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GRIZZLY BEAR HABITAT RESEARCH IN GLACIER NATIONAL PARK, MONTANA

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ABSTRACT: Grizzly bear habitat research began in 1967 and is continuing in Glacier National Park, MT. Direct observations and fecal analysis revealed a relatively definable pattern of habitat use by the bears. Habitat data were subsequently used to develop management models and explore the relationship between grizzlies and park visitors. Current research strategy is based on the concept that humans are an integral component of grizzly bear habitat. A geographic information system is being developed to assist in the application of habitat data. In addition, the behavioral response of grizzlies to annual changes in food production is being studied. Management that addresses bears, humans, and their habitat as a system is proposed.

INTRODUCTION

Grizzly bears (Ursus arctos) and paleolithic humans (Homo sapiens) are relatively recent additions to the megafauna of North America. Both species emigrated eastward from Eurasia and colonized Beringia during the Wisconsin glacial period. Humans dispersed toward southern continental areas early in the glacial period, and grizzlies followed after the continental ice sheet melted some 12,000 years ago. Except for that period between emigrations, grizzlies and humans have coexisted for millenia in holarctic habitats.

The advent of modern humans and their sophisticated weapons was significant to grizzly bear evolution. In Europe, exploitive pressures began nearly a thousand years ago and reduced bear population numbers and distribution substantially (Cowan 1972). Similar impacts occurred more recently in North America and were measurably more dramatic. The species currently occupies less than half of its historic range, and its status is tenuous south of Canada. On both continents, grizzly demographic responses have been accompanied by increasing shyness, a behavioral trait with distinct survival value.

Large national parks provided the first sanctuaries for grizzlies on the southern edge of their shrinking range in North America. Parks initially protected remnant populations that persisted in spite of intense exploitation. Subsequently park management goals included restoring grizzly bear numbers to those that existed under pristine conditions. This effort was unique in the historic relationship between grizzlies and humans in that it largely eliminated the demographic and behavioral consequences of bear mortality from hunting and other human-related causes. Most likely, this policy is at least partly responsible for the dynamic history of grizzlies and humans in the parks.

The relationship between grizzly bears and modern humans is reflected in the history of Glacier National Park, MT (Martinka 1976a). The bear population appears to have been heavily exploited, and numbers were low when the Park was established in 1910. Recovery took at least 50 years; only in recent decades have natural limits to population growth been approached (Keating 1983). Human use of the Park gradually increased over the same period and reached two million visits in 1983. Conflicts between the two species also increased, and there is now evidence that the incidence of human injuries and deaths is accelerating (Martinka 1982).

In 1967, grizzlies killed two campers in separate backcountry campsites in Glacier National Park. Their deaths prompted a critical evaluation of the relationship between grizzly bears and Park visitors. Not surprisingly, it was quickly discovered that little was known about either species and how they fit into the ecological matrix of the Park. However, it was generally agreed that both had a legitimate place and that conflict detracted from the potential for successful Park management. These conclusions inspired a scientific research program designed to gather information and explore means for separating the species and reducing conflicts. A first step toward that goal was to study the habitat in which conflict occurred, and thus grizzly habitat formed an important element of initial study design. This paper presents a synopsis of grizzly bear habitat research findings, describes current habitat research efforts, and attempts a conceptual synthesis of potential management applications in Glacier National Park.

COMPLETED HABITAT STUDIES

Originally grizzly bear habitat studies were descriptive and used traditional field observational techniques. Bear sightings were recorded and fecal samples collected during extensive coverage of the Park trail system. Although individual observers made few sightings, sample size was enhanced through a data base compiled from verified sightings from all sources. Sampling bias resulted from unquantified observer effort, variable reporting rates, observer confinement to roads and trails, and poor bear observability due to rugged topography and forest cover. However, habitat relationships were generally consistent with those

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determined using more sophisticated field technology such as radio telemetry.

Results of the early Park studies suggested that grizzlies were well adapted to postglacial mountain habitats (Martinka 1972, 1976a). Each of the major Park plant communities was used by the bears at some time during the season of activity from May through October. Although the bears frequented coniferous forests, they apparently preferred treeless habitats. Grasslands and alpine tundra provided open habitats; wildfire and snowslides created shrublands within the extensive coniferous forest zone. The distribution of grizzlies shifted in response to favored foods which included succulent herbs and nutritious fruits. Bears were most consistently associated with habitat diversity and abundant moisture.

Extensive field investigations identified two seasonal bear concentrations that were subsequently intensively evaluated. In 1969-70, Shaffer (1971) studied a late summer gathering on the Apgar Mountains. Results supported earlier observations that ripening huckleberries (Vaccinium spp.) were an important attraction to grizzly and black bears (Ursus americanus). Findings also suggested that niche separation occurred between the two species. From 1972 to 1975, Singer (1978) studied a spring concentration of grizzlies along the North Fork Flathead River. Wet meadows and alluvial seres were important habitats that provided rhizomatous grasses, succulent forbs, roots, and tubers. The timing of melting snow appeared to influence the intensity of the spring gathering in that greater numbers were present when snowmelt was late. Both studies demonstrated that seasonal coalescence was an important element of grizzly bear habitat relationships in the Park.

A series of grizzly bear incidents from 1974 to 1976 prompted an assessment of the field research program. It was apparent that knowledge about habitat relationships was improving but questions about the data's usefulness remained unanswered. To answer them, a series of four studies from 1975 to 1980 examined how people were distributed in grizzly bear habitat. Each study related human activities to existing habitat information.

From 1974 to 1977, studies focused on the backcountry travel patterns of visitors using the northern half of the Park (Stuart 1977a, 1977b, 1978). Stuart developed bear contact indexes from sighting data, trail characteristics, and habitat distribution and then constructed models to demonstrate the various management options available for altering the rate of contacts between grizzlies and visitors. The study accurately predicted that increasing backcountry use would lead to an even greater increase in the contact rate (Martinka 1982). In addition, a shift in management to prevent dangerous contacts (females with young) was proposed.

The wilderness travel project was accompanied by a backcountry campsite evaluation in 1975 (Merrill 1978). Ecological and sociological factors associated with damaged property and human injuries were compiled for 50 black and grizzly bear incidents. An unexpectedly high number occurred in deteriorated campsites in mature forests that were near developments and that had large party limits and good fishing nearby. Once again, niche differences were apparent in that a greater proportion of grizzly incidents occurred in the alpine zone and open canopy forests. Extensive changes have been made in campsite location since the study was completed.

In 1977, the research emphasis returned to grizzlies; one project explored food production as a means for predicting habitat use (Riggs and Armour 1981). Field effort focused on riparian habitats, involved intensive vegetation sampling, and used a radio-tagged bear to measure habitat preference. Because selection patterns were consistent, the investigators believed that contact with the bear was avoidable. Unfortunately, the sample size of one radio-tagged bear precluded formulation of conclusions. In spite of this, it seemed reasonable to propose that changing the habitat use patterns of Park visitors could decrease the frequency of dangerous encounters.

Increasing confrontation rates provided incentive for a more detailed assessment of grizzly bear behavior toward people in 1980-81 (Jope 1982, 1985). The study examined habituation and its relationship to conflicts with humans. Results pointed to the importance of habituation as a process that allowed bears to exploit habitats being used by Park visitors. In addition, ancillary data revealed year-to-year changes in bear distribution that likely reflected geographic flux in habitat productivity. These conclusions emphasized the dynamic nature of grizzly bear habitat relationships as well as the potential for change with expanding human use.

CURRENT HABITAT STUDIES

Recent research has focused on habitat relationships as a key to understanding bear behavior and its influence on conflicts between bears and humans. The unique nature of bears ties them closely to habitat configuration and productivity. An inefficient digestive tract generalized for omnivorous habits combined with the demands of hibernation require that bears consume large amounts of food during their six months of activity each year. Because bears devote much of their energy budget to foraging, their distribution and activities should reflect environmental variation as it affects vegetation communities and other food supplies. Learning more about how bears adapt to fluctuations in their food resource may help predict behavior changes useful to management of bears and people.

This research direction was given impetus by another year of unusually severe conflict between grizzlies and humans in Glacier National Park. In 1980, three campers were killed in two separate grizzly bear attacks. We hypothesized that low huckleberry production in 1979 and 1980 and associated nutritional stress on bears triggered behavioral changes which increased the chance of dangerous encounters with people. This was compatible with previous studies which found that

forage productivity influenced grizzly bear habitat use (Riggs and Armour 1981; Jope 1982). Rogers (1976) and Picton (1978), among others, demonstrated the importance of climate and its effect on food availability to bear population parameters.

We began to test this hypothesis in 1982. The objectives were to expand understanding of seasonal food habits of bears throughout the Park, document annual fluctuations in the productivity of preferred bear foods, and examine the relationship between food availability and bear behavior (Kendall 1985b). Efforts thus far have been directed toward obtaining data on the first two objectives. Initial results have confirmed early food habits findings (Martinka 1972) and revealed dramatic fluctuations in productivity of huckleberries, a key bear food.

Results from the current food habits study corresponded closely with those reported for the 1967-71 period (Martinka 1972; Kendall 1985b). When these two data bases were combined they provided a representative picture of Park-wide bear food habits (table 1). Several generalities were evident from preliminary analyses. The dominant bear foods were grasses and sedges, umbels (notably Heracleum lanatum and Angelica spp.), and huckleberries. Animal protein, roots, and bulbs apparently played only a minor role in bear nutrition in Glacier National Park. Although use of grasses, sedges, and succulent forbs remained fairly constant each year, consumption of huckleberries and other fruits varied. These patterns reflected food availability and subsequent habitat use. In a typical year, huckleberries from high-elevation shrubfields were the principal food of late summer and fall. When huckleberry crops were poor, bears increasingly moved to low-elevation riparian areas to feed on hawthorn (Crataegus douglasi) berries and other foods.

Huckleberries became the primary focus of food availability studies because production appeared to vary more than in other important bear foods. Work conducted since 1982 has documented large year-to-year changes in huckleberries available to bears (Kendall 1985b). In 1983 and 1984, berry production was approximately 35 percent of the previous year; this was an 88 percent decline in huckleberry crops in a three-year period. This work also produced convincing evidence that huckleberry production could be regionally synchronous. The decreases in production were nearly ubiquitous throughout the park, with declines in over 90 percent of the sites studied in both of the past two years. The next step should be to determine if berry production levels change bear-foraging activity and contribute to bear-human interactions.

Another variable, berry phenology, was also found to influence bear distribution. Aerial surveys designed to monitor grizzly bear population trends have taken advantage of bear concentrations in the shrubfields of the Apgar Mountains (Kendall 1983, 1984, 1985). Bears move into this area as huckleberries mature (Shaffer 1971). Variation in ripening dates and in numbers of bears sighted suggests that knowledge of the ripening process is an effective tool for predicting when bears congregate each year (Kendall 1985a). Linking flight schedules with berry phenology was considered essential for biologically significant year-to-year consistency in surveys designed to track long-term population trends.

Considering both bears and people as elements of the park ecosystem set the stage for further research. In a recent effort to describe the relationship between grizzly bear and human use of the Park (Baldwin and others 1985), researchers mapped grizzly habitat and backcountry visitor use in a portion of the Park. By overlaying these two data bases, the potential for conflict could be evaluated.

Grizzly habitat was mapped in the Two Medicine area of the Park using Glacier's Geographic Information System (GIS) (Butterfield and Key, this proceedings). The GIS classified vegetation by combining Landsat spectral data with digital terrain information. Vegetation classes were grouped into units representing vegetation associations exploited seasonally by grizzly bears. The groupings were based on habitat and food habits information for Glacier National Park (Martinka 1976a; Kendall 1985b) and extrapolation from other studies. Ground verification indicated that the technique provided detailed information on forested areas and habitat mosaics but did not effectively distinguish among moist, shrub-dominated sites. It was felt that the incorporation of ancillary data, such as burn perimeters, snowslide reaches, and riparian corridors would solve this problem allowing the system to provide general but accurate grizzly bear habitat information.

Visitor use patterns of the same area were mapped using a trailhead survey, which provided information on backcountry visitor activities and their use of the Park in space and time (Baldwin and others in preparation). The visitor mapping technique was an effective tool that could be adapted to a variety of situations and information needs. Integration of grizzly habitat and human use patterns revealed high numbers of hikers concentrated in the highest quality bear habitat. However, potential conflicts were minimized because most human use occurred during periods when bear use was not likely. It was concluded that knowledge of grizzly bear habitat needs has limited usefulness to Park managers without understanding the role of humans in that system.

CONCLUSIONS

Habitat studies have been an important part of the grizzly bear research program in Glacier National Park, and the knowledge contributed by them has improved our understanding of the ecological niche of grizzlies in the park environment. Study results also pointed to the likelihood that humans occupied an overlapping niche and competed with the bears for available habitat. It therefore seems appropriate that bears, humans, and their habitat be managed as a system. Field application of this concept requires that habitat be treated as a resource shared by the two dependent species and that management decisions be based on credible habitat information.

Table 1.--Seasonal food habits of bears in Glacier National Park, MT, from analysis of 943 scats sampled 1967-71 and 1982-84

Food Item		Percent frequency and volume[1] Apr.-June (N = 294)		July-Aug. (N = 304)		Sept.-Oct. (N = 345)	
Grass, sedge, rush							
	Total	55	40	45	17	40	21
Herbaceous material							
Angelica spp.		2	1	8	6	1	1
Heracleum lanatum		20	16	17	14	4	3
Misc.[2] umbels		27	16	23	16	4	1
Misc. forbs		20	7	19	6	14	8
Equisetum spp.		24	9	11	4	2	1
Misc. other[3]		5	[4]T	7	T	5	T
	Total	71	49	63	46	26	13
Fruits							
Amelanchier alnifolia		0	0	6	3	10	5
Crataegus douglasii		0	0	2	1	14	13
Sorbus spp.		0	0	0	0	9	5
Vaccinium spp.		0	0	29	19	38	24
Misc. fruits		5	1	6	2	10	4
	Total	5	1	44	26	81	51
Animal							
Insects		21	1	28	4	4	1
Mammals		21	7	7	2	11	4
Fish		0	0	0	0	1	T
	Total	37	8	32	6	13	6
Roots, bulbs							
Erythronium grandiflorum		1	T	8	3	0	0
Hedysarum spp.		3	2	2	1	8	7
Misc. roots		1	T	1	T	3	2
	Total	4	3	10	4	11	9

1/ Total volume for each season may not equal 100 percent due to rounding error.

2/ Items comprising less than 5 percent volume during one season were grouped under the miscellaneous category.

3/ Shrubs, trees, and miscellaneous nonflowering plants.

4/ Less than 0.5 percent of scat volume.

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