less available; habitats are insular and dispersal impeded; populations are small and more vulnerable to extinction following loss of a number of individuals. However, panda rescues from the wild are not warranted with each dieback. They may be desirable when multi-species flowerings are nearly synchronous, or when only one bamboo is available. Rescues may diminish the population's ability to rebound following a dieback, as healthy pandas are often rescued. Survivors must be returned to the wild. Meanwhile, restoration of bamboo forests in carefully selected areas at lower elevations should be a priority (Schaller *et al.* 1985; Johnson *et al.* 1988; Reid *et al.* 1989).

Management

The primary management activities directed at giant pandas since the mid-1900s have been:

1. Establishment of 13 Reserves totalling 5,830km^2 and including 3,751km^2 of giant panda habitat. Three (Wolong in Sichuan, Baishuijiang in Gansu and Foping in Shaanxi) are State run, and 10 are provincially run. Measures taken to protect the giant pandas in these reserves are: 1) Timber logging units used to operate in the reserve areas were moved out. Forest cutting is strictly prohibited in the reserves to protect giant panda habitat. 2) Human disturbance such cattle raising, firewood collecting, herbal medicine digging are strictly controlled and greatly reduced. In some cases, farmers were resettled or moved out of the core areas of the reserves. 3) Some damaged habitat was restored through planting of trees and bamboo. 4) Management and panda rescue work are strengthened by more frequent patrolling and checking of the reserve management staff.
2. Legislation pertaining to giant panda protection including Forestry Law, presidential order, provincial legislation, county regulations and individual reserves. Legislation to make killing of giant pandas and possession or sale of their parts illegal, and subject to penalties ranging from one year in prison to the death penalty. Following the legislation declaration prohibiting possession of panda parts in the early 1980s, more than 200 panda pelts were turned in to the government.
3. Attempts at captive breeding of giant pandas. The Ministry of Forestry and WWF have cooperated since 1980 in efforts to breed pandas in captivity in Wolong Natural Reserve. A breeding center was established in Yingxionggou in 1980 and then moved to Heitaoping in Wolong Natural Reserve, with the name changed to the Giant Panda Research Center. The zoos holding pandas in China have also been cooperating in captive breeding efforts by establishing a network exchanging mating animals and expertise.
4. Rescue of wild giant pandas believed to be starving following a bamboo dieback. About 150 panda were rescued since the early 1980s, and about half of them recovered and were released back in the wild.
5. Management (Machlis and Marsh 1988) training of patrollers and scientists in enforcement and monitoring procedures.

Human-panda interactions

Giant pandas avoid interactions with humans. When humans pass through panda habitat, the pandas remain silent in the bamboo, or move away. A panda will sometimes charge, if repeatedly approached, or if it is a female with a dependent young. Humans have been able to closely

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Giant panda in Beijing zoo, China. Approximately 80 pandas are held in captivity in Chinese zoos and research stations. Many of these were rescued from the wild following bamboo dieback in the 1970s and 1980s.

approach females occupying maternity dens, without aggressive interactions (Schaller *et al.* 1985). Pandas in the wild have been partially or completely habituated to the close proximity of individual research scientists (Lu 1992; Schaller 1993). By providing supplemental food, a wild panda was habituated, lost all fear of humans, and became a "nuisance" animal, begging, threatening for food and causing bodily injury (Schaller 1993). In summary, wild pandas are non-threatening, shy animals.

Wild pandas have been known to leave forest habitats and enter human settlements and farmsteads when weak or ill. Their condition is generally the result of old age or food shortage following a bamboo dieback. In these circumstances pandas may attempt to get food by various means, including eating cooking pots. However, pandas generally do not depredate agricultural crops or threaten livestock (Schaller *et al.* 1985).

In captivity, giant pandas are readily habituated and trained, as evidenced by their use in circus performances.

Their distinctive coloration, overall body proportions, passive nature and occasional bipedalism make them extremely attractive to animal lovers, and prime attractions at zoos. There is much controversy over the ethics and management of panda displays and loans (Carpenter 1989). When managed properly, these may be a major asset for panda conservation by raising funds and public awareness (Schaller 1993).

Public education needs

Public education is required to: 1) inform local people of laws, regulations, and management actions, and of their justifications; 2) build public support for conservation goals, particularly in the local school system; and 3) inform domestic and foreign visitors to Reserves about pandas, their habitats and ecosystem conservation.

Most management actions involve restrictions on the activities of some humans, generally those living closest to pandas. Restrictions are justified since they are mandated by the national government, on behalf of all citizens. Many restrictions will still be controversial, and politically difficult to implement. Education will not be sufficient to persuade everyone, but must be implemented along with active enforcement of the various disincentives and incentives for particular behaviors.

Specific conservation recommendations

Cooperation between the World Wide Fund for Nature (WWF), the New York Zoological Society (Wildlife Conservation International), and the Ministry of Forestry in the 1980s substantially improved our information and understanding of giant panda ecology, status, distribution, and threats to the population. Based on results of the 3-year survey of panda population and its habitat jointly organized by WWF and the Ministry of Forestry in the mid-1980s, a "National Conservation Management Plan for the Giant Panda and its Habitat" was jointly prepared by WWF and the Ministry of Forestry (MacKinnon *et al.* 1989) which outlined necessary management activities for giant panda conservation. It provided for: 1) reduction of human activities in panda habitat (removal of human settlements, modification of forestry operations, control of poaching); 2) management of bamboo habitat; 3) extension of the panda reserve system; 4) outbreeding between panda populations (establishing forest / bamboo corridors to link separate population units, introduction of captive-born young to existing wild populations; 5) maintenance of a captive population.

This Plan was not submitted to the Chinese government for approval, but was reviewed and reassessed by the Chinese State Ministries. The result is a renewed initiative, derived from the original Plan, but entitled "China's National Conservation Project for the Giant Panda and its Habitat" (MoF 1992). China's highest governing body, the State Council, has ratified this Project, which therefore has substantial political momentum within China. The Project provides the framework in which all conservation-related activities for pandas, domestic and international, must fit. To facilitate the implementation of the Project, a national steering group of the Project was formed and a Project office was set up under the Ministry of Forestry in 1993. Each of the three provinces also formed a steering group of its own and set up a Project office under the Forestry Bureau with special staff.

The Project is ambitious, and generally comprehensive in scope and justification. Proposed activities will be directed through virtually the entire range. The Project preamble recognizes the value of giant panda Reserves in conserving representative fauna and flora in this area of rich biological diversity. The Project recognizes the value of forest conservation in maintaining hydrological stability and erosion control, with downstream benefits for agriculture in the Sichuan basin and Yangtze River watershed. Another stated intention is the improvement of living standards and economic conditions for the local people, generally poor members of national minorities, who live beside and in panda habitat. In addition, it is hoped that nature conservation in China will gain an improved public profile as a result of Project implementation (MoF 1992).

The overall budget of the Project was calculated as about 300 million yuan in 1992. The state council only ratified 198 million yuan. The budget went up to more than 400 million yuan at the end of 1996. The principal actions of the Project (MoF 1992) are as below, with a short synopsis of their justification and implementation progress.

1. "To consummate the construction and management of the 13 existing giant panda Nature Reserves."
Existing Reserves include habitat for about 350 pandas (MoF 1992). It is recognized that most of these "... are poor in construction and management, and need further development." (MoF 1992). Giant pandas are poorly protected inside Reserves because: 1) local people degrade panda habitat by cutting trees for energy and market sale, and by grazing livestock, digging herbal medicines and gathering forest products; 2) poaching is not sufficiently deterred and thwarted by Reserves patrollers; and 3) local governments are often unwilling to enforce regulations promoting habitat and panda conservation.

So far, a general plan has been made for each Reserve to set the goals and identify proper actions. The function zones and boundaries of some of them have been adjusted as necessary. Training programs will be set up for the management staff. Necessary fieldwork and panda monitoring equipment will also be provided for each reserve. Some construction such as guard posts, patrol roads, reserve boundary markers etc. will be carried out. Also, some local rural development projects will be set up to help the local people in or around the reserves to reduce to pressure on these reserves.

2. "To establish fourteen new giant panda Reserves."
Eleven will be in Sichuan, two in Shaanxi, and one in Gansu. Currently, individual Reserves each support too few pandas for a viable population and leave some substantial areas of panda habitat without any protection. The new reserves were to be set up a) to protect the areas with high giant panda density; b) to protect important refuge areas for the giant pandas; c) to protect critical population corridors from further human destruction and disturbances.

So far, all of these Reserves have been set up, except three in Sichuan. The total area of these eleven Reserves is 3,332km^2. A general plan has been made for each reserve. Some capital construction such as headquarters, boundary makers, guardposts have been started. In several cases, timber-companies were relocated or transferred to other business.

3. "To link isolated giant panda populations with 17 protected corridors."
Most of the existing giant panda populations are isolated and too small to maintain genetic viability. Outbreeding can be ensured by preserving remaining corridors of suitable giant panda habitat linking the different giant panda populations to maintain large outbreeding giant panda population. Strict protection must be given to intervening giant panda habitat linking the reserves. In areas where natural linkages have been destroyed, it is necessary to apply active management to establish corridors for giant panda by planting trees and bamboo species to link the separated populations so that pandas could move among areas for feeding and breeding.

4. "To set up 34 management stations of giant panda habitat."
In order to strengthen the protection and management out of the reserves, a management station will be set up in each of the giant panda distribution counties to improve the giant panda protection and management in each county. These areas will encompass as much as 40% of the current panda populations, and include areas with active timber cutting and areas with constant public access. Efforts will be put on reducing human activities in the panda habitat area. Agriculture, grazing of domestic livestock, hunting, burning of vegetation will be strictly prohibited in or removed from important giant panda areas. This will be done through promoting rural development activities to reduce local people's dependency on forest products, public awareness and proper management. Hydropower stations will be built in some cases for local people to use electricity to cook so as to alleviate the pressure of cutting forests for firewood. Agro-forestry will be introduced to reduce the demand for natural resources. Appropriate zoning will be applied for firewood cutting and uses by local people. In some areas, there is no alternative but to remove people from the giant panda habitat.

5. "To develop scientific research on giant pandas."
There are numerous gaps in the understanding of panda biology. Principal among these is the lack of success with captive breeding (MoF 1992). Further research efforts will continue on giant panda ecology, physiology, parasitology, disease, bamboo regeneration, habitat restoring, etc. and 1) captive breeding; 2) re-introduction of captive-born giant pandas into the wild; 3) population monitoring to assess trends of the giant panda population.

Despite some impressive accomplishments, previous conservation actions for giant pandas have often been fraught with wasted or misdirected effort and investment, resulting from cultural incompatibilities, poor communication, and sometimes straightforward deceit (Carpenter 1989; Reid 1993; Schaller 1993). These can be minimized in the future by more thorough negotiation, and more open discussion of institutional objectives and cultural perceptions (Reid 1993; Schaller 1993). Successful giant panda conservation is more likely if collaborating parties agree to recognize the following realities and principles:

a. Conservation activities should fit within the framework of the Project (MoF 1992).
b. An international advisory group for panda conservation could be very helpful to provide recommendations to the steering group of the Project.

c. Successful implementation of the Project will be enhanced by financial contributions from agencies outside China and long-term national and international co-operation to help the Ministry of Forestry to raise funds for implementation of the Project.
d. Given the diverse array of activities (projects) that could be funded, priority activities should be assessed annually.
e. A team of scientists and officials representing the various principal agencies, domestic and international, who are providing funds and expertise, should negotiate priority activities (projects).
f. Specific budgets should be allocated to specific activities, with annual auditing of expenditures to insure responsible use of funds and achievement of desired results.
g. Proposed activities should explicitly outline their conservation value, in terms of the threat to giant panda persistence that will be alleviated, or the enhanced viability to be obtained.
h. The most important principle in establishing priorities should be a demonstrated ability of the action to maintain and enhance the viability of wild giant panda populations and habitats.
i. A monitoring system should be established to monitor population trends of the giant panda and assess the effect of any conservation and management efforts.

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Chapter 14

Global Status and Management of the Polar Bear

IUCN/SSC Polar Bear Specialist Group

IUCN Category: Lower Risk, conservation dependent **CITES Listing:** Appendix II
Scientific Name: *Ursus maritimus*
Common Name: polar bear

Figure 14.1. Distribution of polar bear (*Ursus maritimus*) populations throughout the circumpolar basin.

Introduction

The IUCN/SSC Polar Bear Specialist Group (PBSG) was established in 1965 to work with the one marine species, the polar bear (*Ursus maritimus*). Polar bears are treated separately from the other bear species, because the management of polar bears is guided by the Agreement on the Conservation of Polar Bears (from here on called the Agreement) that was signed in Oslo, Norway in 1973 by the five polar range states (Canada, Denmark, Norway, USA, and the former USSR). The PBSG considers that the Agreement is the action plan for polar bears. In the following document, the background of the Agreement and how it has worked for the conservation of polar bears is presented.

Current distribution and status

This summary of the worldwide status of polar bears is the result of discussions held at the February 1997 meeting of the IUCN/SSC PBSG and is based on status reports and revisions given by each nation. The circumpolar distribution of polar bear populations, so far as can be determined from the data available, is given in Figure 14.1. Table 14.1 summarizes the current population estimates, harvest data, and provides a qualified status determination.

Western Hudson Bay (WH): This population has been the subject of research programs since the late 1960s. Over 80% of the adult population is marked and there are extensive records from mark-recapture studies and the return of tags from bears killed by Inuit hunters. This population appears to be geographically segregated during the open-water season, although it mixes with those of southern Hudson Bay and Foxe Basin on the Hudson Bay sea ice during the winter and spring. The size of this population was estimated to be 1,200 in autumn 1995, and the current harvest is believed to be sustainable. The harvest sex ratio of two males per female has resulted in a population composition that is 58% female and 42% male.

Southern Hudson Bay (SH): The population boundaries are based on the observed movements of marked bears, and telemetry studies. The estimate of population numbers comes from a three-year (1984–1986) mark-recapture study mainly along the Ontario coastline. This study also documented seasonal fidelity to the Ontario coast during the ice-free season, and intermixing with the Western Hudson Bay and Foxe Basin populations during the months when the bay is frozen over. The calculated estimate of 763 was increased to 1,000 because a portion of the eastern and western coastal areas were not included in the area sampled. Additionally, the inshore area may have been under-sampled due to the difficulty of locating polar bears inland from the coast in the boreal forest. Thus some types of bears, especially pregnant females, may have been under-sampled. The estimate of 1,000 is considered conservative, and the total harvest by the Northwest Territories, Ontario, and Québec appears to be sustainable. Discussions between these three jurisdictions on co-management and cooperative research are ongoing.

Foxe Basin (FB): The field portion of a 12 year study of movements based on marked bears and telemetry, and population size based on biomark-recapture was concluded in 1996. During the ice-free season, polar bears were

WWF/Jack S. Grove/Eye on the World

Polar bears (*Ursus maritimus*) on pack ice, Arctic Circle, Russia.

Table 14.1. Polar bear population status as determined by both historical harvest (1991–92 to 1995–96) levels and current management practices.

The five year harvest averages are approximate for populations shared with Greenland and Russia, because accurate harvest information is not available from those jurisdictions. The percent females statistic excludes bears of unknown sex, and natural deaths are not included.

Population	% females in harvest	Number	Sustainable annual kill[1]	Mean Annual Kill	Environmental Concerns[2]	Status[3]	Data Quality[4]
Western Hudson Bay (WH)	31	1,200	54	44	None	S[5]	Good
Southern Hudson Bay (SH)	35	1,000	43	45	None	S[5]	Fair
Foxe Basin (FB)	38	2,300	91	118	None	S[5]	Good
Lancaster Sound (LS)	25	1,700	77	81	None	S[5]	Good
Baffin Bay (BB)	35	2,200	94	122	None	D?[2]	Fair
Norwegian Bay (NW)	30	100	4	4	None	S[5]	Fair
Kane Basin (KB)	37	200	8	6	None	S	Good
Queen Elizabeth (QE)	-	(200?)	9?	0	Possible	S?[2]	None
Davis Strait (DS)	36	1,400	58	57	None	S?[2]	Fair
Gulf of Boothia (GB)	42	900	32	37	None	S[5]	Poor
M'Clintock Channel (MC)	33	700	32	25	None	S[5]	Poor
Viscount Melville Sound (VM)	0	230	4[6]	0	None	I	Good
Northern Beaufort Sea (NB)	43	1,200	42	29	None	S	Good
Southern Beaufort Sea (SB)	36	1,800	75	56	None	I?[2]	Good
Chukchi	35	2,000–5,000	86–214	76 + poaching?	None	S?	Poor
Laptev	Unknown	800–1,200	N/A	poaching?	Incidental	U?[1]	Very Poor
Franz Josef Land/Novaya Zemlya	Unknown	2,500–3,500	N/A	poaching?	Possible	U?[2]	Very Poor
Svalbard	N/A	1,700–2,200	N/A	incidental	Possible	S?[2]	Poor
East Greenland	50	?	?	50–100	Possible	U?[2]	Very Poor

Total estimate for all populations combined 22,130–27,030

[1] Except for the VM population, the sustainable harvest is based on the population estimate (N) for the area, the estimated rates of birth and death, and the sex ratio of the harvest (Taylor et al. 1987):

$$\text{SUSTAINABLE HARVEST} = \frac{N \times 0.015}{\text{Proportion of harvest that were females}}$$

In this equation, the value used for proportion of the harvest that was female is greater of the actual value or 0.33. Unpublished modelling indicates a sex ratio of 2 males to 1 female is sustainable, although the mean age and abundance of males will be reduced at maximum sustainable yield. Harvest data (Lee and Taylor, 1994) indicate that selection of males can be achieved.

[2] Refer to text for discussion.

[3] S = Stationary, D = Decreasing, I = Increasing, U = Unknown, ? = indicated trend uncertain.

[4] Good = recent unbiased estimates and good harvest information,
Fair = detail or preliminary population estimates and good harvest data, or recent unbiased population estimates and uncertain harvest data,
Poor = Reconnaissance population estimates and incomplete or no harvest estimates,
Very Poor = no population information, incomplete or no harvest information.

[5] Population is managed with a flexible quota system in which over-harvesting a given year results in a fully compensatory reduction to the following year's quota.

[6] The rate of sustained yield of the VM population is one-sixth that of the other populations because of lower cub and yearling survival and lower recruitment. The projected proportion of the harvest that is female is 15% based on the intention to take only males. A 5-year voluntary moratorium on harvesting bears in the VM population began in 1994/95.

concentrated on Southampton Island and along the Wager Bay coast. However, significant numbers of bears were also encountered on the islands and coastal regions throughout the Foxe Basin area. The marking effort was conducted during the ice-free season, and distributed throughout the entire area. The population estimate is believed to be accurate. The previous harvest quotas are believed to have reduced the population from about 3,000 in the early 1970s to about 2,300 (15% CV) in 1996. The harvest quota in Northwest Territories (NWT) for this area has now been revised to levels that will permit slow recovery of this population, and provided the kill in Quebec does not increase. Co-management discussions with Quebec are ongoing.

Lancaster Sound (LS): The central and western portion of this area is characterized by high biological productivity and high densities of polar bears. The western third of this region (eastern Viscount Melville Sound) is dominated by heavy multi-year ice and low biological productivity. In spring and summer, densities in the western third are low, but as break-up occurs, polar bears move west to summer on the multi-year pack. Recent information on the movements of adult female polar bears monitored by satellite radio collars has shown that this population is distinct from the adjoining Baffin Bay and Norwegian Bay populations. A new estimate of population numbers and population status was to be available in fall 1997, when the results from the final field season (spring 1997) were to have been compiled and reported. The current estimate of 1,700 is based on a preliminary analysis of both historical and current mark-recapture data. The preliminary estimate compares favorably with a previous estimate of 1,657 that included Norwegian Bay, and was considered to be conservative. Harvest quotas for the 1996/97 were reduced to sustainable levels based on the preliminary population estimate.

Baffin Bay (BB): The Baffin Bay population is bounded by the North Water Polynya to the north, Greenland to the east, and Baffin Island to the west. A distinct southern boundary at Cape Dyer, Baffin Island is evident from the movements of marked bears and recent movement data from polar bears monitored by satellite telemetry. In the initial (1984–1989) study conducted in Canada, mark and recapture samples were collected in April and May, when most of the bears were offshore and in Greenland waters. The initial spring estimate (300–600) was based on mark-recapture data collected when capture effort was restricted to shore-fast ice and the floe edge off northeast Baffin Island. Preliminary estimates from mark-recapture sampling done during the autumn (1993–1995) open-water season suggested a population of 2,200. It is clear from both analyses that sampling bias occurs when a portion of the bears are on offshore pack-ice, and unavailable to capture teams. The second study (1993-ongoing) was done in September and October, when all polar bears from this population are found in summer retreat areas on Bylott and Baffin Island. The results of the second year of mark-recapture sampling in 1995 were compromised by an unexpected autumn outflow of multi-year ice from Lancaster Sound, Jones Sound, and the polar basin. An unknown fraction of the Baffin Bay polar bears remained on the offshore pack-ice, and were unavailable to capture teams. A preliminary estimate of 2,200 is based on the 1993–1995 data, and believed to be conservative. Completion of the Baffin Bay mark-recapture inventory is planned for fall 1997. This population is shared with Greenland, which does not limit the number of polar bears harvested. Based on the preliminary population estimate, and the most recent harvest information, it appears the population is over-harvested. Better information on population numbers and the Greenland harvest are required to clarify the status of this population. Co-management discussions between Greenland and Canada were initiated in February 1997.

Norwegian Bay (NW): The Norwegian Bay population is bounded by heavy multi-year ice to the west, islands to the north and east, and the Polynya in Penny Strait and Devon and Bathurst Islands to the south. Most of the polar bears in this population are concentrated along the coastal tide cracks and ridges along the north, east, and southern boundaries. The poor habitat to the west and the preponderance of heavy multi-year ice through most of the central area results in low densities of polar bears relative to the adjacent Lancaster Sound population. Based on preliminary data from ongoing research (see Lancaster Sound summary) the current estimate for this population is 100. The harvest quota for this population was reduced to four (three males and one female) in 1996 and appears to be sustainable.

Kane Basin (KB): The boundaries of the Kane Basin population are the North Water Polynya to the south, and Greenland and Ellesmere Island to the west, north, and east. The Canadian area of this population is essentially unharvested because it is distant from the closest Canadian community (Grise Fiord) and conditions for travel are typically difficult. However, this population is harvested on the Greenland side of Kane Basin and, in some years, Greenland hunters have harvested polar bears in western Kane Basin and Smith Sound. Based on preliminary data from ongoing research (see Lancaster Sound summary), the population estimate of 200 would support a total cumulative harvest of eight per year at two males per female. The current best estimate of the Greenland kill is six per year which is sustainable. The Canadian quota for this population is five, and if Canadian Inuit were to harvest from this area, over-harvest could occur. Although the habitat is good for polar bears on both the Greenland and Canadian sides of Kane Basin, the densities of polar bears on the Greenland (harvested) side were much lower than on the Canadian (unharvested) side; suggesting that this population was probably larger in past years, and could be managed for increase. Co-management discussions between Greenland and Canada were initiated in February 1997.

Queen Elizabeth (QE): The Queen Elizabeth or "Polar Basin" population is a geographic catch-all population to account for the remainder of northern Canada. Polar bears occur at low densities here, but systematic inventory studies have not occurred. This area is characterized by heavy multi-year ice, except for a recurring lead system that runs along the Queen Elizabeth Islands from the northeastern Beaufort Sea to northern Greenland. Perhaps 200 polar bears are resident in this area, and others are known to move through the area or use it for a portion of the year. This population is unharvested except for an occasional defense kill by adventurers or researchers. Given the low numbers and low rate of reproduction that is likely, even a small amount of incidental take could cause population depletion if visitation to this remote area becomes more common.

Davis Strait (DS): The original population estimate came from a mark-recapture study completed in 1979. Preliminary movement information from telemetry is consistent with the population boundaries determined from the movements of tagged animals from the 1974–79 study. The initial population estimate of 818, calculated from the spring mark-recapture data, was increased to 1,200 in 1993 to correct for bias in sampling caused by the inability of researchers to survey the extensive area of offshore pack ice and to account for additional scientific and traditional knowledge suggesting increasing numbers over the last 20 years. However, more recent information on the average Greenland harvest suggests the combined Greenland-Canadian kill would not be sustained by a population of 1,200. Clarification of the status of this population will require a population inventory conducted during the open water season, and more reliable harvest information from Greenland. Within Canada this population is harvested by Inuit from NWT, Québec, and Labrador. Co-management discussions between Greenland and Canada were initiated in February 1997.

Gulf of Boothia (GB): This population was the subject of a limited mark-recapture program conducted in the mid-1970s. The study was geographically restricted to the western coastal areas and no movement data using telemetry was collected. The population estimate of 333 was increased to 900 based on information from local Inuit hunters and because the central and eastern portions of the area were not sampled. The population boundaries are based on both movements of satellite radio-collared bears and recovery of tagged bears. The northern boundary of this population appears to derive from a consolidated island of pack ice in Prince Regent Inlet that is separated from the land fast ice by shore leads. At the southern edge, where it meets the Gulf of Boothia pack ice, this island of ice forms an area of highly crushed brash ice which appears to serve as a barrier to north-south movements of bears between the Lancaster Sound and Gulf of Boothia populations. The Gulf of Boothia is essentially surrounded by land to the east, south, and west. Although population data from this area are limited, local hunters report that numbers have remained constant or increased. The status was listed as stationary (Table 14.1), but this designation should be regarded as uncertain and tentative. A satellite telemetry study of movements and a mark-recapture population inventory is scheduled for 1998–2001.

M'Clintock Channel (MC): A six year mark-recapture population study covered most of this area in the mid 1970s. The population estimate was 900, however local hunters have recently advised that 700 may be a more accurate estimate. The population boundaries are based on both movements of satellite radio-collared bears and recovery of tagged bears. These boundaries are due to barriers to east-west movements caused by large islands to the east and west, the mainland to the south, and the heavy multi-year ice in Viscount Melville sound to the north. Under a local Management Agreement between Inuit communities that share this population, the harvest quota for this area has been revised to levels that will permit the population to grow slowly based on the more conservative estimate of 700. A satellite telemetry study of movements and a mark-recapture population inventory is scheduled for 1998–2001.

Viscount Melville Sound (VM): A five-year study of movements and population size, using telemetry and mark-recapture, was completed in 1992. The population boundaries were based on the observed movements (telemetry) of female polar bears. The population estimate of 230 is accurate with a 14% CV. Because this population occupies such a large geographic area, it was previously thought to be more abundant and productive at the time the original quotas were allocated in the mid-1970s. However, this area is characterized by poor habitat for seals and the productivity and density of polar bears was found to be lower than expected. Consequently, quotas have been reduced, and a five-year moratorium on hunting was agreed to for this area. In 2000, harvest activities will resume with an annual quota of four males.

Northern Beaufort Sea (NB): Studies of movements and population estimates have been conducted using telemetry and mark-recapture in the Northern Beaufort Sea at intervals since the early-1970s. The population estimate of 1,200 is believed to be unbiased. A recent study suggested that the northern boundary of this population probably extends further north than previous studies indicated. However, the number of polar bears using the northern area were few, and they did not appear to be distinct from the other North Beaufort Sea bears. The current harvest appears to be within sustainable limits.

Southern Beaufort Sea (SB): The southern Beaufort Sea population is shared between Canada and Alaska. Mark-recapture and studies of movements using telemetry have been conducted semi-continuously since the late 1960s in Alaska and the early 1970s in Canada. The eastern and northern boundaries of this population have been determined from movements of marked bears and from telemetry. The western boundary, shared with the Chukchi population, is less clear at this point. The population estimate of 1800 is believed to be reliable, but is confounded by uneven sampling in Alaska and Canada in different years resulting in non-random capture. A management agreement for this area was developed by the Inupiat (Alaska) and the Inuvialuit (Canada) who harvest this population. The current harvest appears to be within sustainable limits, and local hunters feel the population has been increasing slowly.

Chukchi Sea: Tagging of polar bears for the purposes of estimating population size using mark-recapture in the eastern Chukchi Sea, based from the Alaskan coast, have been conducted at intervals since the late 1960s. However, cooperative studies between USA and Russia, using telemetry to study movements, have confirmed that polar bears in the area are widely distributed on the pack ice of the northern Bering, Chukchi, and eastern portion of the East Siberian Seas. Consequently, shore-based mark and recapture studies cannot be used to estimate population size. The estimates given are based on observations of dens and are considered uncertain. This population is believed to have increased after the level of harvest was reduced in 1972. Legal harvesting activities are currently restricted to native people in Western Alaska and appear to be sustainable at current levels. However, recent reports of illegal harvest in Russia is cause for concern, particularly because the magnitude of this illegal kill is not known. Legal harvest rates have remained approximately constant, and polar bears are abundant in the Chukchi Sea; however, the unknown rate of illegal take makes the status of this population uncertain.

Laptev Sea: The Laptev population area includes the western half of the eastern Siberian Sea, the entire Laptev Sea, including the Novosibirsk and Severnaya Zemlya Islands. Telemetry data from the East Siberian and the Chukchi Seas support the eastern boundary. Recent telemetry data from the Kara and Laptev Seas indicate the western boundary is probably Severnaya Zemlya, but data analyses are incomplete. The estimate of population size for the Laptev Sea is based on aerial surveys and den counts. The population estimate should be regarded as preliminary. Reported harvest activities here are limited to defense kills and a small but unknown number of illegal kills. The population is not thought to be impacted by current harvest levels.

Franz Josef Land/Novaya Zemlya: This population includes eastern portions of the Barents Sea, the Franz Josef Land archipelago, and the Kara Sea, including Novaya Zemlya. The information for the Kara and Barents Seas in the vicinity of Franz Josef Land and Novaya Zemlya, is mainly based on aerial surveys and den counts. Studies of movements, using telemetry, have been done throughout the area, but data analyses to define the boundaries are incomplete. More extensive telemetry studies in the Svalbard area also suggest that the population associated with Svalbard could be regarded as geographically distinct. The population estimate should be regarded as preliminary. Reported harvest activities have been limited to defense kills and a small but unknown number of illegal kills. The population is not thought to be impacted by current harvest levels. However, contaminant levels in rivers flowing into this area and recent information on nuclear and industrial waste disposal raise concerns about the possibility of environmental damage.

Svalbard: The population estimate for the Svalbard area includes the western Barents Sea. Both movement and population studies using telemetry and mark-recapture have been conducted in the Svalbard area at intervals beginning in the 1970s. Studies of movements using telemetry indicate the polar bears associated with Svalbard are more restricted in their distribution than was previously believed. The population estimate is based on ship surveys and den counts in the early 1980s. This area is currently unharvested and population numbers are believed to be either stable or increasing. High levels of PCBs have been detected in a sample of polar bears from this area.

Eastern Greenland: The harvest data for this population are not completely documented, but approximately 100 polar bears are reported taken per year (documented average for 1970–1987: 72 bears per year). Historically, larger catches have been reported (e.g., 1910–1920: 94 bears per year). Large catches by European sealers on land and offshore ceased in the 1930s. There is no information indicating an overall increase in hunting effort by East Greenlanders in recent times. No indications of population decrease, or of increase, are apparent. Although no studies have been done, the seasonal movements of polar bears in this area are thought to be extensive. The large area of adjacent available habitat suggests the possibility of a large population. However, to date there has been no population inventory in this area and the number can only be presumed to be in the low 1000s.

Population and habitat threats

Both historically and currently the main threat to polar bears is over-harvesting. The life strategy of polar bears relies on high rates of adult survival to mitigate the impacts of environmental extremes in any given year. Poor cub survival and poor mating success in a given year have little impact on long-term population dynamics so long as bears survive and produce cubs when conditions allow. Delayed age of first reproduction and extended parental care require high adult survival for this species to maintain itself. Further reductions in recruitment from environmental contamination or other habitat degradation make polar bear populations even more vulnerable to depletion from direct mortality.

The extent to which human activities, such as shipping, seismic exploration, drilling, hard mineral mining offshore or onshore, transport of oil, and ecotourism might affect polar bear habitat is not known. Also, contamination of ice, water, food species, and bears themselves by oil and other toxins may increase as human activities in the Arctic increase. Preliminary assessments of these problems have been summarized by Øritsland *et al.* (1981) and Stirling (1990).

Hunting: Polar bears are harvested throughout most of their range. The numbers taken are regulated by quota in most of Canada; however, there are no legal limits to the number taken by Inuit in Québec, Greenland and Alaska; or Indians in Ontario. A user group management agreement for polar bears of the Southern Beaufort Sea establishes harvest quotas. These quotas have been effective although they lack the force of law in Alaska. Although harvesting is prohibited in Russia, enforcement and current economic conditions have made it difficult to determine the extent of illegal harvest activities there. In the Svalbard area polar bears are protected from all forms of harvest except defense kills. An important habitat consideration is direct mortality resulting from the proximity of people to bears. Defense kills are inevitable when polar bears and people occur together, although their numbers can be reduced with proper precautions and training. Mortality from set-guns and hunting from ships and aircraft have ceased as a result of the International Agreement. Harvest activities (both number taken and sex ratio) must be closely monitored to ensure that the populations that are harvested by non-regulated subsistence hunters remains within sustainable yield.

Petroleum exploration: Human activities, particularly those related to oil and gas exploration and development, pose several risks to polar bears and their habitat: 1) death, injury, or harassment resulting from interactions with humans; 2) damage or destruction of essential habitat; 3) contact with and ingestion of oil from acute and chronic oil spills; 4) contact with and ingestion of other contaminants; 5) attraction to or disturbance by industrial noise; 6) harassment (disturbance) by aircraft, ships, or other vehicles; 7) increased hunting pressures; 8) indirect food chain effects due to the impacts of oil and gas-related activities on the food web upon which polar bears depend and of which they are a part; and 9) mortality, injury, and stress resulting from scientific research to determine possible effects of oil and gas activities on polar bears and other species. Available information is not sufficient in many cases to accurately assess and determine how to avoid or mitigate possible direct and indirect effects of industrial activities. Experiments on the effects of oil contamination on polar bears showed that individuals exposed to oil will probably die.

Toxic chemicals: Although polar bears have a greater ability to metabolize certain PCB congeners than their prey, surprisingly high PCB levels have been detected in this top predator. A comprehensive survey of chlorinated hydrocarbon contaminants (CHCs) and heavy metals in polar bears in the NWT, Canada, showed that the level of most CHCs, especially chlordane compounds, had increased from 1969 to 1984 in Hudson Bay and Baffin Bay bears (Norstrom 1990). This initiated an international survey of CHCs in polar bears where samples were collected in 1990–91 by members of the PBSG from Canada, USA, Greenland, and Norway. As previously found, the major residues in all areas were PCBs and chlordane-related. Dieldrin, hexachlorocyclohexane and chlorobenzene levels were usually an order of magnitude lower. Mean total PCB concentrations ranged from a low of approximately

WWF-Canon/François Pierrel

Polar bear is anesthetised then carried back to the wild by helicopter, Churchill, Hudson Bay, Canada.

2ppm in the western North American arctic to a high of 15–20ppm in eastern Greenland and Svalbard (Norstom 1995). The high level of PCBs in polar bears from Svalbard were also found by Norheim *et al.* (1992). Levels in Baffin Bay and Hudson Bay areas were generally intermediate at 3–5ppm. Thus, there appears to be a trend for levels to increase from west to east, with a substantial jump going from the Baffin Bay to the Atlantic sites. However, a more recent study incorporating additional samples indicated PCB concentrations from Svalbard, East Greenland, Prince Patrick Islands (Canadian archipelago) were similar (Norstrom *et al.* in review).

These data imply that most contaminants are quite evenly distributed at arctic and sub-arctic latitudes in the northern hemisphere. The significantly higher levels of PCBs in north Atlantic areas than Hudson and Baffin Bays indicates that European, possibly Eurasian, sources are major contributors in this area. The chemicals are most likely transported by high level atmospheric currents.

It is difficult to evaluate potential effects of organochlorine pollutants (OCs) in nature. For more than 20 years, most studies have been concentrated on the determination of occurrence and levels of selected organochlorines in different biota. Currently recorded levels of environmental pollutants in the Arctic reveal a further need for monitoring programs on the input from long range transport of organochlorines to this fauna.

Nuclear waste: Concern has been expressed about the possible detrimental effects on the arctic marine ecosystem of nuclear waste dumping in the vicinity of Novaya Zemlya and other areas in the Russian Arctic. Near Cape Thompson, Alaska, low-level nuclear waste was buried at the completion of a test project. Distribution of radioactivity within the polar basin and its possible effects on the food web supporting polar bears are unknown.

Global warming: Concern is expressed about the possible detrimental effects of climatic warming on polar bears (Stirling and Derocher 1993). Current models project the first and most significant effects will be detected at high northern latitudes as a reduction in the extent of sea ice. If the models are correct, then prolonging the ice-free period will shorten the period during which polar bears in many subpopulations are able to feed on seals, and this will cause nutritional stress. Early signs of impact would include declining body condition, lowered reproductive rates, reduced survival of cubs, and an increase in polar bear-human interactions. Eventually, the seal populations would decline if the quality and availability of pupping habitat is reduced. Rain during the late winter may cause polar bear maternity dens to collapse, causing the death of occupants. Human-bear problems will increase as the open water period becomes longer and bears fasting and relying on their fat reserves become food-stressed. Tourism based on viewing polar bears in western Hudson Bay will likely disappear. Should the Arctic Ocean become seasonally ice-free for a long enough period, it is likely polar bears would become extirpated from at least the southern part of their range. Because the polar bear is at the top of the arctic marine food chain, and ice is an essential component of its environment, it is an ideal species through which to monitor the cumulative effects of change in arctic marine ecosystems.

Trade in polar bear products: The PBSG is concerned about the sale of polar bear gall bladders because of the threat to the survival of other species of bears. It is difficult to control illegal trade while there are still legal sources. In Russia the sale of gall bladders (rumored to be priced at 0.5 million rubles each in January, 1993) is resulting in an increased illegal kill of brown bears (see Chestin, this volume). Polar bears could be equally vulnerable. Therefore, the PBSG has recommended that the sale of polar bear gall bladders should be prohibited. However, local hunters in some areas wish to retain the right to sell gall bladders because they represent a potential source of income. In some of these areas, land claim legislation guarantees access to trade in all parts of legally harvested wildlife. Conservation education efforts to achieve a voluntary ban on trade in gall bladders has been effective in gaining the support of local hunters who in most cases are not informed about the implications of trade on other species.

Management

The International Polar Bear Agreement (Box 14.1)

In the early 1960s great concern was expressed about the increasing harvest of polar bears. When the first international meeting between representatives from the five "polar bear countries" to discuss protection of polar bears was convened in Fairbanks in 1965, there was little management in effect except for the USSR where polar bear hunting was prohibited in 1956 (Prestrud and Stirling 1994). At this meeting the following points were agreed upon:

1. The polar bear is an international circumpolar resource.
2. Each country should take whatever steps are necessary to conserve the polar bear until the results of more precise research findings can be applied.
3. Cubs, and females accompanied by cubs, should be protected throughout the year.
4. Each nation should, to the best of its ability, conduct research programs on polar bears within its territory.

5. Each nation should exchange information freely, and the IUCN should function to facilitate such exchange.
6. Further international meetings should be called when urgent problems or new scientific information warrants international consideration.
7. The results of the First International Scientific Meeting on the Polar Bear should be published.

Following the first international meeting on polar bear conservation, the IUCN/SSC PBSG was formed to coordinate research and management of polar bears on an international basis. In addition, this group took on the role of developing and negotiating the International Agreement on the Conservation of Polar Bears and their Habitats (the Agreement). That Agreement was signed in Oslo, Norway in May, 1973 and came into effect for a five-year trial period in May, 1976. The Agreement was unanimously confirmed for an indefinite period in January, 1981.

Article VII of the Agreement stipulates that: "The Contracting parties shall conduct national research programs on polar bears, particularly research relating to the conservation and management of the species. They shall, as appropriate, coordinate such research with the research carried out by other Parties, consult with other Parties on management of migrating polar bear populations, and exchange information on research and management programs, research results, and data on bears taken." To meet the conditions of Article VII of the Agreement, the PBSG meets every three to five years.

In Annex E to the Agreement, attention was drawn to the need for special protection of female polar bears with cubs and for their cubs. This protection was not included in the Agreement itself (Box 14.1). Annex E was considered by the PBSG in 1997, and a resolution reaffirming the need for special protection measures for adult females (Box 14.2), but noting that occasional take of cubs for cultural and nutritional purposes by subsistence users did not present a conservation concern.

Existing hunting regulations

Canada: In most Canadian jurisdictions, the seasons, quotas, and protected classes of polar bears are enforced by law. Apart from complying with CITES, the Federal Government has delegated its mandate for management of polar bears to the Provinces and Territories. However, the Federal Government has continued to provide both technical (long-term demographic, ecosystem, and inventory research) and administrative (Federal/Provincial Polar Bear Technical Committee, Federal/Provincial Polar Bear Adminstrative Committee, and the National Database) support to the Provinces and Territories. The Provinces and Territories have the ultimate authority for

Box 14.1.

The Agreement for the Conservation of Polar Bears

The Governments of Canada, Denmark, Norway, the Union of Soviet Socialist Republics, and the United States of America,

Recognizing the special responsibilities and special interests of the States of the Arctic Region in relation to the protection of the fauna and flora of the Arctic Region;

Recognizing that the polar bear is a significant resource of the Arctic Region which requires additional protection;

Having decided that such protection should be achieved through coordinated national measures taken by the States of the Arctic Region;

Desiring to take immediate action to bring further conservation and management measures into effect;

Have agreed as follows:

ARTICLE I

The taking of polar bears shall be prohibited except as provided in Article III.

For the purpose of this Agreement, the term "taking" includes hunting, killing and capturing.

ARTICLE II

Each Contracting Party shall take appropriate action to protect the ecosystems of which polar bears are a part, with special attention to habitat components such as denning and feeding sites and migration patterns, and shall manage polar bear populations in accordance with sound conservation practices based on the best available scientific data.

ARTICLE III

Subject to the provisions of Articles II and IV, any Contracting Party may allow the taking of polar bears when such taking is carried out:

– for bona fide scientific purposes; or
– by that Party for conservation purposes; or
– to prevent serious disturbance of the management of other living resources,subject to forfeiture to that Party of the skins and other items of value resulting from such taking; or
– by local people using traditional methods in the exercise of their traditional rights and in accordance with the laws of that Party; or
– wherever polar bears have or might have been subject to taking by traditional means by its nationals.

The skins and other items of value resulting from taking under sub-paragraphs b) and c) of paragraph 1 of this Article shall not be available for commercial purposes.

ARTICLE IV

The use of aircraft and large motorized vessels for the purpose of taking polar bears shall be prohibited, except where the application of such prohibition would be inconsistent with domestic laws.

Box 14.1 ... continued.

ARTICLE V

A contracting Party shall prohibit the exportation from, the importation and delivery into, and traffic within, its territory of polar bears or any part or product thereof taken in violation of this Agreement.

ARTICLE VI

Each contracting Party shall enact and enforce such legislation and other measures as may be necessary for the purpose of giving effect to this Agreement.

Nothing in this Agreement shall prevent a Contracting Party from maintaining or amending existing legislation or other measures or establishing new measures on the taking of polar bears so as to provide more stringent controls than those required under the provisions of this Agreement.

ARTICLE VII

The Contracting Parties shall conduct national research programs on polar bears, particularly research relating to the conservation and management of the species. They shall as appropriate coordinate such research with the research carried out by other Parties, consult with other Parties on the management of migrating polar bear populations, and exchange information on research and management programs, research results and data on bears taken.

ARTICLE VIII

Each Contracting Party shall take actions as appropriate to promote compliance with the provisions of this Agreement by nationals of States not party to this Agreement.

ARTICLE IX

The Contracting Parties shall continue to consult with one another with the object of giving further protection to polar bears.

ARTICLE X

This Agreement shall be open for signature at Oslo by the Governments of Canada, Denmark, Norway, the Union of Soviet Socialist Republics, and the United States of America until 31st March, 1974.

This Agreement shall be subject to ratification or approval by the signatory Governments. Instruments of ratification or approval shall be deposited with the Government of Norway as soon as possible.

This Agreement shall be open for accession by the Governments referred to in paragraph 1 of this Article. Instruments of accession shall be deposited with the Depository Government.

This Agreement shall enter into force ninety days after the deposit of the third instrument of ratification, approval, or accession. Thereafter, it shall enter into force for a signatory or acceding Government on the date of deposit of its instrument of ratification, approval, or accession.

This Agreement shall remain in force initially for a period of five years from its date of entry into force, and unless any Contracting Party during that period requests the termination of the Agreement at the end of that period, it shall continue in force thereafter.

On the request addressed to the Depository Government by any of the Governments referred to in paragraph I of this Article, consultations shall be conducted with a view to convening a meeting of representatives of the five Governments to consider the revision or amendment of this Agreement.

Any Party may denounce this Agreement by written notification to the Depository Government at any time after five years from the date of entry into force of this Agreement. The denunciation shall take effect twelve months after the Depository Government has received this notification.

The Depository Government shall notify the Governments referred to in paragraph 1 of this Article of the deposit of instruments of ratification, approval, or accession, for the entry into force of this Agreement and of the receipt of notifications of denunciation and any other communications from a Contracting Party specially provided for in this Agreement.

The original of this Agreement shall be deposited with the Government of Norway which shall deliver certified copies thereof to each of the Governments referred to in paragraph 1 of this Article.

The Depository Government shall transmit certified copies of this Agreement to the Secretary-General of the United Nations for registration and publication in accordance with Article 102 of the Charter of the United Nations.

[The Agreement came into effect in May 1976, three months after the third nation required to ratify did so in February 1976. All five nations ratified by 1978. After the initial period of five years, all five Contracting Parties met in Oslo, Norway, in January 1981, and unanimously reaffirmed the continuation of the Agreement.]

WWF/Fritz Pölking

Polar bear cub, Hudson Bay, Churchill area, Canada. Annex E to the International Polar Bear Agreement draws attention to the need for special protection of females and their cubs. In 1997, the Polar Bear Specialist Group clarified this resolution by advocating protection of adult females but noting that occasional take of cubs by subsistence users did not present a conservation concern.

Box 14.2. Annex E, Resolution on Special Protection Measures, and a recent related resolution from the PBSG.

The Conference

Being convinced that female polar bears with cubs and their cubs should receive special protection;

Being convinced further that the measures suggested below are generally accepted by knowledgeable scientists to be sound conservation practices within the meaning of Article II of the Agreement on the Conservation of Polar Bears;

Hereby requests the Governments of Canada, Denmark, Norway, the Union of Soviet Socialist Republics and the United States of America to take such steps as possible to:
1. Provide a complete ban on the hunting of female polar bears with cubs and their cubs; and,
2. Prohibit the hunting of polar bears in denning areas during periods when bears are moving into denning areas or are in dens.

Clarification of The Need For Special Protection Measures For Female Polar Bears (Resolution from the 1997 PBSG Meeting)

The IUCN Polar Bear Specialist Group

Recognizing that the **Resolution on Special Protection Measures** appended to the 1973 Agreement for the Conservation of Polar bears and their Habitat urges a complete ban on hunting females with cubs and their cubs, and

Recognizing the requirement for sound conservation measures identified in the Agreement for the Conservation of Polar Bears and their Habitat, and

Recognizing that the polar bear is a significant cultural, nutritional, and economic resource for local subsistence users, and

Recognizing that adult females have relatively greater reproductive value compared to other sex and age groups, and

Acknowledging that harvest management practices that accommodate the occasional take of dependent young for cultural reasons are consistent with sound conservation practices so long as the mother continues to be protected, therefore

Recommends special protection for adult females and emphasizes that harvest management practices that select for males and young animals may aid in offering protection for adult females.

management, although in several areas, the decision-making process is shared with aboriginal groups as part of the settlement of land claims. The existing quota system allows reduction of quotas in response to a decline resulting from over-hunting. The government of the NWT and the Land Claim Boards have reduced quotas in populations where there were indications of over-harvest. In NWT a new quota system has been adopted that takes into account both the number and sex-ratio of the harvest and defense kills for determination of quota allocations in subsequent years. In NWT and Manitoba, all human-killed bears are removed from local quotas so the non-natural mortality is constrained to be within the calculated sustainable limits. The use of aircraft to position hunting camps is allowed, but aircraft are not allowed for spotting or hunting any big game species. Only Québec (James Bay Agreement) and Ontario do not restrict the number of polar bears that are hunted by a quota system. Labrador restricts hunting with a quota system, but does not take defense kills from the quota.

Greenland: In Greenland, the polar bear hunting regulations state that bears can be taken only by hunters who hunt and/or fish as a full time occupation and have a valid hunting license issued by the Greenland authorities. Basically, these regulations try to control hunting efforts by ensuring that polar bears are taken only by traditional means as a part of the Inuit´s subsistence hunting. Hence, it is forbidden to use motorized vehicles (aircraft, helicopters, snowmobiles and large vessels) for the hunting of polar bears or for transportation to and from the hunting grounds. All Greenland municipalities completely protect females with cubs up to 12 months of age. However, there are some regional differences. In all areas outside the municipalities of Avanersuaq (Thule), Upernavik, and Ittoqqortoormiit (Scoresby Sound), females accompanied by young up to 24 months of age are completely protected. The latest revision of the hunting regulations for the municipality of Tasiilaq (Ammassalik, SE Greenland) in 1992 permits the killing of polar bears between 12 and 24 months of age, and females accompanied by such young. All bears are protected in July and August (August–September in the Tasiilaq area). In May, 1988, the law was revised to permit killing of single adult male bears year-round.

Norway: According to the Spitsbergen Treaty of 9 February, 1920, Norway exercises full and unlimited sovereignty over the Svalbard area. However, citizens of the countries contracting to the Treaty have the same rights as Norwegians to hunt and fish in the area and to conduct maritime, industrial, mining, and commercial operations, provided they observe the local laws and regulations.

The main responsibility for the administration of Svalbard lies with the Norwegian Ministry of Justice. Norwegian civil and penal laws and various other regulations are applicable to Svalbard as well. The Ministry of Environment deals with matters concerning the environment and nature conservation. The highest local authority in Svalbard is the Governor (Sysselmannen) who exercises jurisdictional, police, and administrative authority.

After the signing of the Agreement, polar bear hunting was forbidden in Norway. The management of polar bears on Svalbard is regulated by The Royal Decree, "Regulations concerning the management of game and freshwater fishes on Svalbard and Jan Mayen," enacted in 1978.

Russia: In Russia, the Main Administration on Biological Resources of the State Committee of Russian Federation for Environment is responsible for conservation of animals included in the Russian Red Data Book (including the polar bear). Regional Committees control the situation at the local level. In the Russian Arctic, only Wrangel and Herald Islands have special conservation status as a place of high concentration of maternity dens and/or polar bears. Wrangel and Herald island were included in the Wrangel Island State Nature Reserve (zapovednik) in 1976, while the Franz Josef Land State Nature Refuge was established in 1994. Special protected areas are proposed in the Russian High Arctic: the Novosibirsk Islands, Severnaya Zemlya, and Novaya Zemlya. Within these protected areas, conservation and restoration of terrestrial and marine ecosystems, and plant and animal species (including the polar bear), are the main goals. Proposals to establish special protection measures in Novaya Zemlya and for various regions of the mainland coastline and within the "economic zone" of the Russian Arctic are also being considered.

United States: In the United States, the U.S. Fish and Wildlife Service (FWS) is responsible for conservation of polar bears under terms of the Marine Mammal Protection Act (MMPA) and CITES. The MMPA (1972) implemented a general moratorium on all takes of marine mammals including polar bears. However, certain types of take, which is defined as to harass, hunt, capture, collect or kill, are authorized under specific conditions. Alaska Natives may harvest polar bears for subsistence purposes and for purposes of creating and selling traditional handicrafts and clothing. Quotas, seasons, and other limitations are not placed on the harvest provided that the population is within optimum sustainable levels (a range between maximum net productivity level and carrying capacity), and provided that the harvest is not wasteful. Other types of allowable "take" include those for scientific research, public display, incidental takes of small numbers of polar bears through harassment such as during oil and gas exploration or development, defense of life, and takes by Federal, State, or local officials in support of the welfare of the public or the animal.

Effective October, 1988, regulations require hunters to present hides and skulls from harvested polar bears to personnel or local assistants working with the FWS within 30 days of harvest. Skulls and hides are tagged with interlocking nylon-plastic tags. Specimens, including teeth, organ tissues, claws, and ear tags and radio collars of bears marked for research are obtained through this program. Non-compliance can result in a fine.

A local user group agreement between the Inupiat of Alaska and Inuvialuit native people of the Northwest Territories of Canada established harvest guidelines for the shared polar bear population of the Beaufort Sea. The guidelines are based upon scientific data which considers population size, sustainable yield estimates, and the sex ratio of the harvest. In Alaska, compliance with the

Agreement by native hunters is voluntary. The net effect of these guidelines is that harvest levels have been below sustainable levels since 1989. A comparable agreement does not currently exist for the Chukchi and Bering Sea region although the US and Russia governments are in the process of developing a treaty for the conservation of polar bears of this region.

Compliance with the International Agreement: habitat protection

A major weakness of the Agreement has been the lack of its use to help protect critical areas of habitat, with a few notable exceptions occurring for some denning areas (Prestrud and Stirling 1994).

Canada: In Canada, much of the denning areas in Manitoba have recently been protected by inclusion within the boundaries of Wapusk National Park. In Ontario, some denning habitat and coastal summer sanctuary habitat are included in Polar Bear Provincial Park. Some polar bear habitat is included coincidentally in some of the National Parks and National Park Reserves in the Northwest Territories. There is no known protection for offshore areas which may be important habitat, although a proposal to drill near the shore-lead polynya system in the eastern Beaufort Sea was denied because the company could not demonstrate their ability to clean up an oil spill. One of the principal concerns was the potential for detrimental effects on polar bears. Additional habitat protection measures result from restrictions on harassment, approaching dens and denning bears, and a land use permit review that considers potential impacts of land use activities on wildlife.

Greenland: In Greenland, an area of Melville Bay has been set aside as a reserve for polar bears and the major part of NE Greenland is included in the National Park of North- and East-Greenland. It is, however, permitted for licensed hunters under certain restrictions to hunt polar bears in the National Park of North- and East-Greenland.

Norway: Approximately 50% of the land area of Svalbard is totally protected, including all major regions of denning by female bears. However, protection of habitat is only on land and to four nautical miles offshore. Therefore, polar bears and their habitat are unprotected in the Barents Sea. Environmental regulations based on the Svalbard Treaty claim jurisdiction only out to four nautical miles. Norway claims control of waters out to 200 nautical miles, but only Finland has accepted these Norwegian claims.

Russia: In Russia, the denning areas on Wrangel and Herald Islands are protected, but it is not clear if there is any protection for other areas outside the protected areas. Currently, the Chukotka Autonomous Government has petitioned the Russian Federation for the authority to administer the Wrangel Island State Nature Reserve.

United States: In Alaska, land ownership and land leasing status influence conservation and protection of polar bear habitat. The primary landowners are federal and state governments and Alaska natives. Much of the land in federal ownership is designated as National Wildlife Refuges or National Parks, although no lands have been set aside specifically for polar bear habitat. The marine environment is under federal and state jurisdiction. State of Alaska jurisdiction extends from the mean high tide level seaward three miles, and includes offshore barrier islands. Federal jurisidiction extends beyond the three mile limit. In the U.S. a variety of laws provide a legal basis for habitat protection these include but are not limited to the following: MMPA; Outer Continental Shelf Lands Act; Coastal Zone Management Act; Alaska National Interest Lands Conservation Act; and the National Wildlife Refuge System Administration Act. The matrix of land ownership and legal authorities is complex and must operate to balance the need for protection of fish and wildlife habitats as well as provide reasonable public access to these areas for activities such as shipping, oil and gas exploration, and transportation. The level of protection necessary for certain terrestrial polar bear habitat types may be greater than for others based upon their values for denning or feeding. There are debates on whether specific protection should be afforded to areas within the Arctic National Wildlife Refuge that are known to be used by polar bears for denning which coincide with areas of potential oil and gas reserves. Significantly, the Arctic National Wildlife Refuge is the prime denning area for polar bears in the U.S.

Compliance with the International Agreement: hunting regulations

Canada: Most of Canada's harvest occurs in the NWT. Local harvesting has been managed by developing management agreements and memorandums of understanding that specify that human-caused mortality will be less than the sustained yield. In NWT, all family groups are protected. By special permit, dependent cubs may be taken for cultural purposes, however this hunt must be supervised by the local Wildlife Officer or the Hunters and Trappers Organization to ensure the female (mother) is not harmed. A principal area of non-compliance in Canada lies in Québec where, because of the James Bay Agreement, there are no quotas, seasons, protection of females and young, or protection of bears in dens. In past years, harvest studies in Québec have been conducted, the quality of which has recently improved. Reporting of the harvest in the Province of Ontario is irregular and may sometimes be incomplete. Females with cubs and bears in dens are not protected. There is no enforcement of quotas in either Québec or Ontario. The Province of Manitoba allows no hunting of polar bears within its jurisdiction, and records all known mortality of polar bears from defense/deterrent activities and other causes.

Greenland: Under Article VII of the Agreement, Greenland does not currently collect good hunting statistics and share them with neighboring jurisdictions. Complete protection for polar bears is afforded in the reserve in Melville Bay; however, this prohibition is not enforced and polar bears are hunted there. The Greenland hunting regulations are summarized as follows: 1) there is no quota; 2) no motorized vehicles may be used for the hunt except boats less then 40 BRT; 3) hunters must be citizens of Greenland and hunt or fish full-time, 4) females with cubs less than 12 months of age are offered complete protection, and 5) in all areas all bears, except adult males, are completely protected in July-August (in SE Greenland: August–September). As of 1 January, 1993, Greenland residents are required to get special permits to hunt polar bears. This regulation will allow closer monitoring of the hunt and better data to be collected.

Norway: No hunting is allowed in Norway.

Russia: Illegal harvest of polar bears is occurring in different regions of the Russian Arctic, especially the Far East (Chukotka). The magnitude of the illegal harvest is not known.

United States: In the United States, under the Marine Mammal Protection Act (MMPA) of 1972, only coastal dwelling native people are allowed to hunt polar bears for subsistence purposes. The hunt is not regulated provided that the population is within optimum sustainable levels and the take is not wasteful. If populations become depleted regulations on take may be developed. Complete harvest statistics are compiled annually. Although the use of aircraft and large ships is not specifically prohibited, they are generally not used (Article IV).

Compliance with the International Agreement: local people using traditional methods

Article III (d) of the International Agreement on the Conservation of Polar Bears states that polar bears may be taken, "by local people using traditional methods in the exercise of their traditional rights and in accordance with the laws of that Party."

Canada: In Canada, most hunting of polar bears is done by aboriginal people. Maintaining polar bear hunting as part of the subsistence lifestyle is widely viewed as being of significant cultural importance. Canada also permits Inuit guided hunting by some non-native residents and non-residents using traditional dog team methods. The hunts, undertaken by sport hunters, are included with the quota allocated for native hunting and thus, are not additive to the total. There are no restrictions on use of snow machines, except during guided non-resident sport hunts.

Greenland: In Greenland, the prohibition on use of motorized vehicles, aircraft, and large vessels when hunting polar bears was motivated by the Agreement. In fact, this is probably the most effective way to limit the number of bears killed in Greenland since there is no quota system. By law, it is prohibited to guide anybody without a valid license for polar bear hunt.

Norway: Norway interprets the Agreement as limiting hunting to indigenous people. Norway has no indigenous people in Svalbard, but takes the view that the intention of the Agreement was to defer to native people for access and use.

Russia: Russia currently does not allow hunting, but if these regulations are changed in the future, they desire to limit the hunt to indigenous people. An illegal harvest of unquantified levels has begun in response to economic needs and administrative neglect of the ban on hunting. The Russian government is concerned that money would drive a market hunt, and thereby make control and regulation of the hunt problematic. The term "local" people in Russia might be interpreted by some parts of government to include Russians who have been living in polar bear areas for a period of years. There is also interest expressed by certain hunting groups in Russia to start guiding polar bear sport hunts because of the foreign currency they would attract. There have even been some advertisements for such hunts in western countries.

United States: In the United States, all hunting is done by coastal dwelling Natives. Take by non-natives and sport hunting is not allowed, although the MMPA contains provisions to waive these restrictions provided certain determinations are made. Methods and means of native polar bear hunting are not defined or restricted. Hunting is not limited provided that populations are at optimum sustainable levels. If populations become depleted, protective regulations may be enacted. In Alaska, it is technically legal for a native person to use an aircraft to hunt polar bears; however, the use of aircraft to hunt polar bears is currently not a conservation issue. Hunting of polar bears in order to sell hides has been a non-issue since 1972 when the MMPA prohibited commercial sale of non-handcrafted hides to non-natives.

The North Slope Borough and Inuvialuit Game Council hunter management agreement for polar bears of the Beaufort Sea contains sustainable harvest limits, seasons, prohibitions on the use of aircraft, and protection of females with cubs, their cubs, and denning bears. Although the agreement is not technically binding in the US, it has operated effectively over its duration. The US and Russian governments and native organizations from Alaska and Chukotka are in the process of developing a conservation treaty for polar bears of the Chukchi and Bering Seas. A future bialteral treaty must conform to provisions of the Agreement on the Conservation of Polar Bears.

Compliance with the International Agreement: compliance by member nations to Annex E

Canada

Northwest Territories – In most of the NWT, all family groups are protected. In the western three populations, cubs and females with cubs under 1.5m in length prior to being stretched and dried, or 1.8 m after being stretched and dried, are protected. Conversely in the western NWT, females with cubs greater than 1.5m in length (this may include some two year old cubs) are not protected. Denning bears are protected. Hunting season opening dates are in August, and November, and this could permit the harvest of some pregnant female bears before they have the chance to den.

Manitoba – Hunting is currently closed in Manitoba. Treaty Indians may request permission to hunt from the Minister of Natural Resources. By agreement the total quota has been set at the maximum sustainable yield, which is shared equally between Manitoba and NWT. Currently Manitoba has loaned 19 tags to the NWT for the use of local hunters.

Newfoundland – Four bears may be taken by Labrador Inuit, and females with cubs are protected.

Ontario – Females with cubs and denning bears are not protected.

Québec – Females with cubs and denning bears are not protected, except by a voluntary hunter agreement in northern Québec.

Yukon Territories – The harvest quota is on loan to the western Northwest Territories.

Greenland: Dependent cubs older than 12 months can be taken. Females with cubs up to two years of age are protected outside the municipalities of Avanersuaq and Ittoqqotmiit (Scoresby Sound). During the summer, July–August, all bears are protected (during August and September specific regulations exist). Harvest statistics show that approximately 26% of the Thule and Scoresby Sound region kill is comprised of yearling and 2-year old cubs. Hunting in specific denning areas is prohibited.

Norway: The only legal taking of females with cubs, or of females moving into denning areas, is killing in defense of life, which is permissible under the International Agreement.

Russia: Hunting was banned in 1956. Renewal of hunting may occur in the future. As with Norway, killing in defense of life occurs at minor levels. Measures to protect bears which are in or moving to dens are unclear. Nature Reserves, such as Wrangel Island, prohibit disturbance of bears moving to or in dens. Specific covenants protecting denning areas or denning bears in non-reserve areas are not known.

United States: As previously indicated, the MMPA allows unrestricted harvest of polar bears (including females with cubs and the cubs) by Alaska coastal dwelling Natives for subsistence purposes or to make handicrafts and clothing provided that population levels are found to be optimum and sustainable. Regulations may be developed if populations become depleted.

Denning bears are not protected by statute. The North Slope Borough and Inuvialuit Game Council Agreement for the Conservation of the Southern Beaufort Sea contains provisions calling for the protection of females with cubs, for their cubs, and for denning bears. The terms of this agreement are more restrictive than the MMPA. The agreement has no legal status in the United States or Canada, is a voluntary compliance agreement between the two native groups. Although there are no penalties for violations, the agreement has worked effectively since its inception. Alaskan and Russian hunters have developed a

Annex E, Resolution on Special Protection Measures (see Box 14.2)

Country	Ban on hunting cubs and females with cubs
Canada	Not all jurisdictions
Greenland/Denmark	Yes, but lack of enforcement
Norway	Yes
Russia	Yes, but lack of enforcement
United States	No, voluntary prohibitions

Country	Prohibit hunting of bears in dens or during periods when bears are in denning areas
Canada	Not all jurisdictions
Greenland/Denmark	Yes, but lack of enforcement
Norway	Yes
Russia	Yes, but lack of enforcement
United States	No, voluntary prohibitions

draft user's agreement for the Chukchi Sea with the assistance of their respective governments. Negotiations are continuing with the goal of completing a signed bilateral agreement. That is consistent with the Agreement for the Conservation of Polar Bears.

Most of the original habitat of polar bears is still intact (although not protected) and uninhabited. The polar bear is the only bear, and probably one of the only large carnivores that still occurs throughout most of its original range.

The Importance of the International Agreement

A primary goal of the Agreement was to limit the hunting of polar bears to sustainable levels. Because so many management changes had already been put in place during the period when the Agreement was being negotiated, there was little detectable impact immediately following it being signed and ratified (Prestrud and Stirling 1994). However, there is no doubt that the knowledge that the Agreement was being negotiated, and was likely to be successful, was a significant stimulus (Fikkan *et al.* 1993). The Alaskan harvest rate was reduced by 50% following the MMPA in 1972.

To date, the International Agreement on the Conservation of Polar Bears has been the most important single influence on the development of internationally coordinated management and research programs that have ensured the survival of polar bears (Prestrud and Stirling 1994). The Agreement is not enforceable by law in any of the countries that have signed it, a weakness that has been identified in previous reviews of international wildlife law. It has been successful in bringing the harvest of polar bears within sustainable limits for most populations, while still facilitating harvest by local people.

Specific conservation recommendations

According to Article II of the Agreement, each contracting party "...shall manage polar bear populations in accordance with sound conservation practices based on the best available scientific data," and according to Article VII, "The Contracting Parties shall conduct national research programs on polar bears ..." and "... consult with each other on the management of migrating polar bear populations ..." These articles have been very important for stimulating governments to support applied research to answer management questions on polar bears throughout their range. This work has been coordinated through the IUCN/SSC PBSG and has resulted in dramatic improvements in conservation measures for polar bears. However, all aspects of the Agreement have not been realized in all areas. The PBSG urges the signatory governments to take action to comply fully with the Agreement (Box 14.1) and all resolutions, especially the Resolution of Special Protection Measures (Box 14.2). The PBSG identifies populations where the current management practices appear to be causing numbers to decline (Table 14.1) as priorities for research and management action.

Literature Cited

Abramov, V.K. 1972a. Asian black bear and its conservation in the Far East of the USSR. Pp.3–6 *in*: Sokolov, V.E., (ed.) Ecologiya, morphologiya, okhrana i ispolzovaniye medvedey. *Proc. of the conf. 'Nauka'*, Moscow. (In Russian).

Abramov, V.K. 1972b. Migrations of bears in the south of the Far East of the USSR. Pp. 6–8 *in*: Sokolov, V.E., (ed.) Ecologiya, morphologiya, okhrana i ispolzovaniye medvaday. *Proc. of the conf. 'Nauka'*, Moscow. (In Russian).

Abramov, V.K., Pikunov, D.G., and Bazylnikov, V.I. 1979. Seasonal distribution of brown and white-chest bears in the South of the Far East of the USSR. Pp. 202–204 *in*: Sokolov, V.E. *et al.* (eds.). Ecologicheskiye osnovy ohrany i ratsionalnogo ispolzovaniya khishchnykh mlakopitayushchikh. Abstracts of the conf., Moscow. (In Russian)

Adamic, M. 1990. Rjavi medved (*Ursus arctos*) v Sloveniji. *in*: Rosmann, E. (ed.) *L'orso bruno nelle zone di confine del Friuli-Venezia Giulia*. WWF Friuli-Venezia Giulia, Monfalcone.

Adams, N.M. and Mazariegos, M.I. 1994. The plight of the Andean bear of Ecuador: the Andean Bear Welfare and Conservation Issues Project. *Int. Bear News* 3(1):5–8.

Akita Prefecture 1983. *Status report of Japanese black bears in Akita*. 132 pp. (In Japanese)

Alfonso X.I. 1976. *Libro de la monteria*. Ediciones Velazquez, Madrid.

Allendorf, F.W., Christiansen, F.B., Dobson, T., Eanes, W.F., and Frydenberg, O. 1979. Electrophoretic variation in large mammals. I. The polar bear (*Thalarctos maritimus*). *Hereditas* 91:19–22.

Allendorf, F.W., Ballou, J., Beecham, J., Bruissard, P., Gilpin, M., Harris, R., Kasworm, W., Kudsen, K., Magure, L., Martinka, C., Redmond, R., Ryder, O., Servheen, C., Shaffer, M., and Weaver, J. 1986. Results of a workshop on grizzly bear population genetics. U.S. Fish and Wildlife Service, Office of the Grizzly Bear Recovery Coordinator, Missoula, MT. 8 pp.

Allendorf, F.W., and Servheen, C. 1986. Genetics and the conservation of grizzly bears. *TREE* 1:88–89.

Almasan, H. 1988. Bonitatea fondurilor de vinatoare si efectivele optime la principalele specii de vinat din Romania. *I.C.A.S.*

Alonso, M. and Toldra, LL.X. 1993. El oso pardo en Cataluña. *in*: Naves, J. y Palomero, G. (ed.). *El oso pardo en España*. Colección Técnica, ICONA, Madrid.

Alstadheimutvalget. 1991. Norsk landbrukspolitikk. Utfordinger, mål og virkemidler. *NOU* 2B:1–632.

Altamirano, R.C. (ed). 1992. *Territorio indígena Parque Nacional Isiboro Secure: inventario de flora y fauna*. CIDDEBENI-GTZ-UMSA (Centro de Investigación y Documentación para el Desarrollo del Beni, Sociedad Alemana de Cooperación Técnica, Universidad Mayor de San Andres), La Paz, Bolivia. 112 pp.

Amon, R. 1931. *Die Tierwelt Niederösterreichs*. Verlag Optische Werke C. Reichert, Wien.

Amstrup, S.C, Gardner, G.W., Cronin, M.A., and Patton, J.C. 1993. Sex identification of polar bears from blood and tissue samples. *Can. J. Zool.* 71:2174–2177.

Anderluh, G. 1987. Der Braunbär in Kärnten. *Atti del Convegno "L'orso bruno nelle zone di confine del Friuli-Venezia Giulia"*: 35–39.

Andrade, G.I. 1992. Biodiversidad y conservación. Pp. 9–71. *in:* Andrade, G., Ruíz, J.P., and Gómez, R. eds. *Biodiversidad, conservación y uso de recursos naturales: Colombia en el contexto internacional*. CEREC and Fundación Friedrich Ebert de Colombia (FESCOL), Santafé de Bogotá. 126 pp.

Andrade, G.I. 1993. Biodiversidad y conservación en Colombia. Pp. 25–42. *in:* Cárdenas, S. and Correa, H.D. (eds.) *Nuestra diversidad biológica* CEREC and Fundación Alejandro Angel Escobar, Santafé de Bogotá. 296 pp.

Andrade, G.I., Rosas, M.L., Andrade, A., and Etter, A. 1991. Analisis regional para la planificación de áreas silvestres protegidas: estudio del caso del Parque Nacional Natural El Cocuy, Colombia. *Trianea (Acta Cient. Tecn. Inderena)* 4:563–595.

Anon. 1937. Japanese police records in Taiwan. *Aboriginal Chronicle* (2).

Anon. 1969. *Game harvest report for 1968 and population estimates for 1969*. Ministry of Forestry and Water Management, Bratislava. 87 pp.

Anon. 1972. *Indian Wildlife (Protection) Act*. Ministry of Environment and Forests, Govt. of India, New Delhi. Natraj Publishers, Dehra Dun. 86 pp.

Anon. 1988. *Master plan of the Great Gobi National Park*. 2 vols. UN Environmental Programme, Ulaanbaatar, Mongolia. 334 pp.

Anon. 1992a. *Convention on International Trade in Endangered Species of Wild Flora and Fauna*. Annual Report, Ministry of Environment and Forests, Govt. of India, New Delhi. 89 pp.

Anon. 1992b. Guerra contra el ambiente. *Revista Ecológica* (Santafé de Bogotá) 11–12:10–13.

Anon. 1992c. *Red Data Book of Threatened Vertebrates of Greece*. 1992. Hell. Zool. Soc. & Hell. Ornith. Soc., Athens. 356 pp.

Aoi, T. 1990. The effects of hunting and forest environmental change upon the population trend for brown bears (*Ursus arctos yesoensis* Lydekker) in northern Hokkaido. *Research Bulletins of the College Experiment Forest*. Faculty of Agriculture, Hokkaido University 47(2):249–298.

Aomori Prefecture 1990. *Status report of Japanese black bears in Aomori*. 55 pp. (In Japanese)

Arce, J.P. 1988. Las áreas naturales de Bolivia. Pp.1–21. *in*: Centro de Datos para la Conservación, Bolivia (ed.) *Diagnóstico de la diversidad biológica de Bolivia*. La Paz, Bolivia.

Asoshina, T. 1994. Status and management of the Japanese black bear. *Bull. Wildl. Admin*. 6:7–9. (In Japanese)

Aste, C. 1993. *Habitatqualität für Braunbären in Österreich*. 100 pp. Diplomarbeit an der Universität für Bodenkultur Wien.

Augustynowicz, W. 1939. Chronmy przyrode zywiecczyzny. *Gronie* 2(1):11–16.

Aumiller, L. and Matt, C. 1994. Management of McNeil River State Game Sanctuary for viewing of Alaskan brown bears. *Int. Conf. Bear Res. and Manage.* 9:51–62

Avise, J.C. 1994. *Molecular markers, natural history, and evolution*. Chapman and Hall, New York. 511 pp.

Avise, J.C., and Ball, R.M. 1990. Principles of genealogical concordance in species concepts and biological taxonomy. *Oxf. Surv. Evol. Biol*. 7:45–68.

Avise, J.C., and Landsman, R.C. 1983. Polymorphism of mitochondrial DNA in populations of higher animals. Pp. 147–164 *in:*: Nei, M. and Koehn, R.K., (eds.) *Evolution of genes and proteins*. Sinaur Associates, Sunderland.

Avise, J.C., Neigel, J.E., and Arnold, J. 1984. Demographic influences on mitochondrial DNA lineage survivorship in animal populations. *J. Mol. Evol*. 20:99–105.

Azuma, S., and Torii, H. 1980. Impact of human activities on survival of the Japanese black bear. *Int. Conf. Bear Res. and Manage*. 4:71–91.

Baker, R.H. and J.K. Greer. 1962. Mammals of the Mexican state of Durango. *Mich. State Univ. Museum Publ., Biol. Ser.* 2.

Balakrishnan, M. 1984. The larger mammals and their endangered habitats in the Silent Valley forests of south India. *Biol. Conserv.* 29:277–286.

Balakrishnan, M., and Easa, P.S. 1986. Habitat preferences of the larger mammals in the Parambikulam Wildlife Sanctuary, Kerala, India. *Biol. Conserv.* 37:191–200.

Ballard, W.B., W.B., Stephenson, R.O., and Spraker, T.H. 1981. Causes of neonatal moose calf mortality in south-central Alaska. *J. Wildl. Manage.* 45:335–342.

Ballard, W.B., and Larsen, D. 1987. Implications of predatory-prey relationships to moose management. *Swedish Wildl. Res. Suppl. 1* Part 2:581–602.

Ballard, W.B., Miller, S.D., and Whitman, J.S. 1990. Brown and black bear predation on moose in south-central Alaska. *Alces* 26:1–8.

Banci, V. 1991. The status of the grizzly bear in Canada in 1990. COSEWIC status rept. 171 pp.

Bannikov, A. 1954. *Mammals of the Mongolian People's Republic*. Academy of Sciences, Moscow. (in Russian)

Barigozzi, C. 1963. Tentativo di stima numerica degli orsi bruni nel Trentino. *Rend. Ist. Lomb. Acc. Sci. e Lett*. 97(5):119–132.

Baskaran, N. 1990. *An ecological investigation on the dietary composition and habitat utilization of sloth bear (*Melursus ursinus *Shaw) at Mudumalai Wildlife Sanctuary, Tamil Nadu (south India).* M. A. Thesis, A.V.C. Coll. (Bharathidasan Univ.), Mannampandal, India. 57 pp.

Bauer, K., and Spitzenberger, F. 1989. Rote Liste der in Österreich gefährdeten Säugetierarten. *Rote Listen der gefährdeten Vögel und Säugetiere Österreichs und Verzeichnisse der in Österreich vorkommenden Arten*. Bauer, K. (ed.). Pp. 53–58. Österreichische Gesellschaft für Vogelkunde, Wien.

Baumann, H. 1963. *Gold and gods of Perú*. Pantheon Books, New York: 81. 218 pp.

Beard, J.S. 1946. Los climax de vegetación en la América tropical. *Revista Fac. Nac. de Agronomía de Medellín* 6:225–293.

Beard, J.S. 1955. The classification of tropical American vegetation types. *Ecology* 36:89–100.

Belikov, S.E., and Boltunov, A.N. 1998. Problems with conservation and sustainable use of polar bears in the Russian Arctic. *Int. Conf. Bear Res. and Manage*. 10:119–128.

Bensky, D., and Gamble, A. 1986. *Chinese herbal medicine materia medica*. Eastland Press, Seattle. 700+ pp.

Bergstrøm, M.R., Bø, T., Franzén, R., Henriksen, G., Nieminen, M., Overrein, Ø. og Stensli, O.M. 1993. Bjørn, gaupe, jerv og ulv på Nordkalotten. Statusrapport 1993. *Nordkalottkomitéens Rapportserie* 30:1–56.

Bharos, A.M.K. 1988. Albino sloth bear. *J. Bombay Nat. Hist. Soc.* 85:187.

Bjärvall, A. 1980. The brown bear in Sweden – distribution, abundance, and management. *Int. Conf. Bear. Res. and Manage*. 4:255–257.

Blanco, J.C., Reig, S., and Cuesta, L. 1992. Distribution, status and conservation problems of the wolf (*Canis lupus*) in Spain. *Biol. Conserv*. 60:73–80.

Bloxam, Q. 1977. Breeding the spectacled bear at the Jersey Zoo. *1977 Int. Zoo Yearbook* 17:158–161.

Bobek, B., Perzanowski, K., Kwiatkowski, Z., Lesniak, A., and Seremet, B. 1993. Economic aspects of brown bear and wolf predation in southeastern Poland. *Int. Wildl. Manage. Congress, San Jose, Costa Rica Abstr.*

Bonney, R.C., Wood, D.J., and Kleiman, D.G. 1982. Endocrine correlates of behavioral oestrus in the female giant panda (*Ailuropoda melanoleuca*) and associated hormonal changes in the male. *J. Reprod. Fert.* 64:209–215.

Boscagli, G. 1987. Brown bear mortality in Central Italy from 1970 to 1984. *Int. Conf. Bear Res. and Manage.* 7:97–98.

Boscagli, G. 1990. Marsican Brown Bear population in central Italy-status report 1985. *Aquilo Ser. Zool.* 27: 81–83.

Boscagli, G. 1991. Metodo di valutazione dei popolamenti d'orso col "field-tracking". Esperienze e problemi di applicazione in Italia. *Atti II Sem. It. Cens. Faunistici dei Vertebrati, Brescia 6–9 Apr. 1989, Suppl. Ric. Selv.* XVI:545–547.

Boscagli, G., Pellegrini, Ms., Febbo, D., Pellegrini, Mr., Castellucci, C., and Calo, C.M. In press. Distribuzione storica recente (1900–1991) dell'orso bruno marsicano (*Ursus arctos marsicanus*) all'esterno del Parco Nazionale d'Abruzzo. *Atti Soc. It. Sci. Nat., Milano* 134.

Bouchet, J.C. 1988. *Histoire de la chasse à la grande faune dans les Pyrénées françaises du 16 ème au 20 ème siècle.* Thèse 3ème cycle, Université de Pau Pays de l'Adour.

Bourdelle, E. 1937. Quelques précisions sur la répartition de l'ours dans les Pyrénées françaises. *Bull. Soc. Nat. Accl. France.*

Boyce, M.S., Manley, B.F.J., Cherry, S., Knight, R.R., and Servheen, C. In press. Cumulative counts of unique individuals for estimating population size. *J. Wildl. Manage*.

Brack-Egg, A. 1961. El oso de anteojos. *Biota* 3:345–350.

Brana, F., Del Campo, J. C., and Lastra, C. 1979. Sobre el oso pardo en la Cordillera Cantabrica. *Acta Biol. Mont*. 1:91–101.

Brana, F., Del Campo, J.C., and Palomero, G. 1982. Situación del oso pardo en la Cordillera Cantábrica. *Quercus* 2:38–40.

Brander, A.A.D. 1982. *Wild animals in central India*. Natraj Publishers, Dehra Dun, India. 296 pp.

Brandon, K. 1996. Traditional peoples, nontraditional times: social change and the implications for biodiversity conservation. Pp. 219–236 *in:* Redford, K.H. and Mansour, J.A., (eds.) *Traditional peoples and biodiversity conservation in large tropical landscapes*. American Verde Publ., The Nature Conservancy, Arlington, VA.

Brewer, G.D., and deLeon, P. 1983. *The foundations of policy analysis*. Dorsey Press, Homewood, Illinois. 376 pp.

Broch, H. 1954. *Zoologiens historie i Norge til annen verdenskrig*. Akademisk Forlag, Oslo.

Bromley, D.W. 1994. Economic dimensions of community-based conservation. Pp. 428–447 *in:* Western, D., Wright, R.M., and Strum, S.C., (eds.) *Natural connections, perspectives in community-based conservation*. Island Press, Washington, D.C.

Bromley, G.F. 1956. Himalayan bear. *Zool. zhurn*. 35(l). (In Russian)

Bromley, G.F. 1965. *Bears of the South of the Far East of the USSR*. Moscow-Leningrad. 120 pp. (In Russian).

Brown, A.D. and Rumiz, D.I. 1989. Habitat and distribution of the spectacled bear (*Tremarctos ornatus*) in the southern limit of its range. Pp. 93–103. *in*: M. Rosenthal (ed.) *Proc. First Int. Symp. Spectacled Bear*. Lincoln Park Zoological Gardens, Chicago Park District Press, Chicago, Illinois, U.S.A.

Brown, D.E. 1985. *The grizzly in the southwest, documentary of an extinction*. 274 pp. Univ. of Oklahoma Press, Norman, OK.

Brown, F., and Wyckoff-Baird, B. 1992. *Designing integrated conservation and development projects.* Washington, D.C.: Biodiversity Support Program of WWF, TNC and WRI. 62 pp.

Bryant, C., and White, L.G. 1982. *Managing development in the third world*. Westview Press, Boulder, Colorado. 322 pp.

Buchalczyk, T. 1980. The brown bear in Poland. [In: "Bears – Their Biology and Management", C.J. Martinka and K.L. McArthur, eds]. *Bear Biol. Assoc. Conf. Ser.* 3:229–232.

Bunnell, F.E., and Tait, D.E.N. 1980. Bears in models and reality – implications to management. *Int. Conf. Bear Res. and Manage*. 4:15–23.

Bunsch, A. 1967. Jeden z ostatnich. Wierchy, 36: 266–267.

Burzynski, W. 1931. L'ours dans les Carpates orientales. *Ochrona Przyrody* 11:56–70.

Caldecott, J. 1988. *Hunting and wildlife management in Sarawak*. IUCN, Gland, Switzerland and Cambridge, UK. 172 pp.

California Dept. of Fish and Game. 1992. *Final environmental document, sections 265, 265, 366, 367.5, Title 14, California code of regulations regarding bear hunting.* California Dept. Fish and Game, Sacramento, California.

Camarra, J.J. 1990a. Aire de répartition et zones d'activités de l'ours brundans les Pyrénées françaises. *Bull. Mens. de l'O.N.C.* 142:23–25.

Camarra, J.J. 1990b. L'ours dans les Pyrénées. Suivi de la population de 1977 à 1988. *Bull. Mens. O.N.C.* 142:18–22.

Camarra, J.J. 1992. Monitoring techniques of small bear population: application in the western Pyrenees. *9th Int. Conf. Bear Res. Manage*. Grenoble, France (in review).

Camarra, J.J. 1994a. *Suivi de la populaiton d'ours brun des Pyrenees francaises pour 1993.* Rapport intern au Resau Ours Brun.

Camarra, J.J. 1994b. *Essai preliminaire d'individualisation des derniers specimens d'ours brun des Pyrenees par prise de vue photographique a declenchement automatique*. Rapport interne de l'Office National de la Chasse. 11 pp.

Camarra, J.J., and Parde, J.M. 1990. The brown bear in France, status and management in 1985. *Aquilo Ser. Zoologica Tom.* 27:93–96.

Camarra, J.J., and Dubarry, E. 1992. The brown bear in the French Pyrenees: distribution, size and dynamics of the population from 1988 to1992. *Int. Conf. Bear Res. and Manage*. 9: Grenoble, France (in review).

Camarra, J.J., Salinas, R., Larras, J.P., Migot, P., and Stahl, P. 1993. Bilan d'intervention sur un ours à problèmes dans les Pyrénées Atlantiques. *Actes du 16èmeColloque Soc. Franç. Et. Pro. Mamm*., 17–18 Oct. 1992, Grenoble, France: 132–145.

Campo, J.C. del, Marquinez, J., Naves, J., and Palomero, G. 1984. Distribucion y aspectos poblacionales del oso pardo en la cordillera Cantabrica. *Acta Biol. Mont.* 4:371–381.

Carlock, D.M., Conley, R.H., Collins, J.M., Hale, P.E., Johnson, K.G., and Pelton, M.R. 1983. *Tri-state black bear study.* Tech. Rep. No. 83–9. Tenn. Wildl. Resour. Agency, Knoxville. 286 pp.

Caro, T.M., and Laurenson, M.K. 1994. Ecological and genetic factors in conservation: a cautionary tale. *Science* 263:485–486.

Carpenter, R.A. 1989. Giant panda controversy. *Buzzworm* 1:16–29.

Casley, D.J., and Kumar, K. 1987. *Project monitoring and evaluation in agriculture*. Johns Hopkins Univ. Press, Baltimore, Maryland, U.S.A. 159 pp.

Catton, C. 1987. Hua-Hua eschews cuddly reputation. *BBC Wildlife* 5:641.

Caussimont, G., et Herrero, J. 1992. L'ours brun dans les Pyrénées espagnoles: statut actuel et historique du déclin d'une petite population. *Int. Conf. Bear Res. and Manage*. 9: Grenoble, France (in review).

Caussimont, G., Garcia-Serrano, A., and Herrero, J. 1993 El oso pardo en Aragon y Navarra. *in*: Naves, J., and Palomero, G. (eds.) *El oso pardo en Espana.* Coleccion Tecnica, ICONA, Madrid.

Cavelier, J. 1993. Deforestation of montane forests in Colombia as a result of illegal plantations of opium (*Papaver somniferum*). P. 23 *in:* H. Balslev, (ed.) *Neotropical montane forests. Biodiversity and conservation.* Abstracts from a symposium held at the New York Botanical Garden, June 21–26, 1993. Aarhus Univ. Press, Aarhus, Denmark.

Chang, H.Z., Chang, S.T., Shiao, M.L., Liao, C.H., Wen, K.C., Chiang, S.M., Liu, F.S., Chao, T.Y., and Liao, W.B. 1995. *Market report on the bear gall bladder in Taiwan*. 16 pp. Department of Health, The Executive Yuan, Taiwan, R.O.C.

Chaudhuri, M., Kleiman, D.G., Wildt, D.E., Bush, M., Frank, E.S., and Thau, R.B. 1988. Urinary steroid concentrations during natural and gonadotrophin-induced estrus and pregnancy in the giant panda (*Ailuropoda melanoleuca*). *J. Reprod. Fert.* 84:23–28.

Chazee, L. 1990. *The mammals of Laos and the hunting practices*. Unpubl. Report, Vientiane. 81 pp.

Chen, C.S. 1956. *Vertebrate fauna in Taiwan*. Kaiming Press, Taipei.

Chestin, I.E. 1993. Brown bear-human conflicts in Russia. *Report to the Interagency Grizzly Bear Committee, U.S.A.*

Chestin, I.E. In press. Dynamics of the brown bear range in European Russia and Western Siberia. *Int. Conf. Bear Res. & Manage. 9.*

Chestin, I.E., and Poyarkov, A.D. 1993. Preliminary data on the illegal wildlife trade in Russia. *Proc. of 1st Int. Wildl. Manage. Congress.* 19–25 September, 1993, San Jose, Costa Rica.

Chestin, I.E., Poyarkov, A.D., and Stepanitzkiy, V.B. 1994. Evaluation of the illegal wildlife trade in Russia. Final Report, W.W.F. Moscow Project RU 0006.

Chestin, I.E., Gubar, Y.P., Sokolov, V.E., and Lobachev, V.S. 1992. The brown bear (*Ursus arctos* L.) in the USSR: numbers hunting and systematics. *Ann. Zool. Fennici* 29:57–68.

Choudhary, R. 1987. Methodology for population estimates of herbivores: a statistical approach in Indian conditions. *Tiger Paper* 14:11–17.

Choudhury, A. 1993. Potential biosphere reserves in Assam (India). *Tiger Paper* 20(1):2–8.

Chivers, D.J. 1986. Wildlife conservation in Bangladesh. *TREE* 1:34–35.

Cifuentes, M., Ponce, A., Albán, F., Mena, P., Mosquera, G., Rodriguez, J., Silva, D., Suárez, L., Tobar, A. y Torres, J. 1989. *Estrategia para el Sistema Nacional de Areas Protegidas, II Fase*. Ministerio de Agricultura y Ganadería y Fundación Natura, Quito, Ecuador.

Clark, T.W., and Harvey, A. 1991. Implementing recovery policy: learning as we go? Pp. 147–163 *in:* Kohm, K.A., (ed.) *Balancing on the brink of extinction: the Endangered Species Act and lessons for the future*. Island Press, Washington, D.C.

Clark, T.W., Peyton Curlee, A., and Reading, R.P. 1996. Crafting effective solutions to the large carnivore conservation problem. *Conserv. Biol.* 10:940–948.

Clevenger, A.P., 1990. Biologia del oso pardo en la Cordillera Cantabrica. D.Sc. Thesis, Univ. de Leon, Spain.

Clevenger, A.P., and Purroy, P. 1988. *El oso en León*. Servicio de publicaciones de la Universidad de León, León.

Clevenger, A.P., and Purroy, F.J. 1991a. Demografia del oso pardo en la Cordillera Cantabrica. *Ecologia* 5:243–256.

Clevenger, A.P., and Purroy, F.J. 1991b. Ecologia del oso pardo en Espana. *Mus. Nac. de Cienc. Natur. Monogr.* 4.

Clevenger, A.P., Purroy, F.J., and Saenz de Buruaga, M. 1987. Status of the brown bear in the Cantabrian Mountains, Spain. *Int. Conf. Bear Res. and Manage.* 7:1–8.

Clevenger, A.P., Purroy, F.J., Pelton, M.R. 1992b. Brown bear (*Ursus arctos* L.) habitat use in the Cantabrian Mountains, Spain. *Mammalia* 56:203–214.

Clevenger, A.P., Purroy, F.J., and Saenz de Buruaga, M. 1992a. Copulation of wild European brown bears, with comments on the breeding behaviour of one adult male. *Mammalia* 56:3–8.

Codazzi, A. 1970. *Las Memorias*. Ediciones de la Biblioteca, Universidad Central de Venezuela. Caracas. 208 pp.

Collet, R. 1911–1912. *Norges Hvirveldyr I. Norges Pattedyr*. Aschehoug, Kristiania. 744 p.

Consejeria de Medio Ambiente y Urbanismo. 1992. Plan de Caza de las Reservas Regionales: 1992–1994. Oviedo.

Corbet, G.B. 1978. *The mammals of the Palearctic Region: a taxonomic review*. (Brit. Mus. Nat. Hist.) Cornell Univ. Press, London and Ithaca. 314 pp.

Council of Europe. 1989. Workshop on the situation and protection of the brown bear (*Ursus arctos*) in Europe, Strasbourg. *Environmental Encounter Ser.* 6.

Couturier, M. 1954. *L'Ours Brun.* Ed. Artaud, France. 903 pp.

Cowan, I. McT. 1972. The status and conservation of bears (Ursidae) of the world – 1970. *Int. Conf. Bear Res. and Manage.* 2:343–367.

Craighead, L. 1994. *Conservation genetics of grizzly bears.* Ph.D. thesis, Montana State University. 227 pp.

Craighead, L., Paetkau D., Reynolds, H.V., Vyse, E.R., and Strobeck, C. 1995. Microsatellite analysis of paternity and reproduction in Arctic grizzly bears. *J. Hered.* 86:255–261.

Croll, E., and Parkin, D., (eds.) 1992. *Bush base: forest farm, culture, environment, and development*. Routledge, London, U.K. 262 pp.

Cronin, M.A., Palmisciano, D.A., Vyse, E.R., and Cameron, D.G. 1991a. Mitochondrial DNA in wildlife forensic science: species identification of tissues. *Wildl. Soc. Bull*. 19:94–105.

Cronin, M.A., Amstrup, S.C., Garner, G.W., and Vyse, E.R. 1991b. Interspecific and intraspecific mitochondrial DNA variation in North American bears (*Ursus*). *Can. J. Zool*. 69:2985–2992.

Curry-Lindahl, K. 1972. The brown bear (*Ursus arctos*) in Europe: decline, present distribution, biology, and ecology. *in*: Herrero, S. (ed.) *Bears, their biology and management*. *IUCN New Ser. Publ.* 23:74–80.

Cuvier, G. 1823. *Researches sur les ossements fossiles, etc.* Nouvelle Edition, Vol. IV. Paris. Chapter III: 311–380.

Dahle, L. 1987. *Haldningar til bjørn, jerv og ulv i Noreg*. Masters thesis, Norwegain Agriculture University (In Norwegian).

Daldoss, G. 1972. *Rilievi sulla presenza dell'orso bruno nel quinquennio 1967–1971*. WWF. C.A.I., Trento.

Daly, D.C. 1996. The leaf that launched a thousand ships. *Natural History* 105:24–31.

Dathe, H. 1967. Bemerkungen zur Aufzucht von Brillenbaren (*Tremarctos ornatus* Cuvier) im Tierpark Berlin. *Der Zoologishe Garten, Liepzig* 34:105–133.

Davidar, E.R.C. 1983. Sloth bear's (*Melursus ursinus*) method of hunting for termite nests. *J. Bombay Nat. Hist. Soc.* 80:637.

Davies, G. and Payne, J. 1982. *A faunal survey of Sabah*. IUCN/WWF Project No. 1692. Kuala Lumpur. 279 pp.

Davis, D.D. 1955. Masticatory apparatus in the spectacled bear (*Tremarctos ornatus*). *Fieldiana: Zoology*, Chicago 37:25–46.

Davis, D. 1964. The giant panda: A morphological study of evolutionary mechanisms. *Fieldiana: Zoology Memoirs* 3:1–339.

Dean, F.C. 1987. Brown bear density, Denali National Park, Alaska, and sighting efficiency adjustment. *Int. Conf. Bear Res. and Manage.* 7:37–43.

Debazac, E. and Mavrommatis, G. 1971. Les grandes divisions ecologiques de la vegetation forestiere en Grece continentale. *Bull. Soc. Bot. Fr.* 118:429–452.

Del Campo, J.C. 1989. Legal and social aspects of the conservation of the brown bear in Spain: a governmental approach. *Environmental Encounter Ser.* 6:93–103.

Del Campo, J.C., Marquinez, J., Naves, J., and Palomero, G. 1984. Distribución y aspectos poblacionales del oso pardo en la Cordillera Cantábrica. *Acta Biol. Mont*. 4:371–378.

Del Campo, J.C., Marquinez, J., Naves, J., and Palomero, G. 1986. L'ours des Monts Cantabriques. *Acta Biol. Mont*. 6:93–103.

De Wulf, R.R., Goossens, R.E., MacKinnon, J.R., and Wu, S.C. 1988. Remote sensing for wildlife management: Giant panda habitat mapping from Landsat MSS Images. *Geocarto International* 1:41–50.

DeVoto, B., ed. 1953. *The journals of Lewis and Clark*. Boston, Houghton Mifflin.

Deuve, J. 1972. *Les mammiferes du Laos*. Minsitere de l'Education Nationale, Vientiane. 186 pp.

Diaz, A. 1989. *Manual de prevencíon y control de incendios forestales*. Consejo Nacional de Ciencia y Tecnología y Círculo de Estudios Geográphicos U.N.M.S. 56 pp.

Dieberger, J., and Rauer, G. 1991. Arbeitsbericht über die wissenschaftliche Begleitforschung zum Bärenprojekt des WWF Österreich im Jahr 1989. *Bericht des Forschungsinstituts WWF Österreich, Heft* 2:18–32.

Dierenfeld, E.S., Hintz, H.F., Robertson, J.B., Van Soest, P.J., and Oftedal, O.T. 1982. Utilization of bamboo by the giant panda. *J. Nutrition* 112:636–641.

Dizon, E.A., Lockyer, C., Perrin, W.F., Demaster, D.P., and Sisson, J. 1992. Rethinking the stock concept: a phylogenetic approach. *Conserv. Biol*. 4:417–422.

DN. 1993a. *Forskrift om forvaltning av bjørn, jerv, ulv og gaupe*. Directorate for Nature Management, Landøkologisk avd., Rundskriv 3/93.

DN. 1993b. *Regler om erstatning for skader på husdyr voldt av bjørn, jerv, ulv, gaupe og kongeørn, og om kompensasjon for ulemper for dyreeier, fastsatt 8. mars 1993 av* Miljøverndepartementet. – Directorate for Nature Management, Landøkologisk avd., Rundskriv 4/93.

Dodson, C. and Gentry, A.H. 1991. Biological extinction in western Ecuador. *Ann. Missouri Bot. Gar.* 78: 273–295.

Dokus, A., Orlic, S., Oreskovic, Z., Zgela, M., Matic, S., and Orsanic, M. 1992. Sumski rasadnici (Forest nurseries). Pp.101 – 104 i*n:* Raus, D. (ed.) *Sume u Hrvatskoj* (*Forests of Croatia*). Faculty of Forestry and “Hrvatske sume”, Zagreb.

Donovan, R. 1994. BOSCOSA: forest conservation and management through local institutions (Costa Rica). Pp. 215–233 *in:* D. Western, Wright, R.M., and Strum, S.C., (eds.) *Natural connections, perspectives in community-based conservation*. Island Press, Washington, D.C.

Dood, A.R., and Pac, H.I. 1993. *Five year update of the programmatic environmental impact statement: the grizzly bear in Northwestern Montana, 1986–1990.* Montana Dept. of Fish Wildl. and Parks, Kalispell.

Dove, M.R. 1996. So far from power, so near to the forest: a structural analysis of gain and blame in tropical forest development. Pp. 41–58 *in:* Padoch, C. and Peluso, N.L., (eds.) *Borneo in transition: people, forests, conservation and development.* Oxford Univ. Press, Kuala Lumpur.

Downer, C.C. 1993. *Accounts of spectacled bears and mountain tapir in the Northern Andes of South America.* Unpublished Report to the Bear Survival Committee.

Eberhardt, L.L., and Knight, R.R. 1996. How many grizzlies in Yellowstone? *J. Wildl. Manage*. 60:416–421.

Eckstein, S. 1983. Revolution and redistribution in Latin America. Pp. 347–386. *in*: McClintock, C. and Lowenthal, A.F., (eds.) *The Peruvian experiment reconsidered.* Princeton University Press, Princeton.

Eisenberg, J.F., and Lockhart, M. 1972. An ecological reconnaissance of Wilpattu National Park, Ceylon. *Smithsonian Contributions to Zoology* 101:1–118.

Ekman, S. 1910. *Norrlands jakt och fiske*. Norrländskt Handbibliotek, Uppsala, Sweden.

Elgmork, K. 1978. Human impact on a brown bear population (*Ursus arctos L.*). *Biol. Conserv*. 13:81–103.

Elgmork, K. 1979a. *Bjørn i naturen*. Gyldendal, Oslo. 179 pp.

Elgmork, K. 1979b. Bjørn i områdene nord for Oslo 1948–78. *Fauna* 32:49–51.

Elgmork, K. 1983. Influence of holiday cabin concentrations on the occurence of brown bears (*Ursus arctos L.*) in south-central Norway. *Acta Zool. Fennica* 174:161–162.

Elgmork, K. 1988. Reappraisal of the brown bear status in Norway. *Biol. Conserv*. 46:163–168.

Elgmork, K. 1990. Human impact on a brown bear population (*Ursus arctos* L.). *Biol. Conserv*. 13: 163–168.

Elgmork, K. 1994. The decline of a brown bear (*Ursus arctos L.*) population in south-central Norway. *Biol. Conserv*. 69:123–129.

Elgmork, K. og Mysterud, I. 1977. Bjørn i Norge 1977. *Norsk Natur* 13:219–238.

Environmental Agency of Japan. 1979. *Report on mammal distribution research*. 91 pp. (In Japanese)

Environmental Agency of Japan. 1991. *The Japanese red data book.* (In Japanese)

Erdbrink, D.P. 1953. *A review of fossil and recent history of the bears of the old world with remarks on their phylogeny based upon their dentition*. Drukkerj Jan de Lange, Deventer, The Netherlands.

Erickson, A.W. 1966. Spectacled bear status survey in South America. *The Ark Under Way. 2nd rept., World Wildlife Fund 1965–1967*, Morges, Switzerland: 206–207.

Erome, G. 1993. Historique de la disparition de l’ours brun dans les Alpes françaises. *Actes du 16éme Colloque de la Soc. Franç. Et. Prot. Mamm*., 17–18 Octobre 1992, Grenoble, France: 120–126.

Erome, G. et Michelot, J. L. 1990. L’ours dans les Alpes françaises. Faisabilité de sa réintroduction. CORA, Maison deValérie, Artus, Ministère de l’Environnement. 409 pp.

E.U. Greek Ministry of Agriculture. 1988 (unpublished). Brown bear conservation project, Ministry of Agriculture, Game Dept. (internal report). 125 pp.

Eulert, C.F. 1995. Evaluación del estado actual del jucumari (*Tremarctos ornatus* Cuvier), en el Parque Nacional Amboro, Santa Cruz, Bolivia. Tesis de licenciatura Carrera de Biologia, Universidad Autónoma Gabriel René Moreno, Santa Cruz. 89 pp.

Ewer, R. 1973. *The Carnivores.* Cornell Univ. Press, Ithaca, New York, U.S.A. 494 pp.

Ewers, J.C. 1958. *The Black Feet: Raiders on the northwestern plains*. U. of Oklahoma Press, Norman, Oklahoma.

Fain, S.R., Jarrell, P., Morse, C., Nicholson, A., Gill, S., Collins, D., and Ball, J. 1995. DNA analysis and wildlife law enforcement: efforts to stop international commerce in bear products can benefit greatly by the valuable resource of zoo breeding programs. Pp. 23–24. In: *Abstracts for the Fall Meeting of the Northwest Association of Forensic Scientists*. Ashland, Oregon.

Fan, Z., and Song, L. 1997. Current status and conservation of bears in China and Chinese bear farms. Pp. 5–19 *in:* Gaski, A.L., and Williamson, D.F., (eds.) *Proc. 2nd Int. Symp. on the Trade of Bear Parts,* Seattle, Washington. Traffic USA/WWF. 239 pp.

Ferreyros, A. 1988. *Situación actual de los parques nacionales y otras unidades de conservación en el Perú*. Asociación de Ecología y Conservación (ECCO), Lima. 21 pp.

Figueroa, S. 1983. *Importancia y conservación de la vida silvestre Ecuatoriana*. Ministerio de Agricultura y Ganadería. Programa Nacional Forestal, Quito, Ecuador.

Fikkan, A., Osherenko, G., and Arikainen, A. 1993. Polar bears: the importance of simplicity. In: Young, O.R. and Osherenko, G. (Eds.). Pp. 96–151. *Polar politics: creating international environmental regimes*. Cornell Univ. Press, Ithaca.

Filonov, K.P. 1981. *Predatory mammals*. Pp. 5–26. TZNIL Glavokhota RSFSR, Moscow. (In Russian)

Fischer, J.B. 1830. *Synopsis Mammalium. Stuttgardtiae 1829*. Ursidae: pp. 141–146. Addenda emendanda et index ad synopsis mammalium: 356–357.

Floyd, T. and Nelson, R.A. 1990. Bone metabolism in black bears. *Int. Conf. Bear Res. and Manage*. 8:135–137.

Frafjord, K. 1988. Some newspapers' attitudes toward the wolf (*Canis lupus*), bear *(Ursus arctos L.*), wolverine (*Gulo gulo*), and lynx (*Lynx lynx*) in Norway. *Fauna* 41:101–103. (In Norwegian).

Franklin, E.R. 1980. Evolutionary change in small populations. Pp. 135–149. *in*: Soulé, M.E. and Wilcox, B.A., (eds.) *Conservation Biology*. Sinauer Associates, Sunderland.

Friedmann, J. 1973. *Retracking America: a theory of transactive planning*. Doubleday, New York. 289 pp.

Frkovic, A., Ruff, R., Cicnjak, L., and Huber, D. 1987. Brown bear mortality during 1946–85 in Gorski Kotar, Yugoslavia. *Int. Conf. Bear Res. and Manage*. 7:87–92.

Furubayashi, K., Hirai, K., Ikeda, K., and Mizuguchi, T. 1980. Relationships between occurrence of bear damage and clearcutting in central Honshu, Japan. *Int. Conf. Bear. Res. and Manage*. 4:81–84.

Gadgil, M, and Guha, R. 1992. *This fissured land. An ecological history of India*. University of California Press, Berkeley. 274 pp.

Gallarati Scotti, G.G. 1962. *Gli ultimi orsi bruni delle Alpi*. Vimercate, pp. 16.

Gao, Z.S. and Pan, W.S. 1989. The giant pandas of Qinling: response to selective cut of forest. *Abstract to the Fifth International Theriological Congress*, Rome, Italy.

Garcia-Gaona, J.F. In press. The damages attributed to the brown bear in Spain: the case of Asturias. *Int. Conf. Bear Res. and Manag*. 9.

Garcia-Gaona, J.F., Roy, E., and Blanco, J.C. 1993. Daños del oso en la Cordillera Cantabrica. *in*: Naves, J. y Palomero, G. (eds.) *El oso pardo en España*. Colección Técnica, ICON, Madrid.

Garcia-Gaona, J.F., Gonzalez, F., Hernandez-Palacios, O., Naves, J., Palomero, G., and Solano, S. 1990. El lobo (*Canis lupus*) en Asturias. In Blanco, J.C., Cuesta, L., y Reig, S. ed.. *El lobo (*Canis lupus*) en España. Situación, problemática y apuntes sobre su ecología*. Colección Técnica, ICONA, Madrid.

Garshelis, D.L. 1994. Density-dependent population regulation of black bears. Pp. 3–14 *in:* Taylor, M., (ed.) Density-dependent population regulation in black, brown, and polar bears. *Int. Conf. Bear Res. and Manage. Monogr. Series* No. 3. 43 pp.

Garzon, P., Palacios, F., and Garzon, J. 1980. Situacion del oso pardo iberico (*Ursus arctos pyrenaicus*, Fischer 1899). *I Reunion Iberoamer. de Zool. Vert., La Rabida:* 681–683.

Gaski, A.L. 1997. An update on the bear trade. Pp. 62–76 *in:* Gaski, A.L., and Williamson, D.F., (eds.) *Proc. 2nd Int. Symp. on the Trade of Bear Parts,* Seattle, Washington. TRAFFIC USA/WWF. 239 pp.

Gaston, A.J and Garson, P.J. 1992. *A re-appraisal of the Great Himalayan National Park*. A report to the Himachal Pradesh Dept. of Forest Farming & Conservation, International Trust for Nature Conservation, WWF - India. 80 pp.

Gee, E.P. 1967. A note on the occurrence of the Malayan sun bear *Helarctos malayanus* (Raffles) within Indian limits. *J.Bombay Nat. Hist. Soc.* 64: 352–354.

Genov, P. and Gancev, R. 1987. Der Braunbar (*Ursus arctos* L.). Verbreitung und Beitrag zu Seiner Biologie. *Z. fur Jagdwiss* 33:145–153 (in Bulgarian).

Gentry, A.H. 1980. The flora of Perú: a conspectus and index to families. *Fieldiana Bot.* (N.S.)5:1–11.

Gentry, A.H. 1982. Neotropical floristic diversity: phytogeographical connections between Central and South America, Pleistocene climatic fluctuations, or an accident of the Andean orogeny? *Ann. Missouri Bot. Gard.* 69:557–593.

Gentry, A.H. 1986. Endemism in tropical vs. temperate plant communities. Pp. 153–181. *in*: Soule, M., (ed.) *Conservation Biology*. Sinauer Press, Sunderland, Massachusetts, U.S.A.

Gentry, A.H. 1991. Tropical forest biodiversity: distributional patterns and their conservation significance. *Oikos* 62:1–10.

Geptner, V.G., Naumov, N.P., Yurgenson, P.B., Sludskiy, A.A., Chirkova, A.F., and Bannikov, A.G. 1967. *Mammals of the Soviet Union. Vol. 2, part 1*, Moscow. "Vycshaya Shkola": 1004 pp. (in Russian)

Gilbert, R. 1896. Notes on the Indian bear (*Melursus ursinus*). *J. Bombay Nat. Hist. Soc.* 10: 688–690.

Ghimire, K. 1992. *Forest or farm? The politics of poverty and land hunger in Nepal*. Oxford University Press, New Delhi. 213 pp.

Glowacinski, Z., ed. 1992. *Polish Red Data Book of Animals*. PWRIL, Warszawa. 351 pp.

Gokula, V., Sivaganesan, N., and Varadarajan, M. 1995. Food of the sloth bear (*Melursus ursinus*) in Mundanthurai plateau, Tamil Nadu. *J. Bombay Nat. Hist. Soc.* 92:408–410.

Goldman, D., Giri, P.R., and O'Brien, S.J. 1989. Molecular genetic distance estimates among the Ursidae as indicated by one- and two-dimensional electrophoresis. *Evolution* 43:282–295.

Goldstein, I. 1989. Spectacled bear distribution and diet in the Venezuelan Andes. Pp. 2–16. *in:* Rosenthal, M., (Ed.) *Proc. First Int. Symp. Spectacled Bear*. Lincoln Park Zoological Gardens, Chicago Park District Press, Chicago, Illinois, U.S.A.

Goldstein, I. 1990. *Distribución y hábitos alimentarios del oso frontino (Tremarctos ornatus) en venezuela.* Trabajo de Grado. Magister en Ciencias Biológicas. Universidad Simón Bolívar, Caracas, Venezuela. 164 pp.

Goldstein, I. 1991. Spectacled Bear predation and feeding behavior on livestock in Venezuela. *Studies on Neotr. Fauna and Envir.* 26:231–235.

Gonzales, A. 1991. Physical landscape and settlement patterns. Pp. 19–38. *in*: Black, J.K., (ed.) *Latin America: its problems and its promise*. Westview Press, Boulder, Colorado, U.S.A.

Gopal, R. 1991. Ethological observations on the sloth bear (*Melursus ursinus*). *Indian Forester* 117:915–920.

Green, M.J.B. 1985. *An aspect of the ecology of the Himalayan Musk deer*. Ph.D Thesis, Cambridge University. 280 pp.

Green, M.J.B. 1993. *Nature Reserves of the Himalaya and the mountains of Central Asia*. World Conservation Monitoring Centre, IUCN, U.K. 471 pp.

Greve, C. 1892. Die Geographischen Verbreitung der Barenartigen – Zoologische Jahrbucher. *Abtheilung fur systematik, Geographie und Biologie der Thiere*. Jena, Germany 6:589–616.

Grimwood, I.R. 1969. Notes on the distribution and status of some Peruvian mammals. *Spec. Publ., Amer. Comm. Int. Wildl. Prot.*, New York Zool. Soc. 21:1–86.

Grodzinski, W. 1957. Materialy do fauny kregow cow Bieszczad Zachodnich. Zesz. nauk. *UJ Zool.* 10(1):177–221.

Groves, C.R. 1994. Candidate and sensitive species programs: lessons for cost-effective conservation. Pp. 227–250 *in:* Clark, T., Reading, R.P., and Clarke, A.L., (eds.) *Endangered species recovery: finding the lessons, improving the process.* Island Press, Washington, D.C.

Grumbine, R.E. 1994. What is ecosystem management? *Conserv. Biol*. 8(1): 27–38.

Grzimek, B. 1975. *Grzimek's Animal Life Encyclopedia: Mammals vol. 3*. Von Nostrand Reinhold Co., New York, New York, U.S.A. Pp. 117 and 142–143.

Gubar, Yu.P., Lobachev, V.S., and Chestin, I.E. 1992. Brown bear in the RSFSR: systematics, number and hunting. *in*: Novikov, B.V., (ed.) *Large predators*. TZNIL Glavokhota RSFSR, Moscow. (In Russian)

Gunchev, R.G. 1990. Studies on the exterior and somatic features of the brown bear (*Ursus arctos* L.) in Bulgaria (in Bulgarian, Engl. summ.) *Historia Naturalis Bulgarica* 2:67–78.

Gunson, J. 1995. Analysis of grizzly bear mortalities in Alberta during 1972–1994. *Occas. Paper Number 16*, Wildlife Mgt. Div., Alberta Envir. Protection. 101 pp.

Gutleb, B. 1993a. Verbreitung, Situation und Entwicklungschance des Braunbären (Ursus arctos) in Kärnten. *Endbericht des Projektes des Forschungsinstituts WWF-Österreich und der Kärntner Jägerschaft* 38 pp.

Gutleb, B. 1993b. *Geschichte und gegenwärtige Situation des Braunbären (Ursus arctos) in Kärnten. Carinthia II* 183(103):199–208.

Gurung, H. 1984. *Nepal: dimensions of development.* Shayogi Press, Kathmandu, Nepal. 275 pp.

Guyot *et al.* 1988. Aportaciones de sedimentos por el río Beni a los sitios potenciales de presas. *Actas del 2do. Simposio de Investigación Francesa en Bolivia*, La Paz: 107–113.

Hager, E. 1985. Bärwild: ja oder nein. *Österreichs Weidwerk* 6:4–6.

Haglund, B. 1968. De stora rovdjurens vintervanor. *Viltrevy* 5:213–361.

Hainard, R. 1961. *Mammiferes sauvages d'Europe: insectivores, cheiropteres, carnivores (vol. II).* Delachaux et Niestle (eds.) France. 322 pp.

Hall, E.R. 1981. *The mammals of North America*. 2nd ed. John Wiley and Sons, New York, N.Y. 1181 pp.

Hallowell, A.I. 1926. Bear ceremonialism is the northern hemisphere. *Amer. Anthropologist* (n.s.) 28: 1–175.

Hanai, M. 1990. The status of the Japanese black bear and a few problems with its management. *Proc. First E. Asiatic Bear Conf.*

Harris, R.B. 1986. *Grizzly bear population monitoring: currents options and considerations*. Mont. Forest and Conserv. Exp. Stn., Univ of Mont., Missoula Misc. Publ. 45. 80 pp.

Harris, R.B. 1986. Modeling sustainable harvest rates for grizzly bears. Pp. 286–279 in Dood, A., Brannon, R., and Mace, R. *Final programmatic environmental impact statement on the grizzly bear in northwestern Montana.* Montana Department of Fish, Wildlife, and Parks, Helena, Montana. 287 pp.

Hartl, D.L., and Clark, A.G. 1989. *Principles of population genetics*. Sinuaer Associates, Sunderland. 682 pp

Hashimoto, T., Otaka, E., Adachi, J., Mizuta, K., and Hasegawa. M. 1993. The giant panda is closer to a bear, judged by alpha and beta hemoglobin. *J. Mol. Evol.* 36:282–289.

Hazumi, T. 1992. Current status and management of the Asian black bear in Japan. *WWFJ Science Rept. 1* (2):293–333.

Heath, D.C., and Mellen, J.D. 1983. *Development of maternally reared sloth bear cubs in captivity*. Unpubl.ms. presented at the Sixth Int. Conf.Bear Res. and Manage.

Heggberget, T. and Myrberget, S. 1979. Bjørn, jerv, ulv og gaupe i Norge i 1970-årene. *Viltrapport* 9:37–45.

Hell, P., 1992. Biometrie und Bewirtschaftung der Population des Braunbären (*Ursus arctos*) in slowakischen Teil der Westkarpaten. *Vortrag gehalten auf der IX. Internat. Bären-Konferenz in Grenoble* (in press).

Hell, P., and Bevilaqua, F. 1988. Das Zusammenleben des Menchen mit dem Braunbären (*Ursus arctos*) in den Westkarpaten. *Zeitschr. für Jagdwiss*. 34(3): 153–163.

Hell, P., and Sabadoš, K. 1993. Evaluation of brown bear harvests (*Ursus arctos*) in the Western Carpathians during the period 1980–1991. *Folia venatoria* 23:183–201. (Original in Slovak)

Hell, P., and Sládek, J. 1974. *The trophy carnivores of Slovakia*. Príroda, Bratislava. 257 pp. (Original in Slovak)

Hell, P., and Sládek, J. 1994. Body parameters of brown bear in the Western Carpathians. *Folia venatoria* 24:111–123. (Original in Slovak)

Henderson, A.S., Churchill, S.P., and Luteyn, J. 1991. Neotropical plant diversity. *Nature* 351:21–22.

Heptner, V., Naumov, N., Jurgenson, P., Sludskiy, A., Tchirikova, A., and Bannikov, A. 1967. *The mammals of the Soviet Union Vol. 2/I*. Vishaya Shkola, Moscow. 1004 pp. (in Russian).

Herrera, A., Nassar, J., Michelangeli, F., Rodríguez, J., and Torres, D. 1992. The Spectacled Bear in the Sierra Nevada National Park of Venezuela. Pp. 61–82. *in*: Weinhardt, D., (ed.) *International Studbook for the Spectacled Bear,* 1991. Lincoln Park Zoological Gardens, Chicago, Ill.

Herrera, A., Nasser, J., Michelangeli, F., Rodriguez, J.P., and Torres, D. 1994. The spectacled bear in the Sierra Nevada National Park of Venezuela. *Int. Conf. Bear. Res. and Manage*. 9:149–156.

Herrero. S. 1985. *Bear Attacks: Their causes and avoidance.* 287 pp. Nick Lyons Books, New York, NY.

Herrero. S. 1994. The Canadian national parks and grizzly bear ecosystems: the need for interagency management. *Int. Conf. Bear. Res. and Manage*. 9:7–21.

Herrero. S. 1995. *Eastern slopes grizzly bear steering committee: Who are we and what are we doing?* Eastern Slopes Grizzly Bear Steering Committee, Univ. of Calgary, Calgary, Alberta, Canada.

Herrero. S., McCrory, W., and Pelchat, B. 1986. Using grizzly bear habitat evaluations to locate trails and campsites in Kananaskis Provincial Park. *Int. Conf. Bear Res. and Manage*. 7:199–213.

Higgins, J.C. 1932. The Malay bear. *J. Bombay Nat. Hist*. Soc. 35:673–674.

Hill, M.A., and Press, A.J. 1994. Kakadu National Park: an Australian experience in comanagement. Pp. 135–157 *in:* Western, D., Wright, R.M., and Strum, S.C., (eds.) *Natural connections, perspectives in community-based conservation*. Island Press, Washington, D.C.

Hirschman, A.O. 1967. *Development projects observed.* The Brookings Institute, Washington, D.C. 197 pp.

Hodges, J.K., Bevan, D.J., Celma, M., Hearn, J.P., Jones, D.M., Kleiman, D.G., Knight, J.A., and Moore, H.D.M. 1984. Aspects of the reproductive endrocrinology of the female giant panda (*Ailuropoda melanoleuca*) in captivity with special reference to the detection of ovulation and pregnancy. *J. Zool. Lond.* 203:253–267.

Hokkaido Institute of Evironmental Sciences. 1994. *Results of a survey related to sika deer and brown bear sightings in Hokkaido*. Hokkaido Institute of Environmental Sciences, Sapporo. 63+10 pp. (In Japanese)

Hokkaido Institute of Evironmental Sciences. 1995. *Report of brown bear and sika deer ecological survey*. Hokkaido Institute of Environmental Sciences, Sapporo. 164+30 pp. (In Japanese)

Hokkaido Prefectural Government. 1969. *Hunting policy in Hokkaido*. Hokkaido Government, Sapporo. 123 pp. (In Japanese)

Hokkaido Prefectural Government. 1978. Animal distribution survey report: mammals. In: *The 2nd Natural Environmental Conservation Survey*. Hokkaido Government, Sapporo. 22 pp. (In Japanese)

Hokkaido Prefectural Government. 1986. *Results of a survey related to sika deer and brown bear sightings in Hokkaido*. Hokkaido Natural Preservation Division, Sapporo. 115 pp. (In Japanese)

Honadle, G., and Vansant, J. 1985. *Implementation for sustainability; lessons from integrated rural development*. Kumaran Press, West Hartford, Conn. 128 pp.

Honacki, J.H., Kinman, K.E., and Koeppl, J.W. 1982. *Mammalian species of the world*. Association of systematic collections, Lawrence, Kansas.

Hoss, M., Kohn, M., Paabo, S., Knauer, F., and Schroder, W. 1992. Excrement analysis by PCR. *Nature* 359:199.

Hovey, F. and McLellan, B. In press. Estimating population growth of grizzly bears from the Flathead River drainage using computer simulations of reproductive and survival rates. *Can. J. Zool*.

Hu, J.C. 1989. *Life of the giant panda.* Chongqing University Press, Chongqing, Sichuan. 105 pp. (in Chinese).

Huber, D. 1990. The brown bear in Yugoslavia. *Aquilo Ser. Zool*. 27:63–65.

Huber, D. 1991–92. Smece ubija medvjeda (Garbage kills bear). *Ekoloski glasnik* 3(4):77–80.

Huber, D. 1993. Threatened protected natural regions and their fauna: with a special review of the brown bear. Pp. 123–128 *in*: Kraljevic, P. (ed.) *Animal victims of Croatian home land war 1990–1992.* Veterinarski fakultet Sveucilista u Zagrebu.

Huber, D., and Moric, S. 1989. Stete od mrkih medvjeda u Jugoslaviji (Brown bear damage in Yugoslavia). *Proceedings of the third symposium "Savremeni pravci uzgoja divljaci"*. Savez veterinara i veterinarskih tehnicara Jugoslavije, Beograd: 197–202.

Huber, D., and Roth, H.U. 1986. Home ranges and movements of brown bears in Plitvice Lakes National Park, Yugoslavia. *Int. Conf. Bear Res. and Manage*. 6:93–97.

Hugie, R.D. 1980. Species planning: an approach to black bear management and research in Maine. *Int. Conf. Bear. Res. and Manage*. 4:125–129.

Humboldt, A., and Bonpland, A. 1814. *Relation historique aux régions équinoxiales du Noveau Continent*. 3 vol., 4°, F.Schoell, Paris.

IGAC (Instituto Geográfico Agustín Codazzi). 1989. *Atlas básico de Colombia*. Instituto Geográfico Agustín Codazzi, Santafé de Bogotá. 446 pp.

Inderena–FEN. 1986. *Colombia: parques nacionales*. Instituto Nacional de los Recursos Naturales Renovables y del Ambiente, Financiera Electrica Nacional, Fondo para el Proteccion del Medio Ambiente Jose Celestino Mutis, Santafé de Bogotá. 262 pp.

India Proposal to CITES. 1989. *Proposal to include sloth bear in Appendix I of CITES.* Republic of India, Unpublished report. 17 pp.

Indurot. 1993. *Cartografía ambiental (1500*km^2*) del área de distribución del oso pardo en Asturias*. Universidad de Oviedo, Oviedo.

Injoque, F., Gutiérrez R., and Manrique L. 1991. *Una propuesta de criterios para la planificación institucional del sistema de áreas protegidas Perúano*. Documento de Trabajo No. 1. Programa Nacional de Parques Nacionales y Otras Areas Naturales Protegidas Por el Estado. Parques Nacionales–Perú, Lima. 13 pp.

Interagency Grizzly Bear Committee. 1986. Interagency grizzly bear guidelines. 100 pp.

Irecek, K. 1899. *The Bulgarian kingdom*. Khristo G. Danov, Plovdiv. 430 pp. (in Bulgarian).

Israel, S., and Sinclair, T. (eds.) 1987. *Indian wildlife, Sri Lanka, Nepal*. Insight Guides, APA Productions, Hong Kong. 363 pp.

Iswariah, V. 1984. *Status survey report and recommendations for conservation of the sloth bear in Ramnagaram Taluk, Karnataka.* WWF-India, unpubl.report, Bangalore. 34 pp.

IUCN. 1974. *Red Data Book: Mammalia*. IUCN, Morges, Switzerland.

IUCN 1984. Categories and criteria for protected areas. Pp. 47–53. *in*: McNeely, J.A., and Miller, K.R., (eds.) *National parks, conservation, and development: the role of protected areas in sustaining society*. Smithsonian Institute Press, Washington D.C., U.S.A.

IUCN. 1992. *Protected areas of the world: a review of national systems. Volume 4: Neararctic and Neotropical.* IUCN, Gland, Switzerland. 460 pp.

IUCN. 1996. 1996 IUCN Red List of Threatened Animals. IUCN,Gland, Switzerland.

IUCN/SSC Polar Bear Specialist Group. 1995. Summary of polar bear population status 1993. Pp. 19–24 *in*: Wiig, O., Born, E.W., and Garner, G.W., (eds.) *Proc. Eleventh Working Meeting of the IUCN/SSC Polar Bear Specialist Group*. IUCN, Gland, Switzerland

Iwate Prefecture 1990. *Status report of Japanese black bears in Iwate*. 146 pp. (In Japanese)

Jacobi, E.F. 1975. Breeding sloth bears in Amsterdam zoo. Pp. 351–356 *in:* R. D. Martin (ed.) *Breeding endangered species in captivity.* Academic Press, London.

Jakubiec, Z. 1990a. Distribution of the brown bear in Poland and problems concerning its protection. *Aquilo Ser. Zool*. 27:51–57.

Jakubiec, Z. 1990b. Szkody wyrzadzane przez niedzwiedzie w polskiej czesci Karpat w latach 1980–1988. *Mysliwiec* 18:29–36.

Jakubiec, Z. 1993. Factors affecting the survival of brown bears in the Polish Carpathian Mountains. In: *Ochrona Tatr w obliczu zagrozen*. W. Cichocki ed. Zakopane.

Jakubiec, Z., and Buchalczyk, T. 1987. The brown bear in Poland: its history and present numbers. *Acta Theriol.* 32(17):289–306.

Jaffeson, R.C. 1975. Melursus ursinus *survival status and conditions.* Unpubl. report. 37 pp.

Jakubiec, Z. 1987. Recolonization of the brown bear (*Ursus arctos*) in the Polish Carpathians. *Conference Proceeding about the brown bear in Slovakia, Zvolen* VÚLH:55–63.

Jamnický, J. 1988. The food of the brown bear (*Ursus arctos*) in the Tatra region (Slovakia). *Folia venatoria* 18:197–213. (Original in Slovak)

Janzen, D.H. 1976. Why bamboos wait so long to flower. *Ann. Rev. Ecol. Syst.* 7:347–391.

Japan Environmental Agency. 1991. *Red data book of Japan: vertebrates*. Japan Wildlife Research Center, Tokyo. 331 pp. (In Japanese)

Japan Wildlife Research Center 1987. *Report of forest research.* 176 pp. (In Japanese)

Java, R.L. 1991. Environment and wildlife conservation in Gujarat state – a status paper. *Indian Forester* 117:818–842.

Johns, A.D. 1985. Selective logging and wildlife conservation in tropical rain forest: problems and recommendations. *Biol. Conserv*. 31:355–375.

Johns, A.D. 1986. Effects of selective logging on the behavioral ecology of West Malayan primates. *Ecol.* 67:684–694.

Johnsingh, A.J.T. 1981. *Ecology and behaviour of the dhole or Indian wild dog* Cuon alpinus *Pallas 1811, with special reference to predator-prey relations at Bandipur.* Ph.D. dissertation., Madurai University, India. 306 pp.

Johnson, K.G., Schaller, G.B., and Hu, J.C. 1988. Responses of giant pandas to a bamboo die-off. *National Geographic Research* 4:161-177.

Johnson, K.G., Schaller, G.B., and Hu, J.C. 1996. *The home range, feeding habits, and social organization of sloth bears (*Melursus ursinus*) in Royal Chitwan National Park, Nepal.* Ph.D. dissertation, University of Minnesota, Minneapolis. 120 pp.

Jorgenson, J.P. 1984. Colombia. *Spectacled Bear Specialist Group Newsletter* 7:13.

Jorgenson, J.P., and Rodriguez, J.S. 1986a. Proyecto del oso frontino en Colombia. *Spectacled Bear Specialist Group Newsletter* 10:22–25.

Jorgenson, J.P., and Rodriguez, J.S. 1986b. Estudio preliminar de la distribución y el estado del oso frontino en Colombia. *Boletín Informativo GEOF* 10:Enclosure 6.4.

Joshi, A.R. 1997. Seasonal and habitat-related diets of sloth bears in Nepal. *J. Mammal.* 78:584–597.

Joshi, A.R., Garshelis, D.L. and Smith, J.L.D. 1995. Home ranges of sloth bears in Nepal: implications for conservation. *J. Wildl. Manag.* 59:204–214.

Kano, T. 1940. *Zoogeographical studies of Tsugitaka mountains of Formosa*. 145 pp. Shibusawa Institute of Ethnographic Resources, Tokyo.

Karpinski, J.J. 1947. Odrodzenie niedzwiedzia w Puszczy Bialowieskiej. Manuscript 1–29. Bialowieza.

Karpinski, J.J. 1949. La regeneration de l'ours dans la Foret de Bialowieza. *Bijdragen tot de Dierkunde* 28:218–236.

Kashentseva, T.A. 1990. Distribution and number of brown bears and lynx in the center of European part of RSFSR. Pp. 109–117 *in*: Priklonskiy, S.G., (ed.) Mnogoletnyaya dinamika prirodnykh obyectov Okskogo zapovednika, Moscow. (In Russian).

Katsarov, D. 1935. *Survey on the status of the bear in Bulgaria in 1934 and measures for its protection*. Lovna Biblioteka, Sofia 14: (in Bulgarian).

Katti, M., Manjrekar, N., Sharma, D., and Mukherjee, S. 1990. *Wildlife survey in Arunachal Pradesh with special reference to Takin. A report*. Wildlife Institute of India, Dehra Dun. 104 pp.

Kellert, S.R. 1994. Public attitudes towards bears and their conservation. *Int. Conf. Bear Res. and Manage*. 9:43–50.

Kellert, S.R. and Clark, T. 1991. The theory and application of a wildlife policy framework. Pp. 17–25 *in:* Mangun, W.R., and Nagel, S.S., (eds.) *Public policy and wildlife conservation*. Greenwood, New York, NY.

Khan, M.A.R. 1982. *Wildlife of Bangladesh*. University of Dhaka, Dhaka. 173 pp.

Khan, M.A.R. 1984. Endangered mammals of Bangladesh. *Oryx* 18:152–156.

Khramtsov, V.S. 1983. About the number of white-chest bear in the South-East of Primorye and factors influencing it. *Bulletin Moskovskogo obshchestva ispytateley prirody* 88(3):27–28. (In Russian with English summary).

Khramtsov, V.S. and Zhivotchenko, V.I. 1981. Interactions between black bears and other predators in Lazovskiy Reserve. Pp. 64–65 *in*: Uspenskiy, S.M. and Fazhetnov, V.S., (eds.) Ecologiya, morphologiya i ckhrana medvedey. *Abstracts of 2nd conf. Moscow.*

Kiersnowski, R. 1990. Niedzwiedzie i ludzie w dawnych i nowszych czasach. PIW. 471 Pp.

King, S. R. 1992. First in the ancient Americas, foods and medicines that changed the world. *Pacific Discovery* 45(1):23–31.

Kitchener, A.C. 1994. A review of the evolution, systematics, functional morphology, distribution, and status of the Ursidae. *Int. Zoo News* 242:4–24.

Kivilinna, M. 1936. *Suurmetsästäjiä ja suurriistaa* (Big game and its hunters: in Finnish). Otava, Helsinki.

Kivirikko, K.E. 1940. *Suomen selkärankaiset* (The vertebrates of Finland: in Finnish). Porvoo.

Kleiman, D.G. 1983. Ethology and reproduction of captive giant pandas (*Ailuropoda melanoleuca*). *Z. Tierpsychol.* 62:1–46.

Klein, D.R. 1963. Postglacial distribution patterns of mammals in the south coastal regions of Alaska. *Proc. of the Alaska Science Conf.* 14:65–66.

Knaus, W. 1972. Der Kärnter Bär. *Der Anblick:* 27, 237–239, 283–285.

Knight, R.R. and Eberhardt, L.L. 1985. Population dynamics of Yellowstones grizzly bears. *Ecology* 66:323–334.

Knight, R.R., Blanchard, B.M., and Eberhardt, L.L. 1988. Mortality patterns and populations sinks for Yellowstone grizzly bears, 1973–1985. *Wildl. Soc. Bull.* 16:121–125.

Knight, R.R., Blanchard, B.M., and Eberhardt, L.L. 1995. Appraising status of the Yellowstone grizzly bear population by counting females with cubs-of-the-year. *Wildl. Soc. Bull*. 23:245–248.

Kohn. M., Knauer, F., Stoffella, A., Schroder, W., and Paabo, S. 1995. Conservation genetics of European brown bear: a study using excremental PCR. *Mol. Ecol*. 4:95–103.

Kolstad, M., Kvam, T., Mysterud, I., Sørensen, O.J. og Wikan, S. 1984. Bjørn i Norge 1978–1982. Utbredelse og bestand. *Viltrapport* 31:1–68.

Kolstad, M., Mysterud, I., Kvam, T., Sørensen, O.J. og Wikan, S. 1986. Status of the brown bear in Norway: distribution and population 1978–1982. *Biol. Conserv*. 38:79–99.

Korhonen, H. 1935. *Martti Kitunen* (The great bear hunter of Finland, Martti Kitunen: in Finnish).

Kostoglod, V.E. 1981. Reconstruction of damaged white chest bear dens. Pp155–156 *in*: *Redkiye i ischezayushchiye zhivotniye sushi Dalnego Vostoka SSSR*. Vladivostok. (In Russian).

Kraus, E. 1993. Konzept-Entwurf für einen NÖ Artenschutzfonds. *Studie des Forschungsinstituts WWF-Österreich im Auftrag der NÖ Landesregierung/ Naturschutzabteilung.*

Kraus, E. and Kutzenberger, H. 1993. Artenschutz-programme von nationaler und internationaler Bedeutung. *Studie des Forschungsinstituts WWF-Österreich im Auftrag des Umweltbundesamts*.

Kr'e, B. 1988. Rjavi medved (Brown bear). In: Krystufek, B., Brancelj, A., Kr'e, B., and Cop, J eds. *Zveri II* (*Carnivors II*). Lovska zveza Slovenije, Ljubljana.

Krishna Raju, K.S.R., Krishna Murthy, A.V.R.G., Subba Reddi, C., Prasad Reddy, N.A.V., Lokaranjan, R., and Shankar, K.J.N.G. 1987. Status of wildlife and habitat conservation in Andhra Pradesh. *J. Bombay Nat. Hist. Soc.* 84:605–619.

Krishnan, M. 1972. An ecological survey of the larger mammals of peninsular India. *J. Bombay Nat. Hist. Soc.* 69:26–54.

Krpan, A.P.B. 1992. Iskoriscivanje suma (Forest exploitation). Pp. 153–170. *in*: Raus, D. (ed.) *Sume u Hrvatskoj* (*Forests of Croatia*). Faculty of Forestry and "Hrvatske sume", Zagreb.

Kucherenko, S.P. 1972. Brown and black bears of Amur Ussuri region. Pp.51–53 *in*: Sokolov, V.E., (ed.) Ecologiya, morphologiya, okhrana i ispolzovaniye medvedey. *Proc. of Int. conf. 'Nauka'*, Moscow. (In Russian)

Kucherenko, S.P. 1973. Bears of Amur-Ussuri region. *Okhota i okhotnichye khozaystvo* 2: 18–19. (In Russian.)

Kucherenko, S.P. 1975. What to do with black bears? *Okhota i okhotnichye khozaystvo* 10: 16–17. (In Russian)

Kurtén, B. 1966. Pleistocene bears of North America: Genus *Tremarctos*, spectacled bears. *Acta Zool. Fennica* 115:1–96.

Kurten, B. 1968. *Pleistocene mammals of Europe*. Aldine, Chicago.

Kvam, T., Vaag, A. B. & Sørensen, O.J. 1990. The brown bear in Norway: status and management. *Aquilo Ser. Zool*. 27:33–40.

Kvam, T., Berntsen, F., Eggen, T., Knutsen, K., Overskaug, K. and Sørensen, O.J. 1994. Annual report from the large carnivore projects of North-Trondelag 1993. *NINA Oppdragsmelding* 267:1–32.

Lamba, B.S. 1987. Status survey of fauna. *Nanda Devi National Park. Occasional Paper*. No. 103. Zoological Survey of India. 50 pp.

Landbruksdepartementet. 1975. Om norsk ernærings- og matforsyningspolitikk. *Stortingsmelding nr*. 32:1–184.

Landbruksdepartementet. 1976. Om landbrukspolitikken. *Stortingsmelding nr*. 14:1–183.

Landbruksdepartementet. 1992. Landbruk i utvikling. Om retningslinjer for landbruks-politikken og opplegget for jordbruksoppgjørene m.v. *Stortingsproposisjon* 8:1–55.

Lande, R. 1995. Mutation and conservation. *Conserv. Biol.* 9:782–791

Larsen, T., Tegelstrom, H., Kumar Juneja, R., and Taylor, M.K. 1983. Low protein variability and genetic similarity between populations of the polar bear (*Ursus maritimus*). *Polar Research* 1:97–105.

Lau, D., Melville, S., and Ngai, C. 1994. Study on bear gall bladders for sale in Hong Kong. *TRAFFIC Bulletin* 14:59–62.

Laurie, A., and Seidensticker, J. 1977. Behavioural ecology of the sloth bear (*Melursus ursinus*). *J. Zoology (London)* 182:187–204.

Lee, J., and Taylor, M. 1994. Aspects of the polar bear harvest in the Northwest Territories, Canada. *Int. Conf. Bear Res. Manage*. 9(1) 237–243.

Lekagul, B. and McNeely, J.A. 1977. *The mammals of Thailand*. Association for the Conservation of Wildlife, Bangkok. Second Edition (1988). 758 pp.

Lenkowa, A. 1966. W sprawie ochrony niedzwiedzia. *Chronmy Przyr. Ojcz.* 22(4):55–57.

Leo, M. 1993. The importance of tropical montane cloud forest for preserving vertebrate endemism in Perú: the Río Abiseo National Park as a case study. Pp. 198–211. *in*: Hamilton, L.S., Juvik, J.O., and Scatena, F.N., (eds.) *Tropical Montane Cloud Forests.* Springer–Verlag, New York, NY.

Leopold, A.S. 1959. *Wildlife of Mexico*. University of California Press, Berkeley. 608 pp.

Lewin, B. 1994. *Genes V*. Oxford University Press, Oxford, England. 944 pp.

Liberman, M. 1991. *Evaluación del impacto ambiental de la carretera Cotapata-Santa Bárbara*. Centro de Estudios Ecológicos y Desarrollo Integral (CEEDI-PCA), La Paz. 340 pp.

LIDEMA (ed.) 1992. *El estado del medio ambiente en Bolivia: propuestas políticas y programáticas.* Publication of the Liga de Defensa del Medio Ambiente, La Paz. 52 pp.

Lin, C.Y., and Lin, K. 1983. The preliminary study on the biogeography of Formosan mammals. *Taiwan Museum Bull*. 26:53–61.

Lindzey, F.G., Barber, K.R., Peters, R.D., and Meslow, E.C. 1986. Responses of black bear populations to a changing environment. *Int. Conf. Bear Res. and Manage*. 6:57–63.

Little, P.D. 1994. The link between local participation and improved conservation: a review of issues and experiences. Pp. 347–372 *in:* Western, D., Wright, R.M., and Strum, S.C., (eds.) *Natural connections, perspectives in community-based conservation*. Island Press,Washington, D.C.

Lönnberg, E. 1929. *Björnen i Sverige 1856–1928*. Almqvist & Wiksell, Uppsala & Stockholm, Sweden.

Lozada, R. 1989. Status of field biology on the spectacled bear in Colombia: a preliminary report. Pp. 28–37. *in*: Rosenthal, M., (ed.) *Proc. First Int. Symp. Spectacled Bear* Lincoln Park Zoological Gardens, Chicago, IL. 318 pp.

Lu, Z. 1993. Newborn panda in the wild. *National Geographic* 183:60–65.

Lu, Z. 1992. Population Dynamics, Activity Type, and Reproductive Organisation of Qinling's Giant Pandas. Ph.D thesis, Peking University.

Lu, Z. and Pan, W.S. 1989. The giant pandas of Qinling: distribution, population estimation and future. *Abstract to the Fifth International Theriological Congress*, Rome, Italy.

Luonnonvarainneuvosto. 1986. *Suomen suurpetokannat ja niiden hoito* (The big predator populations of Finland and their management: in Finnish). Luonnonvarainjulkaisuja Maa- ja metsätalousministeriö (Publications of Ministry of Agriculture and Forestry), Helsinki.

Lydekker, R. 1906. On the occurrence of the Bruang in the Tibetan Province. *Proc. Royal Soc. London*. 2:997–999

Mäensyrjä, P. 1971. *Korpiemme kontio* (The brown bear of our wildwood: in Finnish). Karisto, Hämeenlinna.

Machlis, G. and Marsh, J. 1988. *Protected area management and planning in China: a training manual.* Ministry of Forestry, Beijing and WWF, Gland, Switzerland.

Mace, G., Collar, N., Cooke, K., Gaston, K., Ginsberg, J., Leader Williams N., Maunder, M., and Milner-Gulland, E.J. 1992. The development of new criteria for listing species in the IUCN Red List. *Species* 19:16–22.

Mace, R. and Waller, J. 1997. *Final report: grizzly bear ecology in the Swan Mountains, Montana.* Montana Fish, Wildlife, and Parks. Helena, Montana. 191 pp.

Mace, R.D., Minta, S.C., Manley, T.L., and Aune, K.E. 1994. Estimating grizzly bear population size using camera sightings. *Wildl. Soc. Bull*. 22:74–83.

Macey, A. 1979. The status of the grizzly bear in Canada. COSEWIC status rept. 54 pp.

MacKinnon, J., Bi, F., Qiu, M. J., Fan, C.D., Wang, H.B., Yuan, S.J., Tian, A.S., and Li, J.G. 1989. *National conservation management plan for the giant panda and its habitat.* Ministry of Forestry, Beijing and WWF, Gland, Switzerland. 157 pp.

Madoz, P. 1843. *Diccionario geografico-estadistico-historico de Espana*. Madrid.

Maehr, D.S. 1984. Distribution of black bears in eastern North America. *East. Workshop Black Bear Res. Manage*. 7:74.

Mainka, S.A., Qiu, X.M., He, T.M., and Appel, M.J. 1994. Serological survey of Giant Pandas (*Ailuropoda melanoleuca*), and domestic dogs and cats in the Wolong Reserve, China. *J. Wildl. Dis.* 30(1):86–89.

Mainka, S.A. and Qiu, X.M. 1992. Preparing for the reintroduction of giant pandas. *Proc. Annual Meeting Amer. Assoc. Zoo Veterinarians*, Oakland. 65–69 pp.

Mainka, S.A., Cooper, R.M., Li, M., and Zhao, G. 1990. Urinary hormones in two female giant pandas (*Ailuropoda melanoleuca*). *J. Zoo and Wildl. Med.* 21:334–341.

Makarova, O.A. 1987. The brown bear on the Kola Peninsula. *8th IUGB Congress, Poland Sept. 1987. Abstracts:* 111.

Mallon, D. 1985. The mammals of the Mongolian People's Republic. *Mamm. Rev.* 15:71–102.

Manjrekar, N. 1989. *Feeding Ecology of the Himalayan Black bear (*Selenarctos thibetanus *Cuvier) in Dachigam National Park.* M.Sc., Thesis. Saurashtra University, Rajkot. 55 pp.

Manlove, M.N., Baccus, R., Pelton, M.R., Smith, M.H., and Graber, D. 1980. Biochemical variation in the black bear. Pp. 37–41 *in:* Martinka, C.J. and McArthur, K.L., (eds.) *Bear Biology Association Conference Series: Bears – Their Biology and Management, Vol.*

Mano, T. 1990a. Status and management of brown bears in Hokkaido. Pp. 12–18. *in*: Ohtaishi, N., Kaji, K., and Mano, T., (eds.) *Proc. Deer and Bear Form. Wildl. Inf. Cent*. Sapporo. 192 pp. (In Japanese with English summary)

Mano, T. 1990b. Mortality and its causes of radio collared brown bears in relation to management. Pp. 283–286. *in*: *Wildlife management survey for coexistence with human activities report-black bears and brown bears survey*. Japan Wildlife Research Center, Tokyo. 292 pp. (In Japanese)

Mano, T. 1993. Monitoring and management of brown bear populations. *Mammalian Science* 35(2):159–163. (In Japanese)

Mano, T. 1994. Home range and habitat use of brown bears in the southwestern Oshima Peninsula, Hokkaido. *Int. Conf. Bear Res. and Manage*. 9(1):319–325.

Maraven. 1993. *Región Los Andes: Estados Mérida y Trujillo*. Número 8 Serie Estudios Regionales Sistemas Ambientales Venezolanos, Caracas, Venezuela. 108 pp.

Marconi, M. and Donosco, S. 1992. Bolivia, habitantes en las áreas protegidas. Pp. 53–79. *in:* Amend, S., and Amend, T., (eds.) *Espacios sin habitantes? Parques nacionales de América del Sur*. IUCN and Editorial Nueva Sociedad, Caracas, Venezuela.

Mares, M.A. 1992. Neotropical mammals and the myth of Amazonian diversity. *Science* 255:976–979.

Marquinez, J., Garcia, P., Naves, J., and Ruano, A. In press. Application of a geographical information system (GIS) to the methodology for the analysis of the brown bear (*Ursus arctos* L.) habitat in the Cantabrian Mountain range. *Int. Conf. Bear Res. and Manage*. 9.

Marquinez, J., Naves, J., and Palomero, G. 1986. El problema de la supervivencia de las pequeñas poblaciones de oso pardo: el caso de las poblaciones cantábricas. *Naturaleza y Sociedad*: 193–196.

Martin, E.B. 1992. The trade and uses of wildlife products in Laos. *TRAFFIC Bull.* 13:23–28.

Masui, M., Hiramatsu, H., Nose, N., Nakazato, R., Sagawa, Y., Tajima, H., and Saito, K. 1989. Successful artificial insemination in the giant panda (*Ailuropoda melanoleuca*) at Ueno Zoo. *Zoo Biology* 8:17–26.

Mattson, D. J., Knight, R.R., and Blanchard, B.M. 1987. The effects of development and primary roads on grizzly bear habitat use in Yellowstone National Park, Wyoming. *Int. Conf. Bear Res. and Manag.* 7: 259–274.

Mattson, D.J., Wright, R.G., Kendall, K.C., and Martinka, C.J. 1995. Grizzly bears: carnivores. *in:* Laroe, E.T., Farris, G.S., Puckett, C.E., and Doran, P.D., (eds.) *Our living resources 1994: A report to the nation on the distribution, abundance, and health of U.S. plants, animals, and ecosystems*. U.S.D.I. National Biological Survey, Wash., D.C Pp. 11–13.

Mattson, D.J., Herrero, S., Wright, R.G., and Pease, C.M. 1996. Science and management of Rocky Mountain grizzly bears. *Conserv. Biol.* 10:1013–1025.

Mattuschka, H. 1992. Gailtalstraße B 111, Umlegung Hohenthurn – Feistritz, Variantenvergleich. *Studie im Auftrag der Kärntner Landesregierung* Abt. 17A.

May, P.H. 1992. Common property resources in the neotropics: theory, management progress, and an action agenda. Pp. 359–378 *in:* Redford, K.H., and Padoch, C., (eds.) *Conservation of neotropical forests*. Colombia Univ. Press, New York, N.Y.

McCracken, C., Rose, D.A., and Johnson, K.A. 1995. *Status, management, and commercialization of the American black bear (Ursus americanus)*. TRAFFIC USA/WWF. Washington, D.C. 132 pp.

McCrory, W., Herrero, S., and Jones, G. 1989. A program to minimize conflicts between grizzly bears and people in British Columbia's provincial parks. Pp. 9–14 *in*: M. Bromely (ed.) *Bear-people conflicts*. Dept. Of Renewable Resources, Yellowknife, N.W.T.

McCullough, D.R. 1974. *Status of larger mammals in Taiwan.* 35 pp. Tourism Bureau, Taipei.

McLaughlin C.R., Matula, G.J., Cross, R.A., Halteman, W., Caron, M.A., and Morris, K.I. 1990. Precision and accuracy of estimating age of Maine black bears by cementum annuli. *Int. Conf. Bear Res. and Manage.* 8:415–419.

McLellan, B.N., and Shackleton, D.M. 1988. Grizzly bears and resource-extraction industries: effects of roads on behaviour, habitat use, and demography. *J. Appl. Ecol.* 25:451–460.

McLellan, B.N., and Shackleton, D.M. 1989. Grizzly bears and resource-extraction industries: Habitat displacement in response to seismic exploration, timber harvesting, and road maintenance. *J. Appl. Ecol.* 26:371–380.

McNamee, T. 1984. *The grizzly bear*. 308 pp. Alfred A. Knopf, NY.

Meijaard, E. 1997. *The Malayan sun bear* (Helarctos malayanus) *on Borneo, with special emphasis on its conservation status in Kalimantan, Indonesia.* International MOF Tropendos Kalimantan Project and the World Society for the Protection of Animals. London. 51 pp.

Mela, A.J. 1882. *Suomen luurankoiset* (The vertebrates of Finland: in Finnish). WSOY, Porvoo.

Mertzanis, G. 1989. Quelques elements sur l'etat des populations et l'ecologie de l'ours brun (*Ursus arctos*) dans le NW de la Grece. *Biologia Gallo-Hellenica* 15: 191–198.

Mertzanis, G. 1991. Donnees nouvelles sur l'etat des populations et le regime alimentaire de l'ours brun (*Ursus arctos* L.) en Grece. *Biologia Gallo-Hellenica* 18:81–98.

Mertzanis, G. 1992. *Aspects biogeographiques et ecologiques des populations Helleniques d'ours brun (*Ursus arctos *L.). Cas d'une sous-population du Pinde: application a la conservation de l'espece et de son habitat.* These, Universite de Montpellier II, France. 220 pp.

Mertzanis, G. 1994a. Wildlife research on brown bear populations in Greece: present situation and implementations. Pp.189–208 *in*: Dorrestein and Kahraman (eds.) *Proc. Int. Conf. on Aspects of Bear Conservation*, Bursa, Turkey, May 31–June 5, 1994.

Mertzanis, G. 1994b. Brown bear in Greece: distribution, present status, and ecology of a nothern Pindus sub-population. *Int. Conf. Bear Res. and Management 9: 187–198*.

Mertzanis, G., Amaslidis, A., Giannatos, G., Karahalios, T., and Papaioannou, H. In prep a. First case of relocation and radiotracking of a problem bear in Greece. *10th Int. Conf. Bear Res. and Management*, Mora, Sweden, 11–14 September, 1995.

Mertzanis, G., Bousbouras, D., Bourdakis, E., Giannatos, G., Iliopoulos, G., Ioannidis, I., Karahalios, T., and Papaioannou, H. (In Prep b). *Present status and ecology of the brown bear in Greece.* ARCTOS Project Report.

Mertzanis, G., Grivas, C., Ioannidis, I., Bousbouras, D., Giannatos, G., Papaioannou, H., Poirazidis, C., and Gaetlich, M. 1994b. The status of brown bear (*Ursus arctos* L.) in Greece. *Biologia Gallo- Hellenica* 21: 225–232.

Messerschmidt, D.A. 1992. Success in small farmer development: paper making at Pang and Nanglibang, Nepal. Pp. 213–238 *in:* Messerschmidt, D.A., and Rai, N.K., (eds.) *Readings in social forestry and natural resource management for Nepal*. HMG Ministry of Agriculture and Winrock International, Kathmandu.

Micu, I. 1979. Ursul brun (*Ursus arctos)* simpozion international. C.I.C.

Micu, I. 1993. Ursul brun in Harghita. *V.P.S.* 11/12 1992, 1/1993.

Miller, S.D. 1990. Population management of bears in North America. *Int. Conf. Bear Res. and Manage.* 8:357–373.

Miller, S.D. 1993. Brown bears in Alaska: A statewide management overview. *Alaska Dep. Fish and Game Wildlife Technical Bull.* 11: 40 pp.

Miller, S.D., Backer, E.F., and Ballard, W.B. 1987. Black and brown bear density estimates using modified capture-recapture techniques in Alaska. *Int. Conf. Bear Res. and Manage.* 7:23–35.

Miller, S.D., and Ballard, W.B. 1992. Analysis of an effort to increase moose calf survivorship by increased hunting of brown bears in southcentral Alaska. *Wildl. Soc. Bull.* 20:445–454.

Miller, S.D., and Chihuly, M. 1987. Characteristics of nonsport brown bear deaths in Alaska. *Int. Conf. Bear Res. and Manage.* 7:51–58.

Miller, S.D., White, G.C., Sellers, R.A., Reynolds, H.V., Schoen, J.W., Titus, K., Barnes, V.G., Smith, R.B., Nelson, R., Ballard, W.B., and Schwartz, C.C. in prep. Grizzly and black bear density estimation in Alaska using radio-telemetry and replicated capture-mark-resight techniques. *Wildl. Monogr.*

Mills, J.A. 1995. Asian dedication to the use of bear bile as medicine. Pp. 4–16 *in:* D. Rose and A.L. Gaski (eds.) *Proceedings of the international symposium on the trade of bear parts for medicinal use.* TRAFFIC USA, World Wildlife Fund, Washington, D.C.

Mills, J.A. and Servheen, C. 1991. *The Asian trade in bears and bear parts*. TRAFFIC USA/WWF. Washington D.C. 131 pp.

Mills, J.A., Chan, S., and Ishihara, A. 1995. *The bear facts: the East Asian medical market for bear gall bladder. A TRAFFIC Network Report*. TRAFFIC East Asia and TRAFFIC International. Cambridge United Kingdom. 41 pp.

Ministry of Environment. 1992. Om forvaltning av bjørn, jerv, ulv og gaupe (Rovviltmeldingen). *Stortingsmelding* 27:1–54.

Ministry of Environment. 1994. Fastsetting av administrative grenser for kjerneområder for bjørn og jerv. Miljøverndept. Arkiv 446.6 Ref. 93/2969-NK/KGA.

Ministry of Forestry (MoF), 1992. *National conservation project for the giant panda and its habitat.* (Synopsis in English) Ministry of Forestry, Beijing, China.

Mishra, H.R. 1982. Balancing human needs and conservation in Nepal's Royal Chitwan Park. *Ambio* 11:246–251.

Mishra, H.R. and Jeffries, M. 1991. *Royal Chitwan National Park wildlife heritage of Nepal.* King Mahendra Trust for Nature Conservation, Kathmandu. 192 pp.

Mituch, J., and Hovorka, I. 1987. The helminth fauna of eurosiberian brown bear in Slovakia. *Conference Proceeding about Brown bear in Slovakia, Zvolen*, VÚLH:78–87. (Original in Slovak)

Molnar, A. 1992. Forest conservation in Nepal: encouraging women's participation. Pp. 239–253 *in:* Messerschmidt, D.A., and Rai, N.K., (eds.) *Readings in social forestry and natural resource management for Nepal.* HMG Ministry of Agriculture and Winrock International, Kathmandu.

Monasterio, M. 1980. Las formaciones vegetales de los páramos de Venezuela. Pp. 93–158 *in*: Monasterio, M., (ed.) *Estudios ecológicos en los páramos andinos.* Ediciones de la Universidad de Los Andes. Mérida, Venezuela.

Monasterio, M. and S. Reyes. 1980. Diversidad ambiental y variación de la vegetación en los páramos de Los Andes venezolanos. Pp. 47–92 *in*: *Estudios ecológicos en los páramos andinos*. Ediciones de la Universidad de Los Andes. Mérida, Venezuela.

Mondolfi, E. 1971. El oso frontino. *Defensa de la Naturaleza* 1:31–35.

Mondolfi, E. 1989. Notes on the distribution, habitat, food habits, status and conservation of the Spectacled bear (*Tremarctos ornatus* Cuvier) in Venezuela. *Mammalia* 53:525–544.

Monfort, S.L., Fahl, K.D., Czekala, N.M., Stevens, L., Bush, M.. and Wildt, D.E. 1989. Monitoring ovarian function and pregnancy in the giant panda (*Ailuropoda melanoleuca*) by evaluating urinary bioactive FSH and steroid metabolites. *J. Reprod. and Fert.* 85: 203–212.

Moore, H.D.M., Bush, M., Celma, M., Garcia, A-L., Hartman, T.D., Hearn, J.P., Hodges, J.K., Jones, D.M., Knight, J.A., Monsalve, L., and Wildt, D.E. 1984. Artificial insemination in the giant panda (*Ailuropoda melanoleuca*). *J. Zool. Lond.* 203:269–278.

Moric, S., and Huber, D. 1989. Istrazivanje misljenja stranih posjetilaca Nacionalnog parka Plitvicka jezera o medvjedima i vukovima (Study on the public opinion of the Plitvice Lakes National Park foreign visitors about bears and wolves). *Ekologija* 24:21–33.

Moritz, C. 1994. Defining 'evolutionary significant units' for conservation. *TREE* 9:373–375.

Moss, S.P. 1987. Analysis of the vocal communication between a captive mother and cub spectacled bear (*Tremarctos ornatus*). Pp. 73–91. *in*: Weinhardt, D., (ed.) *International studbook for the spectacled bear, 1986.* Lincoln Park Zoological Gardens, Chicago Park District Press, Chicago, Illinois, U.S.A.

Mueller, P. 1989. Observations on behavior and reproductive biology in spectacled bears (*Tremarctos ornatus*) at the Leipzig Zoological Garden. Pp. 209–220. *in*: Rosenthal, M., (ed.) *Proc. First Int. Symp. Spectacled Bear*. Lincoln Park Zoological Gardens, Chicago Park District Press, Chicago, Illinois, U.S.A.

Murphree, M.W. 1994. The role of institutions in community-based conservation. Pp.403–427 *in:* Western, D., Wright, R.M., and Strum, S.C., (eds.) *Natural connections, perspectives in community-based conservation*. Island Press, Washington, D.C.

Myers, N. 1989. *Deforestation rates in tropical forests and their climatic implications*. Friends of the Earth Trust, London, U.K. 78 pp.

Myrberget, S. 1969. The Norwegian population of brown bears (*Ursus arctos L.*). *Medd. Stat Vilt. Ser* 2(29):1–21.

Myrberget, S. 1978. Utviklingen i den norske bjørnebestand. *Naturen* 5:219–238.

Nash, W.G., and O'Brien, S.J. 1987. A comparative chromosome banding analysis of the Ursidae and their relationship to other carnivores. *Cytogenet. Cell Genet*. 45:206–212.

Naves, J. and Palomero, G. 1989. The brown bear in the Cantabrian Mountains: a case study. *Environmental Encounter Ser*. 6:47–51.

Naves, J. and Palomero, G. 1993a. Distribucion actual del oso pardo en la Cordillera Cantabrica. *in*: Naves, J. y Palomero, G. (eds.) *El oso pardo en España*. Colección Técnica, ICONA, Madrid.

Naves, J. and Palomero, G. 1993b. Ecologia de la hibernacion del oso en la Cordillera Cantabrica. *in*: Naves, J. y Palomero, G. (eds.) *El oso pardo en España*. Colección Técnica, ICONA, Madrid.

Naves, J. and Ruano, A. 1993. Distribucion espacial y caracteristicas de las zonas de refugio en la poblacion occidental de osos cantabricos. In: Naves, J. y Palomero, G. ed. *El oso pardo en España*. Colección Técnica, ICONA, Madrid.

Nédélec, L., Arthur, C. P. et Chaumeil, D. 1992. Evolution spatio-temporelle et caractéristiques éco-éthologiques des attaques d'ours sur bétail domestique dans les Pyrénées Occidentales françaises de 1968 à 1991. *Int. Conf. Bear Res. and Manage*. 9 (in review).

Negi, S.S. 1991. *Handbook of national parks, sanctuaries and biosphere reserves of India*. Indus Publishing Company, New Delhi. 248 pp.

Negrutiu, A. 1979. *Consideratii privind ecologia si comportarea ursului brun in Carpatii*. A.G.V.P.S.

Nei, M. 1987. *Molecular evolutionary genetics*. Columbia Univ. Press, New York. 512 pp.

Nelson, R. 1973. Winter sleep in the black bear: A physiologic and metabolic marvel. *Mayo Clin. Proc*. 48: 733–737.

Newmark, W.D. 1985. Legal and biotic boundaries of Western North American national parks: a problem of congruence. *Biol. Conserv*. 33: 197–208.

Niigata Prefecture 1987. *Status report of Japanese black bears in Niigata*. 95 pp. (In Japanese)

Nikolaenko, V. A. 1993. On the status of Kamchatkan brown bear. Oral presentation at the *6th Conference of Specialists Studying Bears in Russia and Adjacent Countries.* 6–11 September, 1993, Central Forest Reserve, Tver oblast.

Nores, C. 1988. Reduccion areal del oso pardo en la Cordillera Cantabrica. *Acta Biol. Mont., Serie doc. de travail.* 2:7–14.

Nores, C. 1993. Estimacion de la poblacion del oso pardo en Asturias durante el siglo XIX. *in:* Naves, J. y Palomero, G. (eds.) *El oso pardo en España*. Colección Técnica, ICONA, Madrid.

Nores, C. and Naves, J. 1993. Distribucion historica del oso pardo en la Peninsula Iberica. *in*: Naves, J. y Palomero, G. (eds.) *El oso pardo en España*. Colección Técnica, ICONA, Madrid.

Norheim, G., Skaare, J. U., and Wiig, Ø. 1992. Some heavy metals, essential elements, and chlorinated hydrocarbons in polar bears (*Ursus maritimus*) at Svalbard. *Environm. Poll.* 77: 51–57.

Norling, I., Jagnert, C., and Lundahl, B. 1981. Viltel och allmanheten. Pp. 9–80. *in:* Ekstrom, S. (ed.) *Vilt och jakt, sociala och ekonomiska varden*. Jordbruksdepartementet, Ds Jo 1981:4.

Norris, T. 1969. Ceylon sloth bear. *International Wildlife* 12:300–303.

Norstom, R. 1990. Are polar bears threatened by PCB s? *Comite Artique Intrenat*. 2: 13–17.

Norstom, R. 1995. Chlorinated hydrocarbons in polar bears from North America, Greenland and Svalbard: A biological measure of hemispheric pollution. In: Wiig, Ø., Born, E.W. and Garner, G. (Eds). *Polar Bears. Proceedings of the eleventh working meeting of the IUCN/SSC Polar Bear Specialist Group Occ. Pap. IUCN/SSC* No. XX.

Norstom, R., Belikov S.E., Born E.W., Garner G.W., Malone B., Olpinski S., Ramsay M.A., Schliebe S., Stirling I., Stishov M.S., Taylor M.K., Wiig O., in review. *Chlorinated hydrocarbon contaminants in polar bears from eastern Russia, North America, Greenland, and Svalbard: Biomonitoring of Arctic Pollution*. Simultaneously submitted to: Archives of Environmental Contamination and Toxicology.

Norton-Griffiths, M. and Torres, H. 1980. *Evaluation of ground and aerial census work in Pampa Galeras, Peru.* WWF/IUCN, Nairobi. 110 pp.

Noss, R.F. and Cooperrider, A. 1994. *Saving nature's legacy: Protecting and restoring biodiversity.* Defenders of Wildlife and Island Press, Washington, D.C.

Notario, R. 1964. *El oso pardo en Espana.* Minist. de Agric. y Pesca, Madrid.

Notario, R. 1970. *El oso pardo en Espana.* 2nd Ed. Minist. de Agric. y Pesca, Madrid.

Notario, R. 1980. Informe de la situacion actual en Espana del oso pardo. *Caza y Pesca.* 445:26–39.

Nowak, R., and Paradiso, J. 1983. *Walker's mammals of the world, Vol. II*. 1363 pp. Johns Hopkins Univ. Press, Baltimore.

Noyce, K.V., and Garshelis, D.L. 1994. Body size and blood characteristics as indicators of condition and reproductive performance in black bears. *Int. Conf. Bear Res. and Manage*. 9:481–496.

Nozaki, E., Azuma, S., Aoi, T., Torii, H., Ito, T., and Maeda, K. 1983. Food habits of the Japanese black bear. *Int. Conf. Bear Res. and Manage*. 5:106–109.

Nygren, T. 1993. *Hirvikantamme 1992* (Finnish moose population: in Finnish). RKTL, Helsinki.

Nyholm, E. 1985. Populations of large terrestrial predators in Finland 1979–1984. *Symposium predateurs: Lisbonne, Portugal*. 29–31/3:304–321.

Nyholm, E.S. 1987. *Ruskeakarhukannan kehittämissuunnitelma Suomessa vuoteen 2000* (Plans for the development of brown bear population in Finland until year 2000: in Finnish). Moniste.

Nyholm, E.S. 1989a. *Suomen suurpetokantojen kehitys vuosina 1978–1987* (The development of the populations of the large predators years 1978–1987: in Finnish). RKTL, Helsinki.

Nyholm, E.S. 1989b. The problem bears of Finland. Bear-people conflicts proceeding of symp. man. strat. NWT, Dep. of Renew. Res.

Nyholm, E.S. 1991a. *Suomen suurpetokantojen kehitys 1988–1990* (The development of the populations of large predaors years 1988–1990: in Finnish). RKTL, Helsinki.

Nyholm, E.S. 1991b. *Ruskeakarhu* (The brown bear: in Finnish). WSOY, Porvoo.

Nyholm, E.S. and Nyholm, K-E. In press. Distribution of brown bear (*Ursus a. arctos L.*) in Finland years 1978–1990 *Int. Conf Bear Res and Manage*.

O'Brien, S.J. and Knight, J.A. 1987. The future of the giant panda. *Nature* 325:758–759.

O'Brien, S.J., Nash, W.G., Wildt, D.E., Bush, M.E., and Benveniste, R.E. 1985. A molecular solution to the riddle of the giant panda's phylogeny. *Nature* 317:140–144.

Ogonowski, T. 1958. Niedzwiedzie w Bieszczadach. *Low. Pol.* 2:15.

Olszewski, J. 1971. To wlasnie ten. *Lowiec Pol.* 3(1390):6–7.

O'Neill, J. 1992. Montane avifauna of Perú. Pp. 47–55. *in*: Young, K. R. and Valencia, N. (eds.) *Biogeografia, ecologia y conservacion del bosque montano en el Perú*. Universidad Nacional Mayor de San Marcos, Lima, Perú.

Øksnesutvalget. 1974. Støtteordninger i landbruket. *NOU* 1974:26:1–328.

Øritsland, N.A., Engelhardt, F.R., Juck, F.A., Hurst, R.J., and Watts, P.D. 1981. *Effect of crude oil on polar bears. Environmental studies No. 24*. Report to the Northern Environmental Protection Branch, Indian and Northern Affairs, Canada. 268 pp.

Osgood, W.H. 1914. Mammals of an expedition across northern Perú. *Field Mus. Nat. Hist. Publ., Zool. Ser.* 10:143–185.

Osti, F. 1987. Status of a remnant brown bear population in Trentino, Italy: 1981–1985. *Int. Conf. Bear Res. and Manage*. 7:17–18.

Osti, F. 1990. The brown bear in Trentino, Italy. *Aquilo, Oulu, Ser. Zool*. 27:89–91.

Osti, F. 1991a. *L'orso bruno nel Trentino*. Ed. Arca, Trento, pp. 210.

Osti, F. 1991b. Attuale consistenza e distribuzione dell'orso druno delle Alpi (Ursus arctos L.). Atti II Seminario Italiano sui censimenti faunistici. *Brescia. Suppl. Ist. Biol. Selvagg., Bologna* 16:599–603.

Pacheco, V., de Macedo, H., Vivar, E., Ascorra, C., Arana-Cardó, R., and Solari, S. 1995. Lista anotada de los mamíferos Perúanos. *Conservation International, Occasional Paper No. 2.*, Washington, D.C., U.S.A. 35 pp.

Paetkau, D. and Strobeck, C. 1994. Microsatellite analysis of genetic variation in black bear populations. *Mol. Ecol*. 3:489–495.

Paetkau, D. and Strobeck, C. 1998. Ecological genetic studies of bears using microsatellite analysis. *Int. Conf. Bear Res. and Manage* 10:299–306.

Paetkau, D. and Strobeck, C. In press. Mitochondrial DNA and the biogeography of Newfoundland black bears. *Mol. Ecol*.

Paetkau, D., Calvert, W., Stirling, I., and Strobeck, C. 1995. Microsatellite analysis of population structure in Canadian polar bears. *Mol. Ecol*. 4:347–354.

Paetkau D., Waits, L., Craighead, L., Shields, G.F., Vyse, E.R., Talbot, S., Ward, R., and Strobeck, C. In prep. Conservation genetics of North American brown bears.

Palit, S. 1996. Indian forest departments in transition. Pp. 210–229 *in:* Poffenberger, M., and McGean, B., (eds.) *Village voices, forest choices: joint forest management in India*. Oxford University Press, Delhi.

Paliskuntainyhdistys. 1993. Porotilastot (Statistics on reindeer husbandry: in Finnish). *Poromies* 2.

Palmen, E. 1913. Bär, wolf und luchs in Finland (Bear, wolf, and lynx in Finland: in German). *Zool. Beob*. L IV:3.

Palomero, G., Fernandez, A., and Naves, J. In press a. On reproductive rates in the Cantabrian Mountains brown bear population. *Int. Conf. Bear Res. and Manag*. 9.

Palomero, G., Ayermich, M., Callejo, A., Rasines, J., and Roy, E. In press b. Brown bear Conservation in the Cantabrian Mountains (Spain): recovery plans. *Int. Conf. Bear Res. and Manag*. 9:.

Palomero, G., Fernandez, A., and Naves, J. 1993. Demografia del oso pardo en la Cordillera Cantabrica. In: Naves, J. y Palomero, G. ed. *El oso pardo en España*. Colección Técnica, ICONA, Madrid.

Pan, W.S. and Lu, Z. 1989. The giant pandas of Qinling: why are they limited in present range? *Abstract to the Fifth International Theriological Congress*, Rome, Italy.

Papavassiliou, A. 1963. I arctos eis ton ellinikon horon (The brown bear in Greece). *Kyniyetika Nea* 6/93:828–830 (in Greek).

Parde, J. M. 1984. *Ecologie de l'ours brun dans les Pyrénées Centrales et Orientales*. Thèse deèmes cycle. Université P. Sabatier, Toulouse. 229 pp.

Parker, T.A., III, Parker, S.A., and Plenge, M.A. 1982. *An annotated checklist of Peruvian birds*. Buteo Books, Vermillion, South Dakota, U.S.A. 108 pp.

Parusel, J.B. 1985. The occurrence of brown bear (*Ursus arctos L.*), in Babia Gora, Jalowiec and Polica ranges (High Beskid Mts.). *Acta Zool.* 29:53–68.

Pausanias. 1954, 1955, 1965, and 1969. *Arkadika, Attika, Lakonika*. (Loeb Classical Library eds.) 1, 2, 3, and 4:573 pp. (in Greek with English translation).

Payne, J., Francis, C.M. and Phillips, K. 1985. *A field guide to the mammals of Borneo*. The Sabah Society with WWF Malaysia. Kota Kinabalu,Sabah, Malaysia. 332 pp.

Peek, J.M., Pelton, M.P., Picton, H.D., Schoen, J.W., and Zager, P. 1987. Grizzly bear conservation and management: A review. *Wildl. Soc. Bull.* 15:160–169.

Pelletier, K. 1996. *Managing private land in the Swan Valley for grizzly bears and other wildlife. The Swan Valley Linkage Zone Working Group.* U.S. Fish and Wildlife Service, Missoula, Montana. 16 pp.

Pelton, M.R. 1982. Black bear. Pp. 504–514 *in:* Chapman, J.A., and Feldhamer, G.A., (eds.) *Wild mammals of North America; biology management, and economics*. Johns Hopkins University Press, Baltimore, MD.

Peluso, N.L. 1992. *Rich forests, poor people*. Univ. of California Press, Berkeley, California. 321 pp.

Pernalete, J. 1991. Spectacled Bear management at the Barquisimeto Zoo. Pp. 95–103. *in*: Weinhardt, D., (ed.). *International Studbook for the Spectacled Bear,* 1990. Lincoln Park Zoological Gardens, Chicago, Ill.

Peyton, B. 1980. Ecology, distribution, and food habits of spectacled bears (*Tremarctos ornatus*) in Perú. *J. Mammal*. 61:639–652.

Peyton, B. 1981. Spectacled bears in Perú. *Oryx* 16:48–56.

Peyton, B. 1984. *Spectacled Bear Habitat Use in the Historical Sanctuary of Machu Picchu, Peru.* M. Sc. Thesis. University of Montana, Missoula, Montana. 165 pp.

Peyton, B. 1985. President's report: Ecuadorian National Parks. *Spectacled Bear Specialist Group Newsletter* 9:1–5.

Peyton, B. 1986. President's report: Ecuador field research. *Spectacled Bear Specialist Group Newsletter* 10:1–7.

Peyton, B. 1987. Habitat components of the spectacled bear. *Int. Conf. Bear Res. and Manage*. 7:127–133.

Peyton, B. 1987a. Criteria for assessing habitat quality of the spectacled bear in Machu Picchu, Perú. *Int. Conf. Bear Res. and Manage*. 7:135–143.

Peyton, B. 1987b. Bear in the eyebrow of the forest. *Animal Kingdom* 90(2):38–45.

Peyton, B. 1987c. Uso de hábitat por el oso frontino en el Sanctuario Histórico de Machu Picchu y zonas adyacentes en el Perú. Pp. 23–31. *in*: Aguilar, P. G., (ed.) *Symposio Conservación y Manejo Fauna Silvestre Neotropical*. APECO, Lima.

Peyton, B. 1989. The ecology of conservation: a case for an ecosystem approach. Pp. 75–92. *in:* Rosenthal, M., (Ed.) *Proc. First Int. Symp. Spectacled Bear*, Lincoln Park Zoological Gardens, Chicago Park District Press, Chicago, Illinois, U.S.A.

Peyton, B. 1994. Conservation in the developing world: ideas on how to proceed. *Int. Conf. Bear Res. and Manage*. 9:115–127.

Peyton, B., Yerena, E., Rumiz, D.I., Jorgenson, J., Orejuela, J., and Suarez, L. 1998. Status of wild Andean bears and policies for their management. *Int. Conf. Bear Res. and Manage*. 10:In Press.

Phillips, W.W.A. 1984. *Manual of the mammals of Sri Lanka*. Part III. Wildlife and Nature Protection Society of Sri Lanka. 2nd ed.

Pikunov, D.G. 1987. Censusing bears in the mountain forests of the South of the Far East of the USSR. Pp. 174–184 *in*: Yudin, B.S., (ed.) *Ecologiya medvedy*. Proc. 3rd Conf. Novosibirsk. (In Russian)

Pikunov, D.G. 1991. White-chest bear in Sikhote-Alin. Pp.206–216 *in*: Pazhetnov, V.S., (ed.) *Medvedi SSSR – sostoyaniye populatsiy.* Proc. 4th Conf. Pzhev (In Russian)

Pikunov, D.G., Fomenko, P.V., and Kovalenok, S.I. 1991. Dens of white-chest bears. Pp. 242–251 *in*: Zavatskiy, B.F. and Shvetsov, G., (eds.) *Medvedi v SSSR.* Proc.5th Conf. Novosibirsk. (In Russian)

Pinto, R.F.S. 1969. *The political ecology of the Brazilian National Bank for Development (BNDE): a study of politics, development, and public administration*. Organization of American States, Washington, D.C. 80 pp.

Pocock, R.I. 1941. The black and brown bears of Europe and Asia Part II. The sloth bear (*Melursus*) and the Asian black bear (*Selenarctos*) and the Malayan sun bear (*Helarctos*). *J. Bombay Nat. Hist. Soc*. 36:101–138.

Podobinski, L. 1962. Zwierzeta TPN w 1961 i wiosna 1962. *Wierchy* 31:250–260.

Poffenberger, M., (ed.). 1990. *Keepers of the forest. Land management alternatives in southeast Asia.* Kumarian Press, Hartford, Connecticut. 289 pp.

Poffenberger, M. 1994. The resurgence of community forest management in eastern India. Pp. 53–79 *in:* D. Western, R.M. Wright, and S.C. Strum (eds.) *Natural connections. Perspectives in community-based conservation*. Island Press, Washington, D.C.

Poffenberger, M. and Singh, C. 1996. Communities and the state: re-establishing the balance in Indian forest policy. Pp. 56–85 *in:* Poffenberger, M., and McGean, B., (eds.) *Village voices, forest choices: joint forest management in India*. Oxford University Press, Delhi.

Polyakova, A.D. 1975. Changes in the distribution and number of brown bear and lynx in Middle Russia. *Trydy Okskogo Gosudarstvennogo zapovednika* 11:289–320 (In Russian)

Pombo, D., (ed.) 1989. *Perfil ambiental de Colombia*. U.S. Agency for International Development, Fondo Colombiano de Investigaciones Científicas y Proyectos Especiales "Francisco José de Caldas" Colciencias, and Fondo FEN Colombia, Santafé de Bogotá. 348 pp.

Poyarkov, A.D., and Chestin, I.E. 1993. Status of large predators and ungulates in Russia. *Lutreola* 1(2):22–24

Prater, S.H. 1971. *The book of Indian animals*. Oxford University Press, Bombay. 324 pp.

Prater, S.H. 1980. *The book of Indian Animals*. Bombay Nat. Hist. Soc. Bombay.

Pressman, J.L. and Wildavsky, A. 1984. *Implementation*. Univ. California Press, Berkeley, California. 281 pp.

Prestrud, P. and Stirling, I. 1994. The International Polar Bear Agreement and the current status of polar bear conservation. *Aquatic Mammals* 20: 1–12.

Priklonskiy, S.G. 1969. Distribution and number of brown bear and lynx in Middle Russia. *Trydy Okskogo Gosudarstvennogo zapovednika* 7: 69–116. (In Russian)

Project ARCTOS. 1996 (unpublished). *Project for conservation of brown bear populations and habitats in Greece, final report.* "ARCTUROS" Society, Greek Ministry of Agriculture. 140 pp.

Prpic, B. 1992. Ekoloska i gospodarska vrijednost suma u Hrvatskoj (Ecological and economical value of Croatian forests). Pp. 237–256 *in*: Raus, D., (ed.) *Sume u Hrvatskoj* (*Forests of Croatia)* Faculty of Forestry and "Hrvatske sume", Zagreb.

Pulliainen, E. 1980. *Suomessa vuosina 1973–1976 kaadetut karhut ja ilvekset* (The hunting statistics of bear and lynx in Finland years 1973–1976: in Finnish). Suomen riista 28, Helsinki.

Pulliainen, E. 1983. Brown bear immigration into Finland from the east. *Int. Conf. Bear Res. and Manage*. 6: 15–20.

Purroy, F. 1991. Daños a ganadería y agricultura. *in:* Clevenger, A. y Purroy, F. (eds.) Ecología del oso pardo en España. *Monografías del Museo Nacional de Ciencias Naturales* 4.

Purroy, F. and Clevenger, A. 1991. Conservación. *in*: Clevenger, A. y Purroy, F. (eds.) Ecología del oso pardo en España. *Monografías del Museo Nacional de Ciencias Naturales* 4.

Puschmann, V.W., Schuppel, K.F., and Kronberger, H. 1977. Detection of blastocyst in uterine lumen of Indian bear (*Melursus u. ursinus*). Pp. 389–391 *in:* R. Ippen and H.D. Schrader (eds.) *Sickness in zoos*. Akad. Verlag, Berlin. In German with English abstract.

Puschnig, R. 1928. Seltenere Säugetiere in Kärnten. *Carinthia II* 37(38):57–65.

Puschnig, R. 1930. Von der Tierwelt des Rosentales. *Sonderheft der Carinthia II: Naturgeschichtliches aus dem Abstammungsgebiet.*

Putney, A. 1979. *Estrategia preliminar para la conservación de areas silvestres sobresalientes del Ecuador*. Ministerio de Agricultura y Ganadería, Quito, Ecuador.

Quezel, P. 1967. A propos de quelques hetraies du Macedoine. *Bull. Soc. Bot. Fr.* 114:200–210.

Qiu, M.J. 1990. *Ecological and social implications for the management of the giant panda.* M.Sc. Thesis, University of Idaho, Moscow, Idaho. 56 pp.

Qiu, X.M. and Mainka, S.A. 1993. Review of mortality of the giant panda (*Ailuropoda melanoleuca*). *J. Zoo and Wildl. Med.* 24: (in press).

Randall, R. 1982. Qoyllur Rit'i, and Inca fiesta of the pliedes: reflections on time and space in the Andean world. *Bull. Inst. Fr. Et. And.* 11:37–81.

Randi, E., Gentile, L., Boscagli, G., Huber, D., and Roth, H.U. 1994. Mitochondrial DNA sequence divergence among some west European brown bear (*Ursus arctos*) populations: lessons for conservation. *Heredity* 73:480–489.

Rauer, G. 1993. Arbeitsbericht über die wissenschaftliche Begleitforschung zum Bärenprojekt des WWF Österreich im Jahr 1990–92. *Bericht des Forschungsinstituts WWF Österreich, Heft* 10:7–21,23–30,31–41.

Rausch, R.L. 1963. Geographic variation in size in North American brown bears, *Ursus arctos* L., as indicated by condylobasal length. *Canadian J. Zoology* 41:33–45.

Raychev, R.G. 1985. The brown bears of the Stara Planina mountains. *Ochota i okhotnichie khoziaystvo* 10:28–29 (in Russian).

Raychev, R.G. 1989. Investigations on the population number, biology, and ecology of the brown bear (*Ursus arctos* L.) in the Stara Planina mountains. Ph.D. Thesis, VLTI, Sofia (in Bulgarian).

Read, B.E. 1982. *Chinese materia medica: animal drugs*. Southern Materials Center, Inc., Taipei. 281 pp.

Rebel, H. 1933. *Die freilebenden Säugetiere Österreichs*. Österreichischer Bundesverlag für Unterricht, Wissenschaft und Kunst, Wien und Leipzig.

Reid, D.G. 1993. Pandas and politics. p. 146 *in*: Stirling, I., (ed.) *Bears: majestic creatures of the wild.* Rodale Press, Inc. Emmaus, Pennsylvania. 240 pp.

Reid, D.G. 1994. The focus and role of biological research in giant panda conservation. *Int. Conf. Bear. Res. and Manage*. 9:23–33.

Reid, D.G. and Hu, J.C. 1991. Giant panda selection between *Bashania fangiana* bamboo habitats in Wolong Reserve, Sichuan, China. *J. Appl. Ecol*. 28:228–243.

Reid, D.G., Hu, J.C., Dong, S., Wang, W., and Huang, Y. 1989. Giant panda (*Ailuropoda melanoleuca*) behaviour and carrying capacity following a bamboo die-off. *Biol. Conserv.* 49:85–104.

Reid, D.G., Taylor, A.H., Hu, J.C., and Qin, Z.S. 1991. Environmental influences on bamboo *Bashania fangiana* growth and implications for giant panda conservation. *J. Appl. Ecol*. 28:855–868.

Reques, P. 1993. Antropogeografia del area de distribucion del oso pardo en la Cordillera Cantabrica. In: Naves, J. y Palomero, G. ed. *El oso pardo en España*. Colección Técnica, ICONA, Madrid.

Revenko, I.A. 1997. Status of brown bears in Kamchatka, Russian Far East. *Int. Conf. Bear Res. and Manage*. 10:In Press.

Reynolds, H.V., and Garner, G.W. 1987. Patterns of grizzly bear predation on caribou in northern Alaska. *Int. Conf. Bear Res. and Manage.* 7:59–67.

Ribera, M.O. 1996a. *Guía para la categorización de vertebrados amenazados*. Centro de Datos para la Conservación, La Paz. 106 pp.

Ribera, M.O. 1996b. Aná1isis sobre categorías de manejo, dependencias juridiccionales, declaratoria de áreas protegidas y zonificación de manejo. *Revista Boliviana de Ecología y Conservación Ambiental* 1:71–79.

Ricciuti, E.R. 1983. Dukuduku: can the bear of the Andes survive? *Safari* Sept/Oct:46–51.

Robinson, J. 1997. Chinese bear farms and the use of bear bile in traditional Chinese medicine: an animal welfare perspective. 1997. Pp. 106–115. *in:* Gaski, A.L., and Williamson, D.F., (eds.) *Proc. 2nd Int. Symp. on the Trade of Bear Parts,* Seattle, Washington. TRAFFIC USA/WWF. 239 pp.

Rockwell, D. 1991. *Giving voice to bear: North American Indian rituals, myths, and images of the bear*. Roberts Rinehart, Niwot, CO. 224 pp.

Rodgers, W.A. and Panwar, H.S. 1988. *Planning a Wildlife Protected Area network in India*. Vol. I & II. Wildlife Institute of India, Dehra Dun.

Rodriguez, E.D. 1991. *Evaluación del habitat del oso de anteojos* (Tremarctos ornatus) *en el P.N.N. Las Orquídeas.* Thesis, Universidad Nacional, Facultad de Ciencias, Departamento de Biología, Santafé de Bogotá. 134 pp.

Rodriguez, E.D., Poveda, F., Rivera, D., Sanchez, J., Jaimes, V., and Lozada, R. 1986. Reconocimiento preliminar del hábitat natural del oso andino (*Tremarctos ornatus* F. Cuvier, 1825) y su interacción con el hombre en la región nororiental del Parque Nacional Natural El Cocuy. *Boletín Divulgativo MANABA* (Santafé de Bogotá) 1:1–47.

Rogers, L.L. 1987. Effects of food supply and kinship on social behavior, movements, and population growth in black bears in northeastern Minnesota. *Wildl. Monogr*. 97. 72 pp.

Romero, J.C. and Suárez, L. *In prep.* Wildlife use and perceptions of hunters living adjacent to the Podocarpus National Park, Ecuador.

Rose, D.A. and Gaski. A.L., (eds.) 1995. *Proceedings of the international symposium on the trade of bear parts for medicinal use.* 9–11 Sept. 1994. Seattle, Washington. TRAFFIC USA/WWF. Washington, D.C.

Rosenthal, M.A. 1987a. Official historical register for all spectacled bears. Pp. 11–28. *in*: Weinhardt, D., (ed.) *International studbook for the spectacled bear, 1986.* Lincoln Park Zoological Gardens, Chicago Park District Press, Chicago, Illinois, U.S.A.

Rosenthal, M.A. 1987b. Biological management of spectacled bears (*Tremarctos ornatus*) in captivity. Pp. 93–103. *in*: Weinhardt, D., (ed.) *International studbook for the spectacled bear, 1986.* Lincoln Park Zoological Gardens, Chicago Park District Press, Chicago, Illinois, U.S.A.

Rosler, R. 1989. The status of the brown bear in central and eastern Europe. i*n*: Proc. of a workshop on the situation and the protection of the brown bear (*Ursus arctos*) in Europe. Oviedo, Spain, 18–20 May, 1988. *Council of Europe, Environ. Encounters Ser.* 6:15–25.

Roth, H.H. 1964. Ein beitrag zur Kenntnis von *Tremarctos ornatus* (Cuvier). *D. Zoolog. Garten* 29:107–129.

Roth, H.H. 1980. Il metido dei percorsi campione e la sua applicazione per lo studio dell'orso in Trentino. *Natura Alpina* 24:19–25.

Roth, H.H. 1983. [The] activity of a remnant population of European brown bears. *Int. Conf. Bear Res. and Manage*. 5:223–229.

Roth, H.U. and Osti, F. 1979. Prime esperienze di radiolocalizzazione di due orsi bruni nel Trentino. *Natural Alpina* 17:44–46.

Rukovskiy, N.N. 1981. The Brown bear and timber cutting in Vologda oblast. In: Ekologia, morfologia i okhrana medvedey. *Abstracts of the 2nd Conf. of Specialists Studying Bears in the USSR. Moscow, and Nauka*: 62–63.

Rumiz, D.I and Eulert, C.F. 1996. Mastozoología. Pp. 1–15 *in*: Rumiz, D., (ed.) *Diagnóstico del componente de fauna, Plan de Manejo del P.N. Amboro, Vol. II.* Report submitted to Fundación Amigos de la Naturaleza and The Nature Conservancy, Santa Cruz.

Ruskov, M. 1961. On the distribution of the brown bear in Bulgaria. *Nauchni trudove na VLTI, Sofia* 9:185–187 (in Bulgarian).

Ruskov, M. and Markov, G. 1984. Der Braunbare (*Ursus arctos* L.) in Bulgarian. *Zeitschr. Saugetierkunde* 39: 358–368.

Russo, L., and Boscagli, G. 1992. Seven years of brown bear filing-cards in the Abruzzo National Park: a data base analysis. *Int. Conf. Bear Res. and Management 9, October 1992.*

Ryder, A.O. 1994. Ex situ conservation and the conservation role of zoological parks and aquariums. Pp. 175. *in*: Meffe, G.K. and Carroll, C.R, (eds.) *Principles of conservation biology*. Sinauer Associates, Sunderland

Saberwal, V. 1989. *Distribution and Movement Patterns of the Himalayan Black bear (*Selenarctos thibetanus *Cuvier) in Dachigam National Park*. M.Sc., Thesis. Saurashtra University, Rajkot. 81 pp.

Saez-Royeula. 1985. L'évolution demographique du sanglier (*Sus scrofa*) en Espagne. *Mammalia* 49(2): 195–202.

Saharia, V.B. 1980. Wildlife census and monitoring in India – a review. Pages 159–172 *in* Director, Zoological Survey of India, ed. *Proceedings of the workshop on wildlife ecology*. Zoological Survey of India, Dehra Dun, India.

Saharia, V.B. 1982. *Wildlife of India*. Nat Raj Publishers, Dehra Dhun. 278 pp.

Salazar, J., and Anderson, S. 1990. Informe sobre el estado actual del conocimiento del oso andino en Bolivia. *Ecología en Bolivia* 15:3–23.

Santiapillai, A., and Santiapillai, C. 1990. Status, distribution and conservation of the sloth bear (*Melursus ursinus*) in Sri Lanka. *Tiger Paper* 17(1):13–15.

Saporiti, E.J. 1949. Contribucion al conocimiento de la biologia del oso de lentes. *Anales Soc. Cien. Argentina* 147:3–12.

Sarich, V. 1973. The giant panda is a bear. *Nature* 245:218–220.

Sarin, M. 1996. From conflict to collaboration: institutional issues in community management. Pp 165–209 *in:* Poffenberger, M., and McGean, B., (eds.) *Village voices, forest choices: joint forest management in India*. Oxford University Press, Delhi.

Sas-Rolfes, M.S. 1997. The economics of the bear trade. Pp. 86–93 *in* Gaski, A.L., and Williamson, D.F., (eds.) *Proceedings of the second international symposium on the trade of bear parts*, Seattle, Washington. TRAFFIC USA/WWF. 239 pp.

Sathyakumar, S. 1993. Status of Mammals in Nanda Devi National Park. *in*: *Scientific and Ecological Expedition to Nanda Devi. A report.* Pp.5–15.

Sathyakumar, S. 1994. *Habitat Ecology of Ungulates in Kedarnath Musk deer Sanctuary, Western Himalaya.* Ph.D Thesis. Saurashtra University, Rajkot. 244 pp.

Schaller, G.B. 1967. *The deer and the tiger. A study of wildlife in India.* University of Chicago Press, Chicago. 370 pp.

Schaller, G.B. 1977. *Mountain Monarchs: wild sheep and goats of the Himalaya*. University of Chicago Press, Chicago. 425 pp.

Schaller, G.B. 1988. Towards the dark abyss of extinction. *World Magazine* 15:22–28.

Schaller, G.B. 1992. Field of dreams. *Wildlife Conservation* (September/October):44–47.

Schaller, G.B. 1993. *The Last Panda.* University of Chicago Press, Chicago, Illinois. 291 pp.

Schaller, G.B. 1993a. *UNDP-GEF Mongolia Biodiversity Project final report*. Unpubl. Report to the Mongolia Biodiversity Proj., Min. for Nat. and Envir. Ulaanbaatar. 34 pp.

Schaller, G.B., Jinchu, H., Wenshi, P., and Jing, Z. 1985. *The giant pandas of Wolong*. Univ. of Chicago Press, Chicago and London. 259 pp.

Schaller, G.B., Teng, Q.T., Johnson, K.G., Wang, X.M., Shen, H.M. and Hu, J.C. 1989. *The feeding ecology of giant pandas and Asiatic black bears in the Tangjiahe Reserve, China.* Pp. 212–241 *in:* J.L. Gittleman (ed.) *Carnivore behavior, ecology and evolution*. Cornell University Press, Ithaca, NY. 620 pp.

Schaller, G.B., Tulgat, R., and Narantsatsvalt, B. 1993. Observations of the Gobi Brown Bear in Mongolia. *In*: Bears of Russia and adjacent countries – state of populations. *Proc. 6th Conf. of specialists studying bears*. Central Forest Reserve, Tver oblast Russia, 2:110–125.

Schenk, A., and Kovacs, K.T. 1995. Multiple matings between black bears revealed by DNA fingerprinting. *Anim. Behav*. 50:1483–1490.

Schön, D.A. 1983. *The reflective practitioner: how professionals think in action*. Basic Books, New York. 374 pp.

Schoen, J.W. 1990. Bear habitat management: a review and future perspective. *Int. Conf. Bear Res. and Manage.* 8:143–154.

Schoen, J.W. and Beier, L.R. 1990. *Brown bear habitat preferences and brown bear logging and mining relationships in southeast Alaska.* 90 pp. Alaska Dep. Fish and Game Fed. Aid in Wildl. Restoration Research Final Report on Study.

Schoen, J.W., Kirchoff, M.D., and Hughes, J.H. 1988. Wildlife and old-growth forests in southeastern Alaska. *Nat. Areas J.* 8:138–145.

Schoen, J.W., Flynn, R.W., Suring, L.H., Titus, K., and Beier, L.R. 1994. Habitat capability model for brown bear in southeast Alaska. *Int. Conf. Bear Res. and Manage*. 9:327–337.

Schwartz, C.C., and Franzmann, A.W. 1991. Interrelationships of black bears to moose and forest succession in the northern coniferous forest. *Wildl. Monogr*. 113. 58 pp.

Schwerin, K.H. 1991. Indian populations of Latin America. Pp. 39–53. In Black, J.K. (Ed.) *Latin America: its problems and its promise*. Westview Press, Boulder, Colorado, U.S.A.

Selander, S. and Fries, C. 1943. 1942 års björnutredning. *Sveriges Natur* 1943(1):1–10.

Servheen, C. 1989. Monitoring of bear populations for conservation. *in*: Proc. of workshop on the situation and protection of the brown bear (*Ursus arctos*) in Europe. *Environ. Encounters Ser.* 6:39–46.

Servheen, C. 1990. The status and management of the bears of the world. *Int. Conf. Bear Res. and Manage., Monogr. Series No. 2*. 32 pp.

Servheen, C. 1994. Population and habitat research needs for bear conservation. Pp. 151–171 *in:* Dorrestein, G.M., and Kahraman, M., (eds.) *Int. Conf. on Aspects of Bear Conservation*, 31 May–5 June 1994, Bursa, Turkey.

Servheen, C. 1994 (unpublished). *Recommendations on the conservation of the brown bear in Greece.* ARCTOS Project Collaboration, June 12, 1994. 26 pp.

Servheen, C. 1996. Aspects of the trade in bears and bear parts. *J. Wildl. Res*.

Servheen, C. 1997. Summary of the second international symposium on the trade in bear parts for medicinal use. Pp. 232–239. *in*: Gaski, A.L., and Williamson, D.F., (eds.) *Proc. 2nd Int. Symp. on the Trade of Bear Parts*, Seattle, Washington. TRAFFIC USA/WWF. 239 pp.

Servheen, C. 1998. Conservation of small bear populations through strategic planning. *Proc. Int. Conf. Bear Res. and Manage*. 10:67–74.

Servheen, C., Kasworm, W., and Thier, T. 1995. Transplanting grizzly bears as a management tool – results from the Cabinet Mountains, Montana. *Biol. Conserv*. 71:261–268.

Servheen, C. and Sandstrom, P. 1993. Ecosystem management and linkage zones for grizzly bears and other large carnivores in the northern Rocky Mountains in Montana and Idaho. *End. Sp. Bul*. Vol XVIII. No. 3.

Servheen, C.W. 1990. Suggestions sur la gestion et la recherche nécessaires pour assurer le maintien del'Ours brun en France. *Bull. Mens. O.N.C.* 142:38–43.

Servheen, C.W. 1993. Report on the impacts of road improvements on the brown bear population in the Aspe Valley, western Pyrenees. *Cahier des charges des Amenagements de la RN 134. Ministere de l'Environnement et Ministere de l'Equipement du Logement et des Transports*, 15 fevrier 1994:11 pp.

Seshadri, B. 1969. *The twilight of India's wildlife*. John Baker, London. 212 pp.

Seshadri, B. 1986. *India's wildlife and wildlife reserves*. Sterling., New Delhi. 215 pp.

Shaffer M. 1984. Determining minimum viable population size for grizzly bears. *Int. Conf. Bear Res. and Manage.* 5:133–139.

Shaffer, M.L. 1981. Minimum viable population sizes for species conservation. *BioScience* 31:131–134.

Shepard, P.and Sanders, B. 1985. *The sacred paw: The bear in nature, myth, and literature*. Viking, New York. 243 pp.

Shields, G.F., and Kocher, T.D. 1991. Phylogenetic relationships of North American Ursids based on analysis of mtDNA sequences. *Evolution* 45:218–221.

Simopoulos, K. 1984. *Xeni periigites stin Ellad, de 333 A.D. a 1850* (Foreign travellers in Greece from A.D. 333 to 1850). (Papyros eds.) 1, 2:1400 pp. (in Greek).

Singh, A. 1973. *Tiger haven*. MacMillan London Ltd., London. 237 pp.

Singh, S., Kothari, A., and Pande, P. 1990. *Directory of National Parks and Sanctuaries in Himachal Pradesh – Management Status*. Indian Institute of Public Administration, New Delhi. 164 pp.

Sipari, E. 1926. *Relazione del Presidente del Direttore provissorio dell'Ente Autonomo del Parco Nazionale d'Abruzzo alla Commissione amministratrice dell'Ente stesso, nominata con Regio Decreto 25 marzo 1923.* Tip. Majella, di A. Chicca, Tivoli, Roma.

Sitzko, A. 1983. [The Brown Bear: resources and rational harvest.] *Okhota i okhotnichye khozyaystvo*.

Sládek, J. 1991a. Kraniometrische charakteristik westkarpatischen population des braunbären (*Ursus arctos*) und hinweise zu ihrer subspezifischen stellung. *Folia zoologica* 40(3): 215–229.

Sládek, J. 1991b. Wachstumbedingte veränderungen kraniologischer masse des braunbären (*Ursus arctos*) und möglichkeiten ihrer anwendung zur bestimmung von alter und geschlecht. *Folia zoologica* 40(4): 333–342.

Sokolov, V. and Orlov, V. 1992. *A new species of bear* (Ursus gobiensis sp.n. *), mazaaly or Gobi bear.* Berlin Symposium on Mongolian Biological Resources, 24 March 1992. East German Academy of Sciences. Pp. 133. (In Russian)

Sorensen, O.J. 1990. The brown bear in Europe in the mid 1980s. *Aquilo. Ser. Zool.* 27:3–16.

Sorensen, O.J., Mysterud, I. og Kvam, T. 1984. Central registration of large carnivores in Norway. *Acta Zool. Fennica* 172:213–214.

Sorensen, O.J., Overskaug, K. og Kvam, T. 1990a. Status of the brown bear in Norway 1983–86. *Int. Conf. Bear Res. and Manage*. 8:17–23.

Sorensen, O.J., Overskaug, K. og Kvam, T. 1990b. Bjørn (*Ursus arctos L.*) i Norge. Utbredelse og bestand i 1983–86. *NINA Forskningsrapport* 8:1–76. (In Norwegian with English summary.)

Soule, M.E. 1980. Thresholds for survival: maintaining fitness and evolutionary potential. Pp. 151–169. *in*: Soulé, M.E. and Wilcox, B.A., (eds.) *Conservation biology*. Sinauer Associates, Sunderland.

Southgate, D., Sierra, R., and Brown, L. 1989. The causes of tropical deforestation in Ecuador: a statistical analysis. *World Development* 19(9):1145–1151.

Spassov, N. 1990. Note on the coloration and taxonomic status of the bear (*Ursus arctos* L.) in Bulgaria. *Historia Naturalis Bulgaria* 2.

Spillet, J.J., and Tamang, K.M. 1967. Wildlife conservation in Nepal. *J. Bombay Nat. Hist. Soc.* 67:557–559.

Spiridonov, G. 1985. The bear (*Ursus arctos* L., 1758). In: *Red Data Book of People's Republic of Bulgaria, Vol. II*. Bulg. Acad. Sci., Sofia. 183 pp. (in Bulgarian).

Spiridonov, G. 1990. Status of the brown bear in Bulgaria. *Aquilo Ser. Zool*. 27:71–75.

Spiridonov, G. and Spassov, N. 1990. Status of the brown bear in Bulgaria. *Aquilo Ser. Zool*. 27:71–75.

Spiridonov, G. and Spassov, N. 1993. Large mammals (Macromammalia). In: *National biodiversity conservation strategy of Bulgaria*. General Reports, Vol. 1. Biodiversity Support Program (USA), Sofia and Washington (in Bulgarian and English). Pp. 645–663.

Srikosamarata, S., Siripholej, B., and Suteethorn, V. 1992. Wildlife trade in Lao P.D.R., and between Lao P.D.R. and Thailand. *Nat. Hist. Bull. Siam Soc*. 40:1–47.

Stenin, G., Mitov, I., and Kolev, N. 1983. Distribution and number of the bear. *Gorsko Stopanstvo i Gorska Promishlenost* 11:35–39 (in Bulgarian).

Stirling, I. 1988. *Polar bears*. Univ. of Michigan Press, Ann Arbor. 220 pp.

Stirling, I. 1990. Polar bears and oil: ecologic perspectives. In: J.R. Geraci and D.J.St.Aubin (eds). Pp. 223–224. *Sea Mammals and Oil: Confronting the Risks*. Academic Press, New York.

Stirling, I. and Derocher, A.E. 1990. Factors affecting the evolution and behavioral ecology of the modern bears. *Int. Conf. Bear Res. and Manage*. 8:189–204.

Stirling, I. and Derocher, A.E. 1993. Possible impacts of climatic warming on polar bears. *Arctic* 46: 240–245.

Stocks, A. 1996. The BOSAWAS Natural Reserve and the Mayangna of Nicaragua. Pp.1–31 *in:* Redford, K.H., and Mansour, J.A., (eds.) *Traditional peoples and biodiversity conservation in large tropical landscapes*. American Verde Publ., The Nature Conservancy, Arlington, Va.

Storer, T. and Tevis, L. 1955. *California grizzly*. University of Nebraska Press, Lincoln and London. 335 pp.

Strickland, M.D. 1990. Grizzly bear recovery in the contiguous United States. *Int. Conf. Bear Res. and Manage*. 8:5–9.

Suárez, L. 1985. Hábitos alimenticios y distribución estacional del oso de anteojos (*Tremarctos ornatus*) en el páramo suroriental del Volcán Antisana, Ecuador. Thesis, Pontificia Universidad Católica del Ecuador, Quito. 60 pp.

Suárez, L. 1989. Seasonal distribution and food habits of the spectacled bear (*Tremarctos ornatus*) in the highlands of Ecuador. *Studies on Neotr. Fauna and Envir.* 23(3):133–136.

Suárez, L. and García, M. 1986. *Extinción de animales en el Ecuador*. Fundación Natura, Quito, Ecuador.

Sulli, C., and Bernoni, M. In press. Primi riscontri ai criteri di gestione delle risorse forestali adottati nel Parco Nazionale d'Abruzzo. *Colloque Phytosociologiques.*

Sunquist, M.E. 1982. Movements and habitat use of a sloth bear. *Mammalia* 46:545–547.

Swenson, J.E., Heggberget, T.M., Sandstrom, P., Sandegren, F., Wabakken, P., Bjarvall, A., Soderberg, A., Franzen, R., Linnell, J.D.C., and Andersen, R. 1996a. *Brunbjornens arealbruk i forhold til menneskelig aktivitet.* Norwegian Institute of Nature Research, Oppdragsmelding 416.

Swenson, J.E., and Sandegren, F. In press. Sustainable brown bear harvest in Sweden estimated from hunter-provided information. *J. Wildl. Res.*

Swenson, J.E., Sandegren, F., Wabakken, P., Bjärvall, A., Söderberg, A., og Franzen, R. 1994a. *Bjørnens historiske og nåværende status og forvaltning i Skandinavia*. Norwegian Institute for Nature Research Forskningsrapport 53:1–23.

Swenson, J.E., Sandegren, F., Bjärvall, A., Franszen, R., Söderberg, A. og Wabakken, P. 1994b. Size, trend, distribution, and conservation of the brown bear (*Ursus arctos*) population in Sweden. *Biol. Conserv*. 70:9–17.

Swenson, J.E., Sandegren, F., Heim, M., Brunberg, S., Sorensen, O.J., Soderberg, A., Bjarvall, A., Franzen, R., Wikan, S., Wabakken, P., and Overskaug, K. 1996b. *Er den skandinaviske bjornen farlig?* Norwegian Institute for Nature Research, Oppdragsmelding 404.

Swenson, J.E., Wabakken, P., Sandegren, F., Bjärvall, A., Franzén, R., and Söderberg, A. 1995. The near extinction and recovery of brown bears in Scandinavia in relation to the bear management policies of Norway and Sweden. *Wildl. Biol*. 1:11–25.

Taberlet, P. 1992. Bear conservation genetics. *Nature* 358:197.

Taberlet, P. and Bouvet, J. 1992. Bear conservation genetics. *Nature* 358:197.

Taberlet, P. and Bouvet, J. 1994. Mitochondrial DNA polymorphism, phylogeography, and conservation genetics of the brown bear (*Ursus arctos*) in Europe. *Proc. R. Soc. London B*. 255:195–200.

Taberlet, P., Mattock, H., Dubois-Paganon, C., and Bouvet, J. 1993. Sexing free-ranging brown bears (*Ursus arctos*) using hairs found in the field. *Mol. Ecol.* 2:399–403.

Taberlet, P., Swenson, J.E., Sandegren, F., and Bjarvall, A. 1995. Localization of a contact zone between two highly divergent mitochondrial DNA lineages of the brown bear (*Ursus arctos*) in Scandinavia. *Conserv. Biol.* 9:1255–1261.

Tagle, D.A., Miyamoto, M.M., Goodman, M., Hofmann, O., Braunitzer, G., Goeltenboth, G.R., and Jalanke, H. 1988. Hemoglobins of the pandas, phylogentic relationships of carnivores as ascertained by protein seqeunce data. *Naturwissenschaften* 73:512–514.

Talbot, S.L., and Shields, G.F. In press a. A phylogeny of the bears (Ursidae) inferred from complete sequences of three mitochondrial genes. *Mol. Phy. Evol*.

Talbot, S.L., and Shields, G.F. In press b. Phylogeography of brown bears of Alaska and paraphyly within the Ursidae. *Mol. Phy. Evol*.

Tate, G.H.H. 1931. Random observations on habits of South American mammals. *J. Mammal*. 12:248–256.

Taylor, A.H. and Qin, Z.S. 1988a. Regeneration patterns in old growth *Abies-Betula* forests in the Wolong Natural Reserve, Sichuan, China. *J. Ecol.* 76:1204–1218.

Taylor, A.H. and Qin, Z.S. 1988b. Regeneration from seed of *Sinarundinaria fangiana*, a bamboo, in the Wolong giant panda Reserve, Sichuan, China. *Amer. J. Bot.* 75:1065–1073.

Taylor, A.H. and Qin, Z.S. 1988c. Tree replacement patterns in subalpine *Abies-Betula* forests, Wolong Natural Reserve, China. *Vegetatio*. 78:141–149.

Taylor, A.H. and Qin, Z.S. 1989a. Structure and composition of selectively cut and uncut *Abies-Betula* forest in Wolong Natural Reserve, and implications for giant panda conservation in China. *Biol. Conserv.* 47:83–108.

Taylor, A.H. and Qin, Z.S. 1989b. Bamboo flowering and pandas. *Nature* 341:111.

Taylor, A.H. and Qin, Z.S. 1992. Tree regeneration after bamboo die-back in Chinese *Abies-Betula* forests. *J. Veg. Sci.* 3:253–260.

Taylor, A.H. and Qin, Z.S. 1993a. Structure and dynamics of bamboos in the Wolong Natural Reserve, China. *Am. J. Bot.* 80:375–384.

Taylor, A.H. and Qin, Z.S. 1993b. Bamboo regeneration after flowering in the Wolong giant panda Reserve, China. *Biol. Conserv.* 63:231–234.

Taylor, A.H., Reid, D.G., Qin, Z.S., and Hu, J.C. 1991a. Bamboo dieback: an opportunity to restore panda habitat. *Env. Cons.* 18:166–168.

Taylor, A.H., Reid, D.G., Qin, Z.S., and Hu, J.C. 1991b. Spatial patterns and environmental associates of bamboo (*Bashania fangiana* Yi) after mass flowering in southwestern China. *Bull. Torrey Bot. Club* 118: 247–254.

Taylor, M. 1994. Density dependent population regulation of black, brown, and polar bears. *Int. Conf. Bear Res. and Manage. Monogr. Ser*. No. 3. 43 pp.

Taylor, M.K., DeMaster, D.P., Bunnell, F.L., and Schweinsburg, R.E. 1987. Modeling the sustainable harvest of polar bears. *J. Wildl. Manage*. 51(4) 811–820.

Tewari, R.C. (undated). *Black bear depredation problems in Chamoli Garhwal. A report*. (unpublished).

Thenius, E. 1976. Zur stammesgeschichtlichen Herkunft von *Tremarctos* (Ursidae, Mammalia). *Z. f. Saugetierkunde* 41:109–114.

Thenius, E. 1982. Zur stammes und verbreitungageachichtlichen herkunfft des bambusheren. *Zeit. Geol. Wiss. Berlin* 10:1029–1042.

Thompson, M., and Warburton, M. 1992. Uncertainty on a Himalayan scale. Pp. 41–73 *in:* Messerschmidt, D.A., and Rai, N.K., (eds.) *Readings in social forestry and natural resource management for Nepal*. HMG Ministry of Agriculture and Winrock International, Kathmandu.

Thompson, S.C., and McCurdy, K.E. 1995. Black bear management in Yosemite National Park: more a people management problem. Pp. 105–115 *in:* Auger, J., and Black, H.L., (eds.) *Proc. of the 5th Western Black Bear Workshop*. Brigham Young University Press, Provo, Utah.

Thurn-Valsassina, G. 1965. Der Kärntner Karawankenbär. *Die Furche* 31:9.

Tikhonov, A.N. 1987. Taxonomy, biology and ecology of the brown bear in the mountains of the Soviet Union. In: *Ekologia medvedey*. Nauka, Novosibirsk. Pp. 6–12.

Titus, K., and Beier, L.R. 1991. *Population and habitat ecology of brown bears on Admiralty and Chichagof Islands.* 32 pp. Alaska Dep. Fish and Game Fed. Aid in Wildl. Restoration Research Progress Report on Study 4.22.

Torres, D. 1992. Management of the Spectacled Bear in Venezuelan zoological parks. Pp. 83–116. *in:* Weinhardt, D., (ed.) *International Studbook for the Spectacled Bear, 1991.* Lincoln Park Zoological Gardens, Chicago, Ill.

Toyama Prefecture 1989. *Status report of Japanese black bears in Toyama*. 47 pp. (In Japanese)

Tratz, E.P. 1964. Bär, Wolf, Luchs und Wildkatze in Österreich. In: *Jagd in Österreich*. Herausgeber und Verleger Herbert St. Fürlinger, Wien-München-Zürich.

Tschudi, J.J. von. 1844. Therologie. In: *Untersuchungen ueber die fauna Perúana*. St. Gallen. 262 pp.

Tsuruga, H., Mano, T., Yamanaka, M., and Kanagawa, H. 1994. Estimate of genetic variations in Hokkaido brown bears (*Ursus arctos yesoensis*) by DNA fingerprinting. *Jpn. J. Vet. Res.* 42:127–136.

UNEP. 1991. *Guidelines for the preparation of country studies on cost benefit and unmet needs of biological diversity within the framework of the planned convention on biological diversity.* United Nations Environmental Program. 73 pp.

United States Fish and Wildlife Service. 1993. *Grizzly bear recovery plan*. USFWS, Missoula, Mont. 189 pp.

USDAFS (United States Department of Agriculture – Forest Service). 1990. *CEM: A model for assessing effects on grizzly bears*. USDA Forest Service, Missoula, Montana. 24 pp.

Ustinov, S.K. 1993. Baikal region. Pp. 275–300. *in*: Vaisfeld, M.E. and Chestin, I.E., (eds.) *Bears*. Nauka, Moscow. (In Russian with English summary).

Vareschi, V. 1970. *Flora de los Páramos de Venezuela*. Talleres Gráficos Universitarios. Universidad de Los Andes. Mérida, Venezuela. 429 pp.

Veillon, J.P. 1977. Las deforestaciones en los Llanos Occidentales de Venezuela, desde 1950 a 1975. Pp. 97–110 *in:* Hamilton, L., (ed.) *Conservación de los Bosques Húmedos de Venezuela*. Ministerio del Ambiente y de los Recursos Naturales Renovables, Caracas.

Vereshchagin, N.K. 1959. *Mammals of the Caucasus*. Moscow. (In Russian).

Voionmaa, V. 1947. *Hämäläinen eräkausi* (The wildlife season on Häme: in Finnish). WSOY, Porvoo.

Vrana, P.B., Milinkovitch, M.C., Powell, J.R., and Wheeler, W.C. 1994. Higher level relationships of the Arctoid Carnivora based on sequence data and "total evidence". *Mol. Phy. Evol*. 3:47–58.

Waits, L.P. 1996. *A comprehensive molecular study of the evolution and genetic variation of bears.* PhD Thesis, University of Utah. 232 pp.

Waits, L.P., Paetkau, D., Strobeck, C., and Ward, R.H. 1998a. A comparison of genetic diversity in North American brown bear populations. *Int. Conf. Bear Res. and Manage*. 10:307–314.

Waits, L.P., Talbot, S.L., Ward, R.H., Shields, G.F. 1998b. MtDNA phylogeography of North American brown bear and implications for conservation. *Conservation Biol.* 12:408–417

Waits, L.P., and Ward, R.H. In press. Molecular identification of bear species using Taxon-specific sequences. *Int. Conf. Bear Res. and Manage*. 10.

Waits, L.P., Kohn., M., Talbot, S.L., Shields, G.F., Taberlet, P., Paabo, S., and Ward, R.H. Submitted. Mitochondrial DNA phylogeography of the brown bear and Pleistocene climatic fluctuations. *Proc. Natl. Acad. Sci. USA*

Walker, T. 1993. *River of bears*. Voyageur Press, Stillwater, MN. 155 pp.

Walker, T., and Aumiller, L. 1993. *River of Bears*. 155 pp. Voyageur Press, Inc., Stillwater MN.

Walters, C.J. 1986. *Adaptive management of renewable resources*. MacGraw-Hill, New York.

Wang, Y. 1986. The study on the use of wildlife resources among game shops in Taiwan. *Council of Agr. Res. Rep.* 11(1):1–91.

Wang, Y. 1988. The study on the use of wildlife resources among game shops in Taiwan. *Council of Agr. Res. Rep.* 17(3):1–62.

Wang, Y. 1990. The current status and distribution of the black bear in Taiwan. *Int. Conf. Bear Res. and Manage.* 8:1–4.

Wang, Y., and Chen, T.S. 1991. The study of the ecology and management of the Formosan black bear. *Council of Agr. Res. Rep.* 14:1–44.

Wang, Y., and Lin, W.C. 1987. The study on the use of wildlife resources among game shops in Taiwan. *Council of Agr. Res. Rep.* 21(2):1–77.

Wang, Y., and Tsay, T.T. 1989. The study on the use of wildlife resources among aborigines in Taiwan. *Council of Agr. Res. Rep.* 28(1):1–49.

Wang, Y., and Wang, K.P. 1990. The study on the ecology and management of the Formosan black bear. *Council of Agr. Res. Rep.* 10(1):1–15.

Watanabe, H. 1980. Damage to conifers by the Japanese black bear. *Int. Conf. Bear Res. and Manage*. 4:67–70.

Wathen, W.G., McCracken, G.F., and Pelton, M.R. 1985. Genetic variation in black bears from the Great Smoky Mountains National Park. *J. Mammal*. 66:564–567.

Wayne R.K., Beneveniste, R.E., Janczewski, D.N., and O'Brien, S.J. 1989. Molecular and biochemical evolution of the Carnivora. Pp. 465–493 *in*: Gittleman, J.L., (ed.) *Carnivore behavior, ecology, and evolution*. Cornell Univ. Press, Ithaca.

Weaver, J.R., Escano, D., Mattson, D., Puchlerz, T., and Despain, D. 1986. *A cumulative effects assessment model for grizzly bear management in the Yellowstone ecosystem*. *In*: Contreras, G.P. and Evans, E.K., (eds.) *Proceedings of the grizzly bear habitat symposium*. Intermountain Res. Stat. Gen. Tech. Rep. INT-207. 252 pp.

Wei, F.W., Hu, J.C., Xu, G.Z., Jiang, M.D., Deng, Q.T., and Zhong, Z.M. 1989. A study on the life table of wild giant pandas. *Acta Theriol. Sinica* 9:81–86. (in Chinese).

Weinhardt, D. 1987. *International studbook for the spectacled bear, 1986.* Lincoln Park Zoological Gardens, Chicago Park District Press, Chicago, Illinois, U.S.A. 124 pp.

Weinhardt, D. (ed.) 1994. *International studbook for the spectacled bear (Tremarctos ornatus F. Cuvier, 1825): 1992*. Lincoln Park Zoological Gardens, Chicago. 149 pp.

Wells, M., and Brandon, K. with Hannah, L. 1992. *People and parks: linking protected area management with local communities*. World Bank, WWF, and USAID, Washington, D.C. 99 pp.

Wesley, D.G. 1977. Census of wild animals in Bandipur Tiger Reserve. *Myforest* 13:15–19.

Western, D. 1982. Perspective: how many vicuñas? *Animal Kingdom* (June/July):16–17.

Western, D. 1989. Conservation without parks: wildlife in the rural landscape. Pp 158–165 *in:* D. Western and M. Pearl (eds). *Conservation for the twenty-first century.* Oxford University Press, New York.

Western, D. 1994. Linking conservation and community aspirations. Pp 499–511 *in:* Western, D., Wright, R.M., and Strum, S.C., (eds.) *Natural connections, perspectives in community-based conservation*. Island Press, Washington, D.C.

Western, D., Pearl, M.C., Pimm, S.L., Walker, B., Atkinson, I., and Woodruff, D.S. 1989. An agenda for conservation action. Pp. 304–323 *in*: D. Western and M. Pearl (eds). *Conservation for the twenty-first century*. Oxford University Press, New York.

Western, D., Wright, R.M., and Strum, S.C., eds. 1994. *Natural connections. Perspectives in community-based conservation*. Island Press, Washington, D.C. 581 pp.

Westrum, R. 1994. An organizational perspective: designing recovery teams from the inside out. Pp. 327–349 *in:* Clark, T., Reading, R.P., and Clarke, A.L., (eds.) *Endangered species recovery: finding the lessons, improving the process*. Island Press, Washington, D.C.

WCMC 1992. *Global biodiversity: status of the earth's living resources*. Chapman and Hall, London. 594 pp.

Wikan, S. 1970. Bjørn i Sør-Varanger. *Fauna* 23:85–101.

WIINWDB. 1995. *Wildlife Institute of India National Wildlife Database*. Wildlife Institute of India, Dehra Dun.

Wolfe. 1983. Electrophoretic differentiation between Alaskan brown and black bears. *J. Wildl. Manage*. 47: 268–271.

Wooding, S., and Ward, R.H. In press. Patterns in genetic diversity in a black bear population indicate recent migration. *Ursus*. 10:329–333.

Woods, J.G., McLellan, B., Paetkau, D., Strobeck, C., and Proctor, M. 1996. DNA fingerprinting applied to mark-recapture bear studies. *Int. Bear News*. 5: 9–10.

Wray, N., and Alvarado, J. 1996. Sumaco National Park, Ecuador: change and continuity in the indigenous economy and the challenges of biodiversity conservation. Pp. 93–113 *in* Redford, K.H., and Mansour, J.A., (eds.) *Traditional peoples and biodiversity conservation in large tropical landscapes*. American Verde Publ., The Nature Conservancy, Arlington, VA.

World Resources Institute. 1990. *World resources: 1990–1991*. Oxford University Press, New York. 383 pp.

World Resources Institute. 1992. *World Resources 1992–1993.* Report by the WRI in collaboration with UNEP and UNDP. Oxford University Press, New York, U.S.A. 385 pp.

Wroughton, R.C. 1916. Bombay Natural History Society's mammal survey of India, Burma, and Ceylon. Rept. No. 20. *J. Bombay Nat. Hist. Soc*. 24:294–302.

Wuster-Hill, D.H., and Bush, M. 1980. The interrelationship of chromosome banding patterns in the giant panda (*Aliuropoda melanoleuca*), hybrid bear *(Ursus middendorfi X Thalarctos maritimus*), and other carnivores. *Cytogenet. Cell Genet*. 27:147–154.

Yaffee, S.L. 1994. *The wisdom of the spotted owl: policy lessons for a new century*. Island Press, Publ., Washington, DC. 430 pp.

Yamagata Prefecture 1982. *Status report of Japanese black bears in Yamagata*. 38 pp. (In Japanese)

Yamanaka, M. 1986. For the future of brown bears in the Shiretoko National Park. *Higuma (Brown bear)* 21:31–34. (In Japanese)

Yen, C.W. 1979. *The study of the wildlife population changes during a six year hunting ban*. 48 pp. Environmental Sci. Res. Center, Tunghai University, Taiwan.

Yerena, E. 1988. Planning for spectacled bear conservation in Venezuela. Pp. 44–59 *in* Rosenthal, M., (ed.) *Proc. First Int. Symp. Spectacled Bear*. Lincoln Park Zoological Gardens, Chicago, Ill.

Yerena, E. 1992. *Diseño de un sistema de áreas silvestres protegidas para la Cordillera de Los Andes en Venezuela.* Trabajo Especial de Grado. Magister en Ciencias Biológicas. Universidad Simón Bolívar, Caracas, Venezuela. 137 pp.

Yerena, E. 1994. *Corredores ecológicos en los Andes de Venezuela*. Parques Nacionales y Conservación Ambiental (Caracas), No. 4. 87 pp.

Yerena, E. 1998. Protected areas for Andean bear (*Tremarctos ornatus*) in South America. *Int. Conf. Bear Res. and Manage*. 10: 101–106.

Yerena, E. and Torres, D. 1994. Spectacled bear conservation and dispersal corridors in Venezuela. *Int. Conf. Bear Res. and Manage*. 9:169–172.

Young, K.R. 1991. Floristic diversity on the eastern slopes of the Peruvian Andes. *Candollea* 46:125–143.

Young, K.R. 1992. Biogeography of the montane forest zone of the eastern slope of Perú. Pp. 119–140. *in*: Young, K.R. and Valencia, N., (eds.) *Biogeografia, ecologia, y conservacion del Bosque Montano en el Perú.* Memorias del Museo de Historia Natural No. 21. Lima.

Young, K.R. and León, B. 1988. Vegetación de la zona alta del Parque Nacional Río Abiseo, San Martín. *Revista Forestal del Perú* 15:3–20.

Zetterberg, H. 1951. *Bjornen i sagen och verklighet*. J.A. Lindblads Forlag, Uppsala.

Zhang, Y. and Ryder, O.A. 1993. Mitochondrial DNA sequence evolution in the Arctoidea. *Proc. Natl. Acad. Sci. USA*. 90:9557–9561.

Zhang, Y. and Ryder, O.A. 1994. Phylogenetic relationships of bears inferred from mtDNA sequences. *Mol. Phy. Evol*. 3:351–359.

Zhang, Y., Ryder, O.A., Zhao, Q.G., Fan, Z.Y., He, G.X., Zhang, A.J., Zhang, H.M., He, T.M., and Chen, Y.C. 1994. Non-invasive giant panda paternity exclusion. *Zoo Biol*. 13:569–573.

Zhang, Y. and Shi, L.M. 1991. Riddle of the giant panda. *Nature* 352:573.

Zhdanov, A. and Pavlov, M. 1972. Aggressiveness of brown bear (In Russian). *Okhota i okhotnichye khozyaystvo* 6: 16–20.

Zheleznov, N.K. 1993. Dynamics of human-caused pressure, bear number, and behavioral patterns in the marginal North-East of Russia. Pp. 75–85. *in*: Chestin, I.E. and Uspenskiy, S.M., (eds.) Bears of Russia and adjacent countries – state of populations. *Proc. 6th Conference of Specialists Studying Bears in Russia and Adjacent Countries.* 6–11 September, 1993, Central Forest Reserve, Tver oblast. Moscow Argus: (In Russian with English summary)

Zhirnov, L. and Ilyinski, V. 1986. *The Great Gobi National Park: a refuge for rare animals of the Central Asian deserts*. Centre for Int. Projects, GKNT, Moscow.

Zhu, J. 1989. Nature conservation in China. *J. Appl. Ecol.* 26:825–833.

Zhu, J. and Long, Z. 1983. The vicissitudes of the giant panda. *Acta Zool. Sinica* 29:93–104

Zilincár, J., Zvada, P., and Hell, P. 1992. Die schwermetallbelastung bei den braunbären in den Westkarpaten. *Zeitschr. für Jagdwiss*. 38(4):235–243.

Zunino, F. and Herrero, S. 1972. The status of the brown bear in Abruzzo National Park, Italy. *Biol. Conserv*. 4(4): 263–272.

Zyryanov, A.N. and Smirnov, M.N. 1992. About the relations between brown bear and humans in Yenisey Sibiria. (In Russian). Report at the *2nd Meeting of the Commission on Large Predators of All-Russian Theriologic Society.,* 12–14 March, 1992.

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Appendix 4

IUCN Red List Categories

Prepared by the IUCN Species Survival Commission
As approved by the 40th Meeting of the IUCN Council, Gland, Switzerland
30 November 1994

I) Introduction

1. The threatened species categories now used in Red Data Books and Red Lists have been in place, with some modification, for almost 30 years. Since their introduction these categories have become widely recognised internationally, and they are now used in a whole range of publications and listings, produced by IUCN as well as by numerous governmental and non-governmental organisations. The Red Data Book categories provide an easily and widely understood method for highlighting those species under higher extinction risk, so as to focus attention on conservation measures designed to protect them.

2. The need to revise the categories has been recognised for some time. In 1984, the SSC held a symposium, 'The Road to Extinction' (Fitter and Fitter 1987), which examined the issues in some detail, and at which a number of options were considered for the revised system. However, no single proposal resulted. The current phase of development began in 1989 with a request from the SSC Steering Committee to develop a new approach that would provide the conservation community with useful information for action planning.

In this document, proposals for new definitions for Red List categories are presented. The general aim of the new system is to provide an explicit, objective framework for the classification of species according to their extinction risk.

The revision has several specific aims:

- to provide a system that can be applied consistently by different people;
- to improve the objectivity by providing those using the criteria with clear guidance on how to evaluate different factors which affect risk of extinction;
- to provide a system which will facilitate comparisons across widely different taxa;
- to give people using threatened species lists a better understanding of how individual species were classified.

3. The proposals presented in this document result from a continuing process of drafting, consultation and validation. It was clear that the production of a large number of draft proposals led to some confusion, especially as each draft has been used for classifying some set of species for conservation purposes. To clarify matters, and to open the way for modifications as and when they became necessary, a system for version numbering was applied as follows:

Version 1.0: Mace & Lande (1991)
The first paper discussing a new basis for the categories, and presenting numerical criteria especially relevant for large vertebrates.

Version 2.0: Mace *et al.* (1992)
A major revision of Version 1.0, including numerical criteria appropriate to all organisms and introducing the non-threatened categories.

Version 2.1: IUCN (1993)
Following an extensive consultation process within SSC, a number of changes were made to the details of the criteria, and fuller explanation of basic principles was included. A more explicit structure clarified the significance of the non-threatened categories.

Version 2.2: Mace & Stuart (1994)
Following further comments received and additional validation exercises, some minor changes to the criteria were made. In addition, the Susceptible category present in Versions 2.0 and 2.1 was subsumed into the Vulnerable category. A precautionary application of the system was emphasised.

Final Version
This final document, which incorporates changes as a result of comments from IUCN members, was adopted by the IUCN Council in December 1994.

All future taxon lists including categorisations should be based on this version, and not the previous ones.

4. In the rest of this document the proposed system is outlined in several sections. The Preamble presents some basic information about the context and structure of the proposal, and the procedures that are to be followed in applying the definitions to species. This is followed by a section giving definitions of terms used. Finally the definitions are presented, followed by the quantitative criteria used for classification within the threatened categories. It is important for the effective functioning of the new system that all sections are read and understood, and the guidelines followed.

References:

Fitter, R., and M. Fitter, ed. (1987) *The Road to Extinction*. Gland, Switzerland: IUCN.
IUCN. (1993) *Draft IUCN Red List Categories*. Gland, Switzerland: IUCN.
Mace, G. M. *et al.* (1992) "The development of new criteria for listing species on the IUCN Red List." *Species* 19: 16–22.
Mace, G. M., and R. Lande. (1991) "Assessing extinction threats: toward a reevaluation of IUCN threatened species categories." *Conserv. Biol.* 5.2: 148–157.
Mace, G. M. & S. N. Stuart. (1994) "Draft IUCN Red List Categories, Version 2.2". *Species* 21–22: 13–24.

II) Preamble

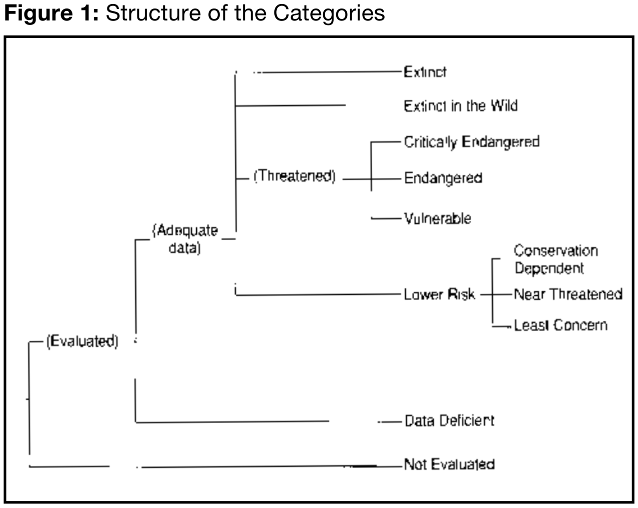
The following points present important information on the use and interpretation of the categories (= Critically Endangered, Endangered, etc.), criteria (= A to E), and sub-criteria (= a,b etc., i,ii etc.):

1. Taxonomic level and scope of the categorisation process
The criteria can be applied to any taxonomic unit at or below the species level. The term 'taxon' in the following notes, definitions and criteria is used for convenience, and may represent species or lower taxonomic levels, including forms that are not yet formally described. There is a sufficient range among the different criteria to enable the appropriate listing of taxa from the complete taxonomic spectrum, with the exception of micro-organisms. The criteria may also be applied within any specified geographical or political area although in such cases special notice should be taken of point 11 below. In presenting the results of applying the criteria, the taxonomic unit and area under consideration should be made explicit. The categorisation process should only be applied to wild populations inside their natural range, and to populations resulting from benign introductions (defined in the draft IUCN Guidelines for Re-introductions as "... an attempt to establish a species, for the purpose of conservation, outside its recorded distribution, but within an appropriate habitat and eco-geographical area").

2. Nature of the categories
All taxa listed as Critically Endangered qualify for Vulnerable and Endangered, and all listed as Endangered qualify for Vulnerable. Together these categories are described as 'threatened'. The threatened species categories form a part of the overall scheme. It will be possible to place all taxa into one of the categories (see Figure 1).

3. Role of the different criteria
For listing as Critically Endangered, Endangered or Vulnerable there is a range of quantitative criteria; meeting any one of these criteria qualifies a taxon for listing at that level of threat. Each species should be evaluated against all the criteria. The different criteria (A–E) are derived from a wide review aimed at detecting risk factors across the broad range of organisms and the diverse life histories they exhibit. Even though some criteria will be inappropriate for certain taxa (some taxa will never qualify under these however close to extinction they come), there should be criteria appropriate for assessing threat levels for any taxon (other than micro-organisms). The relevant factor is whether any one criterion is met, not whether all are appropriate or all are met. Because it will never be clear which criteria are appropriate for a particular species in advance, each species should be evaluated against all the criteria, and any criterion met should be listed.

Figure 1: Structure of the Categories



4. Derivation of quantitative criteria
The quantitative values presented in the various criteria associated with threatened categories were developed through wide consultation and they are set at what are generally judged to be appropriate levels, even if no formal justification for these values exists. The levels for different criteria within categories were set independently but against a common standard. Some broad consistency between them was sought. However, a given taxon should not be expected to meet all criteria (A–E) in a category; meeting any one criterion is sufficient for listing.

5. Implications of listing
Listing in the categories of Not Evaluated and Data Deficient indicates that no assessment of extinction risk has been made, though for different reasons. Until such time as an assessment is made, species listed in these categories should not be treated as if they were non-threatened, and it may be appropriate (especially for Data Deficient forms) to give them the same degree of protection as threatened taxa, at least until their status can be evaluated.

Extinction is assumed here to be a chance process. Thus, a listing in a higher extinction risk category implies a higher expectation of extinction, and over the time-frames specified more taxa listed in a higher category are expected to go extinct than in a lower one (without effective conservation action). However, the persistence of some taxa in high risk categories does not necessarily mean their initial assessment was inaccurate.

6. Data quality and the importance of inference and projection
The criteria are clearly quantitative in nature. However, the absence of high quality data should not deter attempts at applying the criteria, as methods involving estimation, inference and projection are emphasised to be acceptable throughout. Inference and projection may be based on extrapolation of current or potential threats into the future (including their rate of change), or of factors related to population abundance or distribution (including dependence on other taxa), so long as these can reasonably be supported. Suspected or inferred patterns in either the recent past, present or near future can be based on any of a series of related factors, and these factors should be specified.

Taxa at risk from threats posed by future events of low probability but with severe consequences (catastrophes) should be identified by the criteria (e.g. small distributions, few locations). Some threats need to be identified particularly early, and appropriate actions taken, because their effects are irreversible, or nearly so (pathogens, invasive organisms, hybridization).

7. Uncertainty
The criteria should be applied on the basis of the available evidence on taxon numbers, trend and distribution, making due allowance for statistical and other uncertainties. Given that data are rarely available for the whole range or population of a taxon, it may often be appropriate to use the information

that is available to make intelligent inferences about the overall status of the taxon in question. In cases where a wide variation in estimates is found, it is legitimate to apply the precautionary principle and use the estimate (providing it is credible) that leads to listing in the category of highest risk.

Where data are insufficient to assign a category (including Lower Risk), the category of 'Data Deficient' may be assigned. However, it is important to recognise that this category indicates that data are inadequate to determine the degree of threat faced by a taxon, not necessarily that the taxon is poorly known. In cases where there are evident threats to a taxon through, for example, deterioration of its only known habitat, it is important to attempt threatened listing, even though there may be little direct information on the biological status of the taxon itself. The category 'Data Deficient' is not a threatened category, although it indicates a need to obtain more information on a taxon to determine the appropriate listing.

8. Conservation actions in the listing process

The criteria for the threatened categories are to be applied to a taxon whatever the level of conservation action affecting it. In cases where it is only conservation action that prevents the taxon from meeting the threatened criteria, the designation of 'Conservation Dependent' is appropriate. It is important to emphasise here that a taxon require conservation action even if it is not listed as threatened.

9. Documentation

All taxon lists including categorisation resulting from these criteria should state the criteria and sub-criteria that were met. No listing can be accepted as valid unless at least one criterion is given. If more than one criterion or sub-criterion was met, then each should be listed. However, failure to mention a criterion should not necessarily imply that it was not met. Therefore, if a re-evaluation indicates that the documented criterion is no longer met, this should not result in automatic down-listing. Instead, the taxon should be re-evaluated with respect to all criteria to indicate its status. The factors responsible for triggering the criteria, especially where inference and projection are used, should at least be logged by the evaluator, even if they cannot be included in published lists.

10. Threats and priorities

The category of threat is not necessarily sufficient to determine priorities for conservation action. The category of threat simply provides an assessment of the likelihood of extinction under current circumstances, whereas a system for assessing priorities for action will include numerous other factors concerning conservation action such as costs, logistics, chances of success, and even perhaps the taxonomic distinctiveness of the subject.

11. Use at regional level

The criteria are most appropriately applied to whole taxa at a global scale, rather than to those units defined by regional or national boundaries. Regionally or nationally based threat categories, which are aimed at including taxa that are threatened at regional or national levels (but not necessarily throughout their global ranges), are best used with two key pieces of information: the global status category for the taxon, and the proportion of the global population or range that occurs within the region or nation. However, if applied at regional or national level it must be recognised that a global category of threat may not be the same as a regional or national category for a particular taxon. For example, taxa classified as Vulnerable on the basis of their global declines in numbers or range might be Lower Risk within a particular region where their populations are stable. Conversely, taxa classified as Lower Risk globally might be Critically Endangered within a particular region where numbers are very small or declining, perhaps only because they are at the margins of their global range. IUCN is still in the process of developing guidelines for the use of national red list categories.

12. Re-evaluation

Evaluation of taxa against the criteria should be carried out at appropriate intervals. This is especially important for taxa listed under Near Threatened, or Conservation Dependent, and for threatened species whose status is known or suspected to be deteriorating.

13. Transfer between categories

There are rules to govern the movement of taxa between categories. These are as follows: (A) A taxon may be moved from a category of higher threat to a category of lower threat if none of the criteria of the higher category has been met for five years or more. (B) If the original classification is found to have been erroneous, the taxon may be transferred to the appropriate category or removed from the threatened categories altogether, without delay (but see Section 9). (C) Transfer from categories of lower to higher risk should be made without delay.

14. Problems of scale

Classification based on the sizes of geographic ranges or the patterns of habitat occupancy is complicated by problems of spatial scale. The finer the scale at which the distributions or habitats of taxa are mapped, the smaller the area will be that they are found to occupy. Mapping at finer scales reveals more areas in which the taxon is unrecorded. It is impossible to provide any strict but general rules for mapping taxa or habitats; the most appropriate scale will depend on the taxa in question, and the origin and comprehensiveness of the distributional data. However, the thresholds for some criteria (e.g. Critically Endangered) necessitate mapping at a fine scale.

III) Definitions

1. Population

Population is defined as the total number of individuals of the taxon. For functional reasons, primarily owing to differences between life-forms, population numbers are expressed as numbers of mature individuals only. In the case of taxa obligately dependent on other taxa for all or part of their life cycles, biologically appropriate values for the host taxon should be used.

2. Subpopulations

Subpopulations are defined as geographically or otherwise distinct groups in the population between which there is little exchange (typically one successful migrant individual or gamete per year or less).

3. Mature individuals

The number of mature individuals is defined as the number of individuals known, estimated or inferred to be capable of reproduction. When estimating this quantity the following points should be borne in mind:

- Where the population is characterised by natural fluctuations the minimum number should be used.

- This measure is intended to count individuals capable of reproduction and should therefore exclude individuals that are environmentally, behaviourally or otherwise reproductively suppressed in the wild.

- In the case of populations with biased adult or breeding sex ratios it is appropriate to use lower estimates for the number of mature individuals which take this into account (e.g. the estimated effective population size).

- Reproducing units within a clone should be counted as individuals, except where such units are unable to survive alone (e.g. corals).

- In the case of taxa that naturally lose all or a subset of mature individuals at some point in their life cycle, the estimate should be made at the appropriate time, when mature individuals are available for breeding.

4. Generation
Generation may be measured as the average age of parents in the population. This is greater than the age at first breeding, except in taxa where individuals breed only once.

5. Continuing decline
A continuing decline is a recent, current or projected future decline whose causes are not known or not adequately controlled and so is liable to continue unless remedial measures are taken. Natural fluctuations will not normally count as a continuing decline, but an observed decline should not be considered to be part of a natural fluctuation unless there is evidence for this.

6. Reduction
A reduction (criterion A) is a decline in the number of mature individuals of at least the amount (%) stated over the time period (years) specified, although the decline need not still be continuing. A reduction should not be interpreted as part of a natural fluctuation unless there is good evidence for this. Downward trends that are part of natural fluctuations will not normally count as a reduction.

7. Extreme fluctuations
Extreme fluctuations occur in a number of taxa where population size or distribution area varies widely, rapidly and frequently, typically with a variation greater than one order of magnitude (i.e. a tenfold increase or decrease).

8. Severely fragmented
Severely fragmented refers to the situation where increased extinction risks to the taxon result from the fact that most individuals within a taxon are found in small and relatively isolated subpopulations. These small subpopulations may go extinct, with a reduced probability of recolonisation.

9. Extent of occurrence
Extent of occurrence is defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon, excluding cases of vagrancy. This measure may exclude discontinuities or disjunctions within the overall distributions of taxa (e.g. large areas of obviously unsuitable habitat) (but see ‘area of occupancy’). Extent of occurrence can often be measured by a minimum convex polygon (the smallest polygon in which no internal angle exceeds 180 degrees and which contains all the sites of occurrence).

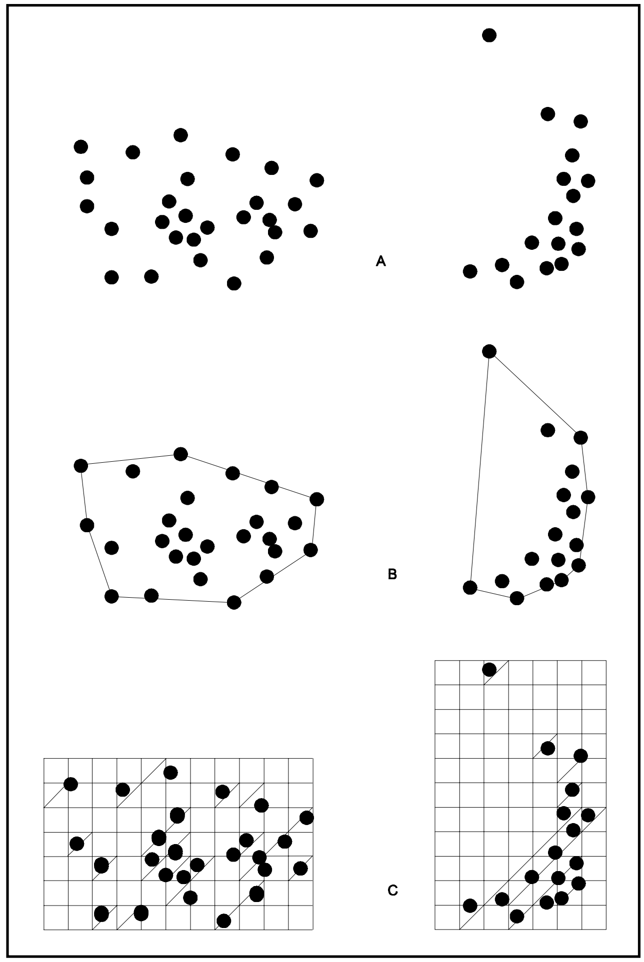


Figure 2: Two examples of the distinction between extent of occurrence and area of occupancy. (a) is the spatial distribution of known, inferred or projected sites of occurrence. (b) shows one possible boundary to the extent of occurrence, which is the measured area within this boundary. (c) shows one measure of area of occupancy which can be measured by the sum of the occupied grid squares.

10. Area of occupancy
Area of occupancy is defined as the area within its ‘extent of occurrence’ (see definition) which is occupied by a taxon, excluding cases of vagrancy. The measure reflects the fact that a taxon will not usually occur throughout the area of its extent of occurrence, which may, for example, contain unsuitable habitats. The area of occupancy is the smallest area essential at any stage to the survival of existing populations of a taxon (e.g. colonial nesting sites, feeding sites for migratory taxa). The size of the area of occupancy will be a function of the scale at which it is measured, and should be at a scale appropriate to relevant biological aspects of the taxon. The criteria include values in km^2, and thus to avoid errors in classification, the area of occupancy should be measured on grid squares (or equivalents) which are sufficiently small (see Figure 2).

11. Location
Location defines a geographically or ecologically distinct area in which a single event (e.g. pollution) will soon affect all individuals of the taxon present. A location usually, but not always, contains all or part of a subpopulation of the taxon, and is typically a small proportion of the taxon’s total distribution.

12. Quantitative analysis
A quantitative analysis is defined here as the technique of population viability analysis (PVA), or any other quantitative form of analysis, which estimates the extinction probability of a taxon or population based on the known life history and specified management or non-management options. In presenting the results of quantitative analyses the structural equations and the data should be explicit.

IV) The Categories [1]

EXTINCT (EX)
A taxon is Extinct when there is no reasonable doubt that the last individual has died.

EXTINCT IN THE WILD (EW)
A taxon is Extinct in the wild when it is known only to survive in cultivation, in captivity or as a naturalised population (or populations) well outside the past range. A taxon is presumed extinct in the wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

CRITICALLY ENDANGERED (CR)
A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the criteria (A to E) on pages 307–308.

ENDANGERED (EN)
A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future, as defined by any of the criteria (A to E) on page 308.

VULNERABLE (VU)
A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the criteria (A to D) on pages 307 and 308.

LOWER RISK (LR)
A taxon is Lower Risk when it has been evaluated, does not satisfy the criteria for any of the categories Critically Endangered, Endangered or Vulnerable. Taxa included in the Lower Risk category can be separated into three subcategories:

1. **Conservation Dependent (cd)**. Taxa which are the focus of a continuing taxon-specific or habitat-specific conservation programme targeted towards the taxon in question, the cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years.

2. **Near Threatened (nt)**. Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable.

3. **Least Concern (lc)**. Taxa which do not qualify for Conservation Dependent or Near Threatened.

DATA DEFICIENT (DD)
A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution is lacking. Data Deficient is therefore not a category of threat or Lower Risk. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and threatened status. If the range of a taxon is suspected to be relatively circumscribed, if a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

NOT EVALUATED (NE)
A taxon is Not Evaluated when it is has not yet been assessed against the criteria.

V) The Criteria for Critically Endangered, Endangered and Vulnerable

CRITICALLY ENDANGERED (CR)
A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the following criteria (A to E):

A) Population reduction in the form of either of the following:

1) An observed, estimated, inferred or suspected reduction of at least 80% over the last 10 years or three generations, whichever is the longer, based on (and specifying) any of the following:
   a) direct observation
   b) an index of abundance appropriate for the taxon
   c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   d) actual or potential levels of exploitation
   e) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.

2) A reduction of at least 80%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer, based on (and specifying) any of (b), (c), (d) or (e) above.

B) Extent of occurrence estimated to be less than $100km^2$ or area of occupancy estimated to be less than $10km^2$, and estimates indicating any two of the following:

1) Severely fragmented or known to exist at only a single location.

2) Continuing decline, observed, inferred or projected, in any of the following:
   a) extent of occurrence
   b) area of occupancy
   c) area, extent and/or quality of habitat
   d) number of locations or subpopulations
   e) number of mature individuals.

3) Extreme fluctuations in any of the following:
   a) extent of occurrence
   b) area of occupancy
   c) number of locations or subpopulations
   d) number of mature individuals.

C) Population estimated to number less than 250 mature individuals and either:

1) An estimated continuing decline of at least 25% within three years or one generation, whichever is longer or

2) A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either:
   a) severely fragmented (i.e. no subpopulation estimated to contain more than 50 mature individuals)
   b) all individuals are in a single subpopulation.

D) Population estimated to number less than 50 mature individuals.

E) Quantitative analysis showing the probability of extinction in the wild is at least 50% within 10 years or three generations, whichever is the longer.

ENDANGERED (EN)
A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future, as defined by any of the following criteria (A to E):

A) Population reduction in the form of either of the following:

1) An observed, estimated, inferred or suspected reduction of at least 50% over the last 10 years or three generations, whichever is the longer, based on (and specifying) any of the following:
   a) direct observation
   b) an index of abundance appropriate for the taxon
   c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   d) actual or potential levels of exploitation
   e) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.

2) A reduction of at least 50%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer, based on (and specifying) any of (b), (c), (d), or (e) above.

B) Extent of occurrence estimated to be less than 5000km^2 or area of occupancy estimated to be less than 500km^2, and estimates indicating any two of the following:

1) Severely fragmented or known to exist at no more than five locations.

2) Continuing decline, inferred, observed or projected, in any of the following:
   a) extent of occurrence
   b) area of occupancy
   c) area, extent and/or quality of habitat
   d) number of locations or subpopulations
   e) number of mature individuals.

3) Extreme fluctuations in any of the following:
   a) extent of occurrence
   b) area of occupancy
   c) number of locations or subpopulations
   d) number of mature individuals.

C) Population estimated to number less than 2500 mature individuals and either:

1) An estimated continuing decline of at least 20% within five years or two generations, whichever is longer, or

2) A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either:
   a) severely fragmented (i.e. no subpopulation estimated to contain more than 250 mature individuals)
   b) all individuals are in a single subpopulation.

D) Population estimated to number less than 250 mature individuals.

E) Quantitative analysis showing the probability of extinction in the wild is at least 20% within 20 years or five generations, whichever is the longer.

VULNERABLE (VU)
A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the following criteria (A to E):

A) Population reduction in the form of either of the following:

1) An observed, estimated, inferred or suspected reduction of at least 20% over the last 10 years or three generations, whichever is the longer, based on (and specifying) any of the following:
   a) direct observation
   b) an index of abundance appropriate for the taxon
   c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   d) actual or potential levels of exploitation
   e) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.

2) A reduction of at least 20%, projected or suspected to be met within the next ten years or three generations, whichever is the longer, based on (and specifying) any of (b), (c), (d) or (e) above.

B) Extent of occurrence estimated to be less than 20,000km^2 or area of occupancy estimated to be less than 2000km^2, and estimates indicating any two of the following:

1) Severely fragmented or known to exist at no more than ten locations.

2) Continuing decline, inferred, observed or projected, in any of the following:
   a) extent of occurrence
   b) area of occupancy
   c) area, extent and/or quality of habitat
   d) number of locations or subpopulations
   e) number of mature individuals

3) Extreme fluctuations in any of the following:
   a) extent of occurrence
   b) area of occupancy
   c) number of locations or subpopulations
   d) number of mature individuals

C) Population estimated to number less than 10,000 mature individuals and either:

1) An estimated continuing decline of at least 10% within 10 years or three generations, whichever is longer, or

2) A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either:
   a) severely fragmented (i.e. no subpopulation estimated to contain more than 1000 mature individuals)
   b) all individuals are in a single subpopulation

D) Population very small or restricted in the form of either of the following:

1) Population estimated to number less than 1000 mature individuals.

2) Population is characterised by an acute restriction in its area of occupancy (typically less than $100km^2$) or in the number of locations (typically less than five). Such a taxon would thus be prone to the effects of human activities (or stochastic events whose impact is increased by human activities) within a very short period of time in an unforeseeable future, and is thus capable of becoming Critically Endangered or even Extinct in a very short period.

E) Quantitative analysis showing the probability of extinction in the wild is at least 10% within 100 years.

Note: copies of the IUCN Red List Categories booklet, are available on request from IUCN (address on back cover of this Action Plan)

[1] Note: As in previous IUCN categories, the abbreviation of each category (in parenthesis) follows the English denominations when translated into other languages.

IUCN/SSC Action Plans for the Conservation of Biological Diversity

Action Plan for African Primate Conservation: 1986–1990. Compiled by J.F. Oates and the IUCN/SSC Primate Specialist Group, 1986, 41 pp. (Out of print.)

Action Plan for Asian Primate Conservation: 1987–1991. Compiled by A.A. Eudey and the IUCN/SSC Primate Specialist Group, 1987, 65 pp. (Out of print.)

Antelopes. Global Survey and Regional Action Plans. Part 1. East and Northeast Africa. Compiled by R. East and the IUCN/SSC Antelope Specialist Group, 1988, 96 pp. (Out of print.)

Dolphins, Porpoises and Whales. An Action Plan for the Conservation of Biological Diversity: 1988–1992. Second Edition. Compiled by W.F. Perrin and the IUCN/SSC Cetacean Specialist Group, 1989, 27 pp. (Out of print).

The Kouprey. An Action Plan for its Conservation. Compiled by J.R. MacKinnon, S.N. Stuart and the IUCN/SSC Asian Wild Cattle Specialist Group, 1988, 19 pp. (Out of print.)

Weasels, Civets, Mongooses and their Relatives. An Action Plan for the Conservation of Mustelids and Viverrids. Compiled by A. Schreiber, R. Wirth, M. Riffel, H. van Rompaey and the IUCN/SSC Mustelid and Viverrid Specialist Group, 1989, 99 pp. (Out of Print.)

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