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Cougar Habitat Use And Food Habits On The Montana Rocky Mountain Front

Abstract

Cougar (Felis concolor missoulensis) habitat use and food habits were investigated in the Sun River area of northern Montana. The food habits and habitat selection of twenty-three radio-collared cougars were monitored in 1991-1992. They selected closed-conifer, open-conifer, aspen-conifer, deciduous tree, and shrubland cover types. Cougars avoided grassland and vegetated rock cover types. Cougars primarily killed deer, bighorn sheep, and elk. Bighorn sheep, elk, and mule deer were killed more often during winter. White-tailed deer, and smaller mammals were killed more often during summer.

Key words: Cougar, *Felis concolor*, habitat selection, prey, food habits, predation, Montana.

Introduction

The cougar *(Felis concolor)* is the most widely distributed large carnivore in North and South America (Young and Goldman 1946, Anderson 1983). In Montana, cougars are found in 42 of 56 counties and in all habitats except the open plains and prairies (Riley 1992). Cougars have been reported historically to follow water courses out on to the more open prairie country of the eastern part of the State (Young and Goldman 1946). Few studies have quantified the use of habitats by cougars in the Rocky Mountains (Logan and Irwin 1985, Laing 1988, Koehler and Hornocker 1991). Impetus for this study was provided by the lack of detailed habitat selection and food habits data on cougars in north-central Montana. Our objectives were to determine (1) cougar macro-habitat selection patterns, and (2) cougar food habits on the Montana Rocky Mountain Front.

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Study Area

The 2127 km² study area is located on the east slopes of the Rocky Mountains 15 miles west of Augusta, in Lewis and Clark County, Montana (Fig. 1). The study area is bounded on the north by Deep Creek, on the west by the Sun River and the Continental Divide, on the south by the Dearborn River, and on the east by U.S. Highway 287. It was selected because it is a distinct ecological land unit, is of management importance, had reasonable access for study logistics and had substantial information available from previous research.

The study area is located in a geologically and topographically complex transition zone between the relatively level, low-elevation (approximately 1300 m) Great Plains to the east and the high-elevation (approximately 2500 m) ranges of the Rocky Mountain Front to the west. Elevations range from 1,311 m on the prairie to 2,805 m on Scapegoat Mountain. The East Rocky Mountain Front is composed of a series of parallel north-south trending ridges and peaks, characterized by moderate west facing slopes and abruptly sloped east faces, separated by narrow canyons.

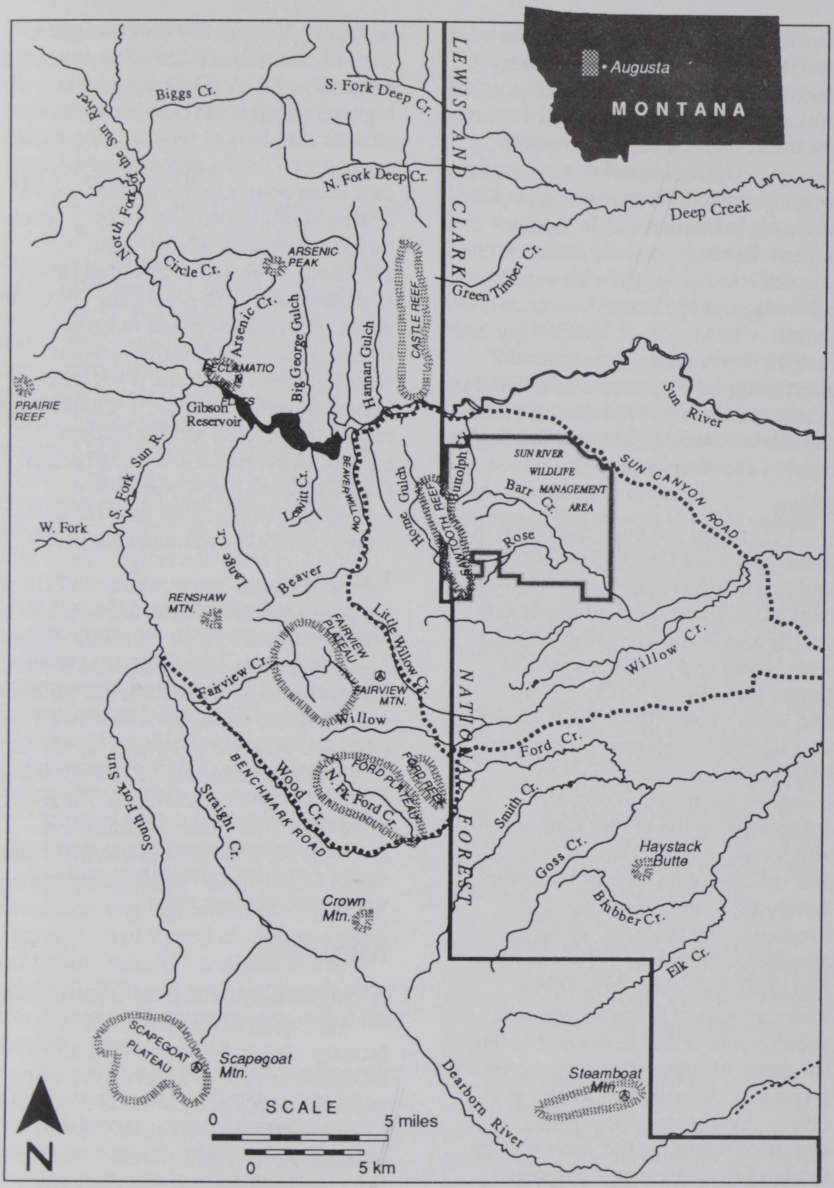

Figure 1. *The Sun River mountain lion study area in northern Montana.*

Climate

The climatic conditions on the study area varied widely due to disparity in elevation and topography. Prevailing weather patterns typically develop from the West, causing downslope wind conditions (Knight 1970). During winter, warming winds limit snow cover on southern and

western aspects within the prairie portion of the study area. In contrast, the northern and eastern aspects of the prairie-Front ecotone, as well as most of the interior study area, were snow covered. Upslope conditions sometimes develop from the east resulting in large amounts (>1m) of snow in single storms. During the study January 1991 was the coldest month with a mean of -6.2C. August 1991 was the warmest month with a mean of 18.6C. May and June 1991 were the wettest months accounting for 71 per cent of the 37.5 cm of precipitation that fell during 1991 at the Gibson Dam weather station in the heart of the study area.

Flora

Vegetation has been discussed in detail by Picton (1960), Knight (1970), and Kasworm (1981). Low elevation sites are characterized by shortgrass prairie and shrublands interspersed with buttes and ridges covered by limber pine *(Pinus flexilis)* savannahs and wind forests (Ihsle 1982). Bluebunch wheatgrass *(Agropyron spicatum)* and Idaho fescue *(Festuca idahoensis)* comprise the major understory component of the limber pine savannah and forest. Aspen *(Populus tremuloides)* and cottonwood *(Populus trichocarpa)* stands are scattered throughout drainages and foothills. At higher elevations, Douglas fir *(Pseudotsuega menziesii)*, lodgepole pine *(Pinus contorta)*, spruce *(Picea engelmannii)*, and subalpine fir *(Abies lasiocarpa)* dominate the forest canopy following successional sequences described by Pfister et al. (1977). Extensive willow (Salix spp.) stands characterize the vegetation in lowland riparian areas. Extensive regions of seral grassland and shrubland are found on burned sites, especially in the southern portion of the study area.

Fauna

The Montana Rocky Mountain Front uniquely supports a high diversity of large mammals. Potential large prey for cougars included elk *(Cervus elaphus nelsoni)*, mule deer *(Odocoileus hemionus)*, white-tailed deer *(O. virginianus)*, bighorn sheep *(Ovis canadensis)*, and smaller numbers of moose *(Alces alces)*, pronghorn *(Antilocapra americana)*, and mountain goat *(Oreamnos americanus)*. Potential small mammalian prey species included snowshoe hare *(Lepus americanus)*, Nuttall's cottontail rabbit *(Sylvilagus nuttalii)*, porcupine *(Erethizon dorsatum)*, yellow-bellied marmot *(Marmota flaviventris)*, and raccoon *(Procyon lotor)*. The lynx *(Felis lynx)*, bobcat *(F. rufus)*, gray wolf *(Canis lupus)*, coyote *(C. latrans)*, red fox *(Vulpes vulpes)*, wolverine *(Gulo gulo)*, badger *(Taxidea taxus)*, black bear *(Ursus americanus)*, and grizzly bear *(U. arctos)* were potential competitors for prey.

Land Use

Livestock grazing was the major agricultural activity in the study area. The Lewis and Clark National Forest administered 10 cattle and horse grazing allotments totalling 1,273 animals and 5 packer allotments totalling 124 animals (Brad McBrattney, USFS pers. comm. June 1992). Hunting, fishing, hiking, and camping comprised the majority of public activity as most of the area was under designated recreation and wilderness management.

Methods

Cougar Capture and Monitoring

We captured cougars from 15 January 1991 to 31 March 1991 and from 2 December 1991 to 6 April 1992 using trained hounds and methods described by Hornocker and Wiles (1972). Radiocollared cougars were relocated at least twice per month primarily from fixed-winged aircraft. Wind conditions restricted these flights to the morning hours after dawn. The extreme topographic relief of the study area contributed to inaccurate radio locations. Data collected on the ground only included locations where the

animal was observed, fresh sign such as a track or kill site was encountered, or the animal was pinpointed by circling at least 270 degrees around the radio-collared animal.

Habitat Selection

Previous studies have demonstrated the importance of vegetative cover to cougars (Hornocker 1970, Seidensticker et al. 1973, Murphy 1983, Logan and Irwin 1985). The vegetation cover map of the study area was previously developed for the Lewis and Clark National Forest using information derived from Landsat multispectral scanner(MSS) digital data (Fitzpatrick 1988). The study area map used three overlapping Landsat(MSS) scenes, 2 taken on the same pass of 3 July 1981 and one on a previous pass of 2 July 1981. The southern one third of the study area burned in 1988, resulting in large scale cover type changes for the burned area. Consequently, only cougar data for the unburned region of about 1425 km^2 of contiguous unmodified habitat in the study area were used for habitat selection analyses utilizing LANDSAT technology.

For this study, data were produced that were compatible with the GIS computer program EPPL7 (Minnesota State Planning Agency, 1990). An aggregation of 9 pixel classes was used for habitat selection analysis in this study. EPPL7 was used for quantitative calculations involving cougar use of the habitat classes.

The 50 m x 50 m habitat pixels of the digital map were smaller than the 150-200 m telemetry error. Telemetry error was estimated by using collars shed by animals and whose exact locations in the field were known. Because of telemetry error, the buffer option in EPPL7 for single pixels was employed. This option adds two pixels at each four compass bearings around the focal pixel cell and 1 pixel at 4 points at the pixel cell corners creating a final cluster of 13 pixels that was used as a sampling unit. This option samples an area of roughly 200 m x 200 m and selects a habitat type based on the majority of the pixels.

For the burned region of the study area we recorded formation (burn, forest, or grassland) for each mountain lion location. The presence or absence of a rock-cliff component in the sampling unit was also noted. These observations were made during radio-tracking flights.

Telemetry data, sites where prey were killed, scat-scrape sites, and track sites represented the four classes of cougar point data for habitat selection analyses. Chi-squared goodness-of-fit tests were used to determine if significant differences ($P < 0.1$) existed between the expected utilization of habitats based on their availability versus the observed frequency of their use. If significant differences existed, Bonferroni simultaneous confidence intervals were calculated to identify habitat selections (Neu et al. 1974, Byers et al. 1984). Due to an association of three kill sites and telemetry locations, total independence for statistical tests probably was not achieved, however, we think this did not effect our overall conclusions. Home range overlap, the presence of unmarked animals, population turnover, days to weeks between observations, separation of successive observations by distances of kilometers all support the independence of observations with the exceptions noted.

Track sites represent the point at which the track was first intercepted. Only one track site was recorded for a given trail of a given animal and tracks associated with telemetry locations, scrapes and kills were not included. Scat/scrape sites associated with kills were not included in the analysis. It should be noted that these data types have very different time constants. A telemetry datum represents most ephemeral observation with the kill sites

representing the longest period of use. Tracks, scrapes and kills also represent use at other than morning hours.

Food Habits

Cougar food habits were based on prey species present at kill sites and scat analysis. Criteria for cougar kill determination included: 1) kill was associated with a radiotelemetry location, 2) cougar tracks were present at the kill, 3) cause of death was typical of a cougar attack (Hornocker 1970), 4) carcass was fed upon in a manner typical of cougars (Shaw 1979), 5) caching of the prey species was typical of cougars (Hornocker 1970), and 6) corresponding cougar scrapes were present.

Cougar scats were analyzed at the Montana Fish, Wildlife, and Parks Laboratory (MFWP) in Bozeman. Scats were air dried and stored in paper bags until analyzed. Prior to analysis, they were soaked in hot water to make the contents pliable. Scat contents were identified macroscopically or with a dissecting and compound microscope. Animal hair was identified macroscopically or by its characteristic scale pattern (Moore et al. 1974). Per cent occurrence by species provided an indication of the relative frequency with which each item was consumed in comparison with other items found in a scat (Ackerman et al. 1984).

Results

Habitat Use

A total of 141 cougar telemetry relocations (n=23 cougars), 53 kill sites, 27 scat/scrape sites, and 27 track sites were assigned habitat cover types (Table 1). No one animal contributed more than 17 percent of the telemetry relocations. The biological hypothesis that the cougars used the habitat cover types in proportion to the abundance of cover types was evaluated using the telemetry data. Inspection of the data (Table 2) suggests disproportionate use of habitat types. Statistical testing of the hypothesis indicated that habitat types were used by cougars disproportionately to their availability (Table 2) when considered simultaneously ($X^2 = 19.484$, $P < 0.001$, 5 d.f.) and with lumping of classes having an expected value of less than five . Closed conifer, open conifer, aspen plus conifer, deciduous tree, and shrubland types were used proportionately more than they were available while the grassland-meadow, vegetated rock, and river-marsh types were used less than available.

Table 1. *Description and availability (%) of 9 macrohabitat cover types on the Sun River cougar study area.*

TYPE	DESCRIPTION	%
grassland	grassland/alpine meadow	42.7
shrubland	shrubfields, dry croplands	1.0
deciduous tree	aspen, cottonwood, riparian shrub	2.0
aspen + conifer	aspen + lodgepole pine and douglas fir	1.0
open conifer	open canopy lodgepole pine, douglas fir, limber pine, spruce, subalpine fir, and whitebark pine	10.0
closed conifer	closed canopy lodgepole pine, douglas fir, limber pine, spruce, subalpine fir, and whitebark pine	29.0
vegetated rock	rock, cliff, or slide areas with vegetation	9.0
bare rock	talus, scree, rock and gravel bars with no vegetation	0.3
river marsh	aquatic areas, fens, marshes, wet meadows, open and closed forest riparian areas	5.0

The biological hypothesis that aerial telemetry observations represent an accurate model of cougar habitat use was tested by using the data for kills, scats and tracks (Table 2). Inspection of the data suggested that the telemetry model overestimates use of the vegetated rock habitat type and underestimates use of the river marsh type. Statistical testing of the hypothesis supports this conclusion ($X^2 = 18.362$, $P < 0.001$, 5 d.f.).

This supports the view that combining the data represents the best biological model of cougar habitat use. The combined data model indicated that cougars used habitats during May-

Table 2. *Percent availability and percent use^a of covr types^b based on summer, winter and annual telemetry kill locations, scat locations, and track locations of mountain lions on the Sun River study area, Montana 1991-1992.*

Cover Type	% Avail	All data n=248	Telemetry			Kills n=53	Scats n=27	Tracks n=27
			Sum c n=55	Win n=86	Ann n=141			
GRA	42.7	30.4-	30.5	27.6-	29.4-	31.5	36.1	35.6
SHR	1.0	1.7+	1.0	2.3+	1.9+	2.1	0.4	2.2
DEC	2.4	5.3+	3.7	7.8+	6.1+	4.6	4.8	3.8
MIX	1.1	2.2+	1.4	2.3	2.0	3.3	3.3	1.3
OPC	10.2	12.9+	12.8	12.6	12.4+	16.1	14.8	6.9
CLC	28.4	37.3+	30.1	40.6+	36.2+	37.7	33.6	42.3
VRO	8.8	6.7-	15.4	5.2	9.2	1.2	2.5	0.0
BRO	0.3	0.2	0.6	0.0	0.3	0.2	0.0	0.0
RIV	5.1	3.3-	4.5	1.6	2.5	3.3	4.5	7.9

^a+=Use>availability (P for simultaneous confidence intervals<0.10);

-=Use<availability (P for simultaneous confidence intervals<0.10).

^bGRA=grassland; SHR=shrubland; DEC=deciduous trees; MIX=aspen + conifer; OPC=open conifer; CLC=closed conifer; VRO=vegetated rock; BRO=bare rock; RIV=river-marsh

^c Sum=summer; Win=Winter; Ann=annual

October disproportionately to their availability when habitats were considered simultaneously ($X^2 = 71.262$, $P < 0.001$, 8 d.f.). The vegetated rock and closed conifer types were used more and the grassland-meadow type was used less than available.

Cougars used habitats during November-April disproportionately to their availability when habitats were considered simultaneously ($X^2 = 32.717$, $P < 0.001$, 8 d.f.). The closed conifer, aspen, and shrubland types were used more than available. The grassland-meadow, vegetated rock, bare rock, and river-marsh types were used less than available. Year-round cougar use of habitats revealed some types were used disproportionately to their availability when habitats were considered simultaneously ($X^2 = 27.413$, $P < 0.001$, 8 d.f.). The closed conifer, open conifer, aspen, and shrubland types were used more while the grassland-meadow and river marsh type were used less than available.

Cougar kills (n=53) were made in some habitats more than others ($X^2 = 10.27$, $P = 0.038$, 4 d.f.). The closed conifer, open conifer, and aspen plus conifer types were used more than available. The grassland-meadow and vegetated rock types were used less than available.

The data were insufficient to draw firm conclusions from the distribution of scats and tracks in the various habitat types ($X^2 = 7.25$, $P = 0.133$, 4 d.f.).

One female (135) and one male (131) used home areas within the region of the study area that were extensively burned in 1988. Sixty percent (n=20) of Female 135's locations were in burned (versus forested or grassland) areas. All of her locations in burned areas were associated with a rock-cliff component. Fifty-seven percent of the Males 131 locations (n=18) were in burned areas, and seven of these were associated with

a rock-cliff component. Of the 42 kill locations where exact kill locations could be identified, two were located in burned areas. Both of these sites had an extensive understory (1.5 m high during summer-fall) of fireweed *(Epilobium angustifolium).*

Food Habits

Analysis of Kills

Nine prey species were represented in the kill sample (Table 3). Deer species (both white-tailed and mule deer) represented 41 percent of the kills, elk (27%), and bighorn sheep (18%). The frequency in which different prey were killed varied by winter-spring and summer-fall (Figure 2).

Table 3. *Composition of cougar diet based on kills located and scats analyzed for the Sun River study area.*

Prey	Kills (n=53) % of total	Scats (n=27) % of total
Elk	27	12
Mule deer	18	29
White-tailed deer	16	15
Unclassified deer	7	
Bighorn sheep	18	20
Snowshoe hare	4	8
Porcupine	4	2
Ground squirrel		8
Raccoon	2	
Marmot	2	
Pocket gopher		2
Vole		2
Mountain lion	4	
Domestic cat		2

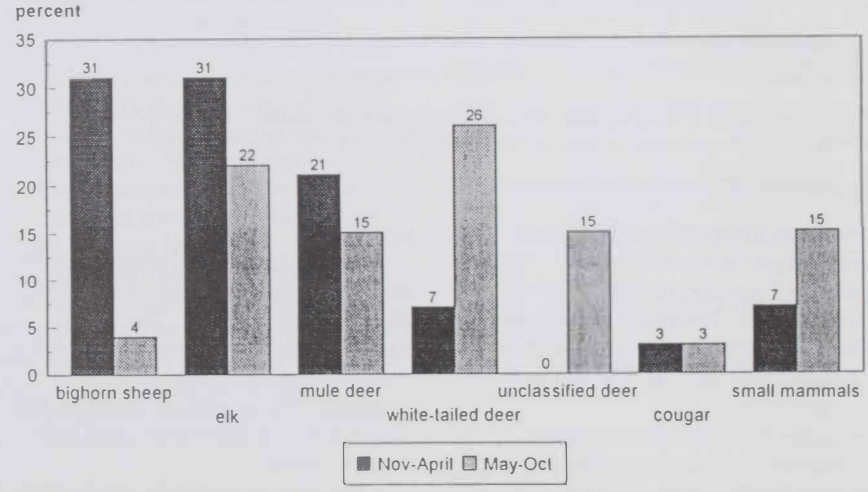

Figure 2. *A comparison of the species composition of 56 total kills made by cougars during summer-fall versus winter-spring on the Sun River study area. N=percent of the total kills for that season.*

Bighorn sheep, elk, and mule deer were killed more in winter-spring than in summer-fall. In contrast, white-tailed deer and smaller mammals were preyed upon more during summer-fall. Four additional deer could not be identified to species in the field.

A killing bite to the neck of the ungulates accounted for 66 percent of the kills while 24 percent was attributed to a facial bite (prey had nasal-jaw region removed), and 10 percent were attributed to decapitation (small mammals).

Thirty-four prey items representing 10 taxa were revealed in 27 scats (Table 3). Deer occurred in 44 percent of the scats, bighorn sheep in 20 percent, elk in 12 percent. Snowshoe hare, ground squirrels, pocket gopher, voles, porcupine and domestic cat were also detected in scats.

Discussion

Habitat Use

Cougar presence indicators demonstrated the importance of cover (Seidensticker et al. 1973, Murphy 1983, and Laing 1988). Hornocker (1970) noted the importance of cover for cougars to successfully stalk and attack prey. Cover also provides security for cougars during feeding periods (Logan and Irwin 1985).

The presence indicators for cougars (telemetry, kills, tracks, and scat-scrapes) in this study indicated that closed conifer, open conifer, aspen plus conifer, aspen, and shrubland cover types were the 5 most important of the 9 habitat types available. These cover types provided both stalking and feeding security habitat for cougars (Hornocker 1970, Logan and Irwin 1985, Koehler and Hornocker 1991). The closed conifer type was preferred in all presence indicator classes except the scat/scrape type. The closed conifer type included riparian areas concealed by a closed canopy.

Although the grassland-meadow, vegetated rock, and river-marsh types were used less than their abundance, cougars were located close to these types in areas with more cover. The grassland-meadow habitats were important ungulate foraging areas on the Rocky Mountain Front in Montana (Picton 1960, Knight 1970, Frisina 1974, and Kasworm 1981).

Based on diurnal telemetry data, the vegetated rock type was used more than its availability by cougars during summer-fall. This type was similar to vegetated rock-scree habitats found to be used during summer by bighorn sheep (Erickson 1972, Andryk 1983) and mule deer Kasworm (1981). Use of this cover type during summer by cougars probably reflected similar use by prey. Based on annual diurnal telemetry data, cougars used more open habitats during summer-fall than winter-spring. Spring dispersal of ungulates from the winter ranges on the Rocky Mountain Front to higher elevation summer ranges occurs from April to mid June (Knight 1970, Kasworm 1981). Increased use of more open cover types by cougars during summer-fall may have reflected an increase in search efforts for more widely distributed prey populations.

Some cougars in this study were located in extensively burned areas. Most of those locations were associated with a rock-cliff component. Cougars likely used the rocky areas for stalking and security cover due to the absence of vegetational cover. Extensive stands of fireweed within the burned area during summer-fall also provided stalking cover. A family group of cougars was observed hunting or travelling through a burned region with no ground cover other than burned trees.

Cougar kills in this study were located in closed conifer, open conifer, and mixed aspen-conifer types more than any other cover type. Although kill sites were not predominately located in the grassland cover type, cougars occasionally attacked bighorn sheep away from the forest edge (>50 m) in a grassland cover type and then dragged the carcass into nearby cover. Most deer and elk were attacked in the timbered areas.

Cougars avoided scraping in vegetated rock and bare rock cover types. All other cover types were used for scrapes and scats. Scats were most often buried in scraped piles of pine duff. Very few scats were found unburied. Usually scrapes were associated with large or atypical trees in monotypic stands. Most large (>1 m deep and 1 m high, 2 m wide) caves discovered on the study area contained cougar scat or kill remains.

Several researchers have noted the tendency for cougars to travel along drainage bottoms or ridges (Hornocker 1970, Seidensticker et al. 1973, Shaw 1979, Murphy 1983, Hemker et al. 1984,

Logan and Irwin 1985, Laing 1988, and Van Sickle and Lindzey 1991) also noted the strong relationship between travelling-hunting areas and cover. Cougars used the closed conifer cover type for travel more than any other. Open areas such as the grassland-meadow type were avoided. Snow-tracking revealed that cougars travelled from one patch of cover to another using both vegetation and rocky overhangs for concealment.

Food Habits

Considerable variation in cougar prey species in North America has been documented (Young and Goldman 1946, Robinette et al. 1959, Hornocker 1970, Spalding and Lesowski 1971, Shaw 1979, Murphy 1983, Anderson 1983, Ackerman et al. 1984, Leopold and Krausman 1986, Logan and Irwin 1985, Murphy et al. 1992, Ross and Jalkotzy 1992). The variation in prey species appears to be associated with latitude and climate at the continental level (Iriarte et al. 1990).

The Montana Rocky Mountain Front area is unique in that it contains all ungulates historically present with the exception of bison. Large numbers and concentrations of both resident and migratory elk, mule deer, white-tailed deer, and bighorn sheep are limited both climatically and topographically to certain migratory pathways and winter ranges (Picton 1960, Knight 1970, Erickson 1972, Kasworm 1981). In this study, selection of prey by cougars was probably related to seasonal availability and vulnerability of prey populations as noted by Hornocker (1970), stalking cover present, and individual cougar reproductive status.

With the exception of the tropics, deer or deer-sized ungulates were the most common cougar prey species (Iriarte et al. 1990). Cervids were the most common prey item for mountain lions in this study. Deer species comprised 41 percent (n= 23) of the kill sample in this study. These results concurred with cougar studies on the Rocky Mountain Front in southern Alberta (Ross and Jalkotzy 1992) and western Montana (Murphy 1983).

White-tailed deer were predominant in the cougar kills during summer-fall in this study and were killed primarily in drainage bottoms. During summer, groups (> 10 individuals) of white-tailed deer were observed most consistently on drainage bottoms and on closed canopy timbered sidehills. White-tailed deer occurred in the study area interior during summer. In winter they appeared to use the Front and associated drainages extending out to the short-grass prairie. White-tailed deer may provide a traditionally reliable and concentrated food source for cougars during summer. During winter however, relatively open low elevation winter ranges utilized by white-tailed deer may not provide desirable stalking cover compared to winter ranges closer to the timbered areas used by other ungulates.

During winter, mule deer populations on the Front use grassland areas intermixed with timbered patches (limber pine forest), moderate-steep slopes, and windward aspects low enough in elevation to be blown free of snow by chinook winds (Ishle 1982). During summer Kasworm (1981) noted that mule deer used timbered and higher elevation habitats on the Front. Mule deer were killed by cougars predominantly during winter and spring. Mule deer primarily occupied the moderately steep limber pine wind forest with interspersed Douglas fir during this period. Consequently, mule deer were generally more vulnerable to predation than white-tailed deer during winter-spring.

Mule deer bucks were killed by cougars more than does and fawns in this study. The solitary nature of mule deer bucks combined with their preference for rugged, dense habitat

were cited as behavioral factors that increase their vulnerability to the stalk-ambush attack strategy of cougars (Robinette et al. 1959, Hornocker 1970, Spalding and Lesowski 1971, Harrison and Hebert 1988).

Elk were killed by cougars predominately during winter and spring. During winter elk utilized the lowland open prairie, the limber pine wind forest, and higher elevation Douglas fir forest (Knight 1970). On the Sun River Wildlife Management Area (SRWMA), where all 3 of the preceding wintering habitats were available, elk were subject to cougar predation in the limber pine and the Douglas fir forest. No cougar kills were located on the open prairie. With the exception of riparian areas, there probably was not sufficient stalking or feeding security cover (Logan and Irwin 1985) on the open prairie for cougars to consistently prey on elk.

Elk cows were killed by cougars in this study more frequently than bulls or calves. Two cow elk were killed on the SRWMA in the closed canopy Douglas fir forest complex. All other cow elk kills were discovered on interior winter ranges associated with a Douglas fir forest which may have provided more stalking cover for cougars. Large groups of cow and calf elk that winter on the open prairie likely were not as vulnerable to cougar predation as the elk that used interior winter ranges which were smaller and surrounded by more potential stalking cover.

Compared to other studies of food habits of cougars in the northwestern United States (Hornocker 1970, Murphy 1983, Murphy et al. 1992, and Ross and Jalkotzy 1992), bighorn sheep were preyed upon extensively in this study (10 kills, 20 percent frequency of occurrence in scats). Only Harrison and Hebert (1988) in British Columbia noted significant predation by cougars on bighorn sheep. Geist (1971) suggested that cougars may occasionally kill a healthy bighorn, but they play a very minor role in sheep mortality. Conversely, Kelly (1980) noted that cougars are an important predator of the desert bighorn sheep *(Ovis canadensis nelsoni)*. He further noted that cougars occasionally killed bighorn sheep incidently at or in route to watering holes in high density mule deer areas.

In the current study, bighorn sheep served cougars as a seasonally important prey resource being killed almost exclusively during the winter and spring. Most appeared to have been killed by a cougar using a short stalk and ambush, near a forest-grassland edge. Erickson (1972) noted that most bighorn sheep in the same study area had migrated to winter ranges by December. Bunchgrass, rocky reef, and old burned habitats were commonly used, whereas timbered habitats were used little by bighorn sheep during winter. Frisina (1974) noted that during fall and spring, most bighorn sheep observations in the same study area were within 150 yards of escape cover; forested habitats were used in only 10 percent of the observations. Frisina (1974) further noted that forested habitats in the study area were used as escape terrain only when bighorns were forced by severe weather to move away from rocky terrain in search of food. Bighorn sheep generally avoid timbered areas (Geist 1971).

Although adult rams and ewes were killed by cougars in this study, ewes were the more frequent prey. Harrison and Hebert (1988) noted that more post-rut rams were killed by cougars than adult ewes and lambs. The remains of one lamb also was found in one cougar scat. Perhaps the traditionally large winter aggregations of female bighorn sheep (Erickson 1972) on the study area provide a more dependable food source for cougars; hence, they may be hunted more by cougars than smaller ram groups.

The majority of the small mammals killed by cougars occurred in summer-fall. One adult female (146) with two kittens was observed feeding on a

porcupine kill. Smaller mammals maybe more important prey items for females with kittens with increased metabolic demands and need for kitten predatory-play behavior (Leyhausen 1979). Seidensticker et al. (1973) in Idaho reported that smaller mammals were important alternative prey species for cougars during the summer. Leopold and Krausman (1986) also reported that mountain lions preyed on small mammals. Spalding and Lesowski (1971) found that snowshoe hares formed a significant part of the cougars diets in British Columbia.

Conclusions

Cougars in this study were adaptable predators, as was revealed in both their habitat selection and seasonal selection of prey species. Overall cougars selected habitats with conifer cover. Wildlife managers in the northern Rocky Mountains, particularly east of the Continental Divide, should focus cougar detection efforts in areas where seasonal ungulate herd ranges overlap with some form of vegetational cover, particularly with a conifer component. Cougars used mule deer, white-tailed deer, elk, and bighorn sheep as seasonally important prey resources. Wildlife managers should consider cougar predation when developing habitat and species management plans for these big game ungulate species.

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