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JUNEAU, ALASKA

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UNIT 13 WOLF STUDIES

By

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Volume II

Project Progress Report
Federal Aid in Wildlife Restoration
Project, W-17-9 and W-17-10, Jobs 14.8R, 14.9R and 14.10R

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JOB PROGRESS REPORT (RESEARCH)

State: Alaska

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Project Nos.: W-17-9 & W-17-10 Project Title: Big Game Investigations

Job No.: 14.8R Job Title: Wolf Populations and
Movements in Relation
to Those of Prey Species

Job No.: 14.9R Job Title: Wolf Food Habits

Job No.: 14.10R Job Title: Impact of Wolf Predation
Upon Ungulate Populations

Period Covered: July 1, 1976 to June 30, 1978

SUMMARY

Between 1 July 1976 and 30 June 1978 a total of 44 individual timber wolves representing 14 different wolf packs were radio-collared in Game Management Unit 13 of Southcentral Alaska. During this reporting period radio-collared wolves representing 16 packs were located on 1,225 occasions and were observed on 884 occasions. The observations represented 617 wolf pack days.

Hair trace element and blood values collected from both radio-collared and harvested wolves were presented. Capture techniques and associated problems and costs were discussed. Histories of individual radio-collared animals are described.

Radio-collared wolf packs were observed on 130 prey kills. Moose of all age classes comprised 75 percent of the kills observed. Adult moose were the most prominent age classes taken, accounting for 45 percent of the total, while calf moose accounted for 22 percent of the total kills. Analysis of prey species taken from April through July revealed a preponderance of moose 11 to 14 months of age, suggesting that these age classes were vulnerable to wolf predation.

Eight wolf packs averaged a kill every 4.5 days with a range of 3.2 to 10.9 days per kill. Differences between packs are briefly described. Summer predation rates for the Mendeltna and Hogan Hill wolf packs ranged from a kill every 3.0 to 4.6 days.

Territory sizes for 10 study packs ranged from 253 to 674 mi². The most intensively studied packs had an average territory of 427 mi². Territory sizes appeared to increase for both larger packs and for those packs in areas of low moose density.

Wolf densities during the study period ranged from one wolf per 38 mi² in fall 1975 to one wolf per 112 mi² in spring 1978. Wolf numbers in GMU 13 have decreased since 1975. It was estimated that as many as 40 to 50 wolf packs inhabit the Unit. Hunting, trapping, and dispersal were identified as the main reasons for declines in numbers within study packs.

The effects of wolf predation on moose calf survival were studied in two areas of GMU 13. In one area, referred to as the Susitna River Study Area, wolf densities were lowered by Department personnel. In the other area of GMU 13 wolves were intensively studied to enumerate population densities and food habits.

During the reporting period a total of 30 wolves were removed from the Susitna River Study area in an effort to measure changes in moose calf survival. Total wolves removed during the entire study since winter 1976 numbered 59. Wolf densities within the Susitna study area were estimated at one wolf per 98 mi² of habitat in spring 1975 to one wolf per 232 mi² of habitat in spring 1978. Fall moose sex and age composition count data were compared to other areas in Unit 13 and Mt. McKinley National Park. Our evaluation of these statistics indicated that there have not been significant increases in calf survival as a result of wolf removal, at least not detectable by the techniques employed. Results of wolf food habit and moose calf mortality studies indicated that the rates of predation on calves by wolves were far less than by brown bears. This tended to explain the lack of response in calf:cow ratios after the reduction of wolf densities.

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BACKGROUND

Rausch (1969) summarized the status of wolves (*Canis lupus*) in the Nelchina Basin (Game Management Unit 13) for the period 1957 through 1968. From 1948 to 1953 extensive poisoning by the Federal Government reduced populations of predators to low levels. In 1953 only 12 wolves were believed to remain in the Nelchina Basin. Rausch believed the wolf population gradually increased after 1953 and reached a peak of 400 to 450 in 1965. Although no formal wolf studies were conducted from 1969 through 1974, McIlroy (1976) speculated that a second peak occurred in 1970 after a low of 300 animals in 1968.

Rausch (1969), Bishop and Rausch (1975), and McIlroy (1974) have described the history of the Game Management Unit 13 moose (*Alces alces*) population. All pointed to an apparent inverse relationship between numbers of predators and numbers of ungulates. Moose apparently began declining after the severe winter of 1961-62. This decline continued with severe winters occurring in 1965-66 and 1971-72. Fall calf:cow ratios declined sharply and reached a record low for the Basin in 1975. Although wolf predation was not suggested as the main reason for the population decline, it was thought to have at least amplified the decline and, more importantly, prevented recovery during mild winters (Rausch et al. 1975). This concern coupled with the findings of Stephenson and Johnson (1972, 1973), which revealed a high percentage of calf moose in wolf scats, suggested that wolf predation on calves was preventing the moose population from increasing. Consequently a series of studies were initiated to obtain information on wolf-moose relationships in the

Nelchina Basin. Results of the first year of the study were presented by Stephenson (1978).

OBJECTIVES

To delineate wolf pack territories and determine wolf densities in an experimental area and a control area in Unit 13.

To compare seasonal wolf movements to seasonal movements and abundance of major prey species and environmental parameters.

To assess wolf food habits in the experimental and control areas of Unit 13.

To quantitatively assess the impact of wolf predation upon ungulate populations in Unit 13.

PROCEDURES

Wolves were studied in two different portions of Game Management Unit 13. In the Susitna River Study Area (Fig. 1) wolves were experimentally reduced with the aid of both helicopter and fixed-wing aircraft to assess the effects of wolf predation on moose calf survival (Stephenson 1978). Moose calf survival there was to be compared to survival in the Nelchina Study Area, where wolf numbers had not been reduced.

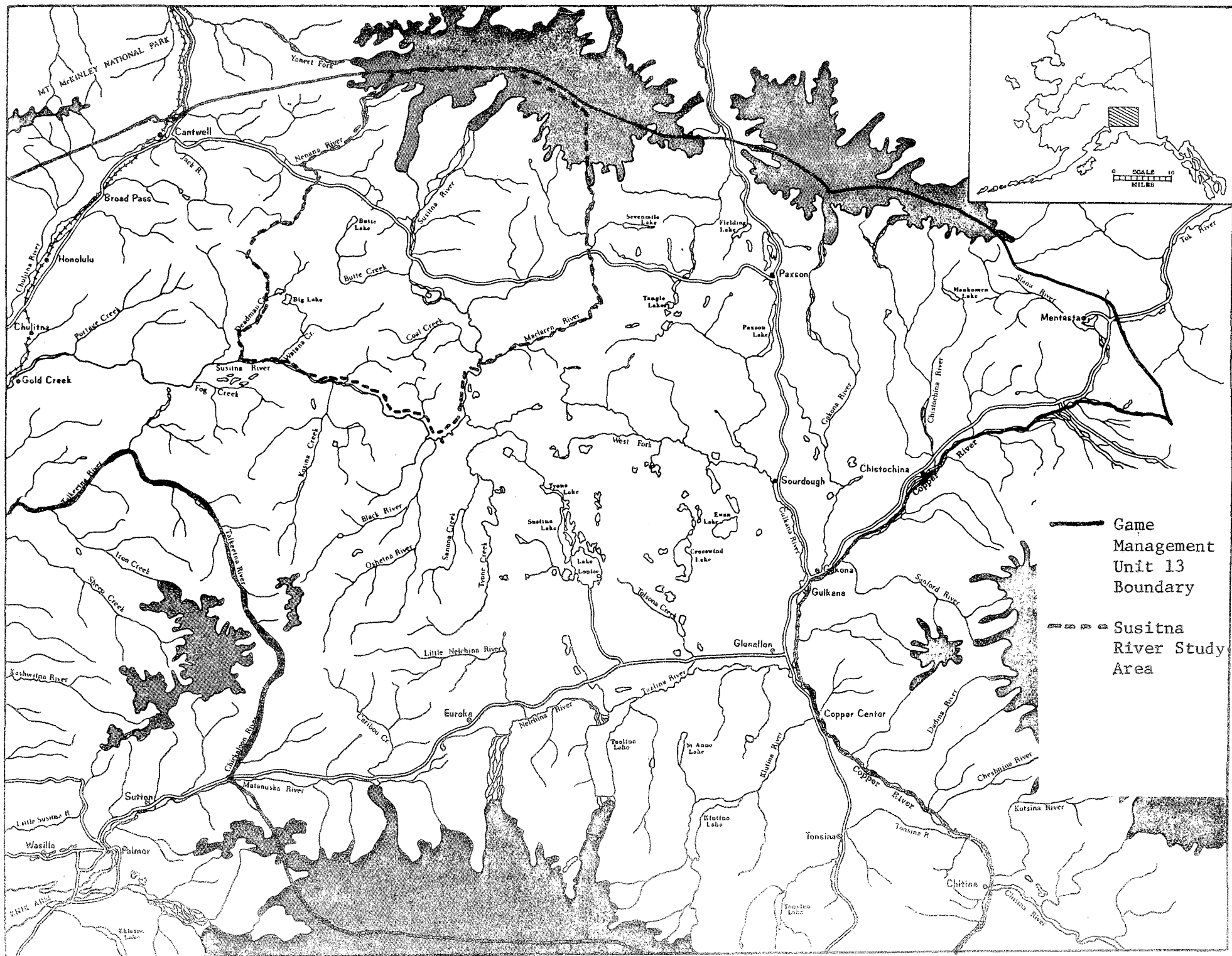
Game Management Unit 13, an area of approximately 23,782 mi², has 7,258 mi² over 4,000 foot elevation. Detailed descriptions of its vegetation, climate and geography were provided by Skoog (1968).

The Sustina River Study Area is located in the northern portion of the Unit (Fig. 1). Its boundaries are as follows: the Alaska Range on the north; the Maclaren River on the east; the Maclaren and Susitna Rivers on the south; the confluence of Deadman Creek with the Susitna River northward to headwaters of Brushkana Creek, downstream to Brushkana Creek's confluence with the Nenana River and then northwest upstream to the Alaska range on the west. The Nelchina Study Area generally comprised those portions of Game Management Unit 13 lying east and south of the Susitna River Study Area.

Wolves were captured for radio-telemetry studies with a Cap-Chur gun and dart (Palmer Chemical Co.) fired from a Jet Ranger 206B helicopter using methods similar to those described by Baer et al. (1978). Our capture technique differed from theirs in that we darted in all types of vegetative cover and while the animal was moving. Captured wolves were equipped initially with an adjustable machine belt radio collar manufactured by AVM Instrument Company (Champaign, IL.) and later with an adjustable collar made of fiberglass and urethane manufactured by Telonics (Mesa, AZ.).

Hair and blood samples were taken from each wolf using methods similar to those described for calf moose (Ballard et al. in press). All hair samples were sent to Dr. Arthur Flynn, Case Western Reserve University, Cleveland, Ohio, for mineral element analysis. When practical, the following body measurements were recorded: weight, total length, heart girth, chest height, neck circumference, shoulder height and tail length.

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We used a portable radiotelemetry receiver manufactured by AVM Instrument Company. The receiver contained four bands with 12 channels per band and covered frequencies in the 150.000 to 152.000 Mhz range.

Radio-collared wolves were tracked and, when possible, visually observed from fixed-wing aircraft using the methods described by Mech (1974). Monitoring intensity varied from pack to pack but consisted of at least bi-monthly monitoring during winter months.

Approximate ages of captured wolves were determined on the basis of tooth eruption and wear. Estimates of the ages of wild wolves were based upon their relative size and by criteria described by Jordon et al. (cited by Mech 1970). In some cases, the age and sex structures of certain packs were not ascertained until the animals had been killed by hunters and trappers. We encouraged hunters and trappers to provide us with wolf carcasses taken in Units 11 and 13 by offering \$10.00 per carcass. Ages of harvested wolves were determined by examining epiphyseal cartilage of the longbone according to methods described by Rausch (1967).

Sex and ages of prey, particularly moose and caribou (*Rangifer tarandus*) killed by wolves were often determined from fixed-wing aircraft according to combinations of size, pelage and antler growth. Moose kills were categorized as: calves, yearlings and adults. For discussion purposes, both calves and yearlings were aged to the nearest month using an assumed birthdate of 24 May (Ballard and Taylor 1978a).

Extent of wolf territories was determined by plotting all radio locations for individual packs and then connecting the outermost observations. Locations for individual radio-collared wolves which had dispersed were not included. Sizes of wolf territories and study areas were determined with a compensating polar planimeter.

When practical wolf kills were examined on the ground. We determined the cause of death according to methods described by Stephenson and Johnson (1973) and Ballard and Taylor (1978a). A femur or metatarsal was collected from each kill, to aid in establishing the animals' physical condition on the basis of percent marrow fat using methods described by Neiland (1970). Ages of moose kills were determined on the basis of tooth eruption and cementum annuli, using methods described by Sargeant and Pimlott (1959). Caribou were aged on the basis of tooth eruption and wear (Skoog 1968).

RESULTS AND DISCUSSION

A total of 44 individual wolves were radio-collared in GMU 13 from July 1976 through June 1978 (Table 1). This total included five wolves originally radio-collared by Stephenson (1978) which were recollared at least once during this period. Including Stephenson's 31 wolves, a total of 70 individual wolves have been radio-collared in GMU 13 since April 1975. Initially, we used a drug dosage of 0.7 ml, 100 mg/cc drug mixture of phencyclidine hydrochloride (Sernylan, Parke-Davis Co.) with 1.0 ml, 100 mg/cc drug mixture of promazine hydrochloride (sparine, Wyeth Laboratories) but later increased the dosage of Sernylan to 1.0 ml,

Table 1. Summary of statistics associated with wolf radio-collaring activities in GNM-13 of Southcentral Alaska from July 1976 through June 1978.

Pack Affiliation	Accession Number	Date Radio-collared	Age	Sex	Weight	Drug Dosage (ml)	# of Hits	Location of Hit	Drug Reaction Time	Mobility State	Habitat Type	Approximate Cost per Animal ¹ / ₁
Mendeltna	122007	10/29/76	Adult	♀	72 lbs	0.7 Sernylan- 1.0 Sparine	2	Left rear leg	?	Fully Tranquilized	Moderate Spruce	\$414
Mendeltna	122008	10/29/76	Pup	♂	54 lbs	0.7 Sernylan- 1.0 Sparine	1	?	<15 min.	Fully Tranquilized	Moderate Spruce	\$414
		04/27/77		♂	92 lbs	1.0 Sernylan- 1.0 Sparine	1	Behind shoulder	15 min.	Moderate Tranquilized	Sparse Spruce	
Deep Lake	122009	10/29/76	Adult	♀	86 lbs	0.7 Sernylan- 1.0 Sparine	1	Behind left shoulder	?	Moderate Tranquilized	Dense Spruce	\$414
		11/13/77	Adult		90 lbs	1.0 Sernylan- 1.0 Sparine	1	Upper left rear quarter	10 min.	(Heavy convulsion) Fully Tranquilized	Dense Spruce	
Keg Creek	122010	10/29/76	Pup	♀	54 lbs	0.7 Sernylan- 1.0 Sparine	1	?	?	(Minor convulsion) Fully Tranquilized	Dense Spruce	\$414
Keg Creek	122011	10/29/76	Pup	♂	52 lbs	0.7 Sernylan- 1.0 Sparine	2	?	?	Fully Tranquilized	Dense Spruce	\$414
Sinona	122048	03/14/77	Adult	♂	-	0.7 Sernylan- 1.0 Sparine	1	Left front shoulder	10 min.	Fully Tranquilized	Dense Spruce	\$627
		10/11/77		-		1.0 Sernylan- 1.0 Sparine	1	?	6 min.	Fully Tranquilized	Dense Spruce	-
Sinona	122049	03/14/77	Adult	♂	-	1.0 Sernylan- 1.0 Sparine	1	Left thoracic cavity	?	Fully Tranquilized	Dense Spruce	\$627
Tsusena	122056	03/19/77	Adult	♂	92 lbs	0.7 Sernylan- 1.0 Sparine	1	?	?	Fully Tranquilized	Open Tundra	\$714
Tsusena	122057	03/19/77	Pup	♀	72 lbs	0.7 Sernylan- 1.0 Sparine	1	?	?	Fully Tranquilized	Open Tundra	\$714
Middle Fork	122061	03/21/77	Pup	♂	68 lbs	1.0 Sernylan- 1.0 Sparine	1	?	<15 min.	Fully Tranquilized	Moderate Spruce	\$436
Middle Fork	122062	03/21/77	Adult	♀	-	1.0 Sernylan- 1.0 Sparine	2	Left thoracic cavity	?	Poorly Tranquilized	Moderate Spruce	\$436
Delta	122063	03/21/77	Adult	♀	72 lbs	1.0 Sernylan- 1.0 Sparine	2	?	?	Fully Tranquilized	Open Tundra	\$436
Delta	122064	03/21/77	Adult	♂	104 lbs	1.0 Sernylan- 1.0 Sparine	2	?	?	Fully Tranquilized	Open Tundra	\$436
Mendeltna	122083	04/27/77	Adult	♂	96 lbs	1.0 Sernylan- 1.0 Sparine	1	Left rear leg	7 min.	Fully Tranquilized	Sparse Spruce	\$266
Sinona	122084	04/28/77	Adult	♀	112 lbs	1.0 Sernylan- 1.0 Sparine	1	Top of body cavity	11 min.	Fully Tranquilized	Dense Spruce	\$504
		11/10/77			102 lbs	1.0 Sernylan- 1.0 Sparine	2	?	25 min.	Fully Tranquilized	Dense Spruce	-
Middle Fork	122085	04/28/77	Pup	♀	82 lbs	1.0 Sernylan- 1.0 Sparine	1	Base of skull	6 min.	Fully Tranquilized	Open Tundra	\$504
		11/10/77			78 lbs	1.0 Sernylan- 1.0 Sparine	1	?	6 min.	(Minor convulsion) Fully Tranquilized	Sparse Spruce	
St. Anne's	122086	04/28/77	Pup	♂	91 lbs	1.0 Sernylan- 1.0 Sparine	2	Behind and above shoulder	24 min.	Slightly Tranquilized	Dense Spruce	\$634
St. Anne's	122087	04/28/77	Pup	♂	82 lbs	1.0 Sernylan- 1.0 Sparine	1	Above abdomen	6 min.	Moderately Tranquilized	Dense Spruce	\$634
St. Anne's	122088	04/28/77	Adult	♂	100 lbs	1.0 Sernylan- 1.0 Sparine	1	Above and behind shoulder	8 min.	Fully Tranquilized	Dense Spruce	\$634

Mendeltna	122090	10/13/77	Pup	♂	50 lbs	1.0 Sernylan- 1.0 Sparine (dart glanced off) 1.0 Sernylan- 1.0 Sparine (dart glanced off- partial dose) 0.3 Sernylan- 1.0 Sparine	3	Rump	<20 min.	Slightly Tranquilized	Moderate Spruce	\$478
St. Anne's	122093	10/11/77	Adult	♂	88 lbs	1.0 Sernylan- 1.0 Sparine	1	Top of back	7 min.	Fully Tranquilized	Dense Spruce	\$478
St. Anne's	122094	10/12/77	Adult	♀	72 lbs	1.0 Sernylan- 1.0 Sparine 1.0 Sernylan- 1.0 Sparine	2	Nose, top left shoulder	20 min.	Fully Tranquilized	Dense Spruce	\$478
Mendeltna	122095	10/13/77	Adult	♀	86 lbs	0.5 Sernylan- 0.5 Sparine 0.5 Sernylan- 0.5 Sparine	3	?	40 min.	Slightly Tranquilized	Moderate Spruce	\$478
Deep Lake	122096	11/13/77	Adult	♂	110 lbs	1.0 Sernylan- 1.0 Sparine	1	Left shoulder	8 min.	Fully Tranquilized	Sparse Spruce	\$626
		01/05/78			-	1.0 Sernylan- 1.0 Sparine	1	Thoracic cavity	<10 min.	Fully Tranquilized	Dense Spruce	\$325
Tyone	122097	11/15/77	Adult	♂	112 lbs	1.0 Sernylan- 1.0 Sparine	1	?	10 min.	Fully Tranquilized	Open Tundra	\$626
Tyone	122098	11/15/77	Pup	♂	92 lbs	1.0 Sernylan- 1.0 Sparine	1	Upper thoracic cavity	8 min.	Fully Tranquilized	Open Tundra	\$626
Tyone	122099	11/15/77	Adult	♂	112 lbs	1.0 Sernylan- 1.0 Sparine	2	?	10 min.	Fully Tranquilized	Open Tundra	\$626
Tyone	122115	02/10/78	Adult	♀	92 lbs	1.0 Sernylan- 1.0 Sparine	1	?	4 min.	Fully Tranquilized	Open Tundra	-
Tyone	122116	02/10/78	Adult	♀	112 lbs	1.0 Sernylan- 1.0 Sparine	1	?	14 min.	Fully Tranquilized	Open Tundra	-
Tyone	122117	02/10/78	Adult	♂	106 lbs	1.0 Sernylan- 1.0 Sparine	2	?	3 min.	(minor convulsion) Heavily Tranquilized	Open Tundra	-
St. Anne's	122118	02/10/78	Adult	♂	92 lbs	1.0 Sernylan- 1.0 Sparine	1	?	12 min.	Fully Tranquilized	Dense Spruce	-
Ewan	122151	03/16/78	Pup	♀	65 lbs	0.7 Sernylan- 1.0 Sparine	2	Rump	?	Fully Tranquilized	N/A	\$400
Watana	122197	03/20/78	Adult	♂	-	1.0 Sernylan- 1.0 Sparine	1	?	9 min.	Fully Tranquilized	Dense Spruce	-
Jay Creek	122199	03/23/78	Adult	♀	-	1.0 Sernylan- 1.0 Sparine	1	?	?	Fully Tranquilized	Open Tundra	-
Keg Creek	122201	04/08/78	Adult	♀	96 lbs	1.0 Sernylan- 1.0 Sparine	1	Left upper thoracic	?	Fully Tranquilized	Dense Spruce	\$771
Hogan Hill	122202	04/08/78	Adult	♂	108 lbs	1.0 Sernylan- 1.0 Sparine	1	?	?	Fully Tranquilized	Dense Spruce	\$771
Keg Creek	122203	04/09/78	Adult	♂	104 lbs	1.0 Sernylan- 1.0 Sparine	1	Head	?	Fully Tranquilized	Dense Spruce	\$771
Deep Lake	122204	04/10/78	Pup	♂	99 lbs	1.0 Sernylan- 1.0 Sparine	1	Left upper thoracic	10 min.	Fully Tranquilized	Sparse Spruce	\$771
Hogan Hill	122205	04/09/78	Pup	♂	82 lbs	1.0 Sernylan- 1.0 Sparine	1	Left rump	12 min.	Fully Tranquilized	Open Tundra	\$771
Hogan Hill	122206	04/09/78	Pup	♀	79 lbs	1.0 Sernylan- 1.0 Sparine	1	Left rump	12 min.	Moderately Tranquilized	Open Tundra	\$771
St. Anne's	122207	04/10/78	Pup	♂	106 lbs	1.0 Sernylan- 1.0 Sparine	1	Center back	?	Fully Tranquilized	Dense Spruce	\$771
St. Anne's	122208	04/10/78	Pup	♀	84 lbs	1.0 Sernylan- 1.0 Sparine	1	Left foreleg	4 min.	Fully Tranquilized	Dense Spruce	\$771
St. Anne's	122209	02/26/78	Pup	♀	-	0.7 Sernylan- 1.0 Sparine	1	Rump	4 min.	Fully Tranquilized	N/A	\$325
Tolsona	122210	06/08/78	Adult	♂	104 lbs	1.0 Sernylan- 1.0 Sparine	2	Rump	11 min.	Fully Tranquilized	Dense Spruce	-

1/ Costs consist primarily of helicopter charter (\$275/hr day prior 2/78, then \$295) and fixed-wing charter (\$60/hr).

100 mg/cc drug mixture to decrease the latent period and obtain more complete immobilization. The increased dosage appeared to accomplish both objectives without apparent injury to the animals. All wolves, with the exception of one mortality, appeared to recover from the drug within several hours and most returned to the pack within 12 hrs of initial immobilization. The one collaring mortality resulted from drowning which apparently occurred as the animal was recovering from the drug.

Costs associated with radio-collaring wolves are shown in Table 1. These figures consisted primarily of charter charges for helicopter and fixed-wing aircraft and costs of darting equipment, and do not include manpower nor the price of the radio collar. An average of \$578 was expended to radio-collar each wolf. Wolves from packs which did not have at least one radio-collared member were more costly ($\bar{x}$ = \$624.00 per animal) than those which did ($\bar{x}$ = \$511.00 per wolf). This difference reflected increased search time with fixed-wing aircraft. Three trapped wolves were purchased from trappers and radio-collared for approximately \$350.00 each. Two of these animals had been injured by the traps and appeared to have difficulty keeping up with other pack members. Nevertheless, trapped animals were useful in establishing contact with a pack so additional members could be subsequently radio-collared from a helicopter.

Our helicopter darting technique was most efficient in moderate to sparse spruce habitat and when powdered snow depths exceeded one foot. These conditions usually slowed the animal and allowed the helicopter to get within easy shooting range. We experienced difficulty capturing wolves in dense spruce habitat and open tundra with hard snow pack. Dense spruce often allowed an animal to evade the helicopter and required many shots for one successful hit. Open tundra allowed a wolf considerable maneuverability at high speeds and although we always successfully darted them, it was usually necessary to tire the animal by running it.

Analyses of blood and hair mineral data (Tables 2 and 3) along with data pertaining to physical measurements will be presented in subsequent reports after computer services are obtained.

Between 1 July 1976 and 30 June 1978, 1,225 radio locations of 54 radio-collared wolves representing 16 packs (2 packs previously collared by Stephenson) were obtained (Table 4). Of that total, we were able to make sightings on 884 occasions (72 %). Individual radio-collared wolves were observed with other pack members on 783 occasions (89% of visual sightings). Our observations represent 617 individual pack days during which we recorded 659 different locations and made almost 2,400 wolf sightings.

During this study we focused our monitoring efforts on seven packs: Deep Lake, Hogan Hill, Keg Creek, Mendeltna, Middle Fork, Saint Anne's, and Sinona. We had a disproportionate number of visual sightings of certain wolves. Most evident was our inability to make visual contact with both black and white wolves, especially with black wolves during snow free periods and white wolves during periods of snow cover. This suggests that the numbers of wolves of these color phases could be underestimated during censuses.

Table 2. Blood values of wolves sampled in GMU-13 of southcentral Alaska from July 1976 through May 1977.

Wolf Accession Number	Carbon dioxide (meg/L)	BUN (mg/dl)	Creatinine (mg/dl)	Bilirubin (mg/dl)	Uric Acid (mg/dl)	Total Protein (gm %)	Albumin (gm %)	Globulins (gm %)	Alpha 1 (gm %)	Alpha 2 (gm %)	Beta % (gm %)	Gama % (gm %)	A/G Ratio	Packed Cell Volume	% Hemoglobin
122001	4	47	1.3	0.0	3.6	7.90	3.72	4.18	0.25	0.21	1.86	1.86	0.89	-	-
122002	0	47	1.3	0.0	2.5	6.90	3.31	3.59	0.17	0.21	1.71	1.50	0.92	-	-
122003	11	42	1.2	0.0	2.6	7.30	3.23	4.07	0.28	0.23	2.01	1.55	0.79	-	-
122004	0	50	1.2	B	0.3	7.30	2.86	4.44	0.30	0.18	2.45	1.51	0.64	-	-
122007	14	71	0.7	0.5	-	6.95	3.36	3.59	0.47	0.47	1.90	0.60	0.95	-	-
122008	13	45	0.7	0.1	-	6.10	3.12	2.98	0.45	0.53	1.55	0.45	1.05	-	-
122009	11	59	1.0	0.2	-	6.20	3.40	2.80	0.24	0.57	1.37	0.62	1.21	-	-
122010	13	21	0.2	0.0	-	5.70	3.19	2.51	0.43	0.23	1.52	0.32	1.27	-	-
122011	14	24	0.8	0.1	-	5.50	3.08	2.42	0.25	0.48	1.32	0.36	1.27	-	-
122012	3	70	1.7	1.5	-	8.3g/dl	G	-	-	-	-	-	-	-	-
122017	11	54	1.5	0.6	3.2	8.00	3.60	4.40	0.23	0.12	3.37	0.68	0.82	-	-
122018	12	27	1.2	0.4	2.2	6.50	3.41	2.09	0.29	0.44	2.07	0.29	1.11	-	-
122019	10	16	1.1	0.1	1.3	2.80	1.85	0.95	0.12	0.12	0.64	0.06	1.94	-	-
122021	10	20	0.9	0.2	2.6	5.50	2.99	2.51	0.33	0.28	1.57	0.33	1.19	-	-
122022	10	29	0.8	0.2	2.6	6.70	3.23	3.47	0.39	0.76	1.95	0.37	0.93	-	-
122048	15	108	1.6	0.3	1.8	9.10	4.55	4.55	0.33	0.91	2.48	0.82	1.00	-	-
122049	14	89	1.5	0.2	2.1	9.50	5.60	3.90	0.52	0.69	2.36	0.33	1.43	-	-
122056	-	-	-	-	-	7.00	4.16	2.84	0.27	0.75	1.04	0.77	1.46	51	-
122057	12	36	1.1	0.0	0.9	6.70	3.30	3.40	0.25	1.00	1.96	0.20	0.97	-	-
122058	10	18	1.3	0.1	1.4	7.00	3.35	3.65	0.34	0.26	2.12	0.92	0.92	56	-
122061	12	23	1.1	0.0	1.1	5.50	2.87	2.63	0.39	0.52	0.85	0.87	1.09	-	-
122062	14	26	1.1	0.0	1.0	6.30	3.50	2.80	0.28	0.72	1.25	0.56	1.25	55	19.5
122063	15	52	0.8	0.0	0.5	4.70	2.44	2.26	0.33	0.31	0.99	0.63	1.08	49	20
122064	14	68	1.1	0.0	0.8	5.40	3.22	2.18	0.28	0.67	0.59	0.64	1.47	49	19.8
122067	13	25	1.3	0.0	1.3	5.50	2.40	3.10	0.27	0.95	1.64	0.24	0.77	43	-
122069	8	27	1.3	0.0	1.6	5.60	2.94	2.66	0.40	0.28	1.24	0.74	1.11	45	-
122070	18	48	0.9	0.0	2.1	5.30	2.92	2.38	0.33	0.42	1.27	0.36	1.23	37	-
122072	9	36	1.3	0.1	5.1	5.60	3.49	2.11	0.19	0.61	0.38	0.93	1.66	50	-
122083	12	60	1.3	0.1	1.4	7.60	4.18	3.42	0.40	0.54	1.31	1.17	1.23	58	-
122084	12	67	0.9	0.0	1.6	6.70	2.85	3.85	0.49	0.41	2.49	0.45	0.74	39	-
122085	12	79	0.8	0.0	1.9	6.20	3.21	2.99	0.43	0.37	1.80	0.40	1.07	-	-
122086	17	28	1.2	0.0	1.1	6.30	3.23	3.07	0.43	0.35	1.97	0.32	1.05	46	-
122087	12	28	1.2	0.1	0.4	6.80	3.45	3.35	0.46	0.26	2.08	0.55	1.03	40	-
122089	8	39	1.1	0.3	5.5	7.20	3.01	4.19	0.28	0.45	3.14	0.31	0.72	-	-

Table 2A. Blood values of wolves sampled in GMU-13 of Southcentral Alaska from July 1976 through May 1977.

Wolf Accession Number	Glucose (mg/dl)	Cholesterol (mg/dl/)	Triglycerides (mg/dl)	LDH (U/L)	SGOT (U/L)	SGPT (U/L)	Alkaline Phosphatase (U/L)	Phosphorus (mg/dl)	Calcium (mg/dl)	Iron (ug/dl)	Sodium (meg/L)	Potassium (meg/L)	Chloride (meg/L)
122001	9	207	18	G	89	D	247	-	12.2	198	157	G	125
122002	266	227	86	G	D	D	67	G	13.3	295	153	G	118
122003	79	217	7	G	63	57	119	G	11.7	259	G	G	130
122004	0	194	87	G	T	T	38	G	12.9	359	158	G	114
122007	70	113	73	323	300	T	28	4.3	8.8	188	G	6.4	124
122008	104	117	22	94	41	75	109	7.5	9.9	165	145	6.1	114
122009	79	163	23	232	238	229	64	2.7	8.1	189	G	6.1	130
122010	102	180	6	137	108	103	176	8.7	12.3	98	159	6.4	122
122011	106	161	25	127	96	86	182	6.8	9.9	112	155	5.7	122
122012	-	241	145	G	T	T	69	G	8.0	231	148	G	94
122017	11	262	110	G	20	T	130	G	12.8	250	151	G	104
122018	154	241	30	G	D	D	358	G	13.8	195	148	G	105
122019	479	110	20	165	138	64	113	4.0	6.6	73	110	6.5	82
122021	73	216	29	G	-	307	161	10.0	11.3	173	132	G	95
122022	56	221	35	G	-	308	162	G	12.5	148	143	G	102
122048	51	232	152	262	220	101	69	5.7	13.4	317	G	6.3	G
122049	50	268	78	389	157	121	76	5.8	G	353	G	6.6	G
122056	-	-	-	-	-	-	-	-	-	-	-	-	-
122057	137	222	15	177	336	384	163	3.6	10.4	186	146	4.4	123
122058	133	180	18	1070	1070	830	30	3.6	9.6	196	149	7.2	118
122061	274	145	31	95	50	38	78	2.9	10.2	112	147	4.4	121
122062	95	140	27	163	93	65	35	1.5	10.3	154	148	4.8	119
122063	176	125	54	128	134	111	64	2.8	8.7	121	147	4.5	119
122064	132	116	57	109	157	127	24	2.1	9.3	150	148	4.2	121
122067	106	128	37	3500	2780	892	114	6.9	8.9	184	142	9.9	110
122069	58	135	82	1222	1250	400	131	13.0	13.6	150	142	14	107
122070	59	148	229	510	486	208	134	9.6	11.6	110	147	8.6	105
122072	334	140	52	213	126	63	32	7.4	10.6	88	148	9.6	115
122083	32	177	18	444	182	112	38	4.1	9.8	269	153	5.4	123
122084	110	255	62	234	121	71	78	3.9	9.3	148	145	5.9	119
122085	83	152	126	214	264	118	33	2.8	8.0	139	148	5.2	115
122086	92	191	11	206	92	76	86	3.3	10.6	128	150	5.1	117
122087	53	185	30	G	161	88	38	2.3	11.0	79	148	5.0	120
122089	102	239	240	G	T	T	252	G	11.1	178	148	G	111

Table 3. Hair mineral element values (ppm) from wolves harvested and radio-collared in GMU's 11 and 13 of southcentral Alaska from June 1976 through May 1977.

Accession Number	Zn	Cu	Ca	Mg	K	Na	Cd	Co	Fe	Pb	Mn	Cr
122001	237	28	1540	185	1460	6030	0.9	0.10	112	6	0.8	0.1
122002	178	15	690	95	540	5770	1.2	0.16	45	2	0.3	0.1
122003	164	19	1210	120	1030	5960	1.1	0.14	144	8	0.8	0.2
122004	160	11	870	95	580	5770	1.1	0.14	74	6	0.6	0.5
122008	171	14	400	60	610	5700	1.0	0.13	59	<1	0.3	0.3
122009	222	14	680	120	790	5720	1.3	0.16	58	6	0.4	0.8
122010	172	10	380	60	820	5790	1.1	0.15	59	<1	0.3	0.3
122011	223	17	520	95	1120	5820	1.3	0.14	63	4	0.4	0.1
122012	169	10	480	40	390	5670	1.1	0.27	61	<1	0.4	<0.1
122013	175	17	580	70	490	5300	0.8	0.17	80	4	0.2	<0.1
122014	202	10	770	110	1470	6320	1.1	0.19	76	<1	0.4	0.6
122015	85	10	250	45	4690	6120	1.0	0.15	74	<1	0.7	<0.1
122016	272	35	850	100	1920	5930	1.2	0.14	87	<1	0.8	0.3
122017	165	13	420	65	410	5520	1.3	0.14	64	<1	0.6	0.3
122018	175	10	390	30	1200	5720	1.3	0.21	65	3	0.2	0.2
122019	150	16	740	85	1960	5790	1.3	0.18	71	<1	0.6	<0.1
122020	142	18	620	95	790	5870	0.9	0.13	76	14	0.3	0.1
122021	177	32	1140	125	2800	5910	1.4	0.20	105	8	0.6	0.4
122022	151	14	650	55	2030	5860	1.0	0.18	74	16	0.4	<0.1
122023	193	12	335	145	1585	2470	1.2	0.21	50	1	1.3	0.4
122024	149	20	700	95	1270	5220	IS	IS	IS	IS	IS	IS
122025	169	6	630	125	965	1350	1.4	0.19	7	<1.0	1.1	0.2
122027	195	9	465	95	445	730	1.5	0.25	20	2	0.9	0.4
122028	196	13	1285	235	470	1715	1.4	0.24	53	6	1.3	0.2
122029	180	6	275	80	525	1390	1.5	0.16	17	8	1.0	0.3
122030	168	8	365	125	915	2090	1.7	0.25	35	<1.0	1.2	0.2
122031	188	16	395	200	1940	2970	1.4	0.19	121	12	1.0	0.4
122032	213	13	215	110	585	880	1.5	0.14	30	7	0.9	<0.1
122033	194	8	200	120	1090	860	1.3	0.19	15	<1.0	0.9	<0.1

Table 3 (Continued). Hair mineral element values (ppm) from wolves harvested and radio-collared in GMU's 11 and 13 of southcentral Alaska from June 1976 through May 1977.

Accession Number	Zn	Cu	Ca	Mg	K	Na	Cd	Co	Fe	Pb	Mn	Cr
122034	188	10	430	115	1170	2575	1.4	0.19	39	5	1.0	0.1
122035	199	10	610	200	1265	2330	1.4	0.22	47	6	1.4	<0.1
122036	143	6	205	100	755	1370	1.8	0.19	13	9	0.7	<0.1
122037	101	5	110	70	900	1540	1.9	0.21	32	7	0.8	<0.1
122038	241	5	515	185	620	1440	1.5	0.19	24	12	1.1	0.1
122039	137	10	375	100	790	1615	1.7	0.18	28	9	0.8	<0.1
122040	100	4	570	105	810	1205	1.5	0.21	24	<1.0	1.1	0.1
122041	148	8	1165	190	570	910	1.7	0.17	19	6	0.8	0.1
122042	89	11	225	45	235	355	1.4	0.18	21	4	0.8	<0.1
122043	132	8	710	135	665	1395	1.6	0.23	26	14	1.0	<0.1
122044	140	4	475	110	815	1675	1.6	0.24	26	7	0.9	0.1
122045	121	4	340	85	395	925	1.4	0.21	26	5	0.7	0.5
122046	123	2	120	50	610	3275	1.4	0.25	12	2	1.1	1.0
122047	114	7	315	145	2375	2760	1.6	0.27	28	1	0.8	0.9
122048	190	10	800	190	625	830	1.7	0.24	37	1	1.0	0.8
122049(2)	233	6	395	130	1165	2060	1.3	0.23	35	6	0.4	0.5
122050(2)	170	<1.0	440	95	640	1065	1.4	0.16	35	14	0.7	0.3
122051	148	6	150	60	455	3255	1.6	0.24	21	<1.0	1.0	1.1
122052(2)	166	<1.0	270	75	470	1715	1.0	0.02	24	6	0.5	<0.1
122053(2)	177	3	415	180	2485	2190	1.4	0.24	29	12	0.6	<0.1
122054	154	7	210	100	1405	3315	1.8	0.33	37	12	1.0	1.1
122056	151	7	175	45	180	675	1.6	0.18	4	9	1.0	0.3
122057	146	5	520	110	1225	1250	1.8	0.28	26	9	1.2	1.0
122061	135	1	315	60	455	820	1.7	0.29	26	<1.0	0.9	0.7
122062	161	2	390	95	370	630	1.6	0.23	27	13	1.0	0.7
122063	175	10	550	105	175	435	1.5	0.20	56	9	1.0	0.7
122064	123	3	260	65	135	1110	1.9	0.33	3	8	0.9	0.9
122065	323	13	805	195	540	635	1.6	0.21	16	15	1.3	0.8
122066	411	7	895	215	795	1095	1.4	0.29	22	4	1.3	0.8
122067	510	16	1150	135	410	1450	1.6	0.29	55	<1.0	1.4	0.9
122068	324	6	795	145	510	1110	1.5	0.27	33	17	1.1	0.9
122069	153	3	400	55	460	840	1.8	0.25	32	3	0.8	1.1
122070	184	9	795	130	800	1300	1.8	0.26	30	9	1.2	0.9
122071	202	9	550	145	900	2835	1.7	0.31	22	10	1.1	0.9
122073	199	9	275	65	680	1300	1.7	0.23	9	22	1.0	0.6
122074	160	13	470	110	760	1825	1.8	0.27	22	13	1.1	0.9

Table 3 (Continued). Hair mineral element values (ppm) from wolves harvested and radio-collared in GMU's 11 and 13 of southcentral Alaska from June 1976 through May 1977.

Accession Number	Zn	Cu	Ca	Mg	K	Na	Cd	Co	Fe	Pb	Mn	Cr
122075	168	9	220	55	430	815	1.4	0.21	20	9	1.2	0.7
122076	172	8	220	90	855	3235	1.4	0.27	29	9	1.4	1.0
122077	174	8	255	95	1245	3175	1.6	0.25	31	8	1.1	0.8
122078	133	7	230	70	470	3275	1.6	0.26	25	13	1.1	0.9
122081	155	<1.0	465	115	600	910	1.1	0.19	23	<1.0	0.6	<0.1
122083	241	1	1170	285	700	1600	1.5	0.30	98	9	1.1	0.4
122084	197	<1.0	665	125	300	780	1.1	0.10	179	8	0.8	0.1
122085	183	4	450	115	345	555	1.5	0.19	52	9	0.5	0.3
122086	206	5	1185	165	720	1610	1.1	0.21	69	14	0.7	<0.1
122087	161	<1.0	890	200	715	490	1.1	0.17	49	<1.0	1.0	<0.1
122088	194	3	760	215	845	550	1.0	0.20	50	9	0.6	<0.1
122089	171	<1.0	895	185	495	1385	1.3	<0.1	170	13	0.5	<0.1

Table 4. Summary of numbers of location observations of radio-collared wolves by individual and pack affiliation from June 1976 through June 1978 in Game Management Unit 13 of Southcentral Alaska.

Pack Name	Radioed Individuals	Accession Number	Number Radio Locations	Number of Locations Visually Observed	Number of Radio Locations With Pack Members	Total Number Wolf Sighting/pack (Collared and Uncollared)	Number Pack Days	Number Different Pack Locations
Deep Lake						158	72	83
	Gray ♂ #1 adult	122067	14	6	3			
	Gray ♀ adult	122009	66	53	28			
	Gray ♂ #3 adult	122096	11	11	11			
	Gray ♂ pup	122204	9	7	5			
Delta						6	3	3
	Gray ♂ adult	122063	4	4	2			
	Gray ♀ adult	122064	2	2	2			
Coal Creek						31	17	16
	Black ♀ adult	122002	19	18	13			
Ewan						12	26	18
	Gray ♀ adult	122000A	20	3	-			
	Gray ♀ pup	122151	6	6	2			
Hogan Hill						174	48	73
	Gray ♂ #1 adult	122000B	10	7	5			
	Gray ♀ adult	122000C	1	1	1			
	Gray ♂ #2 adult	122202	39	35	21			
	Gray ♂ yearling	122205	39	32	18			
	Gray ♀ yearling	122206	33	25	13			

Table 4 (cont.). Summary of numbers of location observations of radio-collared wolves by individual and pack affiliation from June 1976 through June 1978 in Game Management Unit 13 of Southcentral Alaska.

Pack Name	Radioed Individuals	Accession Number	Number Radio Locations	Number of Locations Visually Observed	Number of Radio Locations With Pack Members	Total Number Wolf Sighting/pack (Collared and Uncollared)	Number Pack Days	Number Different Pack Locations
Jay Creek	Gray ♀ adult	122199	42	22	12	41	38	36
Keg Creek	Black ♀ adult	122008	48	22	28	236	87	61
	Gray ♀ pup	122010	23	17	23			
	Gray o pup	122011	24	19	24			
	Gray ♀ adult	122201	39	33	33			
	Gray o adult	122203	39	33	31			
Mendeltna						913	128	151
	Gray ♀ adult	122000D	25	21	16			
	Gray-black ♀ adult	122007	124	110	69			
	Gray o yearling	122008	119	98	73			
	Gray o adult	122083	97	85	73			
	Gray ♀ adult	122095	13	13	13			
	Gray o pup	122090	13	13	13			

Table 4 (cont.). Summary of numbers of location observations of radio-collared wolves by individual and pack affiliation from June 1976 through June 1978 in Game Management Unit 13 of Southcentral Alaska.

Pack Name	Radioed Individuals	Accession Number	Number Radio Locations	Number of Locations Visually Observed	Number of Radio Locations With Pack Members	Total Number Wolf Sighting/pack (Collared and Uncollared)	Number Pack Days	Number Different Pack Locations
Middle Fork	Gray ♀ yearling	122062	1	1	1	51	25	31
	Gray ♂ pup	122061	24	24	15			
	Gray ♀ pup	122085	18	16	12			
Saint Anne's	Gray ♂ #1 pup	122086	3	3	3	229	41	51
	Gray ♂ #3 adult	122088	37	32	28			
	Gray ♂ #2 pup	122087	4	2	3			
	Gray ♂ #4 adult	122093	8	8	8			
	White ♀ adult	122094	20	10	19			
	Gray ♀ #2 pup	122209	10	10	6			
	Gray ♂ #5 adult	122118	9	9	9			
	Gray ♂ #6 pup	122207	1	1	1			
	Gray ♀ #3 pup	122208	4	3	4			

Table 4 (cont.). Summary of numbers of location observations of radio-collared wolves by individual and pack affiliation from June 1976 through June 1978 in Game Management Unit 13 of Southcentral Alaska.

Pack Name	Radioed Individuals	Accession Number	Number Radio Locations	Number of Locations Visually Observed	Number of Radio Locations With Pack Members	Total Number Wolf Sighting/pack (Collared and Uncollared)	Number Pack Days	Number Different Pack Locations
Sinona	Gray ♂ adult	122038	27	26	24	360	65	67
	Gray ♂ adult	122048	58	50	46			
	Gray ♂ #2 adult	122049	2	2	2			
	Gray ♀ adult	122084	26	19	19			
Stephan Lake	Gray ♀ adult	122016	14	2	1	3	13	14
Tolsona	Gray ♂ yearling	122210	19	14	7	32	13	9
Tsusena	Gray ♂ adult	122056	1	1	1	7	1	1
	Gray ♀ pup	122057	1	1	1			
Tyone	Gray ♂ adult	122001	17	12	7	105	35	38
	Gray ♂ #1 adult	122097	5	5	5			
	Gray ♂ pup	122151	8	8	7			
	Gray ♂ #3 adult	122099	5	5	5			
	Gray ♀ adult	122115	2	2	2			
	Gray ♂ #4 adult	122116	15	10				

Table 4 (cont.). Summary of numbers of location observations of radio-collared wolves by individual and pack affiliation from June 1976 through June 1978 in Game Management Unit 13 of Southcentral Alaska.

Pack Name	Radioed Individuals	Accession Number	Number Radio Locations	Number of Locations Visually Observed	Number of Radio Locations With Pack Members	Total Number Wolf Sighting/pack (Collared and Uncollared)	Number Pack Days	Number Different Pack Locations
Tyone (cont.)								
	Gray ♂ #5 adult	122117	2	2	2			
Watana						11	5	7
	Gray ♂ adult	122197	5	5	3			
All Packs Totals			1,225	884	783	2,369	617	659

Wolf pack territories derived from plotting 1,200 radio locations are illustrated in Fig. 2. The territory boundaries, as depicted, indicate that some of the territories overlapped. In most cases the apparent overlap resulted from the manner in which the data were plotted. When overlap actually did occur, only one pack used an area at any given time. Territories depicted for the Stephan Lake, Watana, Ewan, Tyone male, Delta and perhaps Tyone River packs may be incomplete due to interruptions in radio contact.

Histories of individual radio-collared wolves and their respective packs are described in the following section. Individual radio-collared wolves are identified in the text by the last three digits of their assigned accession number.

PACK AND INDIVIDUAL WOLF HISTORIES

Coal Creek

Stephenson (1978) reported on the emigration of the radio-collared black female (002) from the Keg Creek pack in 1976. Shortly after this she began associating with a gray wolf which later was determined to be a yearling male. Both wolves began occupying the lower portion of the Susitna River study area, northwest of the original Keg Creek territory. This pair and the Tsusena female (199) of the Jay Creek pack had one boundary confrontation in late June (described in the Jay Creek pack section). The same wolves were also located less than 1 mi apart from each other on one other occasion.

Our observations of these wolves during June and July 1976 indicated that they maintained a territory of 315 or more mi². They were not associated with a den during this period. During July 1976 they were only observed on two kills; one species unknown and one beaver (*Castor canadensis*). Both wolves were killed in late July as part of the experimental wolf removal program.

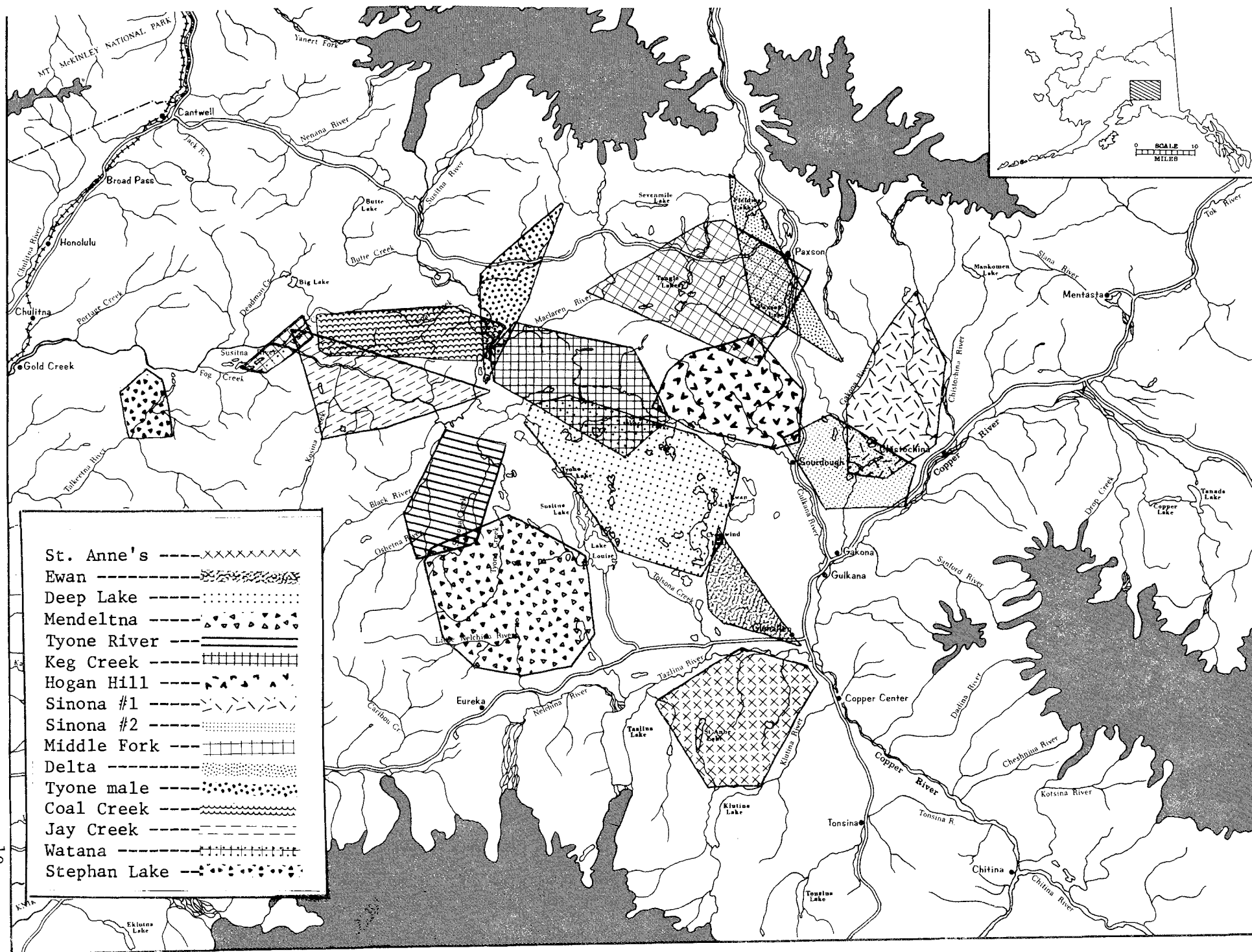
Deep Lake

In July 1976 the Deep Lake pack consisted of at least four and probably five wolves. We suspected that a den site was located approximately 2 mi southeast of Swan Lake but were unable to find it. Subsequent sightings and examination of carcasses turned in by trappers indicated that the pack probably did reproduce in 1976.

Stephenson (1978) reported on the first 4 months' activities of two radio-collared wolves, Deep Lake male 067 and Deep Lake female 000A. Wolf 000A left the Deep Lake pack territory after being radio-collared and dispersed into the Ewan pack territory. She was never observed with other wolves although her movements were restricted to the area reportedly occupied by the Ewan pack.

We lost radio contact with wolf 000A in late September 1976 at her most southerly radio location along the Trans-Alaska Pipeline, 2 mi south

Figure 2. Wolf pack territories derived from monitoring radio-collared animals in Game Management Unit 13 of Southcentral Alaska from 1 July 1976 through June 1978.



of the Tazlina River. We suspect she moved south along the pipeline into the Chugach Mountain Range where her transmitter failed.

In late July 1976 wolf 067 began traveling alone near the northeast edge of the pack's territory. He was last observed in mid-August 1976, 2 mi south of Lone Butte, approximately 18 mi west of the Deep Lake pack territory. In March 1977 he was killed with members of the Keg Creek pack, apparently having become a member of that pack.

Contact with the Deep Lake pack was reestablished in October 1976. Five wolves, including two judged to be pups on the basis of size, were present. During winter 1976-77 ground shooting and perhaps one dispersal reduced the pack to two by spring 1977.

After February 1977 we had no contact with the pack except for track sightings and public observations until November 1977. At that time the pack numbered eight (three adults and five pups) indicating they had reproduced. The location of the den site was unknown, however the 1975 site reported by Stephenson (1978) was not used. During winter 1977-78 ground shooting reduced the pack to one adult and two pups. The pack did not den in 1978 and in June wolf 204 dispersed leaving the pack with only two members.

During this reporting period the Deep Lake pack occupied a territory of approximately 674 mi² (Fig. 2). Territorial boundaries were similar to those reported by Stephenson (1978).

Delta River Pack

Stephenson (1978) suspected that most of the 1975 Delta pack members died or dispersed, perhaps leaving the territory without a denning pack in spring 1976. During this reporting period very little additional information was collected on this area except for public sightings and track counts. Radio contact with wolves in this area was maintained only between 21 March 1977 and 5 May 1977 through eight locations of two adult radio-collared individuals (wolves 063 and 064).

Both radio-collared wolves were observed together on three occasions, but neither was observed with other wolves. Contact with these animals probably was lost through radio failure. However, we never saw additional sign of wolf activity in the Delta pack's area during several hours of surveying from fixed-wing aircraft under ideal snow conditions, and after several checks at the old den site. It is not known whether these wolves were members of the original Delta pack or if they represented new wolves attempting to colonize an area.

Two wolves were reportedly harvested from this area in 1976-77, but none were reported during the 1977-78 season. Two wolves were observed on the Denali Highway at Mile 10 by a member of the public in March 1978. We suspect that the terrain, sparseness of vegetation, density of available prey and snow conditions make wolves occupying the Delta area highly susceptible to trapping and ground shooting. Therefore post-winter wolf densities were probably always low in this area.

Ewan Lake Pack

During this reporting period we were only able to radio-collar one member of the Ewan Lake pack. This pack's territory contained dense spruce stands which made tracking from Super Cub difficult. We were, however, able to maintain records on the numbers of wolves in the pack from track counts and public sightings.

On the basis of track counts and public sightings this pack was believed to number five wolves in fall 1976. Stephenson (1978) believed only one wolf remained in the pack's territory after winter 1975-76. If he was correct, the five wolves present in fall 1976 either represented immigration or the pack reproduced in 1976. We suspect the latter. No wolves were reported taken from this area during the 1976-77 hunting-trapping season, although public sightings and track counts indicated three wolves remained by spring 1977.

Trappers reported taking two pups in this area during the 1977-78 winter, indicating denning and successful reproduction in 1977. Radio contact was established with this pack in February 1978 when a gray female pup (151) was radio-collared. The pack numbered four at the beginning of spring 1978 season. We again lost radio contact with this pack in March 1978 when wolf 151 died apparently from wounds inflicted by an adult moose. Radio contact has not been reestablished with the pack.

Hogan Hill Pack

History of the Hogan Hill pack from June 1975 to June 1976 was described by Stephenson (1978). Information on this pack between June 1976 and April 1978 is limited because the gray female (000C) collared by Stephenson was relocated only once, apparently because of a faulty transmitter. We do not know if the pack denned in 1976 but the 1975 den site, located about 2 mi west of the Trans-Alaska pipeline, was not used. No increase in pack size was evident between spring and fall 1976.

The male (000B) radio-collared by Stephenson (1978) remained in the eastern half of the pack's territory during most of fall 1976. However, he made at least one trip to the east fork of the Chistochina River, about 30 mi east of the normal territory boundary. In December 1976 he was observed back in the Hogan Hill territory accompanied by two gray wolves. Shortly after the first of the year he apparently dispersed from the Hogan Hill pack, since radio contact was lost until March 1977 when he was relocated with one other gray wolf north of Mankomen Lake, about 36 mi from the Hogan Hill territory.

Track counts and observations made by Department personnel and the public indicated that at least four or five wolves remained in the Hogan Hill territory after wolf 000B left the pack. When radio contact with the pack was reestablished in April 1978 it contained eight wolves. Two (205 and 206) of three radio-collared were 11-month-old pups, indicating that the pack denned in 1977. Again they did not use the 1975 den site.

On 9 May 1978 members of the Hogan Hill pack were observed at a new den site, located about 10 mi NNE of Fish Lake. Pups were first observed on 30 May with the largest number, five, observed on 20 June. Movement of the pups to the first rendezvous site, located about 1 mi north of the den, occurred on 18 June. Movement of pups to a second rendezvous site, located 5 mi north of the den, occurred by 6 July.

Our observations of this pack indicated they occupied a year-round territory of 345 mi² (Fig. 2). Calculated territory size was smaller than that reported by Stephenson (1978). This may have been the result of our smaller number of winter observations.

Jay Creek Pack

As reported by Stephenson (1978) the Tsusena gray female (199) moved from the Tsusena pack's territory shortly after being radio-collared in 1976 (a young adult male was also radio-collared at the same time but was never relocated). Our first observation of wolf 199 was on 28 June 1976, within the Susitna River Study Area. She was observed bedded down just east of Jay Creek north of the Susitna River. Wolf 002 and her associate, a yearling gray male, both from a different pack, were observed within 1/2 mi heading towards the Tsusena female. The Tsusena female appeared to become excited, running in short tight circles, then attempted to hide in nearby brush. She hid for a few minutes, then burst out at a full run with the Coal Creek wolves chasing some distance behind. This chase lasted for 20 minutes and covered a distance of approximately 6 km (4 mi). During most of the chase the wolves did not appear to be in visual contact as the pursuing wolves stopped often to pick up the scent. At one point the pursuing wolves were within 1/4 mi of the Tsusena wolf but for the most part they were easily outdistanced. Following the chase the Coal Creek wolves rested at a creek while the Tsusena female continued at a slower pace toward the Susitna River.

After this chase by Coal Creek wolves, wolf 199's movements became more widespread in a southerly direction. She was observed 14 mi up Kosina Creek late in June and then moved back to the mouth of Watana Creek. She remained along the Susitna River until the end of July, then moved 40 mi southeast to the head of Joe Creek. She stayed in that area and the vicinity of upper Daisy Creek, which comprised the summer territory of the Mendeltna pack, until 21 August when she was observed 5 mi southeast of Clarence Lake.

During the remainder of the summer, fall and winter of 1976-77 this wolf's movements were restricted primarily to the Susitna River bottomlands. She was always observed alone until 29 September 1976 when she was seen with a large dark gray wolf which on the basis of size was judged to be an adult male. She was observed with this male on seven different occasions and it became apparent that a social bond had been formed.

We lost contact with wolf 199 after 19 March 1977 due to radio failure and therefore have no location sightings until she was recollared in March 1978.

During winter 1977-78 tracks of three or four wolves were common along the Susitna River in the same locale where the Tsusena female (199) had been observed in 1976. That winter 13 moose kills were observed on the river. We attributed these kills to this pack on the basis of tracks. In March 1978, when wolf 199 was recollared just east of Clarence Lake, she was pregnant and accompanied by three wolves; an adult dark gray male and gray male and female pups. All but wolf 199 were killed by Department personnel as part of the experimental wolf removal study.

Wolf 199 was observed only three times during May and June 1978 because of dense vegetation which prohibited visual observation. She was tracked, however, to an aspen vegetated knob at Jay Creek on several occasions indicating that she was denning in that area. On 28 June she was observed on the same knob accompanied by at least three pups. At the time of this report it was not known whether wolf 199 was able to successfully raise the three pups.

Keg Creek

Stephenson (1978) described the history of this pack from 1975 through June 1976. He suspected that the radio-collared black female (068) captured in March 1976 was the dam of pups produced both in 1975 and 1976.

Dense vegetation prevented observation of pups until 21 August, but radio locations of female 068 indicated that by 9 July the pups had been moved to a rendezvous site about 3 mi north of the den site. By 29 August pups began regularly traveling with adults.

Between late August 1976, when pups were first observed, and March 1977 the size and composition of the pack remained fairly stable at three adults and five pups. No mortality was observed during this period.

Studies of moose movements indicated that some moose from the Susitna River Study Area wintered and calved in the territory of the Keg Creek pack (Ballard and Taylor 1978b). The decision was made to expand the study area to include the year-round range of these moose. Therefore, in late March 1977, department personnel removed seven of eight Keg Creek pack members. The wolf which escaped was the gray adult female (201) originally collared by Stephenson in 1976, which he lost contact with because of a faulty transmitter. One of the grays which we had observed with the pack for the previous several months was the radio-collared adult gray male (067) which had dispersed from the Deep Lake pack in August 1976.

Wolf 201 apparently did not breed during 1977, as we never found any indication of more than one set of wolf tracks until late March 1978 when she was recollared with an adult gray male (203). When collared, wolf 203 was blind in one eye, had one foot missing and was judged to be 8-9 years old. From what area this wolf originated was not known.

Wolf 201 was pregnant when recaptured in 1978. She was first observed at the den site previously used by the pack in 1975 and 1976 on

9 May. Pups were first observed at the site on 29 May. The largest number of pups observed was five (on 12 June).

During our 2-year period of study the Keg Creek pack occupied a territory of approximately 414 mi² (Fig. 2). This corresponds closely with the 432 mi² reported for this pack during 1975 and 1976 by Stephenson (1978).

Den site characteristics were recorded and scats were collected in 1976 and 1978. Both analyses will be reported in subsequent reports.

Mendeltna Pack

Contact with this pack was established by Stephenson (1978) in April 1976 when he determined that the radio-collared, adult gray female (000D) from the Ewan Pack became integrated into a new pack. Stephenson thought this new pack was comprised of wolf 000D, a light gray thought to be a female, one dark gray, one slate black and one black wolf.

The pack denned in 1976 at a site located 1.5 mi SE of Marie Lake. At least six pups, three grays and three blacks, were raised. Pups were moved to a rendezvous site, located approximately 1 mi south of the den, between 28 June and 2 July. The pups remained here until 2 August when they moved approximately 14 mi northwest to the head of Daisy Creek. Between 1 and 8 September the pups began accompanying the adults on a regular basis. On 8 September we observed wolf 000D with three gray and two black pups. The third black pup was observed alone at the Daisy Creek rendezvous site. Following this observation, however, our counts of the entire pack were short one black pup. We suspect the pup observed at Daisy Creek either died or dispersed--which seems unlikely.

In October 1976 radio contact with wolf 000D, originally from the Ewan pack, was lost. We never again observed this wolf with the pack nor was she reported in the harvest records. We speculate that she dispersed or died of natural causes.

Wolf 083, an adult gray male originally tagged by Stephenson as a member of the Keg Creek pack in 1975, was discovered with the Mendeltna wolves in April 1977. Stephenson (pers. comm.) had thought that wolf 083 from the Keg Creek pack had been killed by illegal aerial hunting. Wolf 083 when with the Keg Creek pack may have had contact with wolf 000D from the Ewan pack in October 1975 when both radio signals were located close to a moose kill (Stephenson 1978). Radio contact with wolf 000D was lost in February 1976 and consequently reestablished in the Mendeltna pack in April 1976 while radio contact with Keg Creek wolf 083 was lost in mid-March 1976. This sequence of events suggests that both wolves may have emigrated to the Mendeltna area about the same time. Our contact with the Mendeltna pack in late June indicated wolf 083 was probably present then and was probably the large gray wolf referred to by Stephenson (1978) in April 1976.

The Mendeltna pack contained seven wolves at the beginning of the 1977 denning season. They had begun exhibiting a propensity to visit

the old den site utilized in 1976 by 21 April 1977. After this date observations at the den became more frequent. During the 1977 season this pack maintained two den sites and raised two litters of pups. Adult wolves were first observed at the second den site, located at Nickolson Lake approximately 5 mi northwest of the main den, on 20 May. Wolf 007 was the dam of this second litter.

Pups were first observed at the main den on 1 June 1977 but not at the second den until 12 June 1977. At least seven pups were raised at the main den while at least two were reared at the second den. It was possible, however, that 10 or more pups were born as we had one sighting of three pups at the Nickolson den and perhaps eight at the main den but this was during a period when pups may have been transferred between den and rendezvous sites.

Nickolson Lake pups were first moved to a rendezvous site approximately 1 mi east of the den on 22 June. At the main den we saw two adult wolves begin to move five pups to the Kelly Lake rendezvous site in the morning of 23 June, arriving at the site over 4 mi straight line distance away, at least 12 hours later. We noted that as the pack moved from the den the light gray wolf which we believed to be the dam kept returning to the den site. Since we were certain of at least seven pups for this den we speculate that two pups died. Our observations in the fall when snow conditions were optimum for observing wolves could only confirm the presence of eight pups for the entire pack. Therefore at least one or maybe two or more pups were lost during the summer. The circumstances surrounding these losses were unknown.

By 25 July the Nickolson Lake rendezvous site was abandoned and the pups moved to the Kelly Lake site. Between 8 and 17 August all the pups were moved to a third rendezvous site at White Sand Creek located approximately 9 mi northwest of the Kelly Lake site. By 13 September, the pups began traveling with adults on a regular basis.

By early fall 1977 the pack numbered seven adults and eight pups. In early November wolf 008 was discovered dead at the northern edge of the pack's territory west of Moose Lake on Tyone Creek. Examination of the kill site indicated that he had been killed by several other wolves. Four to five sets of wolf tracks leaving the area were tracked down Tyone Creek, indicating they were members of the Tyone Creek pack. The dead wolf had been fed upon and a portion of the rib cage and most of the viscera were gone. Most of this appeared to be the result of scavenging activity by ravens (*Corvus corax*) and gray jays (*Perisoreus canadensis*). Necropsy revealed several punctures on the neck and considerable subcutaneous hemorrhaging in both the neck area and on the upper left portion of the cranium. We surmise that this wolf was killed by another pack, apparently while trespassing in another territory.

During winter 1977-78 the Mendeltna pack slowly suffered attrition from ground shooting and illegal aerial hunting activities until in early February the pack numbered eight. Heavy snowfall during February followed by clear sunny weather provided excellent wolf tracking conditions.

On 9 February 1978 the remaining eight known members of the Mendeltna pack were taken by trappers. All members of this pack were accounted for by wolf hide sealing documents with the possible exception of three; a radio-collared, gray male pup and two black yearlings. The carcass of the radio-collared pup was found buried in snow. It had been shot with buckshot and not retrieved. The two blacks, one a crippled yearling male, still remain unaccounted for and, either their presence has been undetected after several hours of census, or they actually were harvested and their harvest location falsely recorded. We suspect the latter to be correct.

From June 1976 to February 1978 this pack occupied a territory of 558 mi² (Fig. 2). Summer territory was 515 mi² while winter territory was 266 mi². Members of this pack traveled to the extreme edges of the eastern, western and southern portions of their territory during summer while the northern extreme was most frequented during winter.

Middle Fork Pack

Stephenson (1978) originally radio-collared three pups from this pack in March 1976 but was only able to obtain several radio relocations before the wolves chewed the collars off. At that time the pack contained nine animals.

Our only contact with the Middle Fork pack during fall 1976 was a track sighting by a member of the public which indicated the pack still numbered nine. During winter 1976-77 two wolves were reportedly shot, one of which was the yearling collared by Stephenson (1978) in 1976.

We reestablished radio contact with the pack in March 1977 when it numbered four. Two wolves were collared, a yearling female (062) previously tagged by Stephenson (1978) as a pup and a 10-month-old pup (061). Wolf 062 drowned while still partially immobilized. An additional pup (085) was radio-collared in April 1977. We believed the remaining pack member was also a pup. We were unable to account for three other wolves which still should have been present in the pack.

During summer 1977 the Middle Fork wolves did not den and were rarely observed together. They were never observed on any kills and we believed that they were preying on small game.

In early September these wolves began associating with each other once again and did so through winter 1977-78. During January 1978 both radio-collared wolves and probably the third unmarked member of the pack were shot, leaving the Middle Fork pack territory vacant. An aerial census in late April supported that contention.

The Middle Fork pack occupied an area of approximately 514 mi². Their territory (Fig. 2) appeared to have considerable overlap with that of the old Delta pack's area. Like the Delta area, the somewhat open nature of the terrain and vegetation would probably make members of this pack highly susceptible to winter aircraft activities. We suspect that late winter wolf densities in this area have always been and will remain low.

Stephenson's (1978) diagram of the Middle Fork's territory was similar to ours for the south and eastern boundaries but was considerably different in the other two directions. He did acknowledge, however, that his boundaries were based on only a few observations. Our data indicated that their territory in 1977 ranged to the Maclaren River and northward above the Denali Highway.

St. Anne's Pack

Data pertaining to this pack during 1976 consisted of track counts, public locations and harvest records. Although the pack denned in 1976 it was not known how many pups were produced, however, by fall the pack numbered eight.

In April 1977, three wolves (086, 087 and 088) were radio-collared from a pack of eight. The pack denned in 1977 at the same site used in 1976. Pups were first observed on 11 May. By fall 1977 the pack numbered 14.

Rate of loss (6 out of 9) of radio-collared wolves from this pack was high. Some of the losses were probably due to radio failure and hunting-trapping mortality, however, harvest locations on sealing documents did not explain the losses (see Fig. 2 in relation to Figs. 4 and 5). At least two losses resulted from dispersal. We suspect that much of the fluctuation in numbers for this pack was also due to dispersal.

By early spring 1978 the pack contained 11 wolves. The pack denned at a new den site in 1978, located on Nickel Creek about 6.5 mi NW of the site used in 1976 and 1977. Number of pups raised has not yet been determined.

The St. Anne's pack occupied a territory of approximately 397 mi² (Fig. 2). Summer home ranges were smaller than winter home ranges during both 1977 and 1978.

Sinona Pack

Previous history of the Sinona Pack was provided by Stephenson (1978). During the 1976 denning season the pack of 11 adults was suspected to have two den sites. In September 1976 we visited two sites and found some evidence that the pack probably did raise two litters in 1976. Site descriptions and scat analyses will be discussed in future reports.

During the 1976 denning season we never observed the Sinona pack use a rendezvous site that was of any significant distance from the den site. On 19 July, however, the pups and adult pack members began using a slightly elevated ridge approximately 100 yds south of the main site. This site resembled a den site and was used for several weeks. We began to observe the pups traveling with the adults on a regular basis in late August.

By fall 1976 the pack numbered 11 adults and nine pups. Two adult

males (038 and 048) originally collared by Stephenson (1978) provided most of the radio locations obtained for this pack. The adult gray female (000E) also collared by Stephenson was believed to be present in fall 1976 but her radio was not operational.

During the 1976-77 hunting-trapping season most of the Sinona pack members were shot from the ground. We were able to account for the harvest of at least 16 and perhaps as many as 18 wolves from this pack. We suspected, however, that more than just two members escaped being harvested. At least two wolves, an adult with a distinctive white head and the adult gray female (000E) tagged by Stephenson (1978), were not presented for sealing. If the latter wolf lost its radio collar, it would be the first adult wolf to do so during this study. Further when we reestablished radio contact with the known remaining members of the pack in March 1977 tracks indicated that five wolves may have been present, however only the two radio-collared wolves were observed in subsequent observations. Aerial trappers also believed that more than two wolves remained on the Gakona River in the Sinona pack territory.

Following the heavy harvests from this pack in 1976-77, we never observed the remaining two known pack members (048 and 084) in the territory used the previous year. They occupied the area Stephenson (1978) had outlined as being the "lower Gakona pack." We refer to this area and the two wolves as Sinona #2 pack (Fig. 2).

During summer 1977 the Sinona #2 pack denned close to the Gakona River approximately 14 mi SW of the 1976 main den site. Wolf 084 began frequenting the den site by 12 May 1977. The den site was difficult to observe from the air because of dense aspen stands, but we were able to confirm that in 1977 the site was no longer used by the pups after 20 July. In 1977 we first observed the pups traveling with adults regularly by 15 September. At least six pups were raised and the pack numbered eight in fall 1977.

We suspected that at least two wolves from the 1976 Sinona pack continued to occupy the old Sinona territory, now referred to as Sinona #1 pack territory. A pack's presence was partially confirmed during the 1977-78 hunting-trapping season when at least eight wolves, three adults and five pups, were shot in the middle and upper Gakona River areas. Both of the 1976 den sites were checked but no activity was observed, thus if any wolves from the old Sinona pack reproduced they denned at a new site.

During the 1977-78 hunting-trapping season four pups were harvested from the Sinona #2 pack. The pack numbered four during spring 1978 and denning occurred at the same site used in 1977.

Based upon our observations of this pack, we calculated two territory areas (Fig. 2). Sinona #1 pack occupied an area of 301 mi² during summer and early winter 1976-77. Pack #2, on the other hand, occupied a year-round territory of approximately 235 mi². Had both packs functioned as one, the combined territories would total approximately 554 mi².

Stephan Lake Pack

The Stephan Lake female (016) was radio-collared in February 1976 and her movements through mid-June were reported by Stephenson (1978). A total of 14 locations were obtained from 18 June through 18 October 1976. This wolf was visually observed on only two occasions because of dense spruce cover. Only once was she accompanied by another wolf, a small dark gray. No kills were ever observed in the vicinity of the radio locations, although both cow and bull moose were present within 1/4 to 1/2 mi of the wolves on many occasions. On 14 July the radio signal was located along Prairie Creek. Salmon were numerous and possibly were being fed upon by this wolf. On 18 October she was located at her most southerly location. She was found at the same location on 22 November, and on 3 December she was found dead there under a spruce tree. The cause of death was not immediately diagnosed because the carcass had been scavenged. Necropsy revealed internal hemorrhage and what appeared to be tooth and/or fang marks on the neck in addition to a 3-inch laceration across the top of the skull. It appeared that this wolf may have been killed by either another wolf or a brown bear (*Ursus arctos*). This wolf's left rear femur was greatly deformed and was only 185 mm long, indicating that at one time she had suffered a fracture which had not healed properly.

Stephenson (1978) speculated that this pack of two denned in 1976 but our subsequent observations at the suspected den site revealed no denning activity.

Following the mortality of wolf 016 we never attempted to reestablish contact with this pack because of the logistics involved with routinely monitoring the radios. We had too few radio locations to assess territory size.

Tolsona Pack

Prior to mid-June 1978 our contact with this pack consisted of public sightings, track counts and harvest records. These data indicated that in early fall 1977 the pack had numbered at least 11. By denning season the pack had been reduced to three by trappers.

We established radio contact with this pack in early June 1978 by searching aspen-covered knolls from fixed-wing aircraft in search of a potential den site. The den site was found and a yearling gray male (210) was radio-collared. At least eight pups were raised at the site. Pups were moved to a rendezvous site 3.5 mi away from the den site between 24 and 26 June 1978. Den site characteristics and results of scat analyses will be discussed in subsequent reports.

Tsusena Creek Pack

The original Tsusena Creek pack which was located west of Tsusena Creek was not monitored during this portion of the study. Several flights were made to locate the two radio-collared wolves collared by Stephenson (1978) in 1976, but no contact was ever made. It was not known whether the Tsusena pack denned during 1976. In March 1977 we

located a pack of seven wolves at the head of Clark Creek. From the location we assumed it was the original Tsusena pack. We radio-collared an adult gray male (056) and a gray male pup (057) which suggested that the pack denned during 1976. On the basis of size and behavior it appeared that four or five of the pack members may have been previous year's pups. Unfortunately, we never established contact with the radio-collared animals. Unsubstantiated reports from the public suggested that the radio-collared animals had been taken by illegal aerial hunting. The nature of the terrain within this pack's territory and the extensive snow cover which was present at that time would have made this pack extremely vulnerable to aerial shooting. No attempt has been made to reestablish contact with wolves in this area since that time.

Tyone Male

Stephenson (1978) described the extensive movements of a lone radio-collared adult male (001) during a five-month period. This wolf's initial movements covered a 1,400 mi² area. Following the appearance of this wolf at an active den on Clearwater Creek in late June, his movements became more like that of a pack animal.

During late June and July wolf 001 was frequently observed with a black adult presumed to be the dam of the pups. In late June, the highest number of pups, two blacks and one gray, were observed at the Clearwater den site. The den site was abandoned in early July and we suspected the pups had been moved to a rendezvous site, possibly in the vicinity of Valdez Creek.

During June and July the wolves occupied an area of approximately 290 mi². They were observed at two killsites; a calf caribou at Valdez Creek on 27 July 1976 and an adult moose on 28 July 1976 which was also being eaten by a brown bear with two yearling cubs. The latter kill may have been made by the bears.

The den site was examined in early July 1976. Description of the site and results of scat analyses will be discussed in a future report.

Department personnel attempted to remove this pack from the experimental area in July 1976. However, only wolf 001 was taken at the time. The remainder of the pack was believed to have been removed during winter 1976-77.

Tyone Creek Pack

Prior to establishment of radio contact with this pack in November 1977, our data consisted of track counts and public sightings. Between spring 1976 and fall 1977 the pack numbered from six to eight individuals. In fall 1977 the pack numbered 12. Apparently the pack denned in 1977 because one (151) pup was radio-collared.

During the 1977-78 hunting-trapping season 11 wolves were harvested in this area, one of which was not retrieved.

Following the removal of 11 of 12 pack members the remaining wolf (116) dispersed from the area. By 27 February he was observed accompanied by a black adult female in the western edge of the Keg Creek territory. During March both wolves emigrated to the Susitna River Study Area. In late March the black female was removed by Department personnel. Wolf 116 continued to reside in the Susitna study area and by 20 June was observed with a small gray wolf.

During fall 1977 and early winter 1978 the Tyone pack occupied an area of 253 mi². Public observations and track sightings indicated that the pack also ranged to upper Goose Creek on the west and the Susitna River to the north.

WOLF FOOD HABITS

Specific food habits data on the Delta, Coal Creek, Ewan, Stephan Lake, and Tsusena Creek wolf packs were briefly described in the Pack History section. Specific food habit information on packs which were more intensively studied follows.

Deep Lake Pack

During the period of radio contact, the Deep Lake pack was observed on 15 kills (Table 5). Their winter diet was comprised of both caribou and moose. Moose and probably small game comprised the summer diet. Caribou were available to this pack in small numbers year-round but were more common in late fall through spring as the pack's territory served as both a migratory and wintering area for the Nelchina caribou herd.

From 29 May through 24 June 1978 the Deep Lake Pack was monitored once or twice daily. Wolves 009 and 204 were associated with each other on a regular basis through 30 May 1978. The uncollared member of the pack was only occasionally observed with either of the radio-collared animals during this time period.

Kills from 31 May to 24 June 1978 (Table 5), represent those which could be attributed to a single adult wolf. Unfortunately these data do not truly represent a feeding rate of the wolf because visual observations were only attained on 19 of 25 observation days. During this intense period of observation, we recorded only one instance of this single wolf feeding on a fresh ungulate kill and it was possibly killed by a brown bear with a yearling cub. Two kills which were listed as unknown were extremely small in size and probably were small game species.

Hogan Hill Pack

One or more members of the Hogan Hill pack were observed at 15 kills over a 2-year period (Table 6). Moose comprised 100 percent of the food items identifiable from aerial observation.

During the period 28 May through 28 June 1978 the Hogan Hill pack was monitored once or twice daily. During that period seven kills were

Table 5. Chronology, composition and location of suspected predator-killed prey species at which members of the Deep Lake Wolf Pack were observed from June 1976 through June 1978 in GUM-13.

Date of Observation	Prey Species	Specimen Accession #	Age-Sex of Prey	Est. Age of Kill	Location	# Wolves Observed on Kill	Comments
07/8/76	Moose	-	Yearling - ?	Fresh	10 mi. N. Tyone Village	2+	
12/24/76	Caribou	-	Calf - ?	1-2 days old	First Hill Lake	5	
01/18/77	Caribou	55102	Adult-M	Fresh	Tolsona Creek	3	
11/18/77	Caribou	-	Adult-F	Fresh	Fish Lake	8	
12/20/77	Moose	-	Calf - ?	1 day old	N. of Deep Lake	6+	
01/5/78	Caribou	-	Adult-F	Old	First Hill Lake	8	
01/19/78	Moose	-	Adult-?	Old	Cross Wind Lake	7	
03/13/78	Probable caribou	-	?	Old	Game Trail Lake	2	
04/08/78	Moose	-	Calf - ?	2 days old	Fish Lake	3	
04/09/78	Moose	120095	Calf - ?	Fresh	Dog Creek	3	
04/26/78	Moose	-	Calf - ?	1 day old	Deep Lake	3	
05/31/78	Moose	-	Probable calf	1 day old	Y-Lake	1	Sow brn. bear with yearling on kill
06/07/78	Returned to kill of 5/31/78						
06/17/78	Unk.*	-	Unk.		4 mi. N.W. Minnesota Lake	1	
06/18/78	Unk.*	-	Unk.		4 mi. N.E. Deep Lake	1	
06/24/78	Moose	-	Adult-?	Old	3 mi. N. Y-Lake	1	

* Probably small game species.

Table 6. Chronology, composition and location of suspected predator-killed prey species at which members of the Hogan Hill wolf pack were observed from June 1976 through June 1978 in GMU-13.

Date of Observation	Prey Species	Specimen Accession #	Age-Sex of Prey	Est. Age of Kill	Location	# Wolves Observed on Kill	Comments
09/09/76	Moose	-	Adult - F	?	Gulkana River	1+	Brn. bear on kill
09/10/76	Moose	-	Adult - ?	?	Twin Lake	1+	Probable hunter kill (Gut pile and skinned quarter present)
03/17/77	Moose	-	Adult - ?	?	Mankomen Lake	2	
03/21/77	Moose	-	Calf - ?	Fresh	W. Fork Gulkana River	Tracks of 4-5	50% consumed
03/21/77	Moose	120019A	Adult - F	Fresh	W. Fork Gulkana River	Tracks of 4-5	10% consumed
04/05/78	Moose	120019B	Calf - ?	1-2 days old	W. Fork Gulkana River	Tracks of 4-5	Totally consumed
04/08/78	Moose	120093	Adult - F	1 day	W. Fork Gulkana River	8	
04/08/78	Moose	120094	Calf - ?	1 day	W. Fork Gulkana River	8	
05/28/78	Moose	-	Calf - F	Fresh	5 mi. N. west fork Gulkana	1	
05/31/78	Moose	-	Calf - ?	Fresh	6 mi. N. Lily Pad Lake	1	
05/31/78	Unk.	-	Unk.	Unk.	W. Fork Gulkana River	1	
06/02/78	Moose	-	Yearling - ?	Fresh	W. Fork Gulkana River	1	30% consumed
			Kill revisited on 06/09/78				
06/08/78	Moose	-	Adult - ?	Old	Gulkana River	1	
06/11/78	Moose	-	Adult - ?	3-4 days	4 mi. W. of Den	1	
06/28/78	Moose	-	Adult - ?	Old	12 Mile Creek	1	Totally consumed

made; two calf moose, one yearling moose, three adult moose and one species unknown.

Jay Creek

Table 7 lists species and other pertinent information of prey which wolf 199 and associates fed upon during this period of study. The kills included: one adult caribou, seven adult moose and two calf moose. Several other wolf-killed moose were observed either in or very close to the Jay Creek territory but these kills could also have been made by members of the Watana pack and thus have not been included in Table 7. When alone, wolf 199 was observed on two kills, an adult bull moose which she may not have killed and an adult cow caribou which had just been killed.

Keg Creek

During this reporting period the Keg Creek pack was observed on a total of eight kills (Table 8). All of the kills were moose, even though caribou were seasonally available.

From 27 May through 21 June 1978 the two radio-collared adults were monitored once or twice daily. They were observed only on three kills, two yearling moose and one calf moose.

Mendeltna Pack

During our study this pack was observed on a total of at least 36 kills from 1 July 1977 through 18 November 1977 (Table 9). Overall, adult and calf moose comprised 67 percent of the kills observed, followed by caribou at 18 percent. Beaver, rodents, brown bear and unknown species comprised the remaining 18 percent of observed kills. Of the 36 kills, at least nine (25%) were also shared by one or more brown bears.

Middle Fork Pack

Table 10 lists the prey species members of the Middle Fork pack were observed with from April to January 1978. They were observed at five moose kills; three calves, one adult and one age unknown. As with the Keg Creek pack, caribou were occasionally available to the Middle Fork pack, but no caribou kills were observed.

The Middle Fork pups functioned as a pack through May 1977 after which they were usually observed alone. During spring 1977 they were observed on three moose kills (Table 10). On one occasion both radio-collared members had a cow and calf moose at bay. The cow appeared to be making a stubborn defense of the calf. Observations the following day revealed they were unable to make a kill and had left the area.

During summer 1977 these wolves were rarely observed together. They were never observed on any kills and were believed to be preying on small game.

Table 7. Chronology, composition, and location of suspected predator-killed prey species at which members of the Jay Creek Wolf Pack were observed from June 1976 through June 1978 in GMU-13.

Date of Observation	Prey Species	Specimen Accession #	Age-Sex of Prey	Est. Age of Kill	Location	# Wolves Observed on Kill	Comments
07/26/76	Moose	-	Adult - M	Old	4th of July Creek	1	
08/21/76	Caribou	-	Adult - F	Fresh	5 mi. S.E. Clarence Lake	1	
01/19/77	Moose	-	Adult - ?	-	Susitna River	2	
02/04/77	Moose	210016	Adult - ? (possible yearling)	-	Susitna River at Clarence Lake Stream	-	50% consumed
03/03/77	Moose	120015	Calf - ?	1-2 days	Susitna River	Tracks 2+	Ribs, viscera, neck and portions of quarters consumed
03/09/77	Moose	-	Adult - ?	Fresh	Susitna River near Goose Creek	2	Nose missing, carcass fully intact
02/11/78	Moose	-	Adult - ?	?	Mouth Jay Creek	3	
03/21/78	Moose	-	Adult - F	3-4 days	Susitna River opposite Clarence Lake	4	
	Moose	-	Calf - ?	3-4 days	Susitna River opposite Clarence Lake	4	
03/23/78	Moose	-	Adult - ?	1-2 days	between Clarence Lake and Susitna River	4	

Table 8. Chronology, composition and location of suspected predator-killed prey species at which members of the Keg Creek Wolf Pack were observed from June 1976 through March 1977 and from April 1978 through June 1978 in GMU-13.

Date of Observation	Prey Species	Specimen Accession #	Age-Sex of Prey	Est. Age of Kill	Location	# Wolves Observed on Kill	Comments
07/05/76	Moose	-	Yearling - ?	?	So. of Maclaren River	3	Brn. bear on kill and partially buried
09/25/76	Moose	-	Adult - M	Very old	So. of Maclaren River	?	Brn. bear running from kill
09/29/76	Moose	-	Adult - ?	Old	N. Monsoon Lake	2	Probable hunter kill
10/18/76	Moose	-	Adult - M	?	5 mi. W. Monsoon Lake	5+	Possible hunter kill
12/24/76	Moose	-	Adult - ?	Fresh	So. of Maclaren River	8	
05/27/78	Moose	-	Calf - ?	Fresh	Upper W. Fork Gulkana	2	
05/31/78	Moose	-	Yearling - ?	1 day	2 mi. W. Monsoon Lake	1	80% consumed
06/03/78	Moose	-	Yearling - ?	1 day	3 mi. S.W. Monsoon Lake	2	50% consumed

Table 9. Chronology, composition and location of suspected predator-killed prey species at which members of the Mendeltna wolf pack were observed from June 1976 through February 1978 in GMU 13.

Date of Observation	Prey Species	Specimen Accession #	Age-Sex of Prey	Est. Age of Kill	Location	# Wolves Observed on Kill	Comments
08/17/76	Probable caribou		Adult?	?	Daisy Creek	6	
09/08/76	Moose		Adult?	Old	V Lake	6	
09/23/76	Hare		?	Fresh?	W. of Kelly Lake	1	
09/25/76	Moose	120005	Adult [♀]	Fresh	Mendeltna Creek	9	Brown bear on kill
10/29/76	Moose	120007	Yearling	Fresh	Grayling Lake	8	50% consumed
12/09/76	Moose	120003	Adult [♀]	Fresh	So. of S Lake	5+	70% consumed
12/24/76	Beaver		?		Lower Daisy Creek	7+	
01/19/77	Caribou	55103	Adult [♀]	Fresh	Moose Lake	5+	
01/25/77	Moose	120008B	Calf?	Fresh	Marsh Lake	2+	50% consumed
02/12/77	Caribou	120014	Adult?	2+ days old	Cat Lake	2+	
02/21/77	Moose		Adult	Fresh	Grayling Lake	6+	
03/18/77	Moose		Adult?	Old	2 m. NE Blue Lake	2+	Totally consumed
03/24/77	Moose		Adult?	Old	Mendeltna Spring	1	50% consumed
04/18/77	Moose		Adult?	Fresh	3 mi. N. Moyler Lake	5+	
05/28/77	Moose		Yearling?	Fresh	So. John Lake	1	
05/31/77	Unk.		Unk.	Unk.	Nickolson Lake	1	
06/04/77	Moose		Adult?	Fresh	Old Man Lake	3	50% consumed
		Revisited on 6/9/77					Totally consumed
06/11/77	Moose		Calf?	Fresh	SW Nickolson den	2	4 brown bear on kill, prob. killed by bears
06/14/77	Moose		Adult?	Fresh	Kelly Lake	1	Brown bear on kill
06/15/77	Moose		Calf?	Fresh	Slide Mountain	3	2 brown bears on kill
06/16/77	Moose		Adult?	Fresh	Old Man Lake	3	1 brown bear on carcass
06/22/77	Brown Bear		Yearling	Fresh	John Lake	2	
06/24/77	Moose		Adult?	Fresh	Cat Lake	1	Probable wolf kill with 2 bears
		Kill revisited on 6/29/77					
06/27/77	Ungulate		Unk.	Unk.		1	
06/27/77	Moose		Calf?	Fresh	Kelly Lake		Brown bear feeding on carcass
07/06/77	Moose		Adult?	Old	Horseshoe Lake	1	
07/12/77	Moose		Adult?	Old	Tyone Creek	1	Totally consumed
07/25/77	Caribou		Adult [♀]	Fresh	Yacko Creek	1	30% consumed

Table 9 (cont.)

Date of Observation	Prey Species	Specimen Accession #	Age-Sex of Prey	Est. Age of Kill	Location	# Wolves Observed on Kill	Comments
07/25/77	Caribou		Calf?	Fresh	Yacko Creek	3	
08/08/77	Caribou		Adult♀	Fresh	Blue Lake	4	Brown bear on kill
08/17/77	Rodent (sp. unk.)		?	?	Yacko Creek	1	
08/25/77	Moose		Calf?	Fresh	Tolsona Creek	2	Brown bear feeding on carcass
10/12/77	Caribou		Adult♀	Fresh	Tabert Lake	1	
10/19/77	Caribou		Adult bull	Fresh	Curtis Lake	15	
11/05/77	Caribou		Adult♀	Fresh	5 mi. E. Marsh Lake	13	
11/18/77	Unk.		Unk.	Old	Daisy Creek	12	

Table 10. Chronology, composition and location of suspected predator-killed prey specimens at which members of the Middle Fork Wolf Pack were observed from March 1977 through January 1978.

Date of Observation	Prey Species	Speciman Accession #	Age-Sex of Prey	Est. Age of Kill	Location	# Wolves Observed on Kill	Comments
04/08/77	Moose	-	Calf - ?	Old	Gakona River	Tracks of 2	Totally consumed
04/11/77	Moose	-	Adult - ?	Fresh	Hungry Hollow	3	50% consumed
04/27/77	Moose	-	Prob. calf - ?	Fresh	Twelvemile Creek	3	33% consumed
11/10/77	Moose	-	Unk.	Unk.	Flattop Mountain	3	
12/13/77	Moose	-	Calf - ?	Old	Paxson Lake	2-3	

Sinona Pack

Members of both Sinona packs were observed on 16 kills from July 1976 through June 1978 (Table 11). Most were observed during winter when snowfall facilitated observation of kills. From these data it is obvious that moose comprised most of the winter diet. Adult moose comprised 63 percent of the kills observed. As mentioned earlier, scat analyses for summer seasons 1976 through 1978 will be discussed in subsequent reports.

St. Anne's

Table 12 lists kills at which members of the St. Anne's wolf pack were observed from April 1977 through June 1978. Moose comprised 82 percent of the kills. Moose calves comprised 22 percent of the moose killed. Summer scat analyses from 1976 through 1978 will be discussed in subsequent reports.

Tolsona Pack

Table 13 lists kills at which members of the Tolsona pack were observed during a 2-week period in June 1978. A total of three moose kills were observed, however, in two cases only wolf 210 was present.

Tyone Creek Pack

Between November 1977 and January 1978, while the pack was somewhat intact, we observed them on six kills (Table 14); four adult moose, one calf moose and one species unknown. This pack occupied an area which serves as both a wintering and calving area for at least two populations of moose (Ballard and Taylor 1978b).

Food Habits Summary

Table 15 summarizes most of the kills at which radio-collared wolves were observed by month of observation from 1 July 1976 through June 1978. Radio-collared wolves were observed at 130 kills, 17 (13.1%) of which also had one or more brown bears present. Adult moose (59) were the most common prey item comprising 45.4 percent of the total. However, heavily consumed yearlings may have been classified as adults and vice versa. Calf moose, which were easily distinguishable by size, comprised the second most common prey item (21.5%). Moose of all ages comprised 74.6 percent of the kills we observed. Other prey items in order of frequency were adult caribou (10.0%), miscellaneous species (10.0%), beaver (3.1%) and calf caribou (2.3%). These data underrepresent the importance of small game and rodents, since their remains would be difficult to locate from aircraft.

Adult moose were the most common prey item taken by wolves in all months except April, May and August. During April and May, 11-month-old and newborn moose calves comprised most of the diet.

Table 11. Chronology, composition and location of suspected predator-killed prey species at which members of the Sinona Wolf Packs were observed from June 1976 through June 1978 in GMU-13.

Date of Observation	Prey Species	Speciman Accession #	Age-Sex of Prey	Est. Age of Kill	Location	# Wolves Observed on Kill	Comments
07/15/76	Moose	-	Adult - ?	Old	S.E. Shuna Hill	1+	Totally consumed
08/29/76	Moose	-	Adult-Bull (30-40")	Fresh	Sinona Creek	2+	Totally consumed
09/10/76	Moose	-	Adult - F	Fresh	Sinona Creek	6	
09/27/76	Moose	-	Calf - ?	1-2 days old	Spring Creek	4+	Totally consumed
10/5/76	Moose	-	Adult - ?	?	Sinona Lake	16	Brn. bear on kill also possible hunter kill
12/14/76	Moose	120001	Adult - F	3-4 days old	Sinona Creek	15	Totally consumed
01/03/77	Moose	120002	Adult	Old	Sinona Creek	?	Totally consumed
01/18/77	Moose	-	Adult - F	1 day old	Sinona Creek	6	60% consumed
04/6/77	Moose	120020	Calf - ?	Fresh	Gakona River	2	
04/27/77	Moose	-	Poss. Yearling	2-3 days old	Gakona River	2	50% consumed
07/3/77	Beaver	-	?	Old	Richardson Highway	1	Possibly trapped
10/03/77	Moose	-	Adult - F	Fresh	4 mi. E. Sourdough	7	60% consumed
01/19/78	Moose	120089	Adult cow	Fresh	Tok Highway	4	
01/18/78	Moose	-	Calf	Fresh	Tok Highway	4	
03/13/78	Unk.	-	?	Old	Spring Creek	4	
04/05/78	Moose	-	Calf	2 days old	Gakona River	4	Totally consumed

Table 12. Chronology, composition and location of suspected predator-killed prey species at which members of the St. Anne's Wolf Pack were observed from April 1977 through June 1978 in GMU-13.

Date of Observation	Prey Species	Specimen Accession #	Age-Sex of Prey	Est. Age of Kill	Location	# Wolves Observed on Kill	Comments
06/22/77	Moose	-	Adult - ?	Old	Chultikana Creek	1	Totally consumed
08/17/77	Beaver	-	?	Old	St. Anne's Creek	8+	House dug up
10/11/77	Moose	-	Adult - M	Fresh	S.W. of Hudson Lake	3+	Brn. bear on kill 50% consumed
11/8/77	Moose	-	Calf - ?	Old	Rendevous Lake	10	Totally consumed
12/13/77	Moose	-	Adult - F	1-2 days old	Chultikana Creek	12	90% consumed
02/10/78	Land Otter ?	-	? ?	Old	St Anne's Creek	11	
02/21/78	Moose	-	Adult - ?	2 days old	Tazlina River	12	Totally consumed
02/28/78	Moose	-	Adult - ?	?	Kaina Creek	11	Totally consumed
04/10/78	Moose	-	Adult - F	Fresh	Nickel Creek	8+	20% consumed
04/10/78	Moose	120097	Calf - ?	Fresh	Nickel Creek	8+	20% consumed
06/02/78	Moose	-	Prob. Yearling - M	Fresh	Hudson Lake	1	

Table 13. Chronology, composition and location of suspected predator-killed prey species at which members of the Tolsona wolf Pack were observed during June 1978 in GMU-13.

Date of Observation	Prey Species	Specimen Accession #	Age-Sex of Prey	Est. Age of Kill	Location	# Wolves Observed on Kill	Comments
06/15/78	Moose	-	Adult - F	Fresh	Nelchina River	1	20% consumed
06/17/78	Moose	-	Yearling - F	Fresh	Lake Louise Rd.	1	80% consumed
06/18/78	Above kill revisited					1	
06/26/78	Moose	-	Adult - ?	Old	5 mi. W. Long Lake	3	Totally consumed
06/28/78	Above kill revisited					1	

Table 14. Chronology, composition and location of suspected predator-killed prey species at which members of the Tyone Creek Pack were observed from November 1977 through June 1978 in GMU-13.

Date of Observation	Prey Species	Specimen Accession #	Age-Sex of Prey	Est. Age of Kill	Location	# Wolves Observed on Kill	Comments
11/17/77	Moose	-	Adult - ?	Old	Lower Tyone Creek	10	Totally consumed
11/17/77	Moose	-	Adult - F	Fresh	Lower Tyone Creek	10	30% consumed
11/17/77	Moose	-	Calf - ?	Fresh	Lower Tyone Creek	10	5% consumed
11/23/77	Moose	-	Adult - ?	Fresh	N.W. Square Lake	9+	Totally consumed
12/20/78	Unk.	-	Unk.	2 days old	Lower Tyone Creek	6+	
01/19/78	Moose	-	Adult - ?	4-5 days old	Lower Oshetna River	4+	

Table 15. Summary by month of prey species discovered while radio-tracking wolves in GMU-13 of southcentral Alaska from 1 July 1976 through June 1978.*

Month of Observation	Prey Species								Miscellaneous (species unknown otter, hare, etc.)
	Calf moose	Est. age (mos.)	Yearling moose	Est. age (mos.)	Adult moose	Calf caribou	Adult caribou	Beaver	
May	4	0	2	12					2
June	3	1	4	13	11				4
July		2	2	14	5	2	1	2	1
August	1	3		15	1		3	1	1
September	1	4		16	7				1
October		5	1	17	4		2		
November	2	6		18	4		2		1
December	2	7		19	4	1		1	1
January	2	8		20	6		3		
February		9		21	5		1		1
March	3	10		22	7		1		1
April	10	11	1	23	5				
Totals	28		10		59	3	13	4	13 130

* Includes 17 kills also occupied by one or more brown bears: five calf moose, two yearling moose, nine adult moose, and one adult caribou.

The hypothesis that wolves were actively selecting newborn moose calves in the Nelchina Basin was not substantiated by the data presented in Table 16. However, yearling moose did appear to be more vulnerable to wolf predation than other age classes. Yearlings shown in Table 15 were born in 1976 and 1977. These cohorts comprised 15 and 19 percent, respectively, of moose counted when they were 6 months old. However, these two cohorts combined comprised 45 percent (50% if potential bear are kills excluded) of the moose (excluding newborn calves) killed by wolves during April through July when they were 11 to 14 months old. Small sample size and potential biases in composition counts prevent firm conclusions but an investigation of yearling moose mortality rates has been initiated.

Age and Condition of Prey

When possible we examined kills to aid in determining the age, sex and condition of prey taken by wolves. During this reporting period we examined 28 moose and four caribou kills (Table 16). The moose consisted of 18 wolf kills, one unknown predator kill, one brown bear kill, three winter kills, four road kills, and one nuisance kill. All of the adult, wolf-killed moose examined were females. The six wolf-killed adult moose for which we were able to obtain accurate age estimates were fairly old ($\bar{x} = 14.5$, S.D. = 3.62, range of 8 to 18 years). For eight wolf-killed adult moose the percent femur fat averaged 71.7 (S.D. = 22.7, range of 43.9 to 97.7). In comparison, three adult road-killed moose had an average marrow fat percent of 86.6 (S.D. = 7.17, range 78.4 to 91.5) while one adult winter kill had a value of 75.6 percent. Classification of the latter kill as a natural winter kill could be questionable; the animal exhibited the winter kill characteristics described by Johnson and Stephenson (1973), but the carcass was surrounded by wolf tracks. One brown bear-killed yearling moose had a percent marrow fat value of 93.3.

We also examined seven wolf-killed calf moose, five of which were females. Five of these calves averaged 15.4 percent (S.D. = 10.54, range 7.0 to 32.6) marrow fat. Two of the calves had values less than the 10 percent which Franzmann and Arneson (1976) believed represented calves in poor physical condition. In contrast, two of our road- or nuisance-killed calves had a mean percent marrow fat of 47.8 (S.D. = 25.24, range of 29.9 to 65.6) while one winter kill had a value of less than 10.1 percent.

We were only able to examine four caribou kills (two adult bulls, one adult cow and one calf). The adults were killed by wolves, while the calf was classified as a winter kill. Two adults were aged on the basis of tooth wear at 4 to 7 years and 10 years plus. The adult bull of unknown age was in poor condition as indicated by marrow fat (10.4%) while the remaining two adults exhibited high marrow fat values ($\bar{x} = 84.5\%$, S.D. = 4.29). The calf winter kill had a percent marrow fat of 59.3.

Caribou Populations and Their Relationship to Wolf Food Habits

We observed wolves feeding on surprisingly few caribou (12.3% of

Table 16. Species, age and condition of moose and caribou kills examined in Game Management Unit 13 from 1 July 1976 through June 1978.

Accession #	Species	Age	Sex	Date of Specimen Collection	Approximate Location	% Marrow Fat	Marrow Color	Cause of Death	Wolf Pack Involved
120001	Moose	8 yrs.	♀	01-03-77	Lower Sinona Ck.	-	-	Wolf predation	Sinona
120002	Moose	17 yrs	♀	01-03-77	Lower Sinona Ck.	78.0	Light pink with red spots	Wolf predation	Sinona
120003	Moose	15 years	♀	12-09-76	Grayling Lake	45.2	-	Wolf predation	Mendeltna
120004	Moose	18 yrs	♀	12- ?-76	Tonsina River	91.3	-	Wolf predation	Tonsina
120005	Moose	9 yrs.	♀	09-25-76	Mendeltna Creek	78.0	White	Unknown predation	Mendeltna and brown bear
120006	Moose	Adult	♀	12-27-76	Gakona River	46.4	White with pink spots	Wolf predation	Sinona
120007	Moose	Yearling	♀	10-29-76	Grayling Lake	43.9	Outer - red Inner - white	Wolf predation	Mendeltna
120008	Moose	15 yrs.	♀	01- ?-77	Copper River	75.6	Light pink	Winter kill?? (legs tucked under body)	N/A
120008B	Moose	Calf	♀	01-25-77	Marsh Lake	32.6	Red - semi gelatinous	Wolf predation	Mendeltna
120012	Moose	Calf	♀	02-10-77	Tok Highway	<10.1	Red - gelatinous	Winter kill	
120014	Moose	Adult	♀	02-21-77	Grayling Lake	88.0	White	Wolf predation	Mendeltna
120015	Moose	Calf	?	03-03-77	Susitna River at Jay Creek	-	Red	Wolf Predation	Jay Creek
120016	Moose	16 yrs.	♀	02-16-77	Susitna River at Clarence Lake Stream	-	Red - gelatinous	Wolf predation	Jay Creek
120018	Moose	Calf	?	03-14-77	W. Fork Gulkana River	-	Red - gelatinous	Winter kill	
120019A	Moose	13 yrs.	♀	03-21-77	W. Fork Gulkana River	-	-	Wolf predation	Hogan Hill
120019B	Moose	Calf	?	03-21-77	W. Fork Gulkana River	-	Pink spotted	Wolf predation	Hogan Hill
120020	Moose	Calf	?	04-06-77	Gakona River	12.2	Red	Wolf predation	Sinona
120021	Moose	Yearling	♀	04-13-77	Richardson Highway	78.4	Pink	Road kill	
120022	Moose	Adult	♀	04-13-77	Edgerton Highway	91.5	Light pink	Road kill	
120023	Moose	Adult	?	04-13-77	Unknown - Unit 13	90.0	Light pink	Poached or road kill	
120025	Moose	Calf	♀	04-14-77	Richardson Highway	29.9	Red crystals near wall	Nusiance kill	
120026	Moose	Yearling	♀	04-28-77	Roundtop Mountain	93.3	White	Brown bear predation	
120062	Moose	Calf	♀	07-25-77	Glenn Highway	65.6	Red	Road kill	
120089	Moose	Adult	♀	01-26-78	Tok cutoff	97.7 ^{1/}	Dry cavity	Wolf predation	Sinona
120093	Moose	Adult-10 yr. tooth wear	♀	04-10-78	W. Fork Gulkana River	83.0	Pink	Wolf predation	Hogan Hill
120094	Moose	Calf	♀	04-09-78	W. Fork Gulkana River	17.7	Pink	Wolf predation	Hogan Hill
120095	Moose	Calf	o	04-09-78	Dog Creek	7.0	Red	Wolf predation	Deep Lake
120097	Moose	Calf	♀	04-10-78	Nickel Creek	7.5	Red	Wolf predation	St. Anne's
55101	Caribou	Adult	o	11-03-76	Marie Lake	10.4	Red - gelatinous	Poss. Wolf predation	Mendeltna
55102	Caribou	4-7 yrs.	o	01-18-77	Tolsona Creek	81.5	Pink	Wolf predation	Deep Lake
55103	Caribou	10 yrs.+	♀	01-25-77	Moose Lake	87.5	Light pink	Wolf predation	Mendeltna
55104	Caribou	Calf	?	04-08-77	Lake Louise	59.3	Red	Winter kill?	

^{1/} May be erroneous

all kills observed). Most, if not all, of the area occupied by radio-collared wolf packs has historically been used either year-long or seasonally by the Nelchina caribou herd (Skoog 1968). The Nelchina herd usually calves in the vicinity of Kosina Creek, then during late summer most disperse southeastward to the edge of the Talkeetna Mountain Range. During this period small numbers of caribou could always be found within the Mendeltna and Tyone Creek wolf packs' territories. In late fall caribou generally migrated to the Lake Louise flats and further eastward to the extreme edge of the Wrangell Mountains where they wintered in loose bands. During migration caribou were most available to the Tolsona, Deep Lake and Ewan packs, with considerably fewer available to the Hogan Hill, Sinona, Keg Creek, Middle Fork and Delta packs. Rarely were caribou available to the St. Anne's pack. It is also noteworthy that wolves generally did not leave their territories to follow caribou during migration. If they followed them at all, it was within their territory.

Between 1972 and 1973 the Nelchina caribou herd declined to a record low of approximately 7,500 animals (S. Eide, pers. comm.). Although we have no precise estimates of moose numbers, available data suggest the moose population was considerably larger than the caribou herd during the past few years. Therefore caribou have been a secondary ungulate prey species. However, the herd has increased since 1972-73 and by 1977 numbered about 14,000 animals. Both calf production and survival have been high (60 summer to 47 fall calves:100 cows). At this population level caribou probably will soon surpass in numbers the moose population. During the past 2 yrs we anticipated that caribou would have comprised much more than 12 percent of the kills we observed. If our data are representative of prey selected, a preference for moose is indicated. If wolves are indeed opportunistic we expect to see a larger percentage of caribou in the wolf's diet in the future.

Wolf Predation Rates

We calculated predation rates for several packs by dividing the number of kills we observed into the number of pack days (Table 17). The results should be viewed as minimum rates because some kills may not have been observed. Also, our contacts with some packs may have been too infrequent and the calculated number of pack days includes some radio-relocations when we were unable to observe the wolves.

Eight study packs were observed at a kill on the average of every 4.5 days with a range of 3.2 to 10.9 days between kills. The lowest predation rate was recorded for the Keg Creek pack but this figure was probably inaccurate since we were often unable to observe the pack due to dense vegetation which could have easily concealed kills.

We believe the most reliable data were obtained on the Deep Lake, Hogan Hill, Mendeltna, St. Anne's and Sinona wolf packs. Throughout the year these packs made a kill an average of every 3.8 days (range 3.2 to 4.8). Our data on predation rates do not take into consideration pack size, pack age composition, nor potential differences between seasons. Potential bear kills were not excluded. Conversion of Stephenson's (1978) predation data to our method of estimation revealed a predation

Table 17. Rates of predation by selected study wolf packs within GMU-13 from 1 July 1976 through 30 June 1978.

Pack	Number of pack days	Number of kills observed ^{1/}	Days/kill
Deep Lake	72	15	4.8
Hogan Hill	48	15	3.2
Keg Creek	87	8	10.9
Mendeltna	128	36	3.6
Middle Fork	25	5	5.0
Saint Anne's	41	11	3.7
Sinona	65	16	4.1
Tyone	35	6	5.8
Totals	501	112	4.47 = $\bar{x}$

Includes kills at which bears were also present.

or yearling moose, two calf moose and one species unknown. Five other observations indicated these wolves were in the process of making a kill but our presence interfered and/or the kill was made after our observation ceased. Our observation of 31 May (#3, Appendix I) may be a good example of the significance of observations in which wolves were seen resting close to cow moose with calves. On that occasion we observed the radio-collared, adult gray male (202) resting alone close to a cow and calf. At one point the cow chased the lone wolf when it approached the pair. During a low pass with our Piper Super Cub we could see that the calf's rear quarters were injured. We returned to the site 12 hrs later by helicopter and found the calf had been killed and partially eaten by the lone wolf as evidenced from tracks, predator hair and bite marks. Further details will be presented in the moose calf mortality study report (Job 1.23R).

During this period when the pack was being intensively monitored they fed on a new kill at least every 4.6 days. If five other instances of suspected predation were considered the rate of kill could have been as short as one every 3.2 days.

Our summer predation rates for the Mendeltna and Hogan packs indicated a rate of at least 4.6 days which was less than our year-round average of 3.8 days but more than the rate of 6.1 calculated from Stephenson's (1978) data. If we included questionable kills, however, the summer rate would have ranged from 3.2 to 3.9 days and would have been more comparable with our year-round average. Stephenson's hypothesis probably applies more to wolf populations which prey more heavily on calf moose than what our predation data indicate.

Wolf-Brown Bear Relationships

Of the 130 kills at which wolves were observed during this reporting period, 17 were also occupied by one or more brown bears. Of the total wolf kills, 36 (28%) were observed in connection with studies of the Mendeltna wolf pack which had nine (53%) of its 17 kills occupied by bears. We cannot explain why this pack had a disproportionate number of its kills shared by bears, but it may be partially related to the superior observation conditions within that pack territory.

Studies initiated in spring 1978 on brown bear feeding behavior indicated that predation by bears on moose was occurring on a large scale (Spraker pers comm.). If true, competition between bears and wolves at kills may be occurring at a higher rate than what present data indicate. One result of competition at kills was observed in 1976:

On 25 September 1976 we observed the Mendeltna pack present at an adult cow moose kill which was also occupied by an adult brown bear. On 26 September guide Alfred Lee reported that he had found a black adult male wolf which had been killed by a brown bear at the moose kill. The wolf hide had what appeared to be puncture marks on the neck, lower chest cavity and around the anus in addition

to blood coming out of the mouth. Examination of the skinned carcass indicated that hemorrhaging had occurred on both the front and rear left quarters. In addition, the left rear leg was broken. The area immediately surrounding the wolf carcass was partially torn up, indicating that some sort of violent interaction had taken place. We inferred from our examination that Lee was indeed correct and that the wolf had been killed by a bear. In all likelihood the kill occurred as a result of conflict over the moose kill.

During spring-summer 1977, when we intensively monitored the Mendeltna pack's activity, we observed a number of bear-wolf encounters which are summarized in Appendix II. Most of these encounters were at either kill sites or close to a den site. On one occasion we discovered a yearling brown bear which, from the evidence, appeared to have been killed by wolves.

The effects of competition between the two predator species are largely unknown but it is apparent that mortality of either predator occasionally results. Stephenson (1978) suggested that competition may increase the wolf predation rate if bears commonly take over kills. The reverse could also be true.

Summer Activity Patterns

Data pertaining to the summer activity patterns of the Deep Lake, Hogan Hill, Keg Creek and Mendeltna wolf packs were collected during 1977 and 1978. Only data from the Hogan Hill pack will be presented here.

Table 18 depicts some of the activities of the three individual radio-collared Hogan Hill wolves (202, 205 and 206) during May and June 1978. We classified wolf observations into five general categories: (1) resting at den, (2) traveling, (3) bedded away from den, (4) at kill site and (5) stalking. The first four are self explanatory; we classified an observation as stalking when we subjectively believed there was a relationship between the wolf's presence and the presence of prey. We potentially could have observed the three radio-collared wolves on 114 occasions but were only able to see them 97 (85%) times. During our 97 sightings, the radio-collared wolves were observed at either the den or rendezvous site on 44 (45%) occasions. Of the 53 observations away from the den or rendezvous site, 41 of them were of single wolves (77%), reflecting the relatively solitary habits of wolves during this season of the year.

Wolf Territories

Territory sizes for 10 study packs are shown in Table 19. Year-round territories ranged in size from 253 to 674 mi², averaging 398 mi². This average territory size was smaller than the 452 mi² reported by Stephenson (1978), possibly because we included non-denning packs in our figures and for some packs we probably had insufficient data to

Table 18. Activity and association of three radio-collared wolves from the Hogan Hill wolf pack in Game Management Unit 13 which were intensively monitored during late May and June, 1978.

Individual Wolf	<u>Resting at Den or rendezvous site</u>			<u>Traveling</u>			<u>Bedded away from den</u>			<u>At kill site</u>			<u>Stalking</u>			<u>Not found</u>	<u>Totals</u>
	Alone	With 1 wolf	With more than 1 wolf	Alone	With 1 wolf	With more than 1 wolf	Alone	With 1 wolf	With more than 1 wolf	Alone	With 1 wolf	With more than 1 wolf	Alone	With 1 wolf	With more than 1 wolf		
Adult Gray Male 122202	2	3	10	5	--	3	3	1	--	3	--	--	2	2	--	4	38
Yrl. Gray Male	1	2	12	2	1	2	8	1	--	3	--	--	1	--	--	5	38
Yrl. Gray Female	4	2	8	5	--	1	8	--	--	1	--	--	--	1	--	8	38
Totals	7	7	30	12	1	6	19	2	0	7	0	0	3	3	0	17	114

Table 19. Ranges of territory size for 10 wolf packs as determined by monitoring individual radio-collared wolf packs from June 1976 through June 1978 in GMU-13 of Southcentral Alaska.

Pack name	Territory size square miles
Deep Lake	674
Hogan Hill	345
Jay Creek	288
Keg Creek	414
Mendeltna	559
Middle Fork	514
Saint Anne's	397
Sinona #1	301
Sinona #2	235
Tyone Creek	253
	$\bar{x} = 398$
	S.D. = 144.42

accurately define territories. Considering territory size for those packs which denned and for which we had year-round coverage, our average territory was 427 mi².

The Deep Lake and Mendeltna packs had the largest territories. Of possible significance was the fact that these two packs accounted for 31 percent and 56 percent, respectively, of all caribou kills observed for all packs studied. In light of the low density of moose on the Lake Louise flats, we suspect that larger territories were a function of the year-round density of ungulates. Territory size could also reflect pack size and age composition. The Mendeltna pack, for example, extended its western, southern and eastern boundaries in 1977 when two litters of pups were being raised. Stephenson (1978) recorded a territory of 432 mi² for the Sinona pack during part of the year in which two litters were being raised by 11 adults. Our estimated territory size when the pack numbered 11 adults and nine pups was 301 mi². Following the drastic reduction in pack size down to two or three adult animals, the territory was reduced to 235 mi².

Unit 13 Wolf Density

Spring and fall wolf densities within a portion of Unit 13 (Fig. 3) were estimated for the period of spring 1975 through spring 1978. We based our estimates on eight wolf packs, most of which have been under intensive study since 1975 (Table 20). Data on wolf numbers in other packs were not sufficiently complete (Table 21) for such analysis. For spring 1975 through spring 1976 estimates we utilized data presented by Stephenson (1978), but some of our estimates differ from his. Stephenson did not estimate the size of some packs and he made no estimate for the Deep Lake pack but included it in his calculations.

For purpose of discussion we estimated the size of these packs for 1975 and spring 1976 by using the mean number of wolves per pack in 1976 and 1977. We feel that on the average this method produces a conservative estimate of wolf numbers, particularly for 1975, as most packs which were studied intensively throughout the entire period exhibited declines in numbers from 1976 to 1978.

Our estimates indicate that from 1975 through spring 1978 wolf densities ranged from one wolf per 38 mi² in fall 1975 to one wolf per 112 mi² in spring 1978 (Table 20). Spring densities reflected losses due to trapping and hunting, dispersal and natural mortality, while fall densities reflected subsequent pup production and survival. Both spring and fall densities showed a progressive decline since 1975. This decline can be attributed primarily to hunting and trapping mortality, although dispersal and natural mortality also accounted for losses of some pack members.

We estimated the total wolf population for Unit 13 by expanding wolf density estimates from the territories of study packs (Fig. 3) to the entire unit. Two sets of estimates were made: one for all of Unit 13 excluding the Susitna River study area and the other for "wolf habitat" only, where glaciers and all areas lying above 4,000 ft elevation were also excluded. We believe the second method is more

Figure 3. Areas utilized for calculating wolf density in GMU-13 of Southcentral Alaska from Spring 1975 through Spring 1978.

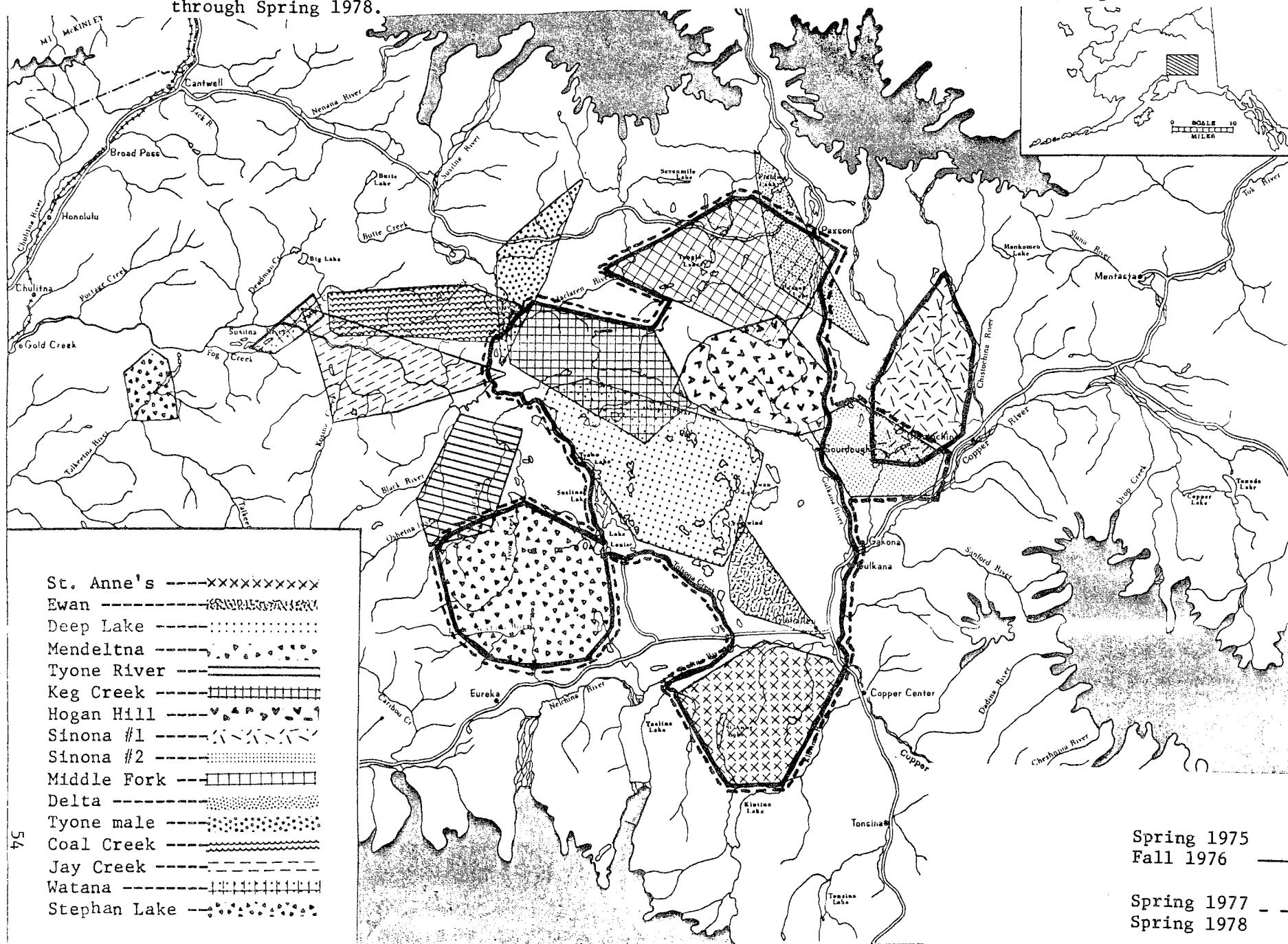


Table 20. Spring and fall wolf numbers from selected study packs utilized to calculate wolf density and population estimates for GMU-13 in Southcentral Alaska from spring 1975 through spring 1978.

Pack Name	Spring ^{1/} 1975	Fall ^{1/} 1975	Spring ^{1/} 1976	Fall 1976	Spring ^{2/} 1977	Fall 1977	Spring 1978
Deep Lake	4*	6*	8	5	2	8	3
Ewan	7	11	5*	5	3	5	3
Hogan Hill	7	9	7	5	5	8	8
Keg Creek	7	13	5	8	1	1	2
Mendeltna	4*	12*	5	9	7	15	0
Middle Fork	4*	11	9	9	3	3	0
Saint Anne's	9*	11	8	8	8	14	8
Sinona	7	11	11	20	2	8	4
Subtotal	49	84	58	69	31	62	28
Lone wolves (10%)	5	8	6	7	3	6	3
Total	54	92	64	76	34	68	31
Square miles	3516	3516	3516	3516	3456	3456	3456
Square miles/wolf	64.1	38.2	54.9	46.3	101.7	50.8	111.5
GMU-13 Population Estimate							
Total Area ^{3/} (20,978 sq.mi.)	322	549	382	453	206	412	188
Wolf Habitat ^{3/} (14,666 sq mi)	225	384	267	317	144	289	132

^{1/} Data from Stephenson (1978).

^{2/} Keg Creek Pack reduced by experimental wolf removal.

^{3/} Excludes 2,800 sq. mi. wolf removal area.

* Data based on mean number per season in other years.

Table 21. Minimum number of wolves in selected study wolf packs from spring 1975 through spring 1978 in GMU 13 of Southcentral Alaska.^{1/}

Pack	Spring 1975 ^{1/}	Fall 1975 ^{1/}	Spring 1976 ^{1/}	Fall 1976	Spring 1977	Fall 1977	Spring 1978
Delta	4	8	1?	?	2+	?	2+
Jay Creek	?	?	1	2	2	4	1
Tolsona	?	?	?	4?	?	7+	3
Tyone	?	?	6	6	7-8	12	1

^{1/} Data from Stephenson (1978).

realistic since neither wolves nor their prey regularly inhabit these areas. The main problem with the second method was that some habitat of Dall sheep (*Ovis dalli*) which may be an important prey species for some wolf packs was excluded. However, the St. Anne's, Coal Creek and Jay Creek packs which had sheep available to them were rarely observed above 4,000 ft elevation. Based upon the second method, our estimates over the study period for Unit 13 ranged from 132 animals in spring 1978 to 384 animals in fall 1975.

Tables 22 and 23 summarize wolf sightings made by the public and Department personnel during the study period. Based upon these observations and our radio telemetry data, we roughly estimated that between 40 to 50 wolf packs inhabited Game Management Unit 13 during the study period.

Trapping and Hunting Mortality

During the 1976 and 1977 trapping-hunting seasons 102 and 128 wolves, respectively, were taken by both the public and Department personnel in Unit 13. Figs. 4 and 5 show the approximate location of kills as determined from sealing documents and conversations with trappers for both Units 11 and 13. In most cases, the reported kill figures corresponded with our observation of declines in numbers of wolves in radio-collared packs, indicating that information provided from hunters and trappers was generally accurate.

Harvests for 1977 were the highest on record for Unit 13 since 1968 and for Unit 11 since 1973. Reasons for the increased harvest are difficult to assess, particularly for Unit 11 where wolves have not been studied. At least part of the Unit 11 harvest could probably be attributed to an increase in hunting pressure. It was also possible that the wolf population in the area had increased. Increases in the Unit 13 harvest, however, can not be attributed to a wolf population increase. A portion of the increased harvest could be attributed to the Department's removal program, however, most could be attributed to the increased efficiency of two aerial trappers and perhaps illegal aerial hunting.

Fewer wolves were legally harvested from packs which inhabited areas of dense spruce cover than from packs which inhabited more open terrain. This probably resulted from the increased difficulty of sighting wolves from aircraft and landing aircraft in dense spruce cover. Most documented instances of wolf dispersal involved packs inhabiting dense spruce habitats. Good examples were Hogan Hill, Keg Creek and St. Anne's wolf packs. We suggest that packs in such areas, particularly along the Susitna River bottomlands, provide a reserve population for emigration to areas where harvesting either eliminates packs or severely reduces population density.

Table 24 summarizes the fate of the 70 wolves radio-collared from April 1975 through June 1978. Excluding experimental removal (12) and collaring mortality (1), the leading cause of known mortality was hunting and trapping harvest (17 of 24, 71%) with ground shooting the most common method (15 of 17, 88%). Natural mortality accounted for four

Table 22. Summary of reported Department and public wolf observations within the Nelchina, Susitna and Copper River Basins from 1 July 1976 through 1 July 1977.

Date of observations	Number and type of observations	Location	Source
1. 7/11/76	1 wolf	Clarence Lake	?
2. 7/16/76	1 wolf	Dump at Glenn-Rich	Russel
3. 8/26/76	2 wolves (black-gray)	15 mile Denali Highway	Gardner
4. 8/29/76	2 wolves (white)	Sikonsina Pass	McMahan
5. 8/31/76	1 wolf (gray)	Athna Lodge	Potterville
6. 9/1/76	1 wolf ("dark")	Mile 34 Denali Highway	Johnson
7. 9/76	7 wolves (2 black-5 Gray)	Between Tazlina Lake and Klutina	Ronning
8. 9/76	5 wolves (gray)	Stuver Creek	? (Ellis)
9. 9/5/76	2 wolves (1 black-1 gray)	Opposite Tyone River on west side Sue	Hunter to ADF&G
10. 9/5/76	1 wolf (white)	Chistochina	?
11. 9/5/76	2 wolves (black-gray)	So. fork of Coal Creek	Hunter to ADF&G
12. 9/6/76	12 wolves (1/2 blk-1/2 gray)	Head of Daisy Creek	M. Haggstran
13. 9/10/76	10-15 wolves (hunter got 2-3)	Between Monsoon Lk. & Maclaren	Hunter to ADF&G
14. 9/15/76	1 wolf	Chistochina	?
15. 9/18/76	5-6 (howls)	Between Boulder and Drop Creek	ADF&G
16. 9/26/76	3 wolves (2 black-1 gray)	N. Roundtop Mtn. on gut pile	McMahan
17. 1/8/76	3 tracks	Between Goose Creek and Oshetna	ADF&G
18. 10/8/76	6 tracks	Between Sanona-Oshetna	ADF&G
19. 10/8/76	16 wolves	White River	Vaden
20. 10/17/76	1 wolf (gray)	Tolsona Lake	Roberson
21. 10/21/76	2-4 tracks	Big bend of Maclaren	ADF&G
22. 10/21/76	2 tracks	On Denali between lodge & Clearwater	ADF&G
23. 10/21/76	2-3 tracks	East Fork of Sue	ADF&G
24. 10/21/76	4-6 tracks	7 miles above hwy. to 15 below	ADF&G
25. 10/23/76	2 tracks	Sue River down to bridge	McMahan
26. 10/23/76	1 track	Between lodge and Clearwater	McMahan
27. 10/29/76	1 wolf (gray)	Kelly Lake	ADF&G
28. 10/28/76	9 tracks	Dickey Lake	McMahan
29. 10/30/76	3 tracks	West of Gulkana on pipe	ADF&G
30. 11/2/76	3 tracks (1 wolf taken)	Warm Sp. Camp	ADF&G
31. 11/3/76	1 track on caribou kill	Marie Lake	ADF&G
32. 11/5/76	6 wolves (4 gray-2 black)	3 miles west of K.C. den on West Fork	ADF&G
33. 11/5/76	2 wolves (gray-black)	Across from Maclaren Lake	ADF&G
34. 11/5/76	2 wolves (gray)	2 miles N. of Tyone Butte on Tyone River	ADF&G
35. 11/5/76	3-4 tracks	5-6 mi. below M. Brushkana	ADF&G
36. 11/8/76	1 wolf (gray)	3-4 miles from H. Hill	ADF&G
37. 11/3/76	1 wolf (gray)	Island Lake on caribou kill	ADF&G
37A. 11/3/76	1 wolf (gray)	SW of Island Lake on caribou kill	ADF&G
38. 11/13/76	5 tracks	W. Fork to Sourdough	ADF&G

Table 22 (cont.)

Date of observations	Number and type of observations	Location	Source
39. 11/13/76	3 tracks	Little Tonsina	McLaughlin
40. 11/17/76	Fresh caribou kill	Lone Butte Lake	ADF&G
41. 11/14/76	2 wolves (gray 1 small female or pup)	Butte Creek	L. Steele
42. 11/23/76	4 tracks (2A-2 pup)	2 mi. S. of Lake Louise	L. Steele
43. 1/2/76	2 tracks	On pipe near Sourdough	ADF&G
44. 10/76 or 12/27/76	6 wolves	Sanford River	ADF&G
45. 12/6/76	6-8 wolves	Lower Tonsina	ADF&G
46. 12/18/76	2 tracks	Chistochina, 2-3 mi. from road	Steele
47. 12/23/76	1 wolf (gray)	Sheep Mountain	Schmidt
48. 1/5/77	1 wolf (gray)	Round Lake	Steele
49. 1/5/77	1 wolf (gray)	N.E. of Round Lake	Steele
50. 1/10/77	3-4 tracks	S. of Ewan Lake & Glenn Hwy.	Hunt
51. 1/10/77	7 tracks	W. Fork Gulkana	Hunt
52. 1/10/77	4-5 tracks	Klutina Lake	Hunt
53. 1/21/77	1 track	Between Sue Lodge-Valdez Creek	Shorty
54. 1/21/77	6-8 tracks	lower Tyone Creek	ADF&G
55. 1/24/77	3 tracks (one trapped and lost)	Fish Lake	D. Hansen
56. 1/24/77	4-5 tracks (one trapped and lost)	Fish Lake	D. Hansen
57. 1/24/77	1 wolf (black)	Simpson Hill	E. McKenzie
58. 3/18/77	15 tracks on moose kill	Tazlina River	H. Billum
59. 3/24/77	12 wolves (gray) on 2 moose kills	Mankomen Lake	C. Farnham
60. 3/77	3-5 tracks	East Fork of Susitna	Hardy
61. Winter	6-7 tracks	Indian River	C. Farnham
62. 4/5/77	6 wolves on moose kill	Woods Canyon on Copper River	A. Fejes
63. 4/8/77	3 wolves (gray)	Ewan Lake	ADF&G
64. 4/8/77	4 wolves	Ewan Lake	J. Smolen
65. 4/19/77	1+ tracks on caribou kill	South of Lake Louise	ADF&G
66. 4/19/77	4 tracks on caribou kill	Copper Lake, Unit 11	ADF&G
67. 4/25/77	3 tracks on moose kill	Natat Creek on Slana, Unit 11	ADF&G
68. 5/10/77	4 wolves (gray)	5 miles west Mankomen Lake	ADF&G
69. 5/10/77	1+ wolf (gray) on collared moose kill	West of the Copper River near Gulkana Airport	K. Bunch
70. 5/20/77	1 wolf (gray)	West of Sheep Mountain	ADF&G

Table 23. Summary of reported Department and public wolf observations within the Nelchina, Susitna and Copper River Basins from 1 July 1977 through 15 May 1978.

Date of observations	Number and type of observations	Location	Source
8/11/77	4-6 tracks	Dan Creek	R. Johnson
9/1-9/20/77	2 wolves	Lone Butte	ADF&G hunter check station
	1 wolf (gray)	Tanawa Lake	" "
	1 wolf (black)	Little Oshetna River	" "
	7 tracks	Confluence Tyone Creek-River	" "
	7 wolves (all gray)	Goose Creek and Susitna River	" "
	1 track	Middle Fork Chistochina River	" "
	7 wolves	Little Nelchina River	" "
	20 approx. wolves?	Head of Chistochina River	" "
	1 wolf (black)	8-10 miles N. of Eureka	" "
9/1/77	2 wolves (gray)	Swiss Lake	Hunter to R. Halford
9/1/77	2 wolves (gray)(harvested)	West Fork Susitna River	Hunter to ADF&G
9/7/77	1 track	Lower Clearwater Creek	Hunter to ADF&G
9/26/77	14 wolves on moose kill	W. bank Big Nelchina River	Northright
10/20/77	6 tracks	Trappers Den Lake	R. Carter
10/24/77	5 tracks	Tyone River above village	ADF&G
10/27/77	2-3 tracks	3 miles S. Sourdough	ADF&G
10/28/77	3-4 tracks	Upper Gakona River	ADF&G
10/28/77	1+ tracks on yearling moose kill with bear and cub	Upper Gakona River	ADF&G
10/28/77	1 track	Mouth Windy Creek	ADF&G
10/30/77	5 tracks	1 mile N. Sourdough	ADF&G
10/31/77	3 tracks	Minnesota Lake	ADF&G
10/31/77	5 tracks	Tyone River	ADF&G
10/31/77	2 tracks	Across from Tyone River	ADF&G
10/31/77	2-5 tracks	East Fork Watana Creek	ADF&G
11/2/77	1+ tracks on caribou kill	South side Ewan Lake	ADF&G
11/3/77	3-4 tracks	Mouth Oshetna River	ADF&G
11/3/77	4 wolves (all grays)	On Susitna River between Jay and Watana Creek	ADF&G
11/3/77	2-4 tracks on moose kill	5 miles So. of confluence of Maclaren and Susitna R. on Sue	ADF&G
11/7/77	2 tracks	5 miles So. of confluence of Maclaren and Susitna R. on Sue	ADF&G
11/9/77	3 tracks	On pipeline at Roundtop Mtn	ADF&G
11/11/77	5 tracks	Meiers Lake	ADF&G
11/15/77	5 wolves (all gray)	On Lake Louise Road	J. Dimarco
11/17/77	4-5 tracks	Between Sourdough and Glennallen	ADF&G
11/22/77	1 wolf	On pipeline W. of Gulkana Airport	R. Armstrong
Early winter	3-5 tracks	Mae West Lake	H. Billum
Early winter	3-5 tracks	Ewan Lake	H. Billum
Early winter	6-7 wolves	Drop Creek to Boulder Creek	McMahan
Early winter	7 wolves	Boulder Creek to Sanford River	McMahan
Early winter	18 wolves	Sanford River to Nadina River	McMahan

Table 23 (cont.)

Date of observations	Number and type of observations	Location	Source
Early winter	12 wolves	Nadina River Chesnina River	McMahan
Early winter	5-6 wolves	Chesnina River to Kuskulana River	McMahan
Early winter	12+ tracks	Gold Creek (Susitna)	ADF&G
Early winter	4 tracks	Upper Talkeetna River	ADF&G
Early winter	5 tracks	Indian River	E. Ross
1/10/78	6 tracks (2 harvested)	Between Butte Creek and Deadman Lake	K. Bunch
1/22/78	8-9 tracks on adult and calf moose kill	Mouth of Gulkana River	ADF&G
1/24/78	7 tracks	Matanuska Glacier	R. Giger
1/27/78	4-6 tracks	Head of Moose Creek	ADF&G
1/27/78	2-4 tracks on moose kill	Maclaren River Bend	ADF&G
1/27/78	4 wolves (all grays)	Lower Watana Creek	ADF&G
2/9/78	3-4 tracks on 2 adult moose kills	On Susitna River near Jay Creek	ADF&G
2/9/78	5 old tracks	Moose Creek (Alphabets)	ADF&G
2/9/78	1-2 tracks	Maclaren River cabin	ADF&G
2/11/78	3 wolves (all grays) on adult moose kill	Jay Creek and Susitna River	ADF&G
2/11/78	1 wolf (gray) and 2 tracks	3 miles up Watana Creek	ADF&G
2/11/78	1-2 track	Kelley	ADF&G
3/7/78	2 tracks	15 miles So. Susitna River Br.	J. Wilson
3/7/78	4-5 tracks	W. Fork Gulkana River	J. Wilson
3/78	2 wolves	Mile 10 Denali Highway	C. Gardner
4/6/78	5 tracks	W. Fork Gulkana River	ADF&G
4/6/78	2 tracks	3 miles So. of Birch Lake	ADF&G

[illegible]

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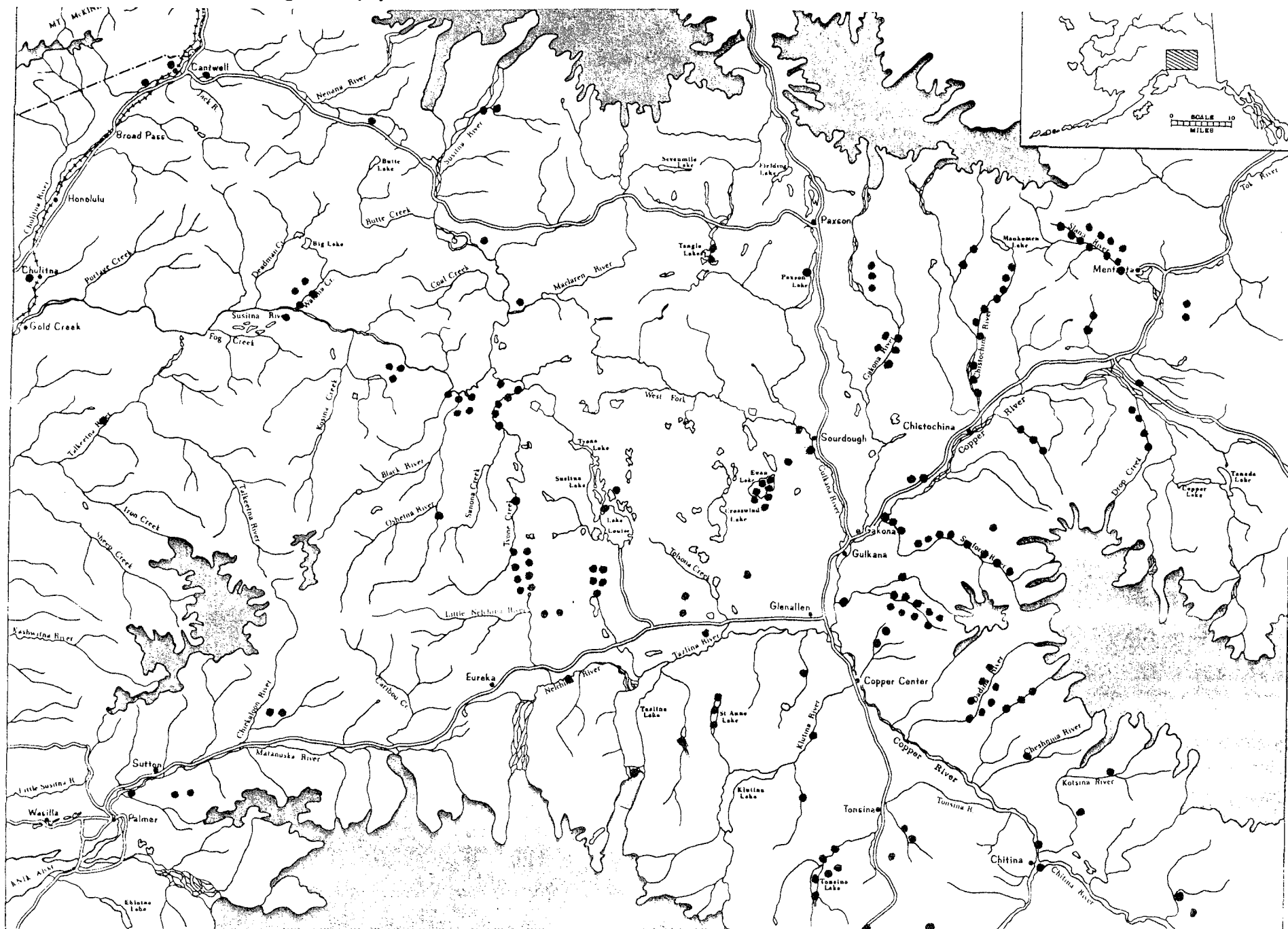


Table 24. Summary of the status of all known radio-collared wolves in GMU 13 of Southcentral Alaska from April 1975 through June 1978.

Original Pack Affiliation	Color, Age and Sex Sex of Individual	Accession Number	Date Radio-Collared	Month Contact or Mortality Occurred	Status of Individual as of 6/30/78	Cause of Mortality
Brushkana	Black Adult Female	61314	04/20/75	1/76	Dead	Experimental removal
Butte Lake	Black Adult Male	61305	04/20/75	1/76	Dead	Experimental removal
Deadman	Gray Adult Male	Unk.	04/21/75	3/76	Dead	Experimental removal
	Black Adult Female	61318	04/20/75	3/76	Dead	Experimental removal
Deep Lake	Gray Adult Male	122067	03/22/76	3/77	Dead	Experimental removal
	Gray Adult Female	122000A	03/22/76	10/76	Missing	
	Gray-brown Adult Female	122009	10/29/76		Alive	
	Gray Adult Male	122096	11/13/77	1/78	Dead	Ground shot
	Gray Pup Male	122204	04/09/78		Alive	
Delta	Gray Adult Male	Unk.	06/06/75	11/76	Dead	Natural mortality
	Gray Pup Male	Unk.	Unk.	Unk.	Dead	Trapped
	Gray Adult Female	122064	03/21/77	4/77	Missing	
	Gray Adult Male	122063	03/21/77	5/77	Missing	
Ewan	Gray Adult Female	122000D	04/15/75	10/76	Missing	
	Gray Adult Male	Unk.	11/04/75	1/76	Dead	Wolf predation
	Gray Pup Male	Unk.	11/04/75	12/77	Dead	Trapped
	Gray Pup Female	122151	02/17/78	3/78	Dead	Natural mortality
Gakona	Gray Adult Male	122005	03/18/76	8/76	Dead	Automobile
Hogan Hill	Gray Adult Male	122000B	11/05/75	4/77	Missing	
	Gray Adult Female	122000C	06/06/75	6/76	Missing	
	Gray Adult Male	122202	04/08/78		Alive	
	Gray Yearling Male	122205	04/09/78		Alive	
	Gray Yearling Male	122206	04/09/78		Alive	
Keg Creek	Black Adult Male	Unk.	04/20/75	3/76	Possibly dead	Illegal aerial hunting
	Black Adult Female	122002	04/20/75	7/76	Dead	Experimental removal
	Gray Adult Male	122083	04/20/75	2/78	Dead	Ground shot
	Gray Pup Female	122201	03/21/76		Alive	
	Black Adult Female	122068	03/21/76	3/77	Dead	Experimental removal

	Gray	Pup	Female	122010	10/29/76	3/77	Dead	Experimental removal
	Gray	Pup	Male	122011	10/29/76	3/77	Dead	Experimental removal
	Gray	Adult	Male	122203	04/09/78		Alive	
Maclaren River	Gray	Adult	Female	Unk.	04/21/75	1/76	Dead	Experimental removal
Mendeltna	Gray-black	Adult	Female	122007	10/29/76	2/78	Dead	Ground shot
	Gray	Pup	Male	122008	10/29/76	11/77	Dead	Ground shot
	Gray	Adult	Female	122095	10/13/77	2/78	Dead	Ground shot
	Gray	Pup	Male	122090	10/13/77	2/78	Dead	Ground shot
Middle Fork	Gray	Adult	Female	Unk.	03/21/76	5/76	Missing	
	Gray	Pup	Female	122062	03/21/76	3/77	Dead	Collaring mortality
	Gray	Pup	Male	122078	03/21/76	2/77	Dead	Ground shot
	Gray	Pup	Male	122061	03/21/77	1/78	Dead	Ground shot
	Gray	Pup	Female	122085	04/28/77	2/78	Dead	Ground shot
Saint Anne's	Gray	Pup	Male	122087	04/28/77	5/77	Missing	
	Gray	Pup	Male	122086	04/28/77	4/77	Missing	
	Gray	Adult	Male	122088	04/28/77	6/78	Missing	
	Gray	Adult	Male	122093	10/11/77	1/78	Missing	
	White	Adult	Female	122094	10/12/77		Alive	
	Gray	Pup	Female	122209	02/26/78		Alive	
	Gray	Adult	Male	122118	02/10/78	4/78	Missing	
	Gray	Pup	Male	122207	04/10/78	4/78	Missing	
	Gray	Pup	Female	122208	04/10/78		Alive	
Sinona	Gray	Adult	Female	Unk.	04/20/75	5/76	Missing	
	Gray	Adult	Male	122038	11/05/75	2/77	Dead	Ground shot
	Gray	Adult	Male	122048	11/05/75		Alive	
	Gray	Adult	Male	122049	03/14/77	3/77	Dead	Ground shot
	Gray	Adult	Female	122084	04/28/77		Alive	
Stephan Lake	Gray	Adult	Female	122016	02/19/76	10/76	Dead	Natural mortality
Tolsona	Gray	Yearling	Male	122210	06/08/78		Alive	

Tsusena	Gray	Adult	Female	122199	02/17/76		Alive	
	Gray	Adult	Male	Unk.	02/20/76	5/76	Missing	
	Gray	Adult	Male	122056	03/19/77	3/77	Missing	
	Gray	Pup	Female	122057	03/19/77	3/77	Missing	
Tyone	Gray	Adult	Female	61323	02/16/76	3/76	Dead	Experimental removal
	Gray	Adult	Female	122001	02/18/76	7/76	Dead	Experimental removal
	Gray	Adult	Male	122097	11/15/77	1/78	Dead	Ground shot
	Gray	Pup	Male	122098	11/15/77	2/78	Dead	Illegal aerial hunting
	Gray	Adult	Male	122099	11/15/77	1/78	Dead	Ground shot
	Gray	Adult	Female	122115	02/10/78	2/78	Dead	Ground shot
	Gray	Adult	Male	122116	02/10/78		Alive	
	Gray	Adult	Male	122117	02/10/78	2/78	Dead	Ground shot
Watana	Gray	Adult	Male	122197	03/20/78	4/78	Missing	

deaths (17%), illegal aerial shooting resulted in two deaths (8%), and one (4%) wolf was hit by an automobile. Illegal aerial hunting was probably under-represented; we observed what appeared to be buck shot holes in several hides presented for sealing which were reportedly taken by ground shooting. We suspect that some of the missing radio-collared wolves were either: 1) taken illegally, 2), if taken legally, reported as taken elsewhere, or 3) properly reported, but no mention made of the radio collar. Of our three confirmed cases of radio-collared wolves being taken illegally, two were found abandoned in the field. All human related causes combined accounted for 83 percent of the known mortality.

We lost contact with 27 percent of the wolves radio-collared during this study. At least five of the missing animals were known to disperse prior to loss of contact. Most of the remainder may be attributable to faulty transmitters.

Wolf Dispersal

Table 25 lists the radio-collared wolves known to have moved from their resident pack territories during the study period. Six of these eight wolves were males with ages ranging from 11 months to 6 years. Most dispersed in either early summer or early fall. None of the wolves known to have emigrated from established pack territories returned and at least five were known to have formed new packs or joined other established packs. Excluding the Deep Lake gray female (000A), which may have moved into the Chugach Mountain Range and was never seen accompanied by other wolves, the average distance moved was 42 mi. Average distance moved for wolves which formed new packs or joined existing ones was 47 mi.

Changes in pack numbers that could not be accounted for by analysis of harvest records suggested that other wolves also may have dispersed from their original territories. For example a total of nine wolves were radio-collared in the St. Anne's pack over a 2-year period. Seven of these disappeared. Either these wolves were harvested and not correctly sealed or they actually dispersed from the area. Since we lost contact with most of these in April through June when few were harvested we believe the latter to be true. Even though some losses could be attributed to faulty transmitters, these animals should have been represented in total pack numbers, but they were not.

Experimental Wolf Removal

During this reporting segment a total of 30 wolves were killed by Department personnel as part of the experimental wolf removal program (Table 26). This brings the total number of wolves removed to 59 since January 1976. Thirteen of these were killed outside the study area, seven from the Keg Creek pack and six believed to be from the Tyone Creek pack. Although only small portions of the territories of these packs overlapped the study area, a substantial number of the study area moose migrated out of the study area and wintered and calved in the territories (Ballard and Taylor 1978b). As a consequence, moose originally thought to be living in areas with very low wolf densities were in fact spending half the year in areas with wolf densities approaching one wolf

Table 25. Summary of data pertaining to radio-collared wolf dispersal in GMU-13 from June 1976 through June 1978.

Pack Affiliation	Wolf accession #	Color and sex of individual	Estimated age at collaring	Date Radio-collared	Approx. longest distance moved from territory	Date movement occurred
Deep Lake	122067	Gray male	3 yrs ^{1/}	03/22/76	30 miles	August 1976
Deep Lake	122000A	Gray female	9 yrs ^{1/}	03/22/76	20 miles	September 1976
Hogan Hill	122000B	Gray male	2.5 yrs ^{1/}	11/05/75	40 miles	September 1976
Keg Creek	122083	Gray male	3 yrs ^{1/}	04/20/75	45 miles	March to Oct. 1976
St. Anne's	122087	Gray male	11 mo.	04/28/77	30 miles	May 1977
Tsusena	122199	Gray female	2 yrs ^{1/}	02/17/76	60 miles	July 1976
Tyone	122116	Gray male	6 yrs	02/11/78	60 miles	June 1978
Deep Lake	122204	Gray male	11 mo.	04/09/78	30 miles	June 1978

^{1/} Estimates from Stephenson 1978.

Table 26. Summary of wolves taken by Department personnel as part of experimental wolf removal program from July 1976 through June 1978 in GMU 13 of Southcentral Alaska.

Accession #	Suspected Pack Affiliation	Color	Sex	Longbone Age	Date of Harvest	Location
122001	Clearwater	Gray	M	Adult	07/29/76	Upper Valdez Creek
122002	Coal Creek	Black	F	Adult	07/29/76	Upper Coal Creek
122003	Coal Creek	Gray	M	Adult	07/29/76	Upper Coal Creek
122012	Clearwater	Black	F	Adult	10/28/76	Upper Clearwater Creek
122013	Clearwater	Gray	M	Adult	10/28/76	Upper Clearwater Creek
122017	Brushkana	Gray	M	Adult	12/30/76	Brushkana Creek
122018	Brushkana	Gray	F	Pup	12/30/76	Brushkana Creek
122019	Brushkana	Black	F	Pup	12/30/76	Brushkana Creek
122020	Brushkana	Black	F	Adult	12/30/76	Brushkana Creek
122021	Brushkana	Black	M	Pup	12/30/76	Brushkana Creek
122022	Brushkana	Black	M	Pup	12/30/76	Brushkana Creek
122058	Unknown	Gray	F	Adult	03/20/77	Middle Maclaren River
122059	Clearwater	Black	F	Pup	03/20/77	Lower Clearwater Creek
122060	Watana	Gray	M	Adult	03/19/77	Delusion Creek
122010	Keg Creek	Gray	F	Pup	03/22/77	Keg Creek
122011	Keg Creek	Gray	M	Pup	03/22/77	Keg Creek
122067	Keg Creek	Gray	M	Adult	03/22/77	Keg Creek
122068	Keg Creek	Black	F	Adult	03/22/77	Keg Creek
122069	Keg Creek	Black	F	Pup	03/22/77	Keg Creek
122070	Keg Creek	Black	F	Pup	03/22/77	Keg Creek
122071	Keg Creek	Gray	F	Adult	03/22/77	Keg Creek
122072	Clearwater	Black	F	Pup	03/23/77	Valdez Creek
122089	Clearwater	Black	M	Pup	05/28/77	Valdez Creek
122192	Jay Creek	Gray	M	Pup	03/23/78	Clarence Lake
122193	Jay Creek	Gray	M	Adult	03/23/78	Clarence Lake
122194	Jay Creek	Gray	M	Pup	03/23/78	Clarence Lake
122195	Clearwater	Black	F	Adult	03/21/78	Middle Clearwater Creek
122196	Watana	Gray	M	Adult	03/20/78	Fog Creek
122198	Watana	Gray	M	Pup	03/22/78	Fog Creek
122200	Watana	Gray	F	Adult	03/22/78	Fog Creek

per 50 mi². Therefore, attempts were made to remove wolves from packs occupying the western Alphabet Hills and lower Tyone Creek and River floodplain.

From track counts, wolf removal and radio telemetry, we were able to estimate wolf population densities within the Susitna River Study Area from spring 1975 through spring 1978 (Table 27). Estimates of numbers of wolves within the study area for 1975 are from Stephenson (1978). Prior to wolf removal, wolf densities for all of the study areas ranged from one wolf per 148 mi² in spring (pre-parturition) to one per 78 mi² in fall (post-parturition). Densities were higher if actual "wolf habitat" areas were considered (98-52). These pre-removal densities appear average for areas of northerly latitudes and we concur with Stephenson (1978) that the densities fall within the middle range of reported densities. They also are comparable to Rausch's (1967) earlier estimate of Unit 13 population densities. We suspect, however, that the Susitna Study Area wolf population was probably lower than the remainder of Unit 13 because the topography, vegetation and snow cover over most of the area provide ideal aerial wolf hunting conditions.

For purposes of evaluating wolf removal on moose calf survival, spring densities were used, since they would represent the number of adult wolves which potentially would prey upon moose. Obviously, newborn pups would initially have low food demands for a few weeks following birth, but their demands would increase rapidly and probably come close to that of an adult by late November. According to spring density figures, we had a reduction from the spring 1975 wolf density of 42 percent, 53 percent, and 58 percent for springs of 1976, 1977 and 1978, respectively. These latter figures obviously do not consider the presence of two large wolf packs located on the southern boundary of the study area where study moose populations winter. If we include these data our percent reduction in density for the springs of 1976 through 1978 would have been about 37, 54, and 69 percent, respectively. Regardless of which technique was used to estimate wolf densities following control, spring wolf densities averaged at least 50 percent less than the 1975 level.

The rate of immigration of wolves into the study area each year was significant. Movements of individual wolves such as both of the radio-collared Tyone males, (001 and 116), the young Keg Creek female (002) and the Tsusena female (119) which were described under pack histories, demonstrate how rapidly areas void of wolves can be repopulated. With the present rate of immigration and reproduction we suggest that if Department control were to cease, wolf densities would return to the spring 1975 density within 1 to 2 years.

Evaluation of Wolf Removal on Moose

Initially, the effect of wolf removal on moose calf survival was to be evaluated by comparing fall calf:cow ratios as measured by standard moose sex and age composition counts. Pre and post wolf removal ratios within specific count units could be compared. Also, ratios in low wolf density count units could be compared with those in medium to high wolf density count units. This approach presented certain problems.

Table 27. Numbers and density of wolves estimated to occupy the Susitna River Study area from spring 1975 through June 1978.

Possible or Known Pack Affiliation	Spring ^{1/} 1975	Fall ^{1/} 1975	Spring 1976	Fall 1976	Spring 1977	Fall 1977	Spring 1978
Brushkana River- Butte Creek	7	12	2	7	1	2	2
Coal Creek	6?	10?	2	0	0	0	0
Clearwater Creek			3	3	2	0	1
Jay Creek			0	2	2	4	1
Maclaren River	2	6	?	?	1	0	0
Middle Fork of Susitna River			1	2	0	2	2
Watana-Deadman Creeks	2	5	2	4	2	6	1
Subtotal	17	33	10	18	8	14	7
Lone Wolves (10% of subtotal)	2	3	1	2	1	1	1
Total	19	36	11	20	9	15	8
Sq. miles/wolf							
Total area (2804 sq. mi.)	148	78	255	140	312	187	351
Habitat area (1858 sq. mi.)	98	52	169	93	206	124	232

^{1/} Data transformed from Stephenson (1978), numbers for Coal Creek also included Jay Creek.

Calf:cow ratios in a count unit normally fluctuate from year to year and factors such as moose density, climate and habitat vary between count units. Therefore, direct comparisons between count units or between years could obscure or exaggerate the apparent effect of wolf removal unless it was certain that other factors were constant.

In an effort to minimize these problems we selected combinations of count units in which calf:cow ratios had historically fluctuated in phase. The assumption was that, when calf:cow ratios were positively correlated between groups of count units over a period of years, there was a high likelihood that factors influencing ratios in those units were similar. We would expect these units to continue to exhibit similar trends unless some factor was altered in one group of units but not the other. If wolf densities strongly influenced moose calf survival we would expect a divergence in trends between a group of count units in which wolf densities were substantially reduced and another group of units in which densities remained "normal."

We selected combinations of composition count units in which calf:cow ratios, yearling bull percentages and number of moose seen per hour fluctuated similarly prior to wolf reductions (Figs. 6, 7 and 8). Count units 3, 6 and 7 were within the Susitna River Study Area (wolf removal area) while count units 10, 13, 15, 16 and 17 were in areas of "normal" wolf density (Fig. 9). Count areas 2, 5 and 14 were adjacent to the Susitna River Study Area and thus wolf densities in those areas were occasionally influenced by removal activities. Not all count units were surveyed each year. The best correlation of calf:100 cow ratios prior to wolf control was between comparison areas 1 and 4 ($P \leq 0.05$, $r=0.86$).

Trends in calf:cow ratios between comparison areas 1 and 3 and 1 and 4 (Fig. 5) diverged in 1976 and 1977 but not in 1978. Prior to wolf control, calf:cow ratios in the Susitna River Study Area fluctuated, surpassing 30:100 for 4 of 7 years. Therefore, the trends in 1976 and 1977 could have resulted from either reduced wolf predation or just normal variation in other factors.

We also compared percentages of yearling bulls (Fig. 7) between the comparison areas. We would have anticipated a divergence in trends for percent yearling bulls beginning in 1977, had the 1976 calf crop actually experienced greater survival. This was not the case and, although there was an increase in 1978, all the comparison areas continued to fluctuate in the same manner making any interpretation difficult at this time.

Moose seen per hour of survey exhibited a tendency to diverge in 1976 and 1977 but not in 1978. However, this parameter may be influenced by a number of factors and any short term changes are not likely to be related to wolf density.

This evaluation of wolf removal was based on the premise that one factor, wolf predation, was responsible for low calf survival. If this hypothesis were correct, removal of this factor should have produced substantial increases in calf:cow ratios, particularly since moose pregnancy rates were high (Ballard and Taylor 1978b). We did not select

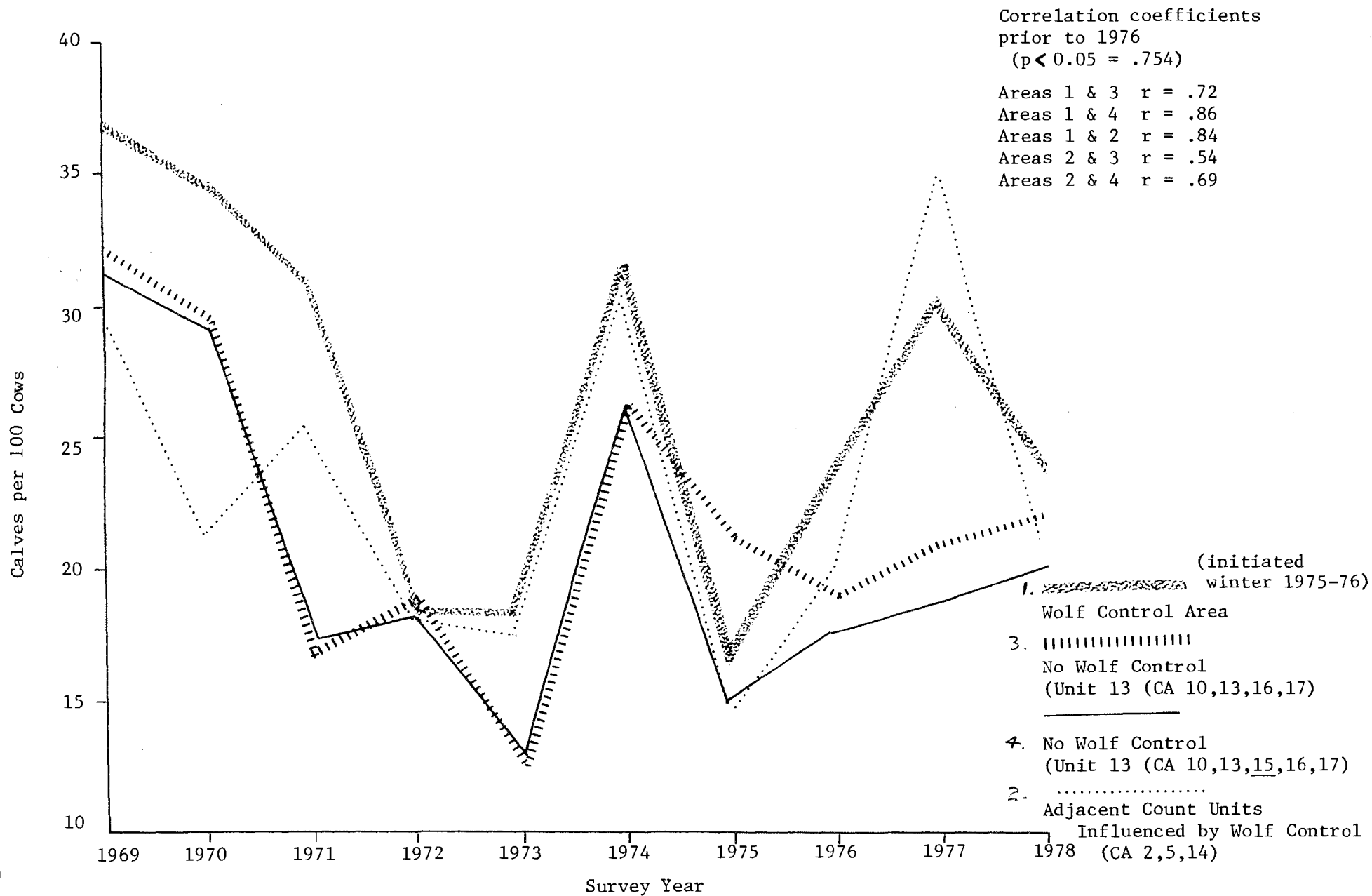


Figure 6. Calf per 100 cow moose ratios from selected moose sex and age composition count areas within Game Management Unit 13 of Southcentral Alaska from 1969 through 1978.

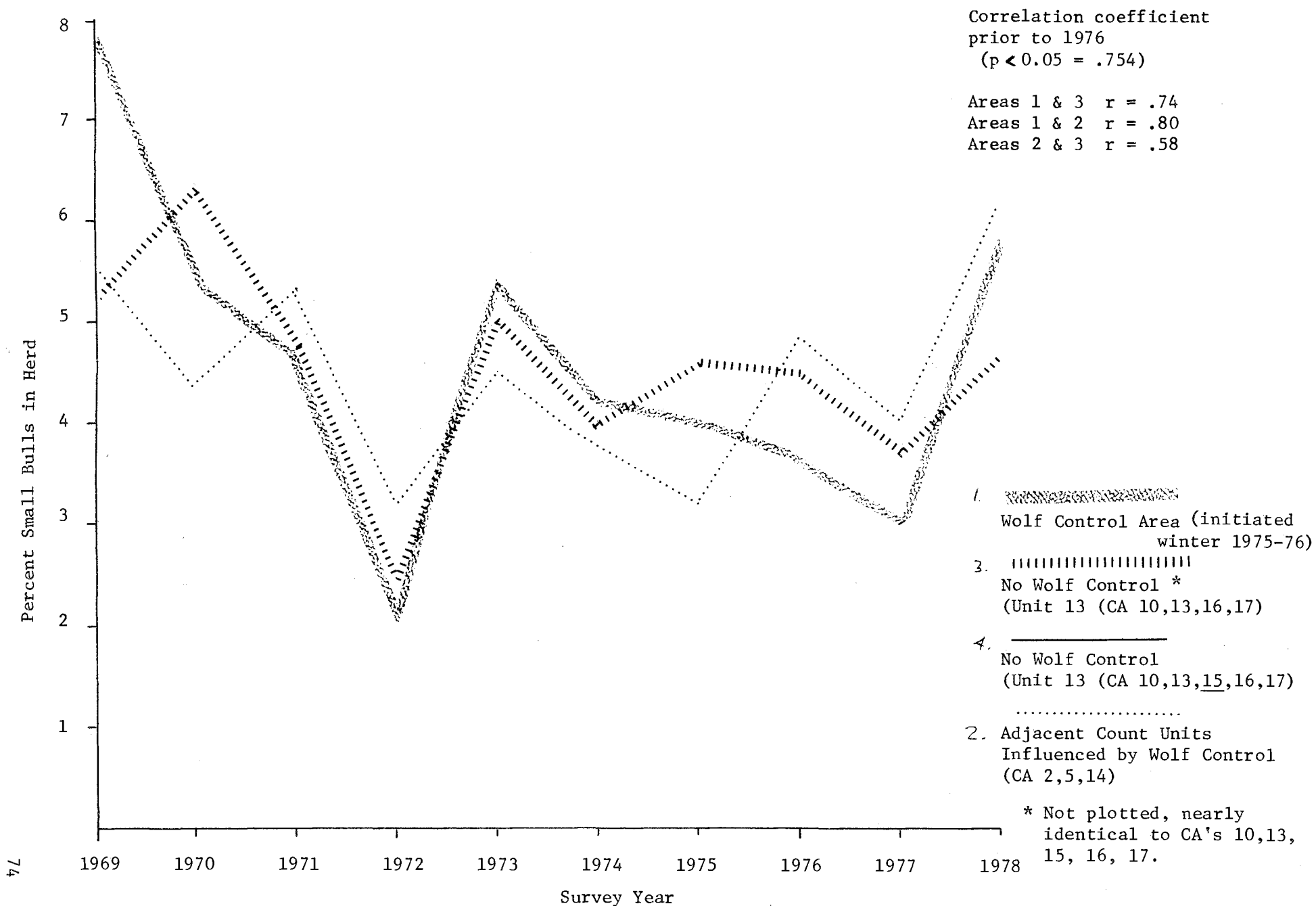


Figure 7. Percent small bulls within selected moose sex and age composition count areas within Game Management Unit 13 of Southcentral Alaska from 1969 to 1978.

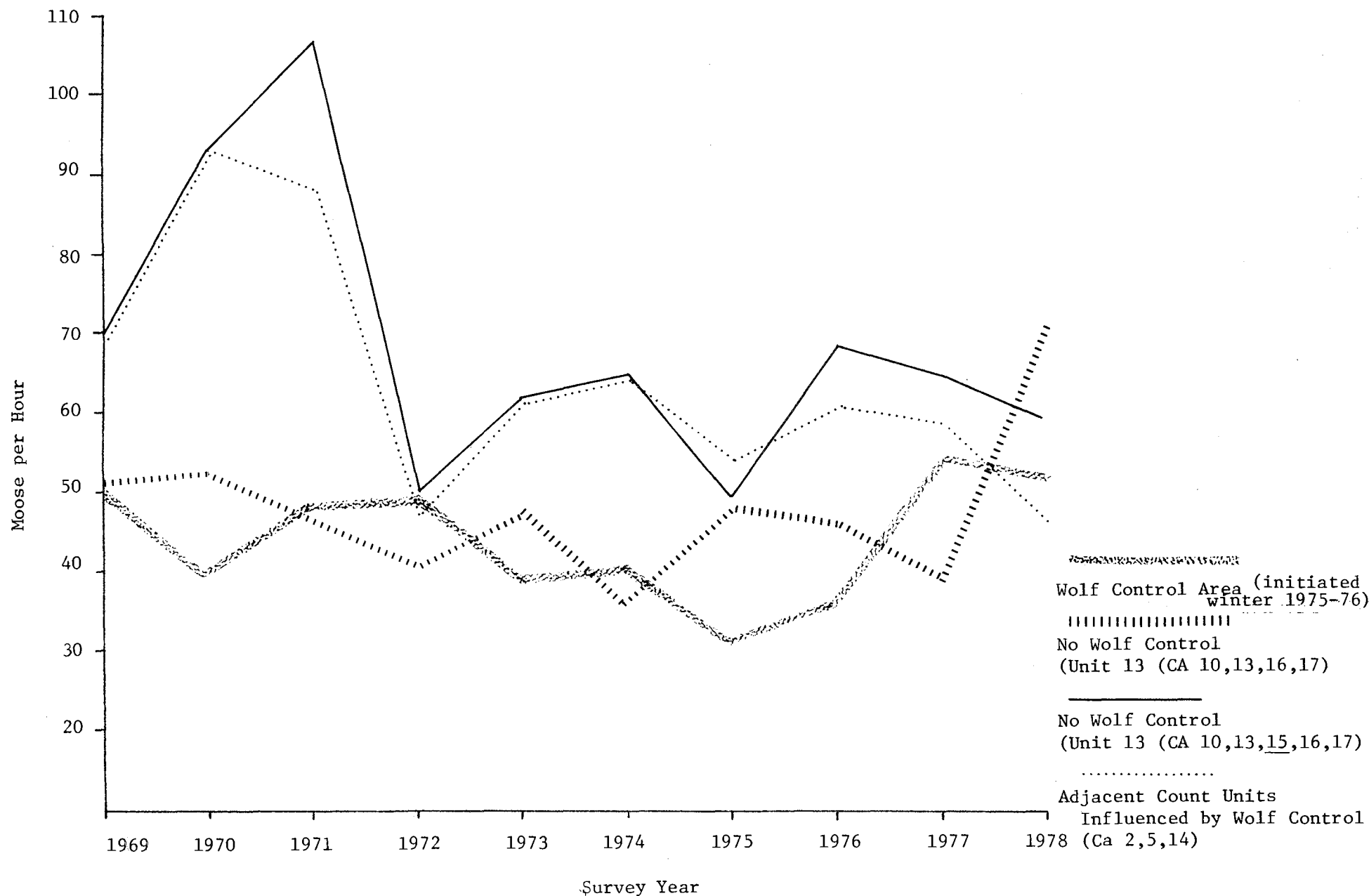
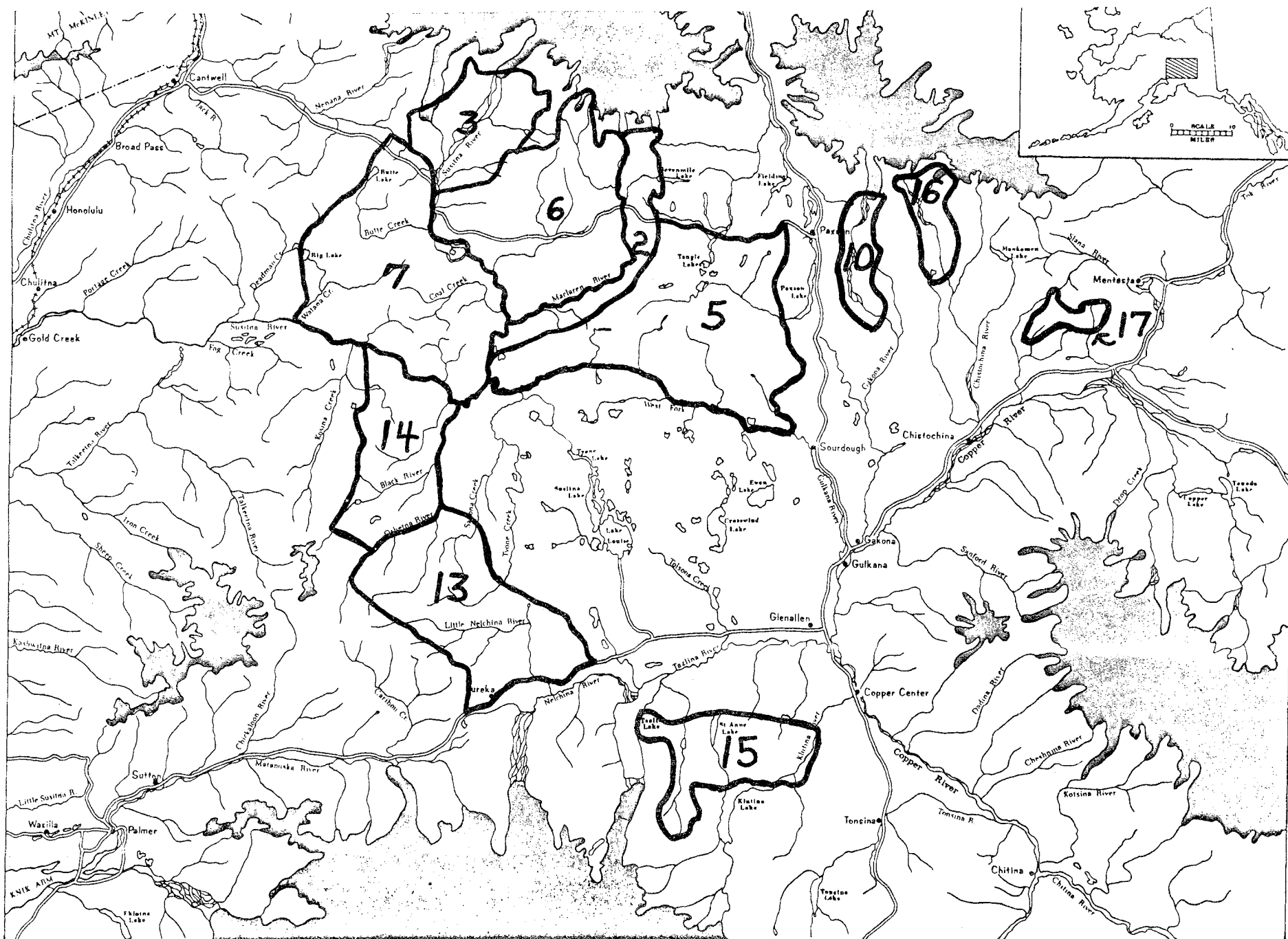


Figure 8. Moose per hour values from selected moose sex and age composition count areas within Game Management Unit 13 of Southcentral Alaska from 1969 through 1978,

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a calf:cow ratio prior to the study, at which we would have concluded calf survival had definitely improved as a result of wolf control. However, a value of 50 calves to 100 cows appeared reasonable if wolf predation were indeed primarily responsible for low calf survival. Obviously the reported ratios were considerably less. If, however, wolf predation was only one of several factors a smaller increase would be expected. Composition counts, as currently conducted, might not be precise enough to measure such small changes. If correct, at least one and preferably several years of composition count data may be needed to evaluate wolf control. Even then, a definite conclusion may not be possible.

Calf:cow ratios for the study area were compared with other moose populations in the state (Fig. 10). Of particular interest were the data from Mt. McKinley National Park (Troyer 1976, 1977 and 1978). Wolf densities in the park have been estimated at approximately one wolf per 50 mi² (Murie 1944 and Haber 1977). Wolf populations in the park are for the most part unexploited and thus we'd expect the moose population to be characteristic of a population subjected to high levels of wolf predation. The study area, the remainder of Unit 13 excluding the Susitna River Study Area, and McKinley Park all have exhibited the same trends in calf:cow ratios since 1974 even though wolf densities differed greatly among these areas. In contrast, however, Unit 20A calf:cow ratios have increased tremendously following wolf removal in 1976.

A second method of evaluating the effects of wolf removal on moose calf survival was instituted in 1977. Newborn moose calves were radio-collared with a radio transmitter which allowed us to investigate the causes of mortality soon after it occurred (Ballard and Taylor 1978b and Ballard et al. in press). During both 1977 and 1978 predation by brown bears accounted for approximately 80 percent of the natural mortality both in the Susitna River Study Area and in other comparison areas. As a result of the calf mortality study, a brown bear study was initiated in spring 1978 which confirmed the results of the calf study that indeed predation by brown bear on moose was high (Spraker pers comm.) Based upon these studies it was not surprising that the moose count data failed to show sizeable increases in calf survival where wolf densities had been lowered.

Based upon wolf predation data presented in Table 15, lack of sizeable increases in moose calf:cow ratios in areas of low wolf density, the results of the calf mortality study, and preliminary results of the brown bear feeding behavior study, it appears that wolf predation on newborn moose calves is not a significant mortality factor in the Nelchina Basin at this time. These data would also indicate that, if wolf control had increased moose calf survival, it has not been significant and certainly not worth the costs of a wolf control program.

Our data on kills made by radio-collared wolf packs indicated a strong preponderance of both 11- to 14-month-old moose and old adult moose. Although wolf predation was not identified as the predominant neonatal mortality factor, it could still be of importance in preventing a moose population from increasing. Further study on rates and causes of yearling moose mortality are warranted.

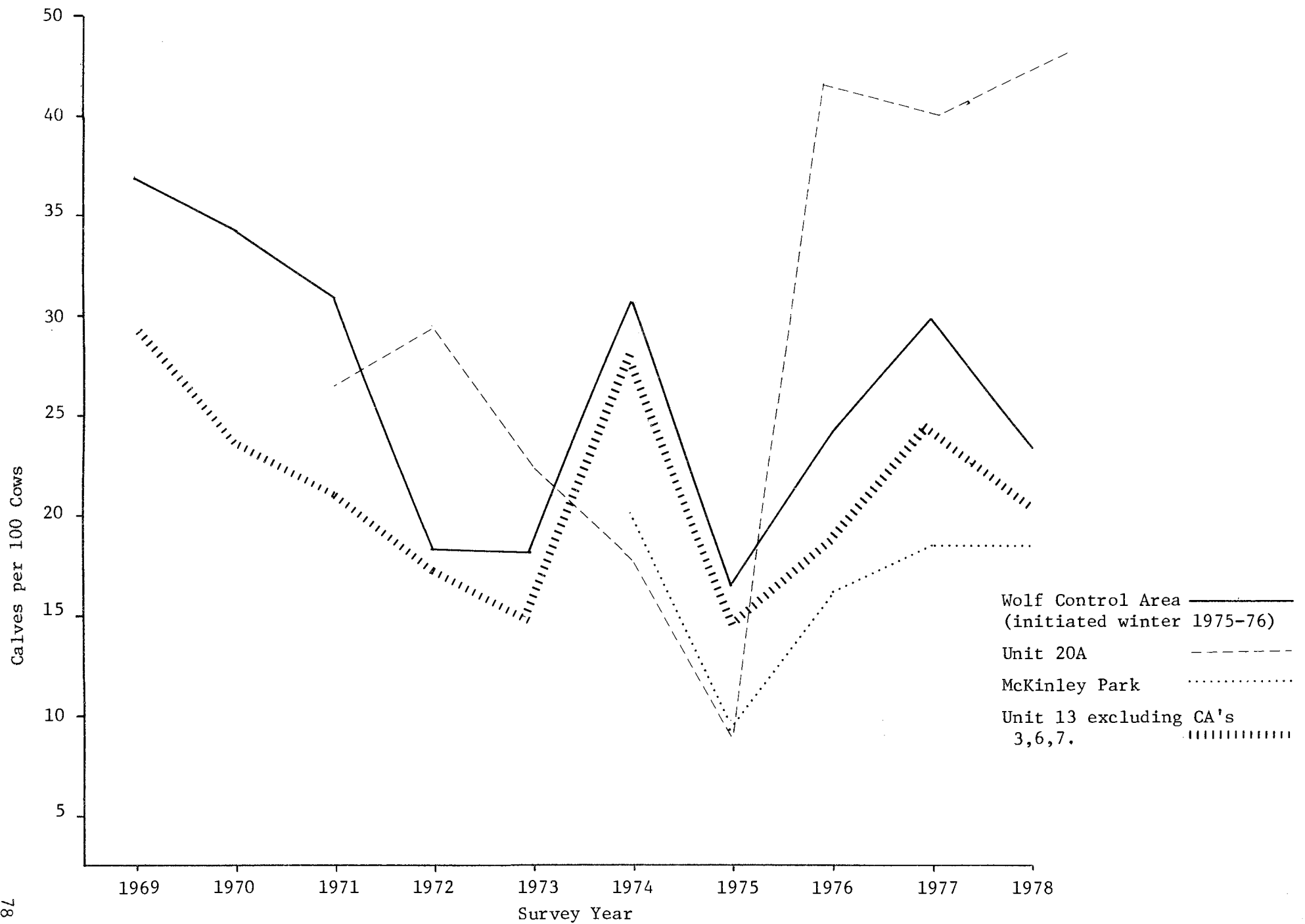


Figure 10. Comparison of calf per 100 cow moose ratios between Susitna River Study Area and other moose populations within Alaska from 1969 through 1978.

Gasaway (pers. comm.) in Unit 20A, located next to Unit 13 on the north side of the Alaska Mountain Range, reported large increases in calf survival for areas where wolves had been removed. In that area black bear (*Ursus americanus*) populations were reportedly moderate and brown bear populations low. In Unit 13, however, where brown bear populations are believed to be high, moose calf survival did not increase when wolf densities were lowered. It is evident that more information is needed on bear-wolf-moose relationships. We speculate that predation by both predator species may be compensatory and that both species would need control if moose calf survival were to be increased.

RECOMMENDATIONS

1. A core area within the Susitna Study Area should be selected and all brown bears within that area should be removed (by transplant) to determine if moose calf survival can be substantially increased and to determine what, if any, other compensatory mortality factors exist.
2. Removal of wolves from the Susitna study area should continue for 1 year in order to facilitate evaluation of bear removal.
3. Wolf populations in Unit 13 should continue to be monitored indefinitely, particularly up to and through a severe winter. Only through long-term study will the population dynamics of an exploited wolf population and its influence on ungulates be understood.
4. Determination of the age and condition of wolf prey taken during both mild and severe winters should receive increased effort. Effort should also focus on determining pack predation rates during all seasons of the year.
5. Determine the rates and causes of mortality of yearling moose.

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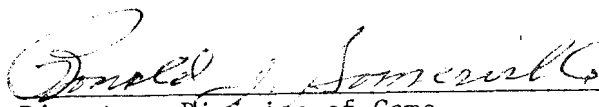
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1977. U.S. Nat. Park Service. Anchorage. Typewritten.

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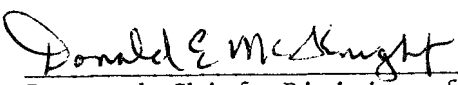
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Appendix 1. Daily observations of individual members of the Hogan Hill wolf pack related to predation for the period 28 May through 28 June, 1978.

Hogan Hill wolf pack--8 adults, 5+ newborn pups.

Radio-collared wolves comprised of adult gray male #122202, yearling gray male #122205 and yearling gray female #122206.

Location	Date	Time	Description of observation
1	May-June 1978		Wolf den contained at least 5 pups.
2	05/28/78	0915	Radio-collared moose calf killed by pack.
3	05/31/78	1040	Wolf 202 observed lying approximately 75 ft. from cow moose standing over calf. Calf was injured. Wolf stood and walked towards pair. Cow chased wolf 100 yards and then returned to calf. Wolf wandered away.
		2200	Returned to area via helicopter and found same moose calf dead and 40 percent consumed.
4	05/31/78	1105	Wolf 205 resting next to small unidentifiable kill. Ravens also present.
5	06/02/78	2110	Wolf 202 observed bedded within 30 feet of fresh yearling moose kill. Wolf appeared full and we estimated the moose to be 30 percent consumed.
	06/09/78	1100	Wolf 206 observed bedded within approximately 200 yards of kill of 06/02/78.
6	06/03/78	2100	Wolf 202 observed being chased by cow moose. No kill located.
7	06/08/78	1020	Wolf 206 observed feeding on old adult moose kill. Almost totally consumed.
8	06/08/78	2045	Wolf 202 observed bedded apparently observing cow moose with calf. Cow was located half-way between wolf and calf and was exhibiting aggressive behavior.
9	06/10/78	1030	Wolf 202 and 206 observed bedded within 150 feet of cow moose with calf. Calf appeared uninjured but cow was facing wolves and exhibiting aggressive behavior.

Appendix 1 (cont.).

Location	Date	Time	Description of observation
10	06/11/78	1300	Wolf 205 observed alone feeding on either adult or yearling moose kill. Estimated kill at 3-4 days old.
11	06/13/78	1000	Wolf 205 observed alone bedded within 1/4 mile of cow moose with newborn calf.
12	06/17/78	2135	Wolf 202 and one unmarked gray adult were observed running from cow moose with calf when spooked by aircraft. Cow was standing in water up to neck facing wolves while calf was swimming toward a small island in the center of the pond.
13	06/28/78	1225	Wolf 205 observed traveling away from old adult moose kill which was totally consumed.

Appendix II. Daily observations of individual members of the Mendeltna wolf pack related to predation and/or bear encounters for the period 27 May through 1 November 1977 (see Figure 1 for approximate location of observation).^{1/}

Mendeltna Wolf Pack - 7 adults, 9 newborn pups.

Adults consisted of radio-collared adult gray male #122083, radio-collared yearling gray male #122008, radio-collared adult gray-black female #122007, uncollared adult gray female, one yearling gray and two black yearlings. Pack had two dens and three rendezvous sites during course of calf mortality study. Only observations pertaining to predation and wolf-bear encounters are presented here.

Location	Date	Time	Description of observation
#1			Main wolf den contained at least six pups.
2			Secondary Nickolson Lake den contained at least three pups.
3	5/28	1040	Wolf 122083 observed resting next to yearling moose kill. Wolf appeared bloated and kill looked fresh. Estimated kill to be 20% consumed.
"	5/29	0925	Yearling moose kill 30% consumed. No wolves observed.
"	5/30	0930	Yearling moose kill unchanged. No wolves observed.
"	5/31	0945	Yearling kill partially consumed since 5/30. No wolves observed.
"	5/31	1900	Yearling kill 50% consumed. No birds on carcass. No wolves observed.
"	6/1	0850	Yearling kill turned over and around indicating had been fed upon.
"	6/1	1830	Kill appeared unchanged from observation taken at 0850.
"	6/2	0955	Kill 60% consumed. No wolves observed.
"	6/4	0915	No change in kill.
"	6/4	1845	No change.
"	6/5	1010	No change.
"	6/5	1915	Kill moved 5 m. to east close to large spruce tree. No wolves observed.
"	6/6	0750	Kill 70% consumed. No wolves observed.
"	6/7	1020	Kill 90% consumed. No wolves observed.

4	5/30	0950	Observed cow moose chase lone gray uncollared wolf approx. 45 m. Cow was within 6 m of catching wolf at one point. Wolf continued traveling towards den. Unknown if cow had calf.
5	6/3	0945	Wolf 122083 observed alone attempting to take calf moose (120092) which was mired in mud. Cow was present and defended calf. Wolf approached from south and made several advances towards calf. Cow would counter charge and kept wolf at least 10 m from calf. This activity lasted 3 minutes at which time the wolf resumed traveling towards den. Cow stayed with calf and began licking it.
"	6/4	0920	Calf still mired in mud and barely alive. Cow bedded down 12 m away.
"	6/4	1910	Calf still alive as evidenced by change in body position. Cow still present.
"	6/5	1015	Calf dead and fully intact. Cow still present.
"	6/5	1920	Dead calf undisturbed. Cow feeding in pond 100 m to east.
"	6/6 thru 6/30		Calf decomposed in mud and was never found by predators or scavengers including birds.
6	6/4	1900	Wolves 122083, 122008, and uncollared gray adult female observed leaving an adult moose kill. Kill had rear quarters missing and was estimated to be 50% consumed.
"	6/5	1915	Wolf 122008 tracked to but not observed at adult moose kill listed for location #6.
"	6/9	1045	Observed wolves 122083, 122008, and one black yearling traveling NE 1.4 km east of outlet on Old Man Lake. Wolves traveled 3.2 km plus in 20 minutes. Pack went directly to adult moose kill listed for location #6 on 4 June.
"	6/9	1900	Adult moose kill totally consumed. No wolves observed.
7	6/11	2100	Wolf 122007 was observed being chased by a cow moose which was exhibiting aggressive behavior (maine ruffed up, ears down and indiscriminate running). Wolf would veer off of a straight line in what appeared to be an attempt to lose the pursuing cow. When wolf appeared to lose cow by crouching in brush the cow would search for the wolf and, in the three instances we observed, found it each time. Cow gained ground on the wolf which appeared tired. On one occasion the wolf stopped and crouched in the brush. The cow ran over to the area and appeared to trample the wolf. Wolf then continued running but at much slower pace and with a limp. This chase lasted approx. 15 minutes at which time the wolf appeared heading for den #2 and the cow

began traveling back the direction from which it had come. Cow continued to exhibit aggressive behavior. Cow began swimming a pond on the other side of which we observed a grizzly bear sow with three yearling cubs. Yearling cubs were huddling over and dragging around a calf moose carcass (#120087). The cow ran around the bears within a 40-50 m radius. Wolf 122008 was present in dense spruce some 150-175 m away from the bears but was not observable.

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| " | 6/11 | 2230 | Returned to calf kill via helicopter. Yearling cubs were huddled over calf carcass when we arrived. As we approached, the startled cubs dropped the calf and ran towards sow. The sow then ran to calf carcass and stood over it until the chopper was within approx. 15 m at which time she turned and lead cubs away. Examination of kill revealed puncture marks on the neck and either puncture or claw marks on the anus. The only portion of the kill which had been fed on was the head. The skull was cleaned out so that all that remained was skin casing. Tongue, eyes and ears had been eaten. Some bear pad imprints were noted in area and bear hair was noticeably evident on surrounding brush. |
| " | 6/12 | 2120 | Calf carcass unmolested. |
| " | 6/13 | 1800 | Calf carcass unmolested. |
| " | 6/15 | 0900 | Calf carcass buried. |
| 8 | 6/12 | 0910 | Aerially tracked wolf 122083 and a smaller drabber gray adult which was judged to be a yearling. Wolves were chasing and harassing same bears observed previous evening. The wolves stayed fairly close to each other while chasing the fleeing bears. When bears stopped running one wolf would crouch and approach sow. Sow would charge the approaching wolf at which time the other wolf would charge and chase the yearling cubs causing the sow to charge the second intruding wolf. On one occasion the wolves treed all three cubs. The wolves appeared to press their charge when the bear's direction of movement was towards den #2 which was less than 2 km away to the east. On one occasion the radio-collared wolf was observed sneaking around and crouching down in front of the bear's direction of movement. Apparently the sow detected this action because when she was approx. 10 m away she charged the crouched wolf and almost caught it by the hind quarters. It appeared that when the bears finally established a trend of movement away from the den the wolves no longer pursued and began heading back towards the den. These activities lasted 15 minutes and covered 0.6 km from where we first observed the bears. |

9	6/14	0930	Wolves 122083, 122008 and two black yearlings observed traveling east. All had bloated stomachs and thus we suspected a kill had been made. Approx. 100 caribou observed in surrounding area.
10	6/14	1720	Wolf 122009 observed alone resting on sand bar. Approximately 60 m away a single adult brown bear was feeding on an adult moose kill estimated to be 80% consumed. Wolf appeared to have swollen abdomen, indicating it also had fed on the kill.
11	6/15	0850	We aeriually tracked wolves 122083, 122008 and one black yearling to calf moose kill (#120089). Wolves were just approaching kill which had one sow brown bear with one yearling cub feeding on it. Kill estimated to be 80% consumed with guts and hide remaining. Approach of airplane and perhaps wolves spooked bears causing them to run from kill. Wolves went directly to kill and began feeding.
12	6/16	1945	Wolves 122083, 122008, a small gray adult (age not estimated), and one black yearling observed attacking an adult brown bear which was on an adult moose kill. Initially three wolves were observed equally spaced surrounding the bear. One of the wolves was observed attempting to nip bear in hind quarters. Bear made several short charges at wolves which were approaching to within 3-5 m. Wolves easily outmanuevered bear and three of wolves appeared to keep bear away from kill as the fourth wolf fed on it. The bear's direction of movement was toward the kill and after 15 minutes of encountering the wolves the kill was reached. When the bear reached the kill the wolves stopped harassing the bear and began traveling in the direction of the main den. Kill was estimated to be 50% consumed.
"	6/17	1040	Moose kill of 6/16/77 had 2 adult brown bears feeding on it. Kill was 80% consumed.
"	6/19	0945	Kill totally consumed and no predators observed.
13	6/22	0925	Wolves 122083 and one adult gray were observed feeding on what we identified as a moose calf.
"	6/22	1200	Ground inspection of kill site revealed the kill had been misidentified. Instead of a calf moose the wolves had been feeding on a yearling brown bear. A portion of the carcass had been buried but most had been consumed. The kill site contained tracks and hair of both bear and wolf.

14	6/24	1655	Observed wolf 122083 alone resting approx. 10 m from an adult moose kill with 1 adult brown bear on it. Head, rear quarters, guts, and skin was all that remained.
"	6/26	1815	Kill 90% consumed and no predators observed.
"	6/29	1020	Observed wolves 122093, one adult gray and one yearling black at kill of 6/24. Two grays resting while black fed on remains of carcass.
15	6/27	2200	Wolves 122083, one gray adult and one black yearling observed resting close to one adult brown bear which was feeding on calf moose kill (#120090). Estimated kill to be 50% consumed with head and front quarters missing. Bear seemed unconcerned by presence of wolves.
"	6/28	1000	Bear still on moose calf kill. Kill almost totally consumed. No wolves observed.
16	7/2	0930	Wolves 122083 and one black yearling were observed holding a cow moose at bay. The plane spooked the wolves and they began traveling north towards den. The moose did not exhibit aggressive behavior characteristic of a cow which had just lost a calf. No kills were observed in the area.
17	7/6	0930	Wolf 122083 observed alone feeding on an adult moose kill. Estimated kill to be 50% consumed. No other predators observed.
18	7/12	0940	Wolf 122008 observed alone feeding on an adult moose kill. Kill was totally consumed. The airplane spooked the wolf and it began traveling east.
19	7/25	0900	Wolf 122007 observed alone resting next to an adult caribou kill. Head was gone and the carcass was skinned. Kill was estimated to be 30% consumed.
20	7/25	0945	Wolves 122008, 122083 and one black yearling observed feeding on caribou calf kill. Kill almost totally consumed.
21	8/8	0710	Wolves 122083, one gray adult, one gray yearling and one black yearling observed scattered around an adult moose kill with one brown bear on it. Two grays and one black were observed huddled together touching noses and wagging tails before separating and charging bear running it away from kill. A third gray hidden by a large spruce ran to the kill and tore off a large chunk of flesh as the returning bear charged. Another gray followed the wolf carrying the meat into the dense spruce. Several bear charges were observed. Bear remained in possession of kill.

22	8/17	1130	Wolf 122008 observed alone feeding on unknown kill.
23	8/25	1845	Wolf 122007 and one black yearling observed standing approx. 30 m from an adult brown bear which was feeding on a moose calf kill (#120092).
24	10/12	1600	Wolf 122008 observed resting near an adult caribou kill.
25	10/19/77	1430	Wolves 122007, 122008, 122083, one gray adult, one gray yearling, two black yearlings, and at least eight gray pups observed feeding on an adult bull caribou kill.

1/ Daily observations were made from 27 May up to 15 July 1977. Thereafter up to 1 November observations averaged once per week.