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 Characteristics of Grizzly Bear Predation on Caribou in the Calving Grounds of the Western Arctic Herd

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SUMMARY

Grizzly bear use of caribou as carrion and prey was investigated in the vicinity of the caribou calving grounds of the Western Arctic Herd. Caribou aggregations were available to grizzlies during spring migration, calving, post-calving migration, and post-calving shift; most of the grizzly bear predation and scavenging in 1979 occurred during postcalving migration. The availability of caribou to grizzlies was dependent on caribou moving into the home ranges of the bears; no bears were observed leaving home ranges to reach caribou aggregations. The proportions of caribou which were killed by bears and those which were scavenged were not determined. Although most caribou killed by bears were calves. adults were also preyed upon. Grizzlies of all sex and age classes fed on caribou, but adult males were probably the most successful in killing or scavenging caribou or at least in gaining possession of carcasses which other bears killed or scavenged. Although the specific effects of availability of caribou on individual bears were not determined, the fact that the grizzly bear population in this area has a higher density and productive potential than other North Slope grizzly populations was ascribed to the availability of caribou as a food source.

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BACKGROUND

Grizzly bears (Ursus arctos) and ungulates have long coexisted throughout North America. Although grizzlies feed primarily on vegetation, these bears also consume a wide variety of animal matter, including ungulates as carrion and prey. In the past even though it was generally acknowledged that grizzlies could cause serious losses of domestic livestock, the effects of grizzly bear predation on wild animals including moose (Alces alces) and caribou (Rangifer tarandus) populations in Alaska were felt to be negligible (Lent 1964, Skoog 1968, Franzmann and Schwartz 1979). Recently, however, there has been growing evidence that predation by both black bears (Ursus americanus) and grizzlies was responsible for depressing survival rates of moose calves in some areas of Alaska (Ballard et al. 1979, Franzman and Schwartz 1979). Observations of grizzlies killing caribou have been made (Lent 1964, Skoog 1968, Reynolds 1978), but the effects of grizzly bear predation on caribou populations have not been investigated.

In 1970 the Western Arctic Herd (WAH) included at least 242,000 caribou and was the largest caribou population in Alaska (Hemming 1971). By 1975 this herd had declined to a minimum of 100,000 animals; by 1976 it had declined further to a minimum of 64,000 (Davis 1978, Davis and Valkenburg 1978). The major causes of this decline were overharvest by hunters, including losses due to wounding and waste, and predation, primarily by wolves (*Canis lupus*). Beginning in 1977 the WAH began to recover and by 1979 it numbered about 113,000 (J. Davis, pers. comm.). This increase was probably due in part to a decreased kill by hunters, which was brought about by regulatory changes, and to the wintering of a large proportion of the herd on the northern coastal plain where wolf density, and thus predation, was very low.

This precipitous decline and partial recovery of the WAH emphasized the need for additional insight into the population dynamics of caribou, particularly those concerning rates and causes of natural mortality. Davis and Valkenburg (1979) began to study natural mortality of caribou in 1979; their investigations focused on mortality of young age and adult animals during periods other than calving and post-calving migration. Numerically, most mortality in caribou herds occurs to calves within the first 8 weeks after birth. The factors responsible for neonatal mortality in this herd are not fully understood. However, causes of neonatal mortality in a Canadian caribou population, listed in decreasing order of importance, were: predation (by wolves), abandonment by maternal cows, stillbirths, physiological or pathological disorders (nonspecific), pneumonia, malnutrition, and injuries (Miller and Broughton 1974). These causes of mortality are very likely similar to those responsible for calf losses in the WAH except that wolves are responsible for very little neonatal mortality. In the WAH, during calving, caribou are largely unavailable to wolves but are available to grizzly bears and small predators including golden eagles (*Aquila chrysaetos*), red foxes (*Vulpes fulva*), Arctic foxes (*Alopex lagopus*), and wolverines (*Gulo gulo*).

Grizzly bears are the largest and probably the most successful predator of calves on the WAH calving grounds and along the post-calving migration route. Grizzly densities are generally sparse on the north slope of the Brooks Range, averaging 1 bear/260 km². However, the density of bears in the vicinity of the WAH calving grounds in the Utukok/Kokolik River uplands is 1 bear/44 km² (Reynolds 1978). Not only are grizzlies more dense in this area, but they are more productive than grizzlies studied in the eastern North Slope ar well (Reynolds 1976, 1978): females breed successfully at a younger mean age, 8.4 vs. 10.1 years; mean litter size is larger, 2.0 vs. 1.8; and reproductive interval is shorter, 4.0 vs. 4.2 years. The fact that grizzlies are more numerous and more productive in the vicinity of the WAH calving grounds is probably due to the availability of caribou as prey and carrion for grizzly bears (Reynolds 1977).

Lent (1964) observed grizzlies killing calves in this area but estimated that the effect of grizzly-caused mortality on the WAH caribou population was negligible. However, even though predation was a negligible mortality factor when the herd size was large, it is much more likely to have an effect now that herd numbers have dwindled. The extent of grizzly bear predation on caribou and the conditions under which this predation occurs must be known in order to accurately assess the importance of grizzly bear predation on the growth of the WAH.

Population studies of WAH caribou have been conducted in this area since the early 1960's and continue to the present time (Lent 1964; Skoog 1968; Hemming 1971; Davis 1978; Davis and Valkenburg 1978, 1979; Davis et al. 1979, In Press). There is also a data base for grizzly bear population biology, food habits, and movement patterns (Reynolds 1977, 1978, this volume). A large percentage of the grizzlies in the area are individually color-marked or radio-collared, a fact which greatly facilitates further investigations involving predation behavior.

OBJECTIVES

To determine the extent of grizzly bear predation on caribou in the vicinity of the calving grounds of the Western Arctic Herd, characterize the sex and age classes of grizzly bears which prey on caribou, and determine the effect of caribou availability as prey and/or carrion on grizzly bear productivity.

PROCEDURES

The study area included the core caribou calving grounds of the WAH, the area used in post-calving migration from the calving grounds southwest to the Kukpowruk River, and the area south of the calving grounds where Reynolds (1978) studied grizzly bear population biology and habitat use. The core calving grounds of the WAH may shift from year to year but is generally centered in the foothills between the Utukok and Kokolik Rivers, near Avingak Creek, and northwest of the confluence of Carbon Creek and the Utukok River (Lent 1964, Davis and Valkenburg 1978). This area is 150 to 600 m above sea level and consists of rolling hills and upland meadows. From the calving grounds the study area extends southward to the Brooks Range. The post-calving migration route is generally southwest from the calving grounds toward Mt. Kelly and across the Kokolik and Kukpowruk Rivers.

In order to determine the effect of grizzly bear predation on the WAH, it was necessary to learn the number of calves lost to all causes of natural mortality as well as the number of calves killed by grizzlies. The chronology of neonatal mortality was assessed by determining the number of calves:100 cows at the peak of calving, during the postcalving migration, during post-calving shift movements, and during fall migration. The chronology of calving and changes in calf:cow ratios were determined by observers from the ground in the core calving area and from the air in the core and peripheral calving areas. These observations were to continue until post-calving migration composition counts were made in conjunction with an aerial photo-direct count-extrapolation (APDCE) census (Davis et al. 1979). From observations of the proportion of cows with calves and cows without calves but with distended udders, an estimate can be made of: 1) the number of calves produced, 2) the number of calves surviving until post-calving migration, and 3) the number of calves which died between birth and post-calving migration.

Grizzly bear predation on calves was to be determined by several means, some of which were not successfully accomplished. The chronology of caribou calving and changes in calf numbers were determined by observers from the ground in the core calving area and from the air in the core and peripheral calving areas. These observations continued until the post-calving migration composition counts were made in conjunction with the APDCE census estimate. From observations of the proportion of cows with calves and cows with distended udders, an estimate was made of the number of calves produced, the number surviving until post-calving migration, and the number which died between birth and post-calving migration. An effort was made to determine the cause of death of all calves found by ground crews. Two bears which were observed on the calving grounds or killing caribou were to be fitted with radio transmitter collars and followed by a ground crew to determine the number and age of caribou which were killed or which were eaten as carrion. In addition, observers in aircraft were to locate all radio-collared bears in the calving grounds twice daily to determine the number of caribou carcasses which radio-collared bears of known sex and age consumed. Data obtained from the two bears followed on the ground were to be utilized as a control to determine the accuracy of data collected by aircraft observers. The amount of bear predation on caribou was to be estimated by relating the number of caribou killed by radio-collared bears to the number killed by all bears on the calving grounds. The effect of availability of caribou calves, as prey or carrion, on the productivity of bears was to be determined by comparing the productivity of females utilizing caribou to that of females for which caribou were not available.

The methodology was predicated on plans by the Alaska Department of Fish and Game (ADF&G) to conduct an APDCE caribou census of the Western Arctic Herd during summer 1979. This planned census was to enable both the census project and this project to share in the use of aircraft, cooperation which would have resulted in a longer period of availability of helicopter and light plane support. However, due to unexpected budget shortfalls on a Department-wide level, the APDCE census for the WAH was not conducted. This not only affected availability of aircraft but also resulted in a shortage of personnel during critical phases of the project. In addition, transmitters in almost half of the bear radio collars in the area failed prematurely, making it more difficult to locate bears in the vicinity of calving or migrating caribou. The end result of these complications was that even though data were collected and techniques evaluated, the study was not carried out as intensively as planned. Caribou composition counts and determination of cow:calf ratios were accomplished soon after the peak of calving. On the postcalving migration route, composition counts were made on an opportunistic basis since the field crew was observing bear/caribou interactions.

FINDINGS AND DISCUSSION

Although grizzlies are distributed throughout the study area, densities vary greatly from the Brooks Range north to the coastal plain (Reynolds 1978). The densities of bears in the mountains (elevation over 900 m) are approximately 1 grizzly/260 km²; in the high foothills (600-900 m), 1/130 km²; in the low (300-600 m) foothills and upland meadows, 1/50-130 km²; and on the coastal plain (0-300 m), 1/780 km².

The traditional calving grounds of the WAH encompass an extensive area on the edge of the coastal plain and low foothills. However, most calving takes place only in a portion of this area during any one year. So, depending on the specific location of the calving grounds in a particular year, caribou of the WAH may calve in areas of low grizzly bear density but could range into areas of moderate or even high bear density. In late June during the post-calving migration, caribou pass through the area of highest grizzly bear density in the study area; in early to mid-July during the post-calving shift they pass through areas of moderate and high bear density.

Movements of, or habitat use by, large aggregations of caribou in the study area can be broken down into four categories: spring migration to the calving grounds, calving, post-calving migration, and postcalving shift (Lent 1966, Skoog 1968). The direction and use of spring migration routes may vary depending on the areas used by caribou during winter. Although it may vary around a central area, the location of the traditional calving grounds probably does not change, and there is evidence that 1t has been used at least since the 1830's (Skoog 1968). The post-calving migration contains the largest aggregations of the WAH that form during any time of the year; this migration occurs along the same general route every year from the calving grounds in a southwesterly direction to the headwaters of the Kukpowruk and Kukpuk Rivers. The post-calving shift occurs from this area. During recent years most aggregations have turned east along the Brooks Range and northern foothills through the central and southern portions of the study area; however, in at least one year they traveled northeast along the Arctic Ocean coast (Davis and Valkenburg 1978).

The availability of caribou to grizzlies appears to be dependent more upon caribou calving in or moving through a bear's home range than on bears moving from home ranges to reach caribou concentrations. Of 34 bears for which home ranges were determined by radio telemetry, only two expanded their home ranges to reach caribou concentrations and these expansions were small. Generally, grizzlies did not move from their established seasonal ranges to reach calving or migrating caribou but instead moved to those portions of their ranges where caribou were available. As a result of this pattern, when caribou calve in areas of low grizzly density where few bears maintain home ranges, the amount of bear predation and scavenging is minimized. In years when caribou calve in the southern portions of the calving grounds, or when snow conditions result in caribou calving before they reach the calving grounds, the potential for contact with higher densities of grizzlies is increased and their vulnerability to predation is increased. After caribou leave the calving grounds in large aggregations they come in contact with higher densities of grizzly bears as they cross the foothills during post-calving migration. It is during this time that caribou of the WAH appear to be the most vulnerable to bear predation. In this early stage of the post-calving migration a few calves are still being born and cows which were debilitated by calving are still traveling with the aggregations. Lone cows or calves separated from and searching for each other probably have increased vulnerability to predation. And, although not confirmed by intensive study, it seems reasonable that the majority of cow-calf separations which occur after leaving the calving grounds would happen in the first week of post-calving migration.

During the post-calving shift they cross the study area in an easterly direction along the southern portion of the study area in the mountains and high foothills in early to mid-July. By this time, cows and calves are probably less vulnerable to predation; calves are better able to keep up with the migrating herd and cows have had a longer period to recover from any disabilities related to calving.

Although the interrelationships between movement and habitat use by WAH caribou, and movement and density of grizzly bears in the area have been established, data regarding the degree of use which grizzlies make of caribou as scavenged food or prey are incomplete and require further investigation. Some patterns of predation and scavenging behavior have emerged, but these should be viewed as tentative and contingent upon additional data collections.

Grizzlies fed on caribou in all portions of the study area from the calving grounds to the mountains; caribou were utilized both as carrion and prey. On the WAH calving grounds Lent (1964) observed grizzlies killing two calves and feeding on 10 others in the early 1960's. During the present study and related caribou studies (Reynolds 1978), grizzlies on the calving grounds were observed killing 1 calf in 1977, 7 calves in 1978, and none in 1979. These differences were due to several factors: in 1977 no effort was made to document grizzly bear/caribou interactions, but many caribou calved to the south prior to reaching the calving grounds; in 1978 calving aggregations used the low foothills where grizzly bear density was moderate; and in 1979 most calving caribou stayed north of the Utukok River where grizzly bear density was very low.

Along the post-calving migration route grizzlies were observed killing three calves in 1977; in 1978 no kills were observed but nine grizzlies were observed on carcasses. In 1979 observers watched grizzlies kill 3 calves and 1 adult female and feed on an additional 6 calves and 3 adults for which the causes of death were unknown. At least one of these calves was dead when found by bears, but the majority were probably killed by grizzlies.

During the post-calving shift and subsequent summer dispersal of WAH caribou in 1977 no bear/caribou interactions were observed; in 1978 grizzlies were observed feeding on the carcasses of seven yearling or adult caribou; in 1979 one bear was observed feeding on the carcass of an adult bull and a female grizzly and her offspring with fresh blood on their muzzles were seen among migrating caribou.

It appears that individual bears representing all sex and age classes of the population, prey on or scavenge caribou. During 1978 and 1979, 21 individuals were observed at caribou carcasses: 7 adult males, 2 subadult males, 4 solitary adult females, 4 females with offspring (each family group was counted as an individual), 2 subadult females, and 2 of unknown sex and age. Thus the proportion of bears of each sex and age class seen feeding on caribou carcasses was similar to their proportion in the population of this area (Reynolds 1978). However, even though it was established that bears of each sex and age class were

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active in predation or scavenging activities, the number of bears in each sex and age class and the proportion of the total population of bears regularly utilizing caribou were not determined. Some indications of these measures were observed in 1978: of 102 sightings of bears from 6 June to 3 July, the period when caribou are most available, a total of 9 observations (9%) were made of bears at caribou carcasses.

Some bears were more successful than others in killing caribou or locating and maintaining possession of carcasses. Most grizzlies were not seen on more than one carcass, but a female with yearling offspring killed four calves in 1977 and a different female with offspring was observed at two calf carcasses. Another female without offspring was seen at 3 carcasses in 1978 and an adult male was seen at 2 carcasses in 1978 and 7 in 1979. Although additional observations are needed, these data indicate that adult males are more successful in killing caribou or gaining possession of carcasses which other bears have killed or scavenged. This is a reasonable assumption since adult males are the largest and most aggressive members of bear populations (Hornocker 1962, Egbert and Stokes 1976). On the other hand, in 1979 at least one adult male which had actively sought caribou in 1978 was preoccupied with courtship and breeding activities when caribou were available during the post-calving migration and was not observed on any carcasses until the post-calving shift when caribou again passed through his home range.

The amount of time grizzlies spent at carcasses depended on the individual bear or family group and the size of the caribou. Some calves which were killed or found dead were consumed within 10 to 30 minutes. In 1977 a family group comprised of a female with three yearlings killed four calves within an hour on the calving grounds (J. Bryant, pers. comm.). Another female killed a calf shortly after she was darted from a helicopter, and before she was immobilized, carried the calf 0.8 km and ate almost one-fourth of it, all within a 10-minute period. Even though bears were capable of consuming calf carcasses rapidly, some bears laid down near the remains of calf carcasses (i.e. those portions which were not consumed--bone, hide, stomach, etc.) for an hour or more. On the other hand, bears stayed near the carcasses of yearling or adult caribou for much longer periods of time, often returning to a carcass after being absent from it for several days.

Grizzlies utilized several techniques to kill caribou. When caribou were in aggregations and resting or feeding, especially on the calving grounds, bears were observed "charging" these groups. The initial reaction of some groups was to run but then females and their calves which were separated from each other often milled around; during this confusion bears caught calves. Some bears used a variation of this method and simply chased moving bands of caribou. During unsuccessful charges bears would stop following these groups after running about 100 m, but some successful kills took place after chases of 0.5 to 0.8 km. The adult caribou which was observed killed was attacked in this manner; however, because caribou are usually able to easily outrun grizzlies, it is probable that this animal was debilitated by disease or injury. Grizzlies were also observed apparently locating calves by scent; whether these animals were injured, recently born, or different from other caribou in some way was not established.

Twelve bears, including a female with two yearlings and nine solitary bears, were attracted to a caribou crossing area west of the Kokolik River. River crossings probably increase the vulnerability of caribou to predation since cows and calves are often separated at river crossings; in addition, the physical stress caused by swimming the river may further weaken injured or infirm animals. During 1979 adult male no. 1082 was in this area between 15 and 21 June. On 16 June he traveled 13 km northwest to an area not used by migrating caribou but returned the next day. On 22 June he left the area and was with a breeding female the next day. During the time he was in the vicinity of the Kokolik River ford he was observed killing two calves and one adult and feeding on carcasses of at least three additional calves and one adult.

More data are needed before the extent of grizzly bear predation and scavenging behavior on WAH caribou can be estimated and the effects evaluated. The amount of calf mortality which occurs from all causes in the first 3 weeks after birth provides a measure of the availability of calves to the bear population but does not differentiate proportions attributable to bear predation. In 1979 the mortality rate of calves in the WAH during that period was estimated to be 35 percent or about 16,200 calves. If calves weigh an average of 5.9 kg (13 lb) at birth and gain about 450 g (1 lb) per day (Skoog 1968), a minimum total biomass of 95,000 kg (210,000 lb), including hide, bones and waste, was available to predators and/or scavengers in the area.

The effects of availability of caribou on the productive potential of the grizzly bear population in this area cannot be critically evaluated without additional data including rates of predation and scavenging for sexually mature females and survival rates for young-age bears. However, all measures of density and productivity in this study area where caribou are commonly utilized by grizzlies were higher than those same measures observed in the eastern Brooks Range in a study area of approximately the same size and at the same latitude (Reynolds 1978). The only other possible difference between the two areas was the "quality" of habitat; the western Brooks Range area contains more foothill habitat and the eastern Brooks Range area contains more foothill habitat. However, the effects of caribou availability were felt to far outweigh differences in habitat since vegetation availability does not appear to be a limiting factor (J. Hechtel, pers. comm.).

RECOMMENDATIONS

Investigations of the interrelationships between grizzlies and WAH caribou should continue. Future investigations should be carried out in conjunction with intensive study of WAH caribou; the chronology of calf mortality and post-calving migration movements and whether migration route use varies from year to year should be established.

Bear predation study emphasis should be on determining: 1) rates of predation for sexually mature females, 2) the proportions of the bear population which are actively involved in predation, 3) the proportions of caribou killed by bears and scavenged by bears, and 4) extent of predation during caribou post-calving shift movements.

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