LOCAL FOOD HABITS OF THE GRIZZLY BEAR IN MONTANA

RICHARD D. MACE,[1] School of Forestry, University of Montana, Missoula, MT 59812
CHARLES J. JONKEL, School of Forestry, University of Montana, Missoula, MT 59812

Abstract: Grizzly bear (*Ursus arctos horribilis*) scats were collected from 4 western Montana study areas from 1976 to 1979 to determine differences in food item selection. Fruit was important to grizzly bears in all areas although the species consumed and the apparent degree of use varied. Globe huckleberry (*Vaccinium globulare*) was important to grizzly bears in the North and South forks of the Flathead River but was rarely eaten in other areas. Domestic apples (*Malus* spp.) and plums (*Prunus* spp.) were eaten extensively by Mission Mountain grizzly bears. Grasses and sedges were a staple food to bears in all areas; variable use of Umbelliferae was found. The nuts of whitebark pine (*Pinus albicaulis*) were eaten extensively by East Front grizzly bears only, and biscuit-root (*Lomatium* spp.) roots were dug to varying degrees in all areas. Yellow hedysarum (*Hedysarum sulphurescens*) roots were an important spring and autumn food to North Fork grizzly bears only. Horsetails (*Equisetum* spp.), clover (*Trifolium* spp.), and dandelions (*Taraxacum* spp.) were important in all areas throughout the grizzly bears' active period. These data suggest that substantial local variation occurs in grizzly bear food habits in Montana. These differences should be considered in land management plans that call for maintenance or enhancement of grizzly bear habitat.

Int. Conf. Bear Res. and Manage. 6:105–110

The omnivorous nature of the grizzly bear was recognized decades ago (Wright 1909, Storer and Trevis 1955); their opportunistic selection of food items has permitted bears to occupy a great variety of vegetation types in North America (Herrero 1972). Although much information is available on the food habits of this species throughout North America, few investigations have compared the diet of a single population occupying several diverse areas. This investigation examined and compared grizzly bear food habits among 4 areas in western Montana: the North and South forks of the Flathead River, the Mission Mountains, and the Rocky Mountain East Front.

We wish to thank all employees of the Border Grizzly Project who aided in the collection of scats. Specific thanks go to Allen Schallenberger, Peter Husby, Nanka McMurray, Gayle Joslin, and Christopher Servheen. We also wish to thank L. Jack Lyon (U.S. Dep. Agric., For. Serv.) for use of laboratory facilities. This research was funded in part by the U.S. Dep. Int., Bur. Land Manage., Mont. Dep. of Fish, Wildl. and Parks, and the U.S. Dep. Int., Fish and Wildl. Serv.

STUDY AREA

The North and South forks of the Flathead River (North Fork and South Fork) and the Mission Mountains are west of the Continental Divide in western Montana (Fig. 1). The Rocky Mountain East Front (East Front) straddles the Divide and includes the transition zone between the Rocky Mountain Cordillera and the Great Plains. Descriptions of these areas are given by Jonkel and Cowen (1971), Servheen (1981), and Schallenberger (1977), respectively. Pfister et al. (1977) described the forested habitat types of western Montana.

The rugged mountain terrain and complex climate of western Montana create an array of habitats and associated vegetation (Arno 1979). Each study area is distinctly influenced by maritime air masses moving east from the Pacific Ocean. Daubenmire (1969) noted that this oceanic influence, as expressed in increased precipitation and cloud cover, is strongest near the international border (North Fork study area) and gradually decreases to the south and east. Moisture-laden air masses pass the Cascade, Selkirk, Bitterroot, and Cabinet mountain ranges before reaching western Montana. Upon reaching the Continental Divide, much of the moisture in these air masses has been depleted.

Continental climate, dramatic temperature fluctuations and severe chinook winds influence vegetation in the East Front (Daubenmire 1969). Here, where the Great Plains meet the Rocky Mountains, extensive stands of limber pine (*Pinus flexilis*) are interspersed with aspen groves (*Populus tremuloides*) and grasslands (Lynch 1955, Pfister et al. 1977, Mueggler and Stuart 1980).

Local climatic conditions also influence the types of vegetation found in each study area. The climate on the western face of the Mission Mountains, for example, is moderated by a large lake and valley. Orchards of domestic plums, cherries (*Prunus* spp.), and apples are scattered throughout the Mission Valley. This mild valley climate is not found in the other 3 areas.

Patterns of human use also affect the vegetation and grizzly bear habitat in each study area. In the

[1]Present address: Montana Department of Fish, Wildlife and Parks, Box 67, Kalispell, MT 59903.

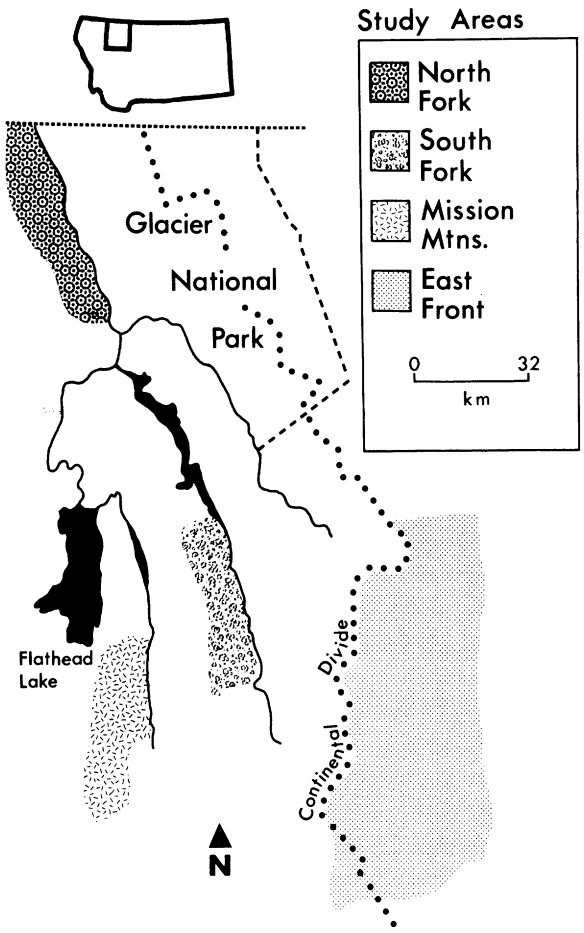

Fig. 1. Location of 4 study areas in western Montana.

North and South fork areas, timber harvesting has created a diversity of stand ages. Recreational and permanent homes are found on the bench lands adjacent to the North Fork, whereas much of the lower South Fork has been flooded for hydroelectric power (Hungry Horse Reservoir). Livestock ranching is the major land use practice along the East Front. Livestock are less commonly grazed in the Mission Valley, but other agricultural uses of this fertile valley have altered the natural vegetation and patterns of grizzly bear habitat use (Servheen 1981).

METHODS

Grizzly bear food habits were determined by analyzing scat samples. Black bears (*U. americanus*) occurred in all study areas, and interspecific characteristics of scats were not positively distinguishable. Several criteria were used, however, to minimize the possibility of inadvertently collecting black bear scats: field crews primarily collected scats from grizzly bears fitted with radiocollars; positive grizzly bear evidence such as tracks associated with scats was required before collection; and the collection site had to exhibit habitat characteristics typical of radio-instrumented animals. Scats were collected from diverse habitats within each area, although systematic collection techniques were not feasible in the mountainous and often unroaded terrain.

Each scat was placed in a plastic bag and the time of scat deposition was estimated to the nearest month. Scats considered to have been deposited the previous year were not collected. Samples were air-dried in the field and transferred to freezers at regular intervals.

Laboratory analysis of scat content generally followed the procedures outlined by Tisch (1961) and Mealey (1977). Each scat was thawed, rehydrated, and washed with water through 2–5 mm screens. Each scat was placed in a large pan and carefully agitated to disperse food items; small subsamples were then separated from the scat and analyzed using a binocular dissecting scope and a microscope. Additional subsamples were analyzed until all distinguishable items had been identified. Percent volume of each food item was ocularly estimated using the following categories: 0–1%, 1%–5%, 5%–25%, 25%–50%, 50%–75%, 75%–95%, and 95%–100%.

Plant and seed specimens collected from each study area and voucher specimens from the U.S. Dep. of Agric., For. Sci. Herb., were used to identify plant food items. Mammalian hair samples were identified using techniques of Moore et al. (1974) and visual comparisons with museum specimens from the Dep. of Zoology, Univ. of Mont.

Food item data were organized into 2 levels of resolution. Recognizable genera and species were listed as individual items. Items were also grouped into broad categories to aid in local food habit comparisons (e.g., fruit). All forbs and ferns with a frequency of occurrence of less than 5% were combined into the "other forbs/ferns" category. Grasses (Gramineae) and sedges (Cyperaceae) were also combined.

Each food category was expresed by an importance value (IV) using Mealey's (1977) formula, where:

$$\text{Importance Value} = \frac{\text{Percent frequency of occurrence} \times \text{Percent of diet volume}}{100}$$

Percent frequency of occurrence is the number of scats from a study area containing a specific food

category divided by the total number of scats from that study area. Percent diet volume is the total percentage (sum of percent volume midpoints) volume of each food category divided by the total number of scats from each area.

RESULTS AND DISCUSSION

Between 1976 and 1979, 1,156 scats were collected and analyzed from the 4 areas. Results of this analysis are first presented for each study area, followed by comparisons among the areas.

North Fork of the Flathead River

Analysis of 306 scats from the North Fork area (Table 1) indicated that on an annual basis, fruit had the greatest IV of all food categories. The fruit of 11 shrub taxa were identified as food items and globe huckleberry was most important. Globe huckleberry fruit production in the North Fork is related to natural fire cycles (Jonkel and Cowen 1971, Martin 1983), and seral shrubfields are important late summer and autumn foraging habitat for grizzly bears. Some North Fork grizzly bears move from higher elevations in the Whitefish Range and Glacier National Park to the North Fork floodplain during the autumn (Singer 1978). These bears feed heavily on the fruit of buffaloberry (*Shepherdia canadensis*) and buckthorn (*Rhamnus alnifolia*). These 2 items both occurred in 14% of the fruit scats.

The roots/corms category had an IV of 8. The roots of yellow hedysarum occurred in 83% of the scats in this category. Grizzly bears dug these roots primarily on sand bars in the floodplain during the spring and autumn (Singer 1978). Hamer and Herrero (1983) found that the roots of hedysarum were an important food for grizzly bears in Banff National Park, Canada. Biscuit-root was also dug by North Fork grizzly bears but in small quantities.

Grizzly bears relied on the stems and leaves of Umbelliferae during the early summer period (IV = 22). Cow parsnip (*Heracleum lanatum*), angelica (*Angelica* spp.), and sweet-cicely (*Osmorhiza* spp.) were dominant Umbelliferae food items. Horsetails and clovers were favored in the spring and autumn. Whitebark pine nuts and mammals represented a small portion of the total diet in the North Fork.

South Fork of the Flathead River

Fruit was the major food eaten by South Fork grizzly bears from late July throughout autumn and exhibited the greatest IV of all categories in the South Fork (Table 1). Globe huckleberry and serviceberry (*Amelanchier alnifolia*) were present in 85% and 22% of the fruit scats. The data suggested that mountain ash (Sorbus spp.) was eaten by grizzly bears in late October following dessication and drop of globe huckleberry. Habitat use studies indicated that relatively moist north-facing, shrubfields with an open timber canopy and natural burns were important fruit-foraging areas for South Fork grizzly bears (Zager et al. 1983).

Grasses/sedges and mesophytic Umbelliferae were particularly important during the spring and early summer as a source of protein (Sizemore 1980) and had IVs of 20 and 18, respectively. Cow parsnip, angelica, and sweet-cicely occurred most frequently in Umbelliferae scats. Pine nuts exhibited a low IV in the South Fork.

Radio-instrumented South Fork grizzly bears stripped the bark of conifers to eat cambium. Although no scats containing cambium were found, 13 incidents of this feeding activity were documented between early July and mid-August, 1979. Preference for a single conifer species was not observed; subalpine fir (*Abies lasiocarpa*), spruce (*Picea* spp.), lodgepole pine (*Pinus contorta*), and Douglas-fir (*Pseudotsuga menziesii*) were all stripped of bark.

East Front

Four hundred seventeen scats were collected from sites varying from low-elevation Great Plains habitat to subalpine areas near the Continental Divide (Table 1). The grass/sedge category had the greatest IV and was most important May–July, when grizzly bears foraged in low elevation riparian habitats. Horsetails and dandelions were also eaten at this time.

The fruit of 10 shrub species were identified as late summer and autumn food items in the East Front, of which chokecherry (*Prunus virginiana*) and buffaloberry occurred most frequently. The overwintering fruit of bearberry (*Arctostaphylos uva-ursi*) was eaten in the spring.

Whitebark pine nuts were a major source of protein in autumn for East Front grizzly bears foraging in mountainous areas (IV = 11). Root digging, primarily for biscuit-root also occurred in the autumn (IV = 2.0). Craighead et al. (1982) found a high degree of biscuit-root digging in the adjacent Scapegoat Wilderness of Montana.

Large mammals were important to grizzly bears in the East Front. Domestic livestock (*Bos taurus*)

Table 1. Frequency of occurrence and importance values of food categories and major food items for 4 Montana study areas.

Food category	Frequency of occurrence (%)			
	North Fork $N = 306$	South Fork $N = 140$	East Front $N = 417$	Mission Mtns. $N = 293$
Grasses/sedges	35.0/13.0	39.0/20.0	43.0/46.0	73.0/39.0
Umbelliferae	32.0/22.0	29.0/18.0	5.0/1.0	16.0/4.0
Heracleum lanatum	44.0	49.0	32.0	32.0
Angelica spp.	20.0	24.0	—	4.0
Osmorhiza spp.	18.0	32.0	55.0	32.0
Ligusticum spp.	1.0	—	5.0	2.0
Unknown	19.0	15.0	9.0	19.0
Equisetum spp.	16.0/4.0	16.0/4.0	5.0/0.5	15.0/1.0
Fruit	45.0/43.0	43.0/53.0	31.0/34.0	46.0/32.0
Vaccinium globulare	40.0	85.0	—	1.0
Vaccinium spp.	1.0	—	—	—
Ribes spp.	2.0	7.0	2.0	—
Cornus stolonifera	3.0	2.0	9.0	2.0
Arctostaphylos uva-ursi	12.0	2.0	21.0	—
Sorbus spp.	0.7	—	1.0	1.0
Rhamnus alnifolia	14.0	—	2.0	2.0
Shepherdia canadensis	14.0	—	23.0	—
Crataegus spp.	0.7	—	—	—
Rosa spp.	0.7	—	10.0	—
Disporum spp.	0.7	—	—	—
Chimaphila umbellata	0.7	—	—	—
Sorbus scopulina	—	7.0	—	—
Amelanchier alnifolia	—	22.0	10.0	44.0
Vaccinium caespitosum	—	3.0	4.0	
Ligusticum canbyi	—	2.0	—	—
Prunus virginiana	—	—	38.0	—
Malus spp.	—	—	—	37.0
Prunus spp. (domestic)	—	—	—	15.0
Berberis repens	—	—	—	2.0
Unknown	9.0	—	2.0	—
Other forbs/ferns	7.0/0.4	15.0/2.0	6.0/0.2	12.0/0.5
Roots/corms	15.0/8.0	0.7/2.0	8.0/2.2	6.0/0.2
Claytonia spp.	2.0	100.0	3.0	6.0
Hedysarum spp.	83.0	—	—	—
Lomatium spp.	7.0	—	82.0	61.0
Melica spp.	4.0	—	—	—
Erythronium grandiflorum	—	100.0	—	33.0
Delphinium spp.	—	—	3.0	—
Unknown	4.0	—	12.0	—
Pinus albicaulis nuts	4.0/0.2	0.7/0.003	15.0/11.0	0.3/0.001
Insects	21.0/4.0	18.0/2.0	20.0/2.2	47.0/20.0
Large mammals	6.0/1.0	6.0/2.0	10.0/4.0	11.0/0.5
Odocoileus spp.	25.0	78.0	43.0	38.0
Cervus elaphus	46.0	11.0	5.0	3.0
Alces alces	8.0	—	—	—
Bos tarus	—	—	43.0	53.0
Unknown	21.0	11.0	10.0	—
Small mammals	4.0/0.04	11.0/0.03	3.0/0.1	3.0/0.002
Spermophilus columbianus	27.0	53.0	10.0	—
Lagomorpha	9.0	—	—	—
Microtus spp.	—	20.0	82.0	63.0
Marmota spp.	—	—	9.0	—
Castor canadensis	—	—	—	25.0
Unknown	64.0	27.0	—	25.0
Debris (rock, twigs)	14.0/2.0	57.0/0.03	15.0/1.0	20.0/0.2

[a] Numbers following slash indicate importance values for food categories.

and deer (*Odocoileus* spp.) were most frequently consumed. There are numerous livestock "boneyards" along the East Front that serve as depositories for dead livestock and these sites are visited by bears each year. The volume of animal matter in scats is typically underestimated because of its high digestibility (Mealey 1977).

Mission Mountains

Grasses/sedges had the highest IV of all categories in Mission Mountain scats (Table 1). Four species of Umbelliferae were identified in the 293 scat samples; sweet-cicely and cow parsnip were present in 32% of the Umbelliferae scats. The use of grasses/sedges and Umbelliferae stems and leaves was greatest in the spring and early summer and declined as fruit began to ripen. Radio-telemetry data (Servheen 1981) showed that Mission Mountain grizzly bears foraged in low elevation seep complexes for early green vegetation during this time.

Fruits of 8 shrubs were identified as food items (IV = 32). Serviceberry, which was present in more fruit scats than any other shrub fruit, was first eaten in mid-July in the Mission Valley and in mid-elevation habitats where early ripening berries could be found (Servheen 1981). Domestic apples and domestic plums were present in 37% and 15%, respectively, of the fruit scats. These items were eaten in abandoned and maintained orchards scattered throughout the eastern edge of the Mission Valley.

Insects occurred in 47% of the scats and had an IV of 20. Interestingly, Mission Mountain grizzly bears eat large quantities of aestivating army cutworm moths (*Chorizagrostis auxiliaris*), which they find in high elevation talus slopes and boulder fields (Chapman et al. 1953, Servheen 1981). These moths, primarily eaten in August, were present in 41% of the scats containing insects.

The root/corm and large mammal categories showed relatively small importance values. Pine nuts were found in only 1 of 293 scats.

Comparison Among Areas

Grizzly bear food habits varied among the 4 areas. Although similarities in food category selection were pronounced, substantial differences in specific items were apparent.

Fruit was an important source of energy in all areas, although the species consumed and the apparent degree of use varied. Mission Mountain grizzly bears have learned to exploit domestic apple and plum orchards. Such use of cultivated fruit has no parallel in the other study areas.

Globe huckleberry was the dominant food in the North and South fork study areas, but was infrequently eaten in the other areas. East Front grizzly bears did not depend on the fruit of a single shrub species. Results from this large and diverse area suggested that the fruit of chokecherry, serviceberry, and buffaloberry were all important. It is possible that individual shrub species are not abundant and that grizzly bears used the fruit of numerous species occurring in low abundance.

Pine nuts are an important food in the more xeric portions of grizzly bear range. Mealey (1977) and Kendall (1981) discussed use of whitebark pine nuts in Yellowstone National Park. The use of pine nuts was negligable in all but the East Front area, the most xeric of the 4 study areas investigated. Whitebark pine in northwest Montana has been greatly reduced by epidemics of mountain pine beetle (*Dendroctonus ponderosae*) in the last decade. Although this may account for the low use of pine nuts in the North Fork, South Fork, and Mission Mountains, it is possible that where fruits are abundant they are preferred over nuts for necessary weight gain before denning.

Moist-site Umbelliferae were consumed in all areas. The importance of this food category decreases from north to south and coincided with a decreasing pattern of precipitation and cloud cover (Daubenmire 1969).

Grasses/sedges may be considered staple foods to grizzly bears in all areas. Clover, dandelions, and horsetails were also important in all areas.

Grizzly bears dug roots in all study areas. Biscuitroot was important on the East Front. Yellow hedysarum was dug along the broad floodplain of the North Fork but did not appear as a food item elsewhere. Mace (1984) noted that yellow hedysarum was not available in the upper South Fork drainage in the Bob Marshall Wilderness.

CONCLUSIONS

The influences of climate and human land-use patterns have produced diverse available grizzly bear habitat in Montana. Some plant species and cover types common to 1 area are rare or absent in others. These factors have led to differences in grizzly bear habitat and food item selection. Grizzly bears in Mon-

tana use a broad food base; resources are obtained from an environment where bear foods are patchy in time and space. Identifying locally important grizzly bear foods aids the agencies responsible for managing grizzly bear habitat. Further, autecological studies of key grizzly bear foods and ecosystem analyses of available habitats would greatly clarify local patterns of food item selection.

LITERATURE CITED

ARNO, S. F. 1979. Forest regions of Montana. U.S. Dep. Agric., For. Serv., Res. Pap. INT-218.

CHAPMAN, J. A., J. I. ROMER, AND J. STARK. 1953. Ladybird beetles and army cutworm moths as food for grizzly bears in Montana. Ecology 36:156–58.

CRAIGHEAD, J. J., J. S. SUMNER, AND G. B. SCAGGS. 1982. A definitive system for analysis of grizzly bear habitat and other wilderness resources utilizing LANDSAT multispectral imagery and computer technology. Wildlife-Wildlands Instit. Monogr. 1. Missoula, Mont. 279pp.

DAUBENMIRE, R. 1969. Structure and ecology of coniferous forests of the northern Rocky Mountains. Pages 25–41 *in* R. D. Taber, ed. Coniferous forests of the Northern Rocky Mountains. Univ. Mont., Missoula. 395pp.

HAMER, D., AND S. HERRERO. 1983. Ecological studies of the grizzly bear in Banff National Park—Final Rep. 1983. Univ. Calgary, Alberta. 303pp.

HERRERO, S. 1972. Aspects of evolution and adaptation in American black bears (*Ursus americanus* Pallas) and brown and grizzly bears (*Ursus arctos* Linne) of North America. Int. Conf. Bear Res. and Manage. 2:221–230.

JONKEL, C. J., AND I. MCT. COWAN. 1971. The black bear in the spruce-fir forest. Wildl. Monogr. 27.

KENDALL, K. C. 1981. Bear use of pine nuts. M.S. Thesis, Mont. State Univ., Bozeman. 27pp.

LYNCH, D. 1955. Ecology of aspen groveland in Glacier County, Montana. Ecol. Monogr. 25:321–344.

MACE, R. D. 1984. Identification and evaluation of grizzly bear habitat in the Bob Marshall Wilderness Area, Montana. M.S. Thesis, Univ. Mont., Missoula. 176pp.

MARTIN, P. 1983. Factors influencing globe huckleberry fruit production in northwestern Montana. Int. Conf. Bear Res. and Manage. 5:159–65.

MEALEY, S. P. 1977. The natural food habits of grizzly bears in Yellowstone National Park, 1973–74. Int. Conf. Bear Res. and Manage. 3:281–292.

MOORE, T. D., L. E. SPENCE, C. E. DUGNOLLE, AND W. G. HEPWORK. 1974. Identification of dorsal guard hairs of some mammals of Wyoming. Wyoming Game and Fish Dep., Laramie. 177pp.

MUEGGLER, W. F., AND W. L. STUART. 1980. Grassland and shrubland habitat types of western Montana. U.S. Dep. Agric., For. Serv., Gen. Tech. Rep. INT-66. 154pp.

PFISTER, R., B. KOVALCHIK, S. ARNO, AND R. PRESBY. 1977. Forest habitat types of Montana. U.S. Dep. Agric., For. Serv., Gen. Tech. Rep. INT-34. 174pp.

SCHALLENBERGER, A. 1977. A review of oil and gas exploitation impacts on grizzly bears. Int. Conf. Bear Res. and Manage. 3:271–276.

SERVHEEN, C. W. 1981. Grizzly bear ecology and management in the Mission Mountains, Montana. Ph.D. Thesis, Univ. Mont., Missoula. 138pp.

SINGER, F. J. 1978. Seasonal concentrations of grizzly bears, North Fork of the Flathead River, Montana. Can. Field-Nat. 92:283–286.

Sizemore, D. 1980. Foraging strategies of the grizzly bear as related to its ecological energetics. M.S. Thesis, Univ. Mont., Missoula. 67pp.

STORER, T. L., AND L. P. TREVIS, JR. 1955. The California grizzly. Univ. Calif. Press, Berkeley. 335pp.

TISCH, F. L. 1961. Seasonal food habits of the black bear in the Whitefish Range of northwestern Montana. M.S. Thesis, Univ. Mont., Missoula. 108pp.

WRIGHT, W. R. 1909. The grizzly bear. Charles Scribner's Sons, New York. 274pp.

ZAGER, P., C. JONKEL, AND J. HABECK. 1983. Logging and wildfire influence on grizzly bear habitat in northwestern Montana. Int. Conf. Bear Res. and Manage. 5:124–32.