

THE DENALI UNGULATE-PREDATOR SYSTEM

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ABSTRACT

During 1981-85, moose (*Alces alces*), caribou (*Rangifer tarandus*), wolf (*Canis lupus*), Dall sheep (*Ovis dalli*), and grizzly bear (*Ursus arctos*) numbers were evaluated within the entire range of the Denali caribou herd and within the expanded Denali National Park and Preserve, Alaska. Wolf numbers were about double in the 1930's when caribou populations were 10 times higher. Caribou populations in 1984 were about 2,600 and were recovering, but the population size was 20,000-30,000 in 1917-40. The decreased availability of caribou as prey for wolves was apparently reflected in a 27% decline in mean wolf pack size and a 40% decline in mean litter size that occurred after 1975. Moose increased dramatically in the western and central park from 1974 to 1984, but declined about 32% in the eastern. Caribou availability may have influenced moose status. Caribou have been more available as alternate prey since 1980 in the areas where moose increased but were unavailable in the eastern park where moose declined.

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In December of 1980, former Mt. McKinley National Park, Alaska, was redesignated Denali National Park and Preserve and its area was greatly expanded about three-fold in size (Fig. 1). A primary objective of the park's expansion was to include the entire annual range of the Denali caribou herd within the new boundaries. From 1981-85, populations of moose, Dall sheep, caribou, and wolves were aerially surveyed within the newly expanded boundaries by the authors. Grizzly bear densities were evaluated in a sample of park habitats in 1983 (Dean unpubl. data). The purpose of this paper is to report findings of the recent predator and ungulate surveys within the entire range of the Denali caribou herd and to report on trends within the Denali ungulate-predator system.

The eastern one-half of the pre-1980 Denali Park has been the focus of significant predator-ungulate studies in the past, particularly within the range of the Savage and Toklat wolf packs (Murie 1944; Haber 1977). The Toklat pack denned along the migration route of the Denali caribou herd and preyed extensively on caribou from May to September (Haber 1977). Caribou wintered elsewhere, however, and both packs preyed primarily on moose and Dall sheep in winter. Seasonal differences in numbers of caribou and year-round differences in numbers of moose apparently influenced pack structures. High availability of caribou prey in summer to the Toklat pack promoted production of two litters per year, but the absence of caribou in winter contributed to unstable winter pack organization and a larger home range than for the Savage pack (Haber 1977). Murie (1944) reported that wolf predation apparently held Dall sheep numbers in check in the eastern half of the pre-1980 Denali Park. Haber (1981) and Van Ballenberghe (in press)

suggested grizzly bears were a major predator of calf moose in the eastern end of Denali.

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DESCRIPTION OF STUDY AREA

Denali National Park and Preserve includes the Alaska Range, northern foothills of the Alaska Range, and, on its northern edge, a portion of the Tanana lowland (Heebner 1982). Average annual precipitation is 38 cm and average snowfall is 192 cm. Annual temperatures range from 32°C to -47°C. We confined our surveys to the 24,600 km² current useable range of the Denali caribou herd exclusive of the mountain massifs and glaciers of the main Alaska Range (Fig. 1).

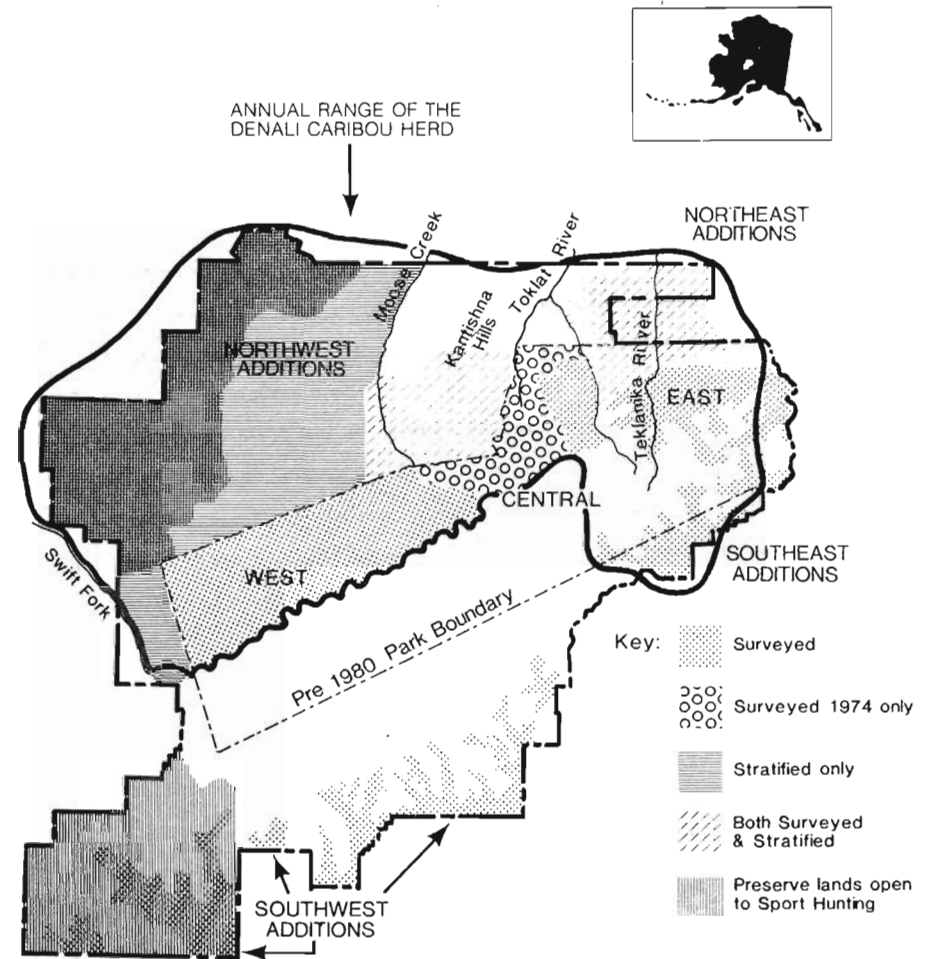


Figure 1
Map of Denali National Park and Preserve, Alaska and areas Surveyed and Stratified for moose, October 30-December 6, 1984. All moose except those in the southwest addition are in the year-round range of the Denali Caribou herd.

Glaser (1978) reported five major vegetation zones and their altitudinal limits as boreal forest--490 to 950 m; shrub tundra--600 to 1,100 m; Dryas heath--1,040 to 1,430 m; Dryas fell-field--1,430 to 1,520 m; and fell-field--1,520 to 1,980 m. For convenience we refer to the western, central, and eastern (east of and including the Teklanika River drainage) pre-1980 or old park areas, and the northeast, northwest, Kantishna Hills, southwest and southeast additions (Fig. 1).

METHODS

Moose Trend Areas

We repeat-counted 14 trend areas aerielly surveyed by Troyer (1974, unpubl. rept., Natl. Park Serv., Anchorage), in the east, central, and western portions of the park and counted another 6 new trend areas in the northeast, Kantishna Hills, and southern park additions (see Fig. 1). Troyer's (unpubl. data) trend areas east of the Teklanika River were modified to better fit watershed boundaries and to more closely approximate the range of the Savage wolf pack as it existed in 1968-73 (Haber 1977).

Each trend area was subdivided into approximately 20 km² blocks for counting purposes. Survey methods followed Gasaway et al. (1985). We approximated a search intensity of 4.5-6.0 minutes per 2.5 km². Distance between straight transects in level areas or contoured transects in the mountains was approximately 0.4 km.

All counting blocks were first assigned to low, medium, or high density categories based upon a rapid stratification flight that noted moose tracks and sign and relative moose abundance (Gasaway et al. 1985). All moose habitat in each major area was surveyed, except in the Kantishna Hills and northeast additions where only 48% each of the counting blocks were surveyed. The relatively low-density numbers of moose in the remaining blocks were estimated from moose numbers in nearby blocks with similar habitat and moose sign, as determined by the stratification flights. The northwest area was stratified only and moose numbers were estimated from stratification and sightability corrections from other similar areas in interior Alaska (DuBois 1985, unpubl. data, AK Dept. Fish and Game, Fairbanks).

Wolf Surveys

Historical wolf information came from park records of wolf and track sightings made primarily during foot and dogsled patrols (Singer in prep.) and from Haber's (1977) work from 1966-74. During 1967, 1968 (R. Prasil unpubl. data), and 1984 the entire park/preserves areas north of the Alaska Range was aerielly surveyed for wolf tracks after fresh snows using the technique of Stephenson (1975). Survey required 5-9 days and flights were made 1-11 days after fresh snow.

Caribou Surveys

Early counts of the caribou herd were made by A. Murie from the

ground along the migration corridor, 1939-67 (Singer 1985). Counts from Super Cub of the post-calving herd (Ju. 1-15) were made in 1972 (Trent 1972), 1974 (S. Buskirk, field notes, Denali Natl. Park), 1975-80 (W. Troyer 1981, unpubl. rept., Natl. Park Serv., Anchorage. 18 pp), and 1981-83 (Duff and Singer 1982; J. Van Horn 1983, unpubl. rept., Denali Natl. Park). During 1984, the herd was counted post-calving (May 31 - Jun. 3) and during the rut (Sept. 26-28) by three observers in a Jet Ranger II helicopter.

RESULTS

Moose Numbers and Trends

Aerial survey time October 31-December 6, 1984, totalled 121 hours. A total of 1,672 moose was actually counted in 18 trend areas and 120 counting blocks, and another 643 moose were estimated in 10 remaining uncounted blocks. There were a minimum of 1,731 moose within the annual range of the Denali caribou herds; 1,585 north of the Alaska Range, and 146 south of the Alaska Range.

Between 1974 and 1984, moose numbers declined in the eastern park, and increased in the central and western park (Table 1). Calf and yearling ratios paralleled the apparent increases and were higher in 1984 in the central and western park (Table 2). Moose densities (0.2-0.5 moose/km²) were moderately low when compared to many areas of



Table 1. Trends in numbers of moose counted in 4 major regions of Denali National Park where prior count data was available. Data for 1968-73 is from Haber (1977) and 1974-78 is from Troyer (unpubl. data). Survey time is in minutes where it was recorded.

	WEST END OF PARK		CENTRAL PARK		EASTERN END OF PARK	
	Unit 10	Unit 11	Unit 10	Unit 11	Unit 10	Unit 11
	SURVEY TIME	NO. OF MOOSE	SURVEY TIME	NO. OF MOOSE	SURVEY TIME	NO. OF MOOSE
1974	725	135	225	32	200	45
1984	552	225	226	53	116	54
% Change	-24	+90	+0.4	+66	-42	+20
SOUTHEAST						
	Windy Creek	NO. OF MOOSE	Troyer's Units 12-17	Haber's Savage Pack Range	SURVEY TIME	NO. OF MOOSE
1970	1/	58				
1968-1973(x̄)	70	78			697	334
1974			845	276		
1975-1978(x̄)				277		
1976				415		
1984	55	87	1,007	281	1,153	335
% Difference with 1974:	-35	+12	+19	+2	+65	+0.2
% Difference with 1976:						-32

1/ Survey time not recorded.

Table 2. Sex and age ratios of moose in Denali National Park and Preserve. Data is from surveys by the authors, Troyer (1974), and Haber (1977).

	East		Central			East	
	1974	1984	1973	1974	1984	1974	1984
Calves/100♀	46	33	28	38	51	34	15
Yearlings/100♀	8	50	8	4	22	24	6
Adult Bulls/100♀	129	106	1/	32	49	25	33
Moose/km ²		0.8			0.6		1.3
Sample Size	134	190	206	143	127	1,516	281

1/ No data.

nearby interior Alaska (Gasaway et al. 1983). The 1984 surveys were about 77% efficient based upon sightability recounts of count units following the technique of Gasaway et al. (1985). No sightability checks were made during the 1970's surveys. Survey times varied considerably between surveys. Differences in survey time strengthened our conclusion of a moose increase in the western park since Troyer (unpubl. data) spent 24% more time there, and also our conclusion regarding a moose decline in the range of the Savage pack since we observed the same number of moose as Haber (1977) but we spent 65% more time (Table 1).

Caribou Numbers and Trends

The Denali caribou herd numbered about 20,000-30,000 animals from 1917-41 (Murie 1935; Murie 1944; Singer in prep.). From 1942-47, the herd declined to 4,000-5,000, then increased and ranged between 5,000-8,000 animals from 1948-62 (Singer in prep.). A second decline occurred from 1962-68, likely exacerbated by severe winters 1964-66 associated with low calf crops, to a population low of 1,200-1,500 (Singer in prep.). Caribou numbers remained low until 1980. From 1981-84, the caribou herd increased about 60%. Calf and yearling ratios were higher. In 1984, 2,134 caribou were counted and the herd was estimated at 2,600.

Dall Sheep Numbers

Methodology differences hinder the interpretation of trends in Dall sheep numbers. In 1984, a helicopter count of 2,134 sheep was made. Super Cub counts from 1966-77 ranged from 500-1,100 but shorter survey times and turbulence suggest these counts were incomplete. Population increases to 1984 are possible since Dall sheep increased in many parts of Alaska since 1977 (Singer 1984). Murie (1944) reported Dall sheep numbered at least 5,000 in 1928, but by 1945 had decreased to 500. Murie (1946) concluded that wolves accelerated the decline that was initiated by severe winters.

Wolves

Wolves have undergone several major fluctuations in Denali. From the park's initial designation in 1917 to 1927 wolves were extremely scarce (Dixon 1938; Murie 1944). Annual reports of the Superintendent indicated an increase in wolf sightings in 1928 and 1929, and by the mid-1930's wolves reached a high of about 140-150 for the range of the Denali caribou herd (Frank Glaser, memo to Frank DuFresne, Regional Director, U.S. Fish and Wildlife Serv., Anchorage, Aug. 16, 1940).

Limited shooting and trapping of wolves was conducted by park staff from 1929-51. During the 23-year period 88 wolves were taken. Control efforts intensified from 1943-46, in response to the decline in the Dall sheep population and fears that it was accelerated by wolves (Murie 1946).

Wolves declined to an all-time low by 1947, apparently in response to declining sheep and caribou numbers and due to the park's control efforts, legal harvest of at least 35 wolves just north of the park's boundaries 1942-46 (Singer in press). As few as 24 wolves were estimated by the Park Superintendent from the pre-1980 Denali park boundaries in 1947.

Wolves slowly increased to the 1967-74 period. Haber (1977) observed high pup production in both the Savage and Toklat packs during this period, and early winter pack sizes averaged 14 for the Savage and 18 for the Toklat packs. From 1975-85, however, winter pack sizes in Denali declined 27%, while wolf litters observed at dens declined 40% (Table 3). The large Savage pack observed by Haber (1977) declined after 1974 (Van Ballenberghe in press) and no denning was observed in their range during 1982-84. Caribou numbers were only 5-10% of the 1930's levels during the last low in wolf populations (Table 3). In addition, poaching of wolves by shooting them from fixed-wing aircraft accounted for at least 11 wolves in the 1984-85 winter. The discovery of evidence of a poached wolf is highly opportunistic and the levels of poaching, or any influence on the park's wolf population is conjectural. A total of 75-80 wolves or their fresh tracks were observed during the

Table 3. Mid-winter pack sizes and litter sizes of pups at dens for wolves in Denali National Park, Alaska.

Wolf Status	Year	Caribou Herd	Winter Pack Size n	Winter Pack Size \bar{x}	Winter Pack Size S.D.	Litter Size n	Litter Size \bar{x}	Litter Size S.D.
Recovering	1927-29	30,000	7	4.6	2.5			
High	1930-42	25,000	34	7.4	4.5	17	5.2	2.4
Lowest	1943-47	10,000 to 5,000	12	4.1	2.2			
Moderate	1966-74	8,000 to 1,200	264	7.5	0.9	17	6.2	2.3
Low	1975-85	1,200 to 2,400	24	5.3	3.1	18	3.7	1.5

1985 winter wolf survey, or only about one-half of the wolves present in the 1930's.

Grizzly Bears

Grizzly bear densities in the eastern and central park were estimated at 32 bears/1,000 km² using ground observations of recognizable individuals (Dean 1976). Densities were similar (38 bears/1,000 km²) when estimated by aerial surveys in 1983 (F.C. Dean unpubl. data). Grizzly densities are high for interior Alaska (Miller and Ballard 1982).

DISCUSSION

Ungulate and Predator Trends

Moose population trends varied throughout the park. The availability of caribou may have influenced the status of moose. Since about 1974, the Denali caribou herd has shifted its distribution to the west making caribou almost totally unavailable within the range of the Savage wolf pack, for example (Singer in press). Caribou were less available everywhere by 1969 after their second decline, but since 1980 when caribou increased, caribou likely have become more available to wolves and grizzlies in the central and western park where moose increased. Perhaps large predators switched to the more abundant

caribou.

Moose declined and calf crops were low in the eastern park, 1975-84, even though the Savage wolf pack declined during that same period. During 1966-73, Haber (1977) reported 17-26 moose:1 wolf in this area and fall calf crops averaged 32 calves:100 cows. By 1982-84, there were 28-47 moose:1 wolf, but fall calf crops averaged only 15-18 calves:100 cows (Troyer 1979, Table 2). Grizzlies numbered about 38 bears/1,000 km² or 8 moose:1 bear (Dean 1976, unpubl. data). Haber (1981) and Van Ballenberghe (in press) attribute the lowered moose recruitment largely to bear predation. Initial calf production was high (125 calves:100 cows) in early June both prior to 1974 (Haber 1977) and in the 1980's (Van Ballenberghe in press). Van Ballenberghe (in press) attributed increased bear predation on moose calves to either a shift in the moose:bear ratio resulting from declining moose or to increased predation efficiency by bears. Haber (1981) suspected grizzlies kill more moose calves when wolf densities and particularly large dominant wolf packs decline.

Naturally regulated numbers of large predators, especially wolves, were suspected of suppressing the denali caribou herd and being responsible for low calf crops in the late 1970's (Gasaway et al. 1983). However, the Denali caribou herd increased about 60% from 1980-84, and in the typical spring of 1984, 45% of radio-monitored calves survived their first year of life (Singer et al. in prep.). Wolf densities in Denali are low (1 wolf per 194 km²) as are ungulate:wolf ratios (86 ungulates:1 wolf). Wolf packs are territorial and do not concentrate on either caribou winter or calving areas (Murie 1944; Haber 1977; Singer

et al. in prep.). Therefore, wolves were apparently unable to slow the growth of the caribou herd and most packs were unable to effectively use the migratory caribou as prey.

Factors Affecting Current Wolf Status

Human-Caused Mortality

Poaching of wolves from aircraft in Denali may have affected pack structure and behavior and possibly influenced total number of wolves. In early 1985, at least 9 of 75 (12%) wolves were taken. Wolves, however, can compensate for annual losses of up to 30% in age class 5 months or older if food is abundant (Keith 1983:75). The Savage pack recovered rapidly to 20 individuals in 1971-72, two years after the pack was reduced to only 6 with only 2 adults present (Haber 1977). The levels of poaching of wolves nor its effect on the wolf population cannot be assessed from the available data.

Reduced Caribou Availability

Lower wolf numbers, 1975-85, may be due to decreased availability of caribou as prey for most of the park's packs. Haber (1977) observed that caribou were easier for wolves to kill; the success rate for wolves hunting caribou, sheep, and moose was 59, 30, and 11. Although caribou reached low numbers by 1969 after their second decline, the wolf decline may have been delayed in time. Smaller wolf pack sizes observed since 1975 could also have been caused by man-caused mortality; however, the



decline in pup litter sizes was more likely related to a decreased food supply (Pimlott et al. 1969; Harrington et al. 1983).

The following changes in numbers and distribution of caribou likely influenced wolf status:

- (1) Caribou declined by 1969 to only 5% of former peak numbers.
- (2) Caribou used only 1-2 winter ranges per year after the decline instead of 3-5 (Singer in press).
- (3) Fewer caribou migrated through or wintered within the range of the Savage wolf pack (Singer in press).
- (4) Caribou wintered in abundance in the northwest additions from at least 1943-63, but since 1963 they have wintered in the western park and northeast additions.

As a consequence of these changes, caribou have been available year round since 1975 to only the wolf packs in western Denali park. Caribou are still available to packs such as the Toklat pack which are located on the caribou migration routes. Many packs such as the Savage pack must have switched to moose and where they are available, to Dall sheep. The respective status of moose in various sectors of the park may have been influenced by declining, or in the case of the western park since 1980, by the increasing availability of caribou to large predators. Denali wolves have been observed to inhabit fixed territories, and they did not concentrate on either caribou winter or calving areas (Murie 1944; Haber 1977; Singer et al. in prep.). As a result, caribou are present in the home ranges of most wolf packs for only brief periods of

time and are not efficiently used as a prey base.

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