Martinka 1976

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Reprinted from

Papers and Proceedings
Rapports et Procès-verbaux

THIRD INTERNATIONAL CONFERENCE

ON

Bears

—Their Biology and Management

BINGHAMTON, NEW YORK, U.S.A.
and
MOSCOW, U.S.S.R.
June 1974

Union Internationale
pour la Conservation de la Nature
et de ses Ressources

International Union
for Conservation of Nature
and Natural Resources

Morges, Switzerland, 1976

Third International Conference on Bears

Paper 13

Ecological Role and Management of Grizzly Bears in Glacier National Park, Montana

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INTRODUCTION

Colonization of western North America by modern man led to significant reduction in numbers and distribution of grizzly bears, *Ursus arctos*, during the past 150 years (Storer & Trevis 1955). Response has been classically evident south of Canada where widespread population declines and local extinctions have occurred. Viable populations have persisted only in more expansive wilderness and park areas of Montana and Wyoming where remoteness and land use characteristics contribute to their protection. National parks provide unique refugia where the natural integrity of grizzly bears can be preserved as an ecosystem component by mitigating detrimental effects of modern man.

This paper summarizes current knowledge relating to the ecological role and management of grizzly bears in Glacier National Park, Montana. The park is administered as a natural area within which grizzlies require a spectrum of management considerations. These may be broadly categorized as environmental requirements and relationships to park visitors. Field studies of population biology and ecosystem relationships provide criteria for interpretation of environmental requirements within park ecosystems (Martinka 1972; 1974a). Evaluations of management programs contribute to an understanding of relationships between grizzlies and park visitors (Martinka 1971; 1974b).

HISTORICAL PERSPECTIVE

Evaluation of species evolution permits a more complete understanding of current status since adaptive development can frequently be correlated with changing environments. These changes may occur within established geographic ranges or result from emigration to new areas. In the case of grizzly bears, physical and behavioral adaptations associated with speciation resulted in potentially efficient utilization of a variety of habitats. In contrast, ability to cope with certain associated fauna may have been less pronounced. Current status and relationships in North America reflect a number of traits which developed during the evolutionary process.

Paleontological records suggest that the grizzly bear differentiated from the Etruscan bear, *Ursus etruscus*, in Asia during the middle Pleistocene (Thenius 1959; Kurten 1968; Herrero 1972). Speciation occurred during a time when climatic fluctuations caused periodically extensive glaciation in northern continental areas. Extensive replacement of forests with treeless tundra and steppe accompanied cold phases and glacial maxima (Giterman & Golubeva 1967). Adaptation to the presence of these treeless habitats appears to have been a key element associated with genetic separation of the grizzly from its forestdwelling ancestor (Herrero 1972).

Formation of land bridges during glacial maxima provided opportunities for faunal interchange between Asia and North America. Dispersals were pre-

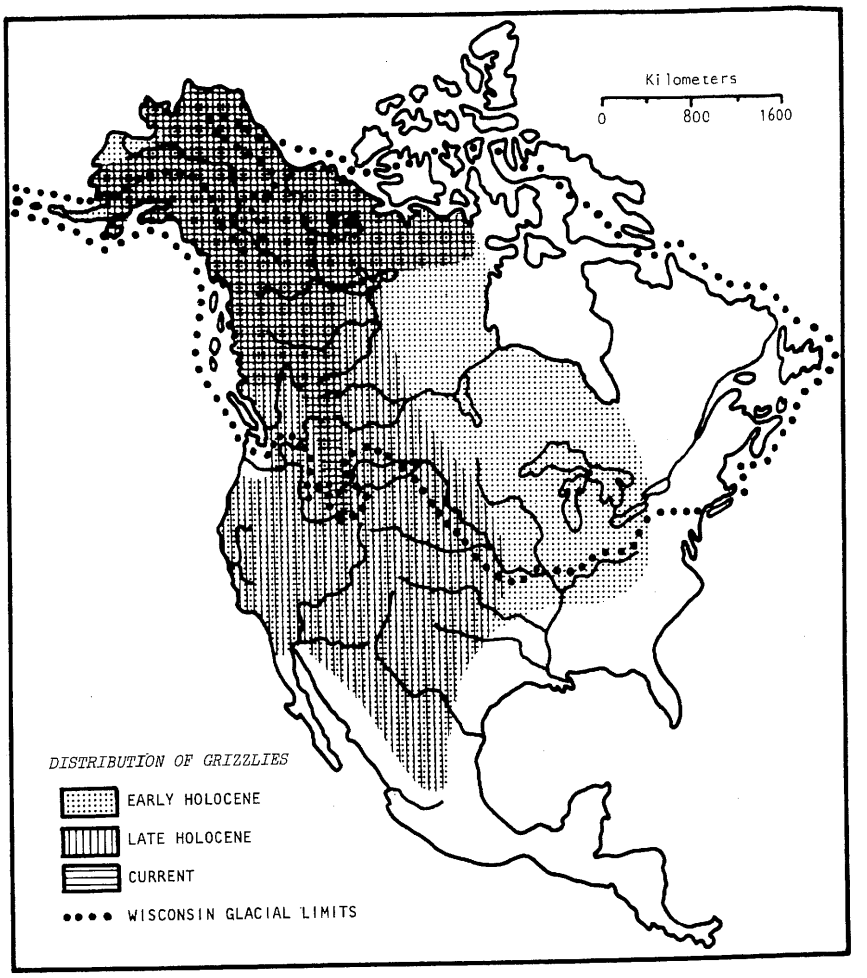

Fig. 1. Postglacial distribution of grizzly bears in North America.

dominantly eastward and generally included species adapted to forest environments during the early and middle Pleistocene (Repenning 1967). Steppe and tundra forms dominated late dispersals and it appears that grizzlies did not successfully colonize Alaska until the Wisconsin glacial period (Herrero 1972). Continued range expansion was temporarily restricted at that point by the merged Cordilleran and Laurentide ice sheets.

Recession of the continental ice sheets opened extensive areas of suitable habitat for grizzly bears in North America (Figure 1). Distribution expanded eastward to Ontario (Peterson 1965), Ohio and Kentucky (Guilday 1968), and southward into Mexico (Storer & Trevis 1955). Distributional recession apparently followed eastward expansion in response to development of unfavourable environmental conditions (Guilday 1968). Populations were present throughout most of western North America during the eighteenth century (Storer & Trevis 1955), but the rapidity of local extinctions suggests that many of these were also of marginal status.

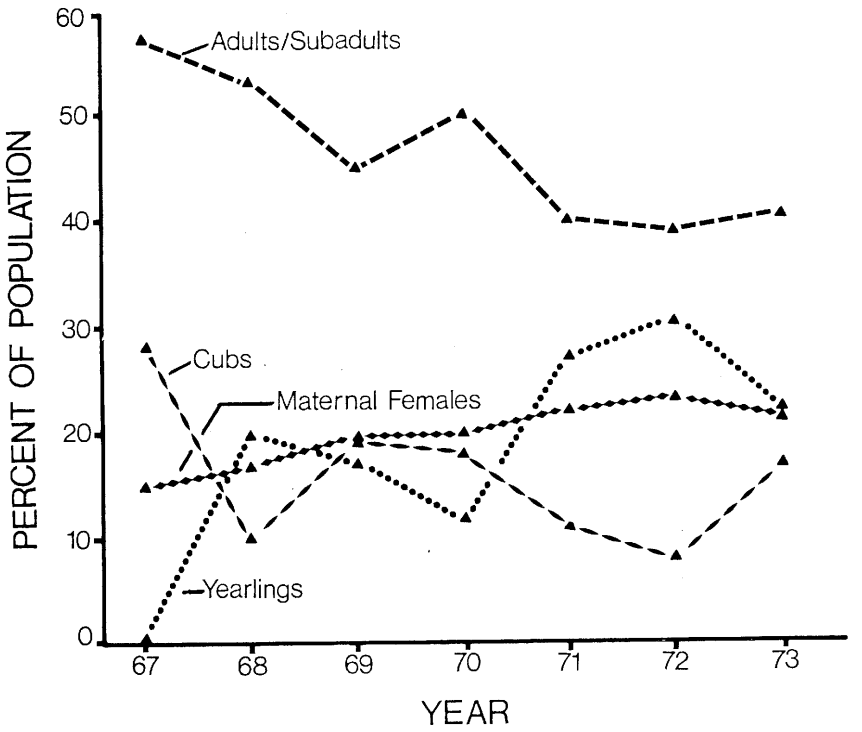

Fig. 2. Composition of the grizzly bear population in Glacier National Park as determined from annual classification of different bears from 1967 through 1973.

Present distribution of grizzlies is largely restricted to the more secure mountain habitats of northwestern North America (Figure 1). It seems likely that postglacial occupancy progressed from midcontinental habitats as mountain glaciers receded and food sources developed. Mosaics of forest, grasslands, and alpine tundra provided a productive habitat for grizzlies but also reintroduced potential competition with black bears, *Ursus americanus*. This closely related species had dispersed to North America during an earlier period and was well adapted to forest environments.

Primitive man and grizzly bears apparently occupied North America in a biologically neutral relationship. In contrast, relatively recent emigration of modern man to North America added a significant dimension to the postglacial history of the grizzly. Protection of human life, depredation control. sport hunting and habitat deterioration were focal points which contributed to population declines. These pressures continue to the present but public expressions have recently added a protective phase to the history of grizzly bears.

Significant developments in the relationship between modern man and grizzly bears are reflected in the history of Glacier National Park. Grizzlies were encountered and shot when railroad survey parties first entered the area in the mid 1800s (Stevens 1860; Pumpelley 1918). Faunal richness attracted sport hunters during the late 1800s (Schultz 1962) and by 1900 commercial trapping of the bears for hides was a common activity (Bailey & Bailey 1918). These

activities undoubtedly influenced grizzly populations until establishment of the park in 1910 provided protection. Limited control continued thereafter but of insufficient magnitude to prevent restoration of a natural grizzly bear population (Martinka 1971; 1974a).

POPULATION STATUS

Glacier is presently inhabited by a wild grizzly bear population which ranges throughout the park under essentially natural conditions. Population estimates determined from density samples ranged from 175-230 and averaged 191 for 7 years of study from 1967-73. Annual fluctuations resulted from deficiencies in the census technique but general trends suggest that population levels were relatively stable. Regulation of numbers is thought to occur naturally through social interaction and associated dispersal and/or death of subordinate bears. Aging of hunter-killed bears and depredation controls beyond the park's periphery provide tentative support for this hypothesis (Greer 1971; 1972; 1974).

The population is characteristically structured as single individuals and family groups (Martinka 1974a). Annual classifications of different bears observed showed means of 46, 20, 16 and 18 percent unclassified adults, productive females, cubs, and yearlings, respectively (Figure 2). Trends toward increasing proportions of maternal females and their offspring correlated with decreasing proportions of unclassified adults observed during the study. Substantial fluctuations occurred in annual production of cubs but combined proportions of cubs and yearlings exhibited a trend similar to that of maternal females.

The mean increment of 16 percent cubs contributed approximately 31 potentially new members to the population each year. Realized recruitment appeared contrastingly low in view of stable population trends and apparent longevity of adult bears (Greer 1971; 1972; 1974; Mundy & Flook 1973). Recruitment probably relates to a replacement function involving displacement and/or mortality of established population members. Surplus subadults likely succumbed to mortality through social interactions, emigrated to vacant habitats, or both.

An average density of 4.6 grizzlies per 100 km^2 was computed from the mean population estimate of 191 bears. Exclusion of offspring provides a basis for estimating a potential breeding density of 2.9 bears per 100 km^2. The presence of sexually immature subadults could reasonably reduce effective breeding densities to 2.5 bears per 100 km^2. This low density requires compensatory movement patterns to assure adequate gene flow and prevent the potential influence of genetic drift on isolated population segments (Wilson & Bossert 1971). The complexity of these patterns is suggested by Craighead & Craighead (1965), Martinka (1970), Mundy & Flook (1973), Murie (1944, 1961) and Pearson (1972).

ECOLOGICAL NICHE

Glacier National Park encompasses 4100 km^2 of cordilleran terrain in northwestern Montana. Glaciation has created rugged topography which is extensively occupied by coniferous forests at lower elevations and alpine tundra above the timberline. Wildfire and snowslides provide habitat diversity within coniferous forests by maintaining seral shrub and conifer communities. Local

influences of soil and wind on certain sites have contributed to the formation of grasslands. Combinations of terrain and vegetation provide an interspersed array of habitats for the grizzly bear population.

Each of the major habitats was utilized by grizzlies during the May through October period of activity. Frequent use was made of coniferous forests but a distinct preference was apparent for treeless types. Grasslands and tundra provided relatively permanent open habitats while wildfire and snowslides created favorable types within the coniferous forest zone. Movements to higher elevation shrub and alpine habitats occurred during the snowfree summer and early fall season. Bears were most consistently observed in areas of maximum habitat diversity.

Seasonal progression in habitat use was accompanied by a predictable sequence in the predominantly herbivorous diet. Spring and early summer preferences included grasses, Gramineae, horsetail, *Equisetem* spp., and cowparsnip, *Heracleum lanatum*. Ripening fruits of huckleberry, *Vaccinium* spp., supplemented with serviceberry, *Amelanchier* spp., mountain ash, *Sorbus scopulina*, and hawthorne, *Crategus* spp., formed the bulk of late summer and fall diets. Predation, scavenging, and digging occasionally added variety in the form of mammals, roots and insects.

Food habits reveal that the grizzly is well adapted to efficient utilization of postglacial mountain habitats. An obvious preference for certain herbaceous foods displaced potential use of numerous alternative items which were also present. Food abundance and distribution undoubtedly influence densities to some extent. For example, ample foods have apparently permitted development of a high density potential by coastal populations in Alaska (Troyer & Hensel 1964). Contrasting conditions existed on historiç steppe and tundra habitats where herbaceous foods were widely scattered or in limited supply. Foraging by predation, scavenging and digging most likely evolved under these conditions. The population in Glacier seems to be regulated at a point somewhat below the biomass carrying capacity of the habitat.

Seasonally high densities of grizzlies are occasionally observed in Glacier. An area of particular interest includes 22 km^2 of high elevation seral shrub habitat on the Apgar Mountains which was created by a wildfire in 1929. The relatively dependable huckleberry crops produced on the area each year attract bears when fruit production fails in surrounding habitats. Combined aerial and ground observations in 1967 and 1973 revealed that late summer densities reached as high as 1.3 grizzlies per km^2 under these conditions (Table 1). Spacing was distinct among the social units present with one agonistic interaction recorded involving an adult chasing a subadult. High concentrations continued for several weeks but the temporary, unpredictable and local nature of the phenomenon reduced potential as a significant influence on overall population levels.

A late summer concentration of black bears also occurred on the Apgar Mountains. The magnitude of observed densities was inversely related to numbers of grizzlies present (Table 2). A low density of grizzlies in 1967 apparently permitted foraging by numerous black bears in spaced distribution. In contrast, a high density of grizzlies in 1973 nearly precluded use by black bears. Those observed were in distinct association with forest edges or isolated stands.

The significance of forest canopies to the evolution of both species has been discussed by Herrero (1972). Highly developed arboreal capabilities by black bears apparently contribute to competitive superiority in forest habitats.

TABLE 1. DENSITY ESTIMATES FOR GRIZZLY BEARS ON A 22 KM^2 AREA OF THE APGAR MOUNTAINS DURING LATE SUMMER AS DETERMINED FROM COMBINED EVALUATION OF AERIAL AND GROUND SIGHTINGS OF DIFFERENT BEARS IN 1967 AND 1973.

	Type of Sightings					
	Aerial 1/		Ground 2/		Total Number of Different Grizzlies	Bears per Square Kilometer
Year	Adults	Young	Adults	Young		
1967	7	2	1	2	12	0.5
1973	5	7	9	7	28	1.3

1/ One hour helicopter survey plus routine sightings during management flights.

2/ Associated primarily with fire surviellance and/or suppression activities.

TABLE 2. GRIZZLY AND BLACK BEARS OBSERVED DURING 1 HOUR HELICOPTER FLIGHTS IN A 22 KM^2 AREA OF APGAR MOUNTAINS DURING SEPTEMBER OF 1967 AND 1973.

	Number of Different Bears Observed	
Year	Grizzlies	Black Bears
1967	9	16
1973	20	6

Aggressiveness and extended maternal care provide competitive advantages for grizzlies in open habitats. Interspecies relationships have apparently evolved to a point of mutual avoidance where spacing is maintained. This system permits overlap in habitat use and is an important consideration in determining population levels of both species.

MANAGEMENT OF GRIZZLIES

Current management is directed toward the dual objectives of park visitor protection and maintenance of a natural grizzly bear population. Field management procedures include a visitor information program, control of attractive unnatural foods, opportunity for visitor travel restrictions, and removal of persistently troublesome bears. Annual program evaluation considers number of conflicts and management actions relative to trends in visitation. Results for 1968 through 1973 are presented in Table 3.

Progressive increases in park visitation through 1973 were accompanied by generally low encounter rates between bears and visitors. Those which occurred were predominantly aggressive displays or equipment damages. Increased contacts during 1972 and 1973 correlated with rapid expansion of backcountry use by hikers and campers. Management response through temporary travel restrictions apparently mitigated the potential for human in-

TABLE 3. SUMMARY OF VISITATION, GRIZZLY BEAR CONFRONTATIONS WITH VISITORS, AND MANAGEMENT ACTIONS IN GLACIER NATIONAL PARK, 1968 THROUGH 1973.

	Annual Visitation			Grizzly Bear Confrontations		Management Action		
		Overnight Visits 2/						
Year	Total 1/	Campgrounds and Hotels	Backcountry 3/	Belligerent Encounter	Personal Injuries	Visitor Restrictions	Transplant	Disposal
1968	936,000	366,000	8,000	5	1	6	0	2
1969	1,023,000	337,000	10,000	2	0	5	0	3
1970	1,034,000	328,000	10,000	0	0	1	1	0
1971	1,081,000	328,000	15,000	3	0	7	1	0
1972	1,114,000	326,000	22,000	12	0	9	1	0
1973	1,174,000	337,000	32,000	7	0	9	0	1

1/ Total visitors passing through gates one or more times, adjusted to exclude those on transient access route.

2/ Visits defined as one visitor for one day in each category.

3/ Includes two chalets.

juries. In addition, bear control was maintained at a biologically acceptable rate for a natural area.

Mutual avoidance appears to be a key element in current relationships between grizzly bears and park visitors. Management design and characteristic shyness of bears are the principal factors contributing to an essentially compatible coexistence. Effects of the relationship on visitors are measureable in terms of imposed changes in activity patterns and travel distributions. Response by grizzlies is more difficult to document but observations suggest that population dynamics and ecosystem role remain nearly unaltered from pristine conditions.

Projections of management needs characteristically identify additional control of human activities as a primary goal (Martinka 1974b). However, it is becoming increasingly apparent that certain ecological phenomena may also require consideration. The potential significance of wildfire seems particularly important as demonstrated by its ability to cause extensive structural and compositional change in park habitats. Temporary reduction or elimination of forest canopies appears to create superior habitat for the grizzly. In contrast, successional advance toward mature forests creates conditions more favorable for black bears. The latter trend has been enhanced by a wildfire suppression policy which continues to the present. Restoration of wildfire to its natural ecosystem role is considered essential to maintaining a natural grizzly bear population within the park.

A wild, free-ranging population of grizzly bears has been shown to present the least conflict with visitors in Glacier National Park (Martinka 1971). Prudent application of facts to management planning is required to assure continued low conflict rates and protect the natural integrity of the bear population.

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