FOREST MANAGEMENT AND BEAR CONSERVATION

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INTRODUCTION

As a group, bears have a wide global distribution and once occurred on every continent except Australia and Antarctica (Nowak and Paradiso 1983). The distribution and abundance of most bear species have declined significantly, however, as wildlands have been exploited by rapidly growing human populations (Servheen 1990). The global human population (currently about 5.2 billion) is expected to reach 10 billion by the year 2025 (UNFPA 1989). Increasing human populations and demand for natural resources are posing significant threats to the earth's biodiversity, particularly in tropical but also in temperate forests (Ehrlich 1988; Franklin 1988; Wilson 1988). Today, most of the earth's bear populations (excluding polar bears *Ursus maritimus* and northern populations of brown bears *U. arctos*) are closely associated with forested habitat isolated from high-density human activity (Schoen 1990).

The objectives of this paper are to identify the management of forest lands as a critical component for the conservation of bears throughout the world and discuss some approaches to forest management more compatible with the unique characteristics of bears. Although my experience and examples are drawn primarily from forest-habitat relationships of brown bears and black bears (*U. americanus*) in western North America, I believe some generalizations may be applicable to bears inhabiting forest lands throughout the world.

STATUS AND ECOLOGICAL CHARACTERISTICS OF BEARS

The status of bears of the world has been reviewed by Servheen (1990). Of the 8 living species, all (if recognized populations within a species are considered) are listed as endangered, threatened, or potentially facing a precarious future. With exception of the polar bear, all populations of concern inhabit forest lands encroached upon by humans.

Clearly, the family *Ursidae* face an uncertain future in a rapidly changing world. The brown bear, for example, recently occupied a wide range of habitats and had one of the greatest natural distributions of terrestrial mammals (Nowak and Paradiso 1983). Once widely distributed across Europe, Asia, northwestern Africa, and western North America, the brown bear has been extirpated in Africa, and greatly reduced in numbers and range in the western and southern regions of Eurasia, and in the United States south of Canada. Surviving populations in Europe are primarily restricted to remote isolated islands of forest habitat. In the conterminous United States, the once abundant and widely distributed brown bear population is now estimated to number fewer than 1,000.

As a group, bears possess many biological characteristics which increase their vulnerability to human interactions and may be exacerbated by forest clearing and timber extraction. All bears are large, heavily-armed animals capable of inflicting serious injury or death to humans. Recognition of this potential danger has historically shaped human attitudes towards bears and resulted in significant and often unjustified persecution of bears by humans.

Bears are intelligent, individualistic animals with great capacity for learning over a relatively long life (> 25 years). This capacity for

learning and their generally omnivorous diet have allowed them to exploit a variety of food resources over a wide range of habitats. As a result of their relatively inefficient carnivore digestive systems, most bears must seasonally exploit high-quality food resources which usually occur on the most productive lands, such as riparian bottom lands, productive forest lands, and anadromous fish streams. These are the same sites most frequently used by humans. Bears' wide ranging movements, opportunistic nature, and capacity for learning also increase their probability of interacting with humans by feeding on livestock, crops, or garbage. Once bears learn to exploit these resources, they may become habituated to humans increasing the opportunity for conflict (Herrero 1985).

Most bear species have large area requirements with home ranges varying in size from several to > 1,000 km^2. Thus the home ranges of some individuals may be larger than most parks or reserves. For example even Yellowstone, the largest national park in the conterminous United States, does not offer a true refuge for the Yellowstone grizzly (Knight et al. 1988).

The reproductive rates of bears are some of the lowest among terrestrial animals (Bunnell and Tait 1981). This aspect of their biology is poorly recognized by many forest managers and some wildlife managers, yet has critical implications for the conservation and management of bears. Within the last several centuries, killing by humans has become the major source of adult bear mortality. Because bears are long-lived and are difficult and expensive to census, it may take years of overexploitation before a serious population decline is detected. Once identified, population declines may be difficult to reverse because of the low productivity of bear populations.

FOREST MANAGEMENT AND BEARS

Global deforestation is occurring at a rapid rate, particularly in the tropics. For example, tropical forests have been reduced to approximately 55% of their original cover (Wilson 1989), and approximately 1% of that biome is deforested annually (Myers 1988). Although a significant portion of original forest land in North America has been converted to residential, industrial, or agricultural uses, today most forests are managed on a sustained yield basis. Few of the original old-growth forests still exist, however, and their depletion rate is equal to or greater than that of tropical forests. In the United States, as little as 2–15% of the ancient forests remain, primarily in southeastern Alaska and the Pacific Northwest (Thomas et al. 1988). Most of the remaining mature and old-growth forest stands throughout the world are becoming fragmented by forest clearing or plantation management (Harris 1984; Wilcox 1987; Wilcox and Murphy 1985).

The effects of forestry on bears can be broken into several component parts. Logging results in a direct habitat change influencing the availability of food and cover. Roads are an integral part of most logging operations and result in increased human access. Garbage, a common byproduct of forest development, often attracts and habituates bears to logging camps and adjacent communities and usually results in the killing of "nuisance" bears.

Although some species like the North American black bear may have relatively broad habitat requirements and can accommodate substantial habitat change (Pelton 1982), others like the giant panda (*Ailuropoda melanoleuca*) may be significantly impacted by changes in habitat composition (Schaller et al. 1985). Knowledge of habitat relationships is necessary for evaluating the specific effects of habitat change on regional bear populations. This should include a cumulative effects analysis over entire rotation periods which may exceed 100 years. For example, the effect of converting productive old-growth forest in southeastern Alaska to second-growth plantations will reduce the area's long-term carrying capacity for brown bears (Schoen and Beier 1990).

Another widespread forest management problem is "high grading" or concentrating the cut in the best stands of timber. This is a serious issue in southeastern Alaska where the rare riparian spruce stands are being cut in much greater proportion than their occurrence. These stands when adjacent to anadromous salmon streams have been identified as critical brown bear habitat in southeastern Alaska (Schoen and Beier 1990). Riparian areas throughout the world are particularly rich wildlife habitats and though rare in occurrence provide important resources to both bears and humans. In the conterminous United States, it is estimated that less than 2 of these sites remain in some semblance of a natural riparian ecosystem (Hunter 1990).

In addition to the direct loss of forest habitat, the increasing fragmentation of forest lands

will have significant long-term impacts on bear populations throughout the world (Schoen 1990). Generally, bear populations become more isolated and their exposure to humans is increased as a result of habitat fragmentation. North American black bear populations, originally widespread throughout the forested regions of the continent, are today much more scattered and isolated particularly in the midwestern, eastern, and southeastern United States where lands have been most intensively developed and high-density human populations exist (Pelton 1982). The major source of mortality for the threatened Florida black bear is vehicle collisions (Harris and Gallagher 1989).

Even in Alaska, the last stronghold of the North American brown bear, roads and habitat fragmentation are beginning to take their toll. Over 200 km of logging roads have recently been built on the 1,000 km^2 peninsula of northeastern Chichagof Island in southeastern Alaska. The human harvest of bears there (including legal hunting and defense kills) increased substantially over the last decade and by 1987 had exceeded sustainable levels. The total kill of brown bears on northeastern Chichagof was significantly correlated ($r = 0.79$, $P < 0.001$) to cumulative kilometers of roads (Titus, unpublished data). The illegal kill was unknown.

Today, few lands on earth are absent of human influence. Because humans interact with bears as predators and/or competitors (in an ecological sense), we must consider habitat relationships in a broader context which includes humans and land-use activities (Schoen 1990). Forest development enhances human access which inevitably leads to increased bear mortality (McLellan, 1989; Peak et al. 1987; Rogers and Allen 1987; Zager 1983). In addition, logging camps, recreational sites, small communities, and garbage dumps scattered throughout bear habitat may become "population sinks" where bears are removed from the ecosystem by humans (Knight et al. 1988; Rogers and Allen 1987).

As habitat is reduced, fragmented or otherwise lowered in value by cumulative development, bear populations may decline incrementally until a threshold is reached, then the decline may become precipitous (Rogers and Allen 1987; Schoen 1990). Unfortunately, it may be many years after habitat thresholds are exceeded before we can measure their long-term effect on the population, and by then the impacts of habitat alteration may be irreversible. Clearly, small, isolated populations are more vulnerable to extinction (Diamond 1986; Wilcove 1987). The application to bears is apparent in threatened populations like the Yellowstone grizzly (Knight and Eberhardt 1985), the Florida black bear (Harris and Gallagher 1989), and the Norwegian brown bear (Mysterud and Falk 1989). Protection from legal hunting alone is no guarantee of population viability.

IMPLICATIONS AND OPPORTUNITIES FOR THE CONSERVATION OF BEARS

I believe the future of most bear populations on earth are inextricably linked with forest management. However, it is unlikely that conventional forestry will promote the long-term conservation of bears. Maintenance of viable populations over the long-term (> 100 years) will require hundreds, perhaps thousands of individuals (Soule 1987). Large bodied species like bears have extensive area requirements. The conventional approach to sustainable forestry of maintaining a few reserves scattered throughout intensively managed forest lands will not accommodate bears because few reserves are large enough and most lack effective connectiveness (Harris and Gallagher 1989). Thus we must bring into our forest planning a landscape-scale of thinking over a time frame of centuries (Harris and Kangas 1988; Schoen 1990). To that end, I offer the following recommendations for making forest management more compatible with bear conservation.

I believe there are both short-term and long-term approaches we must take to ensure the conservation of bears. In the short-term, we must maintain as many of our landscape options as possible. Instead of building roads and cutting timber evenly throughout the landscape, we should begin aggregating impacts (Franklin 1989). This buys time in preventing additional habitat fragmentation of our larger forest tracts and helps separate humans and bears, a major goal in reducing bear mortality. Forest managers should establish guidelines and enforce regulations for forestry activity in bear habitat. These regulations should include effective food security and garbage incineration, a prohibition on feeding bears, human avoidance of seasonal bear concentrations, a prohibition on the carrying of firearms (except by security personnel), minimizing road development, closing roads to public access, and

avoiding road construction or logging activities in critical habitats such as riparian sites. In addition, wildlife management agencies need to develop conservative hunting regulations, develop better population monitoring programs, consider closing hunting in watersheds with road access and active logging operations, and develop comprehensive education programs on bear biology and safety in bear country.

To ensure the long-term conservation of bears, we must begin comprehensive forest planning on a landscape-scale with a time perspective of at least a hundred years. This will require a new level of interagency and international cooperation and the principles of conservation biology must be incorporated into the framework of our planning. On a regional and species-specific basis, we should begin identifying public lands that could serve as core reserve areas. Gap analysis (Scott et al. 1988) might offer one approach for identifying ecologically important lands. It is unlikely that reserves alone will maintain long-term viable populations, however. We will need to work with adjacent land managers to develop buffer zones with variable intensities of management. Next, we must work toward establishing corridors connecting as many of these areas as possible. Harris and Gallagher (1989) suggest that riparian forests represent the best opportunity for creating a system of interconnected corridors.

In the United States, public pressure is mounting for a new more environmentally sensitive approach to forest management. Franklin (1989) and others studying old-growth forests in the Pacific Northwest are developing a "new forestry" based on ecological concepts and designed to maintain biological diversity on a landscape scale. New forestry may offer an opportunity for integrating concepts of bear ecology and forest ecology. The New Perspectives program of the U.S. Forest Service (Salwasser 1990) may offer a mechanism for implementing these concepts into future forest management in the United States.

An important key to integrating bear conservation into forest management is recognition that the traditional emphasis on maximum timber production is not compatible with maintaining ecosystem integrity. Although we may identify a variety of techniques to reduce the impacts of forestry on bears, the historic levels of cut will need to be reduced to achieve long-term sustainability of forest ecosystems capable of maintaining viable populations of bears. Forest ecologists are recognizing the importance of long-term planning on a landscape scale (Franklin 1989). Perhaps bears should be considered a flagship species for the integrity of natural forest ecosystems. Our success in conserving bears will require cooperation and long-term planning, and will likely depend more on our skills as educators, creative people managers, and landscape architects than on wildlife management per se.

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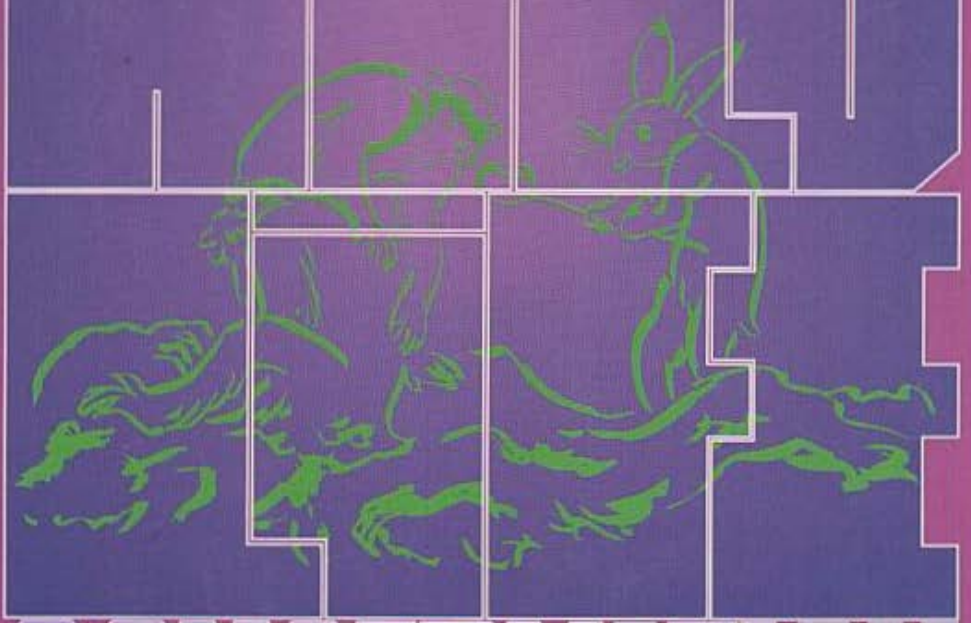
Present Trends and Perspectives for the 21st Century



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