SUSITNA HYDROELECTRIC PROJECT

PHASE II PROGRESS REPORT

BIG GAME STUDIES

Volume V WOLF

Warren B. Ballard
Jackson S. Whitman
Larry D. Aumiller
Pauline Hessing

ALASKA DEPARTMENT OF FISH AND GAME
Submitted to the Alaska Power Authority
April 1983

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PREFACE

In early 1980, the Alaska Department of Fish and Game contracted with the Alaska Power Authority to collect information useful in assessing the impacts of the proposed Susitna Hydroelectric Project on moose, caribou, wolf, wolverine, black bear, brown bear and Dall sheep.

The studies were broken into phases which conformed to the anticipated licensing schedule. Phase I studies, January 1, 1980 to June 30, 1982, were intended to provide information needed to support a FERC license application. This included general studies of wildlife populations to determine how each species used the area and identify potential impact mechanisms. Phase II studies continued to provide additional information during the anticipated 2 to 3 year period between application and final FERC approval of the license. Belukha whales were added to the species being studied. During Phase II, we are narrowing the focus of our studies to evaluate specific impact mechanisms, quantify impacts and evaluate mitigation measures.

This is the first annual report of ongoing Phase II studies. In some cases, objectives of Phase I were continued to provide a more complete data base. Therefore, this report is not intended as a complete assessment of the impacts of the Susitna Hydroelectric Project on the selected wildlife species.

The information and conclusions contained in these reports are incomplete and preliminary in nature and subject to change with further study. Therefore, information contained in these reports is not to be quoted or used in any publication without the written permission of the authors.

The reports are organized into the following 9 volumes:

Volume I.	Big Game Summary Report
Volume II.	Moose - Downstream
Volume III.	Moose - Upstream
Volume IV.	Caribou
Volume V.	Wolf
Volume VI.	Black Bear and Brown Bear
Volume VII.	Wolverine
Volume VIII.	Dall Sheep
Volume IX.	Belukha Whale

SUMMARY

In 1982, wolf studies continued in the Susitna River Basin to investigate potential impacts of the proposed Susitna Hydroelectric Project. Between 1 November 1981 and 31 December 1982, 46 wolves were captured and outfitted with transmitter-equipped collars to enable researchers to document movements, denning and rendezvous locations, habitat use, and food habits. Throughout the period, a total of 12 packs and 1 lone wolf were known to be using areas in or adjacent to the Devil Canyon or Watana impoundment zones. Because 4 of these packs were not located until December 1982, they were not included in most analyses. Four hundred radio locations yielded 501 wolf sightings upon which this report is based.

A population estimate of 64 wolves at the end of 1982 in the upper Susitna River Basin was made based on knowledge of 9 packs with an average of 4.9 wolves per pack, added to an estimate of wolves in an additional 4 suspected packs.

Annual fluctuations in wolf numbers were estimated based on several criteria. Recruitment to packs is due to pup production and immigration into the area. Illegal aerial hunting accounted for the highest mortality (24%) within 8 intensively monitored packs. Sixteen dispersals accounted for an additional 18% loss of wolves from the basin.

Territory sizes of 5 intensively monitored packs ranged from 127 mi^2 to 602 mi^2 (329 km^2 to 1559 k^2), and averaged 344 mi^2 (891 km^2) in 1982. Territory sizes vary considerably among packs, probably due to pack size, prey densities, frequency of monitoring, and adjacent pack boundaries.

Distribution of wolf packs is suspected to be virtually complete in the basin, with elevational use generally restricted to less than 4,000 ft. Elevational distribution varies seasonally and is probably dependent on relative densities of major prey. Moose and wolves both displayed use of lowest annual elevations in February, with a general increase in elevational use until October with subsequent declines thereafter.

Analyses of food habits of wolves in 1982 were based solely on aerial observations of wolves at kills. Moose of all age classes represented 55% of the diet, with caribou comprising 36%. No analysis of 1982 scat collections has been done, but it was suspected that aerial quantification of food habits underestimates percentage of small mammals (non-ungulates) in the diet.

Impacts of hydroelectric development are difficult to quantify. The most important impact will probably be loss of wintering densities of primary prey species (moose and caribou) in the impoundment zone, with resultant declines in wolf numbers. Secondly, loss of habitat through inundation and facilities development will undoubtedly force wolves to readjust territory

boundaries resulting in intra-specific strife. This will affect not only wolf packs presently in the basin (especially the Watana pack), but also packs far removed from the area.

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INTRODUCTION

The proposed Susitna Hydroelectric Project, consisting of 2 dams and power generating facilities, is expected to impact a vast area in the upper Susitna River Basin. A number of wildlife species occupying the inundation zones and adjacent areas will probably be affected detrimentally. Of particular importance are the effects on moose (*Alces alces*) and caribou (*Rangifer tarandus*) populations. Subsequently, large carnivore and scavenging species will also be affected. The impacts on these carnivorous species which depend on large ungulates for food will undoubtedly be great. Wolves (*Canis lupus*), black bears (*Ursus americanus*), brown bears (*Ursus arctos*), and wolverine (*Gulo gulo*) have been identified as large carnivorous species most likely to be severely impacted (Ballard *et al*. 1982).

Wolves in the upper Susitna River Basin and adjacent areas have been the focus of study for over 30 years (Ballard *et al*. 1981). History of Game Management Unit (GMU) 13 wolves has been described in detail by Ballard *et al*. (In Review). Wolf studies of particular importance to the proposed Susitna Project were reported by Ballard *et al*. (1982) and were designed to gather preliminary data on pack sizes and boundaries, denning, rendezvous, and feeding areas, turnover rates, and feeding habits. Reported herein is a continuation of these studies, designed to determine the potential impacts of the Susitna Hydroelectric Project. This report covers the time period from October 1981 through December 1982.

Wolf pack numbers and territory boundaries are highly dynamic. An analysis of population and territory characteristics for 1 year is valuable, but in order to better understand the dynamics involved, continuing efforts should be undertaken. Therefore, this report serves to expand the data collected during Phase I investigations, with emphasis shifting somewhat to better document spatial use of the habitat. Because the information contained in this report treats only portions of continuing studies, it should not be used in scientific technical publications without the written approval of the investigators.

METHODS AND MATERIALS

Wolves were captured according to methods described by Ballard *et al*. (1982). When practical, blood and hair samples were collected from captured wolves, and the following body measurements were recorded: weight, body length, tail length, heart girth, neck circumference, chest height, shoulder height, and length of canines.

Approximate ages of captured wolves were determined on the basis of tooth eruption and wear. Ages of some harvested wolves were estimated according to methods described by Goodwin and Ballard (In Press). Trappers and hunters were encouraged to provide wolf carcasses by offering them $10.00 per carcass, and an additional $25.00 for turning in radio-collars. Ages of harvested wolves were determined by tooth eruption and wear, tooth sectioning and by examination of epiphyseal cartilage of the longbone (Rausch 1967).

Captured wolves were fitted with radio-equipped collars manufactured by Telonics, Inc. (Mesa, Az.), and were located from fixed-wing aircraft on at least a biweekly basis. Radio-collared wolves were visually observed, when possible, using methods described by Mech (1974). On each tracking flight the following data were recorded: exact location (plotted on 1:63,360 USGS maps), elevation, aspect, slope, associated wolves (color, ages), activity (bedded, feeding, etc.), kill data (species, sex, age,

percent consumed, approximate length of time the animal had been dead), associated species, date and time of observation, and general habitat classification according to Viereck and Dyrness (1980) and Viereck *et al*. (1982).

The size of pack territories was outlined by plotting all radio locations on maps, and connecting the outermost observations (Mohr 1947). Radio locations of pack members in the process of dispersing were not included. A compensating polar planimeter was used to determine territory size.

Information on wolf food habits were collected from observations of radio-collared wolves at kill sites. This method grossly underestimates the precentage of the diet made up of small prey such as rodents and birds, as the smaller items are consumed quickly, and are often impossible to identify from aerial observations. When practical, ungulate kills were examined on the ground according to methods described by Stephenson and Johnson (1973) and Ballard *et al*. (1979). In most cases, the mandibles and a femur or metatarsal were collected to aid in establishing the animal's age (Sergeant and Pimlott 1959, Skoog 1968) and physical condition (Neiland 1970).

Wolf dens and rendezvous sites located through radio-tracking efforts were inspected in August or September after the wolves

had vacated the sites. All scats were collected, and records of other food remains were made. Scats were collected and individually placed in paper bags, autoclaved, and stored for later analysis. Scats collected in 1982 have not been analyzed.

RESULTS AND DISCUSSION

Capture and Telemetry Data

Between 1 November 1981 and 31 December 1982, 46 wolves were captured and instrumented in the upper Susitna River Basin (Table 1). A total of 12 wolf packs and one lone wolf were known to be using areas bordering the Devil Canyon or Watana impoundment zones during this reporting period, although not concurrently. Use of the impoundment zones by these packs is dynamic, as some packs no longer exist (due to harvest and dispersal), and other packs immigrated into the area and were not located until late in 1982.

Four hundred radio locations were gathered from 34 wolves in 8 packs and one lone wolf. As a consequence of these radiolocations, 501 wolf sightings were made of collared and uncollared wolves (Table 2). This does not include sightings of 4 wolf packs (a pack is defined as 2 or more associated wolves) in which members were not instrumented until December 1982 (and thus fewer than 4 relocations were gathered to the end of this reporting period).

Table 1. Wolves captured in the upper Susitna River Basin, Alaska between December 1981 and December 1982.

PACK NAME	ACCESSION NUMBER	DATE OF CAPTURE	AGE	COLOR	SEX	BLOOD PARAMETERS P.C.V.	%Hb
Broad Pass	122414	12/06/82	4	gray	M	47.0	13.5
	122415	12/06/82	pup	gray	M	40.0	15.0
	122416	12/06/82	pup	gray	F	47.5	13.0
	122417	12/06/82	2-3	gray	F	54.0	20+
B-S	122367	12/07/81	2-3	gray	F	NR	NR
	122368	12/07/81	Ad.	gray	M	NR	NR
	122405	4/11/82	3	gray	M	52.0	20+
Canyon Creek	122406	10/14/82	1	gray	F	58.0	20+
Clearwater	122323	10/15/82	2	gray	F	59.0	20+
	122424	12/12/82	Ad.	gray	M	55.5	20+
Goose Creek	122324	12/02/82	3	gray	F	NR	20+
	122423	12/12/82	2	gray	M	57.5	20+
Jay Creek	122199	12/06/81	7	gray	F	55.0	20+
	122355	11/30/81	pup	gray	M	NR	NR
	122356	11/30/81	pup	gray	F	50.5	20+
	122357	11/30/81	pup	gray	F	NR	17.0
	122358	11/30/81	pup	gray	M	48.0	17.4
	122365	12/06/81	2-3	gray	F	53.0	19.0
Maclaren	122369	12/08/81	3-4	black	F	NR	NR
Portage Creek	122361	12/02/81	Ad.	gray	M	44.0	18.4
	122362	12/02/81	2-3	gray	F	47.0	17.8
	122363	12/02/81	pup	gray	F	38.0	14.0
	122364	12/02/81	pup	gray	F	44.0	16.4
	122403	4/10/82	5	gray	F	43.0	16.0
	122404	4/10/82	pup	gray	F	NR	NR
Snodgrass Lake	122330	10/15/82	Ad.	gray	M	60.0	20+
	122366	12/06/81	2	gray	F	59.0	20+
	122407	10/15/82	pup	gray	M	39.0	14.4
Susitna-Stephan	122349	11/13/81	2	gray	M	44.0	18.5
Talkeetna R. I	122359	12/02/81	3	gray	M	54.0	18.5
	122360	12/02/81	2	black	F	NR	NR
Talkeetna R. II	122413	12/03/82	2-3	gray	M	53.5	20+
Watana	122308	4/10/81	4	gray	F	47.0	17.5
	122346	4/11/82	3	gray	F	30.0	12.3
	122400	4/09/82	5+	gray	M	46.0	17.0
	122401	4/09/82	2	gray	M	NR	NR
	122402	4/09/82	pup	gray	F	49.0	17.5

Table 2. Telemetry data and status of wolves captured in the upper Susitna River Basin, Alaska between December 1981 and December 1982.

PACK NAME	ACCESSION NUMBER	NO. RADIO LOCATIONS	NO. WOLF SIGHTINGS	NO. PACK DAYS	FINAL STATUS
Broad Pass	414	2	26	2	Still have contact
	415	2			Still have contact
	416	2			Still have contact
	417	2			Still have contact
B-S	367	33	106	35	Still have contact
	368	33			Still have contact
	405	25			Still have contact
Canyon Creek	406	4	4	4	Still have contact
Clearwater	323	3	6	3	Still have contact
	424	3			Still have contact
Goose Creek	324	4	8	4	Still have contact
	423	3			Still have contact
Jay Creek	199	5	68	8	Illegal harvest
	355	7			Illegal harvest
	356	7			Illegal harvest
	357	7			Illegal harvest
	358	7			Illegal harvest
	365	5			Illegal harvest
Maclaren	369	27	26	27	Killed by other wolves
Portage Creek	361	12	70	20	Lost contact 7/02/82
	362	5			Illegal harvest
	363	16			Lost contact 8/18/82
	364	2			Lost contact 4/10/82
	403	6			Still have contact
	404	10			Still have contact
Snodgrass Lake	330	25	85	27	Still have contact
	336	22			Unknown
	407	3			Still have contact
Susitna-Stephan	331	9	9	9	Shot by ADF&G-Unit 20 control
	349	4			Suspected illegal harvest
Talkeetna R. I	359	4	7	5	Suspected illegal harvest
	360	4			Suspected harvest or dispersal

(continued)

Table 2. (Continued)

Talkeetna R. II	413	2	2	2	Still have contact
Watana	308	26	126	31	Still have contact
	309	1			Capture mortality
	323	18			Dispersed to Clearwater Pack
	324	10			Dispersed to Goose Cr. Pack
	325	0			Dispersed to Nelchina Pack
	345	2			Suspected harvest or dispesal
	346	18			Dispersed to Big Bend area
	400	14			Still have contact
	401	14			Still have contact
	402	15			Still have contact
TOTALS		423	543	177	

INDIVIDUAL PACK DESCRIPTIONS

Broad Pass Pack

An attempt was made in December 1982 to capture and instrument additional members of the Portage Creek Pack. Traditional movements within their territory often took them to the East Fork of the Chulitna River and Broad Pass areas, so an attempt was made to locate them there. On 2 December 1982, a wolf pack containing at least 12 members was located within the area traditionally used by the Portage Creek Pack. Four of the pack members were captured and instrumented (wolves 414 through 417). By the end of 1982, 2 more locations were gathered on this pack, and it was determined that this was not the Portage Creek Pack. This new pack was named the Broad Pass Pack. However by the end of 1982 we had an insufficient number of relocations to accurately establish the boundaries of their territory.

B-S Pack

Throughout 1982, the B-S Pack was comprised of 3 adult members (numbers 367, 368 and 405). They were successful in raising a litter of 4 pups. Because of their differential degree of attentiveness to the den site, it was suspected that wolf 367 was the producing female, 368 was the alpha male, and 405 was a subordinate member of the pack. Wolves 367 and 368 were instrumented in December 1981, and wolf 405 was instrumented in April 1982. At the end of 1982, the pack still contained 7 members.

Excluding one northern exploratory foray by wolf 405, the 1982 territory size included 248 mi^2 (642 km^2). The wolves inhabited an area basically south of the Alphabet Hills, bounded on the west by the Susitna River, on the southwest by Tyone Creek, on the southeast by Tyone Butte, and on the east by Funnel Lake and the West Fork Gulkana River. It is interesting to note that many of the outermost points of the territory were made up by locations of wolf 405, indicating that this wolf was the most exploratory member.

Canyon Creek Wolf #406

In October 1982, a lone yearling gray female (406) was captured and instrumented in the upper Susitna River Basin on Canyon Creek near the Denali Highway. Because only 3 radio locations were obtained between collaring and the end of the year, home range and movements are not yet known.

Clearwater Pack

Contact with the Clearwater Pack was established in December 1982 when Watana wolf 323 was relocated between Clearwater Creek and the Maclaren River. Wolf 323 was accompanied by another wolf which was captured and instrumented on 12 December 1982 (adult gray male 424). Only 3 locations were gathered on this pack to the end of the year, so territory size was not calculated. This

pack was apparently recolonizing the area left vacant after the death of wolf 369 (see Maclaren wolf history).

Goose Creek Pack

Contact with the Goose Creek Pack was established on December 1982 when Watana wolf 324 (adult gray female) was captured and radio-collared. Her lone associate was captured 12 December 1982 (adult gray male #423). They remained together until the end of 1982, apparently well established in the Goose Creek - Oshetna River area. Because of the paucity of relocations, no territory size was defined.

Jay Creek Pack

During winter 1979-80 aerial trappers reported 10 to 11 wolves within the Jay Creek pack area. Six wolves were ground shot at that time. At least four wolves were observed on the Susitna River near Jay Creek during a moose survey in March 1980, indicating that the pack area was still occupied, probably by descendants of wolf 199. No further information on this pack was obtained until November 1981.

Radio contact with the Jay Creek Pack was first established on 30 November 1981. Prior to contact, track sightings and uncollared wolf sightings in the area suggested the pack's presence for quite some time. On 30 November, the pack contained 12

members and wolves 355, 356, 357 and 358 were captured and instrumented (all pups; male, female, female and male, respectively). On 6 December, 2 additional wolves were captured (adult gray females 199 and 365). Wolf 199, originally from the Tsusena Pack, was the alpha female. The Jay Creek Pack inhabited the area from Coal Creek to the Susitna River and Jay Creek without attrition until mid-January when they were suspected to have been illegally shot by aerial hunters. Four wolf carcasses were found on the Susitna River in early March, and it was suspected that the rest had also been killed. The unskinned carcass of wolf 365 was found in July and examination of the carcass revealed punctures in the pelvis which matched the size of 00-buck shotgun pellets.

Maclaren Wolf 369

In early December 1981 an adult black female (#369) was captured and radio-collared near Clearwater Creek. At capture, she was accompanied by 1 gray wolf which was apparently harvested in early January. Regular radio-contact with 369 was continued until 30 October 1982, when she was suspected to be sick or injured. Her carcass was retrieved in early 1983 and indications were that she had been attacked by other wolves, was weakened, and later starved to death. Her territory size during the period she was instrumented was 127 mi^2 (329 km^2).

It was interesting to note that during the time she was being monitored, wolf 369 showed fidelity to a den site, although no other wolves were seen at the den and no pups were known to have been produced.

Portage Creek Pack

The Portage Creek Pack was first located on 2 December 1981, and 4 members were captured and radio-collared (wolf 361 - adult gray male; 362 - adult gray female; 363 and 364 - pup gray females). At that time, there were only 5 individuals in the pack. Relocation of the pack was not successful on 9 succeeding attempts, and it was not until 14 January 1982 that they were found. By then, the pack contained at least 8 members.

By early March the pack had split up, with a maximum of five wolves being seen together. Wolf 362 was suspected to have been illegally shot from the air, as the collar was retrieved and had obviously been cut off and the harvest was never officially documented on mandatory sealing certificates. Two additional wolves were captured and instrumented in April 1982 (403 - adult gray female; 404 - pup gray female) bringing the Portage Creek Pack to 5 members, all of which were instrumented.

Wolf 364 was suspected to have dispersed or was harvested from the pack in mid-April, because she was never again observed with the pack. The den site was located on 14 June at which time the

pack was comprised of 2 adults and 2 yearlings (adults 361 and 403; yearlings 363 and 404). At collaring wolf 403 was pregnant, thus was assumed to be the alpha female. The den site was inspected on 17 September and several pup scats were collected even though no pups were ever observed.

By late fall 1982, radio contact with all but two members of the pack was lost. We suspected that several of the wolves had been shot or dispersed. Wolves 403 and 404 were the only pack members known to be still alive.

Between 2 December 1981 and 4 December 1982, the Portage Creek Pack used an area of 262 mi^2 (678 km^2). This excludes an eastern extension of the territory by wolf 404, as this was thought to be a typical dispersing movement, not within the normal territory boundary.

Snodgrass Lake Pack

Wolf 330 apparently colonized the Snodgrass Lake Pack in November 1981 after dispersing from the Susitna Pack in early May. This 2-year- old gray male was accompanied by another wolf which was captured and instrumented on 6 December 1981 (2-year-old gray-black female wolf 366). They remained together through the winter and were observed at a den site near Butte Creek where at least 6 pups were produced.

Pups began to travel with the adults by mid-September and used an area from upper Brushkana Creek to Clearwater Creek throughout the fall. Total area encompassed within their territory was 602 mi^2 (1559 km^2). On 15 October 1982, the 7-member pack was located and an additional wolf (pup gray-brown male wolf 407) was instrumented.

On 18 or 19 November, a trapper near Susitna Lodge watched an airplane harassing the pack, and subsequently observed the occupant(s) aerially shooting at the pack. He reported that they illegally harvested at least three of the pack members. On subsequent radio-tracking flights, the pack was found to contain only 4 members, including wolves 330 and 407. It was not certain whether wolf 366 had been harvested or her transmitter had failed.

Susitna - Stephan Pack

During the short time the pack existed it was comprised of 2 collared wolves. Wolf 331, originally from the Susitna Pack, had a history of wanderings over much of the upper Susitna Basin (Ballard *et al*. 1982). They had apparently not established a territory during the time they were monitored, as their movements were typical of dispersing wolves.

Wolf 331 was recaptured along with his lone associate (wolf 349, adult gray male) in November 1981 near Stephan Lake. It was sus-

pected that wolf 349 was either another Susitna Pack member or was from the Watana Pack (Ballard *et al*. 1982, page 19).

On 13 December 1981, wolf 349 was suspected to have been illegally shot from the air, as evidenced by airplane ski tracks and blood in the snow. This may have prompted wolf 331 to disperse out of the area.

On 16 April 1982, ADF&G personnel from the Fairbanks office reported the death of wolf 331. He had been harvested by Department personnel as part of control efforts in Game Management Unit 20 near Healy. When killed he was accompanied by 6 wolves, apparently having been accepted into an existing pack.

Talkeetna River I Pack

Contact with this pack was established in early December 1981. The origin of the wolves was unknown but because only 2 wolves (359, adult gray male and 360, adult black female) were present, they probably had recently colonized the area. They were located only 3 times between collaring and 4 January 1982, and were always together. On 16 February, however, only wolf 360 was seen, and the signal from 359 was located in steep, rocky terrain not typical of wolves at this time of year. At this time, wolf 360 appeared to be shy of the airplane, leading us to assume that they had been shot at by hunters. Because the signal from 359 remained at that same location on subsequent flights, it was

assumed that aerial hunters had shot him, and the transmitter had been thrown out of the plane. Wolf 360 was never again located, and it was assumed that she had either been harvested or had dispersed. No estimate of territory size was calculated because of the minimal number of relocations.

Talkeetna River II Wolf (413)

Wolf 413 (adult gray male) was captured on 3 December 1982 on the Talkeetna River upstream of Prairie Creek. Tracks in the area indicated other wolves had been present, but apparently had been harvested because 413 remained alone. Not enough data was gathered on this wolf to accurately determine territory boundaries. Radio-contact with him continued into 1983.

Watana Pack

At the beginning of 1982, the Watana Pack was comprised of at least 10 members, at least 6 of which were adults. The Watana Pack resided in a location (482 mi^2, 1246 km^2) which may have been beneficial to their survival. This area does not have a high incidence of lakes, so hunters and trappers using airplanes do not have accessible landing areas. Much of the area is heavily timbered, further limiting accessibility. In addition, the constant human habitation of Susitna Hydroelectric Project's Watana Camp and associated aircraft frequenting the area may deter illegal hunters from using the area. Whether these factors

or others are responsible, the Watana Pack has historically realized little attrition and has been responsible for production of many wolves which have dispersed to other areas.

Only one Watana wolf was suspected to have been harvested during 1982. This was a wolf found 22 March on the Susitna River, suspected to have been illegally shot from the air.

During 1982 at least 4 radio-collared wolves were known to disperse from the Watana Pack, either joining existing packs or starting new packs. We suspect the reason for the high incidence of dispersal was is due to the low attrition within the pack, resulting in high pack numbers and subsequent dispersals. In previous years, at least 5 other wolves from the Watana Pack were known to have dispersed to new areas.

During recollaring operations in early April, wolf 309 was accidentally killed. When a necropsy was performed, it was learned that this wolf was pregnant. Beginning in early May, however, the Watana wolves were repeatedly located at the den site of 1981, indicating that a litter had been produced. This was later verified. Had wolf 309 not been killed, it is suspected that the pack would have double-denned, producing 2 litters.

Pups were first observed in early July. By the end of summer, the Watana Pack contained at least 18 members, when the pack was beginning to split up. By late October, there were at least

three groups, two of which were thought to be dispersing. Wolves 308, 400, 401 and 402, along with the pups, remained in the Watana territory. Wolf 346 and two associates moved approximately 30 mi (48 km) to the upper Coal Creek-Big Bend of the Susitna area. Wolf 323 and one associate had moved about 43 mi (69 km) to the Round Mountain area, between the Clearwater and Maclaren Rivers and were probably attempting to colonize the area after the death of Maclaren wolf 369. In December, the wolves remained separated and in their respective areas.

Additionally, wolf 324 was captured during the December collaring operation in the vicinity of Goose Creek-Oshetna River. This wolf dispersed from the Watana Pack in late April 1982. Its distance from the Watana den site to recapture location was approximately 26 miles (42 km).

Other Packs

In addition to the above-mentioned packs, other packs not directly associated with the impoundment zones were sporadically monitored during 1982. These packs were usually located by following dispersing wolves out of an existing Susitna Basin pack, and subsequently either initiating new packs or joining existing packs.

As mentioned in the individual pack descriptions, many members of the Watana Pack left that territory and dispersed into vacant

areas or dispersed from the Watana territory to join existing packs. In addition to the Clearwater and Goose Creek Packs that were colonized during 1982, 2 other packs have resulted from dispersals out of the Watana Pack.

The Eureka Pack, inhabiting an area from upper Tyone River to Eureka to the south of the Susitna Basin, was colonized by a Watana wolf (344) prior to 1982. This wolf was accompanied by 2 suspected female wolves in 1982, and they were successful in an apparent double-denning attempt and raised a total of 13 pups.

Wolf 325, another Watana wolf, dispersed to the southeast in 1980, and became integrated into the Nelchina Pack. Accompanied by at least 3 additional adults, this pack was successful in raising 5 pups in 1982.

Suspected Packs in the Middle Susitna River Basin

When known territories of wolves in the upper Susitna River Basin were plotted, gaps sufficient in size to accommodate additional packs were found (Fig. 1). It was suspected that 4 additional wolf packs were present, as evidenced by tracks. Specific population numbers and pack composition were not known for these 4 suspected packs.

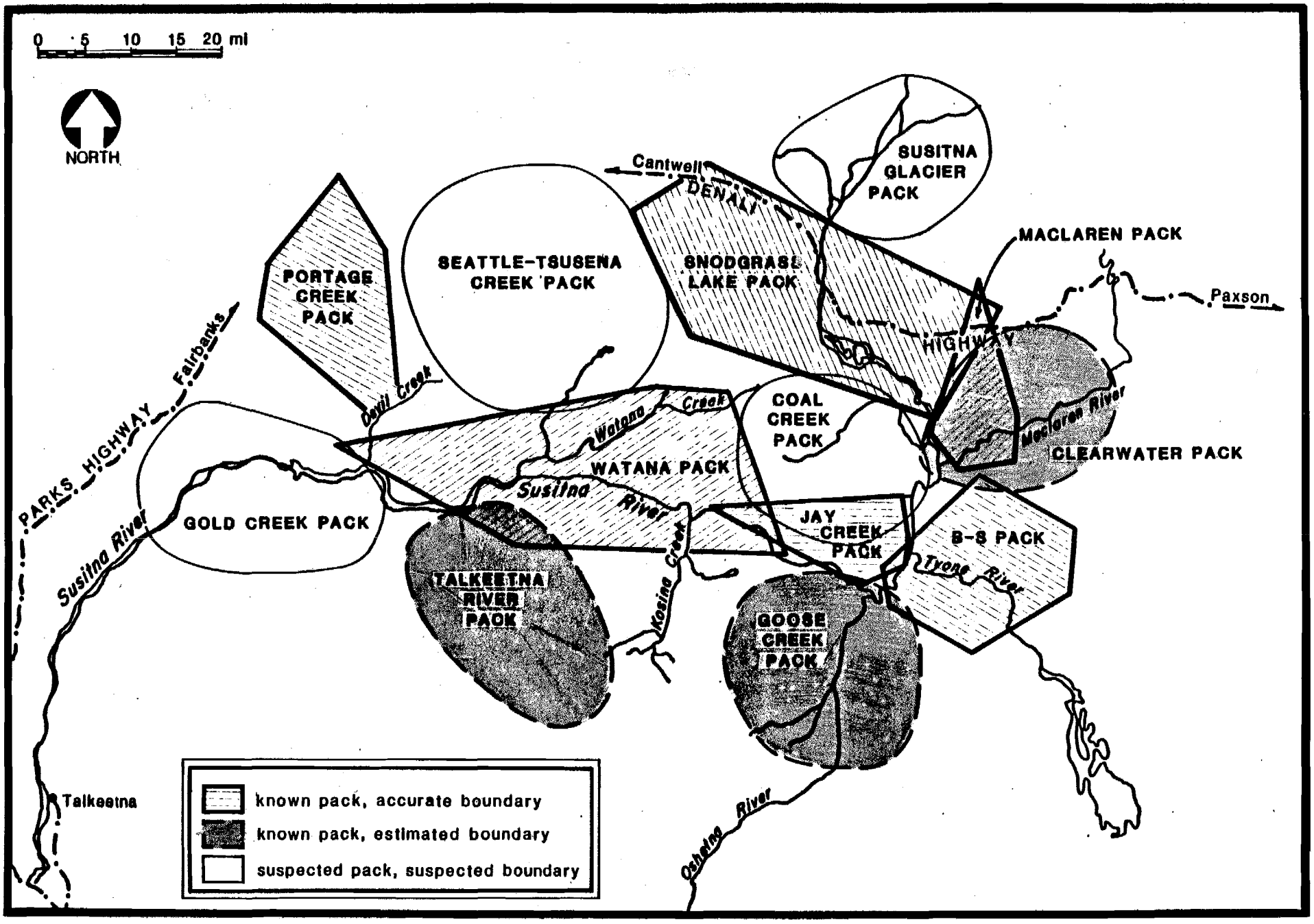

Figure 1. Known and suspected pack boundaries for thirteen wolf packs in the upper Susitna River Basin from December 1981 through December 1982.

POPULATION ESTIMATE

Forty-four wolves in 9 known packs were present in the upper Susitna River Basin in December, 1982. The average pack size of 4.9 wolves was extrapolated to 4 additional suspected packs yielded a total population estimate of 64 wolves.

ANNUAL FLUCTUATIONS IN WOLF NUMBERS

The number of wolves known for 8 packs within the Susitna River study area fluctuated between a high of 51 and a low of 21 from November 1981 to December 1982 (Fig. 2). Annual recruitment to those packs was made up of pup production and immigration into the area (Table 3).

The Susitna River study area is relatively rugged and remote, and as a consequence, few commercial trappers use the area. In 1982 only 5 wolves from the 8 packs were known to have been harvested by trappers or legal ground hunters. Conversely, the lack of people inhabiting the area in the winter and the proximity of the area to population centers such as Anchorage and the lower Matanuska and Susitna Valley's affords easy use by small-aircraft with a relatively high number of aerial wolf hunters using the area. At least 21 wolves were known or suspected to have been illegally shot from the air. This is about 24% of the population and is by far the single most important mortality factor in the study area. Dispersal from the 8 intensively monitored packs in

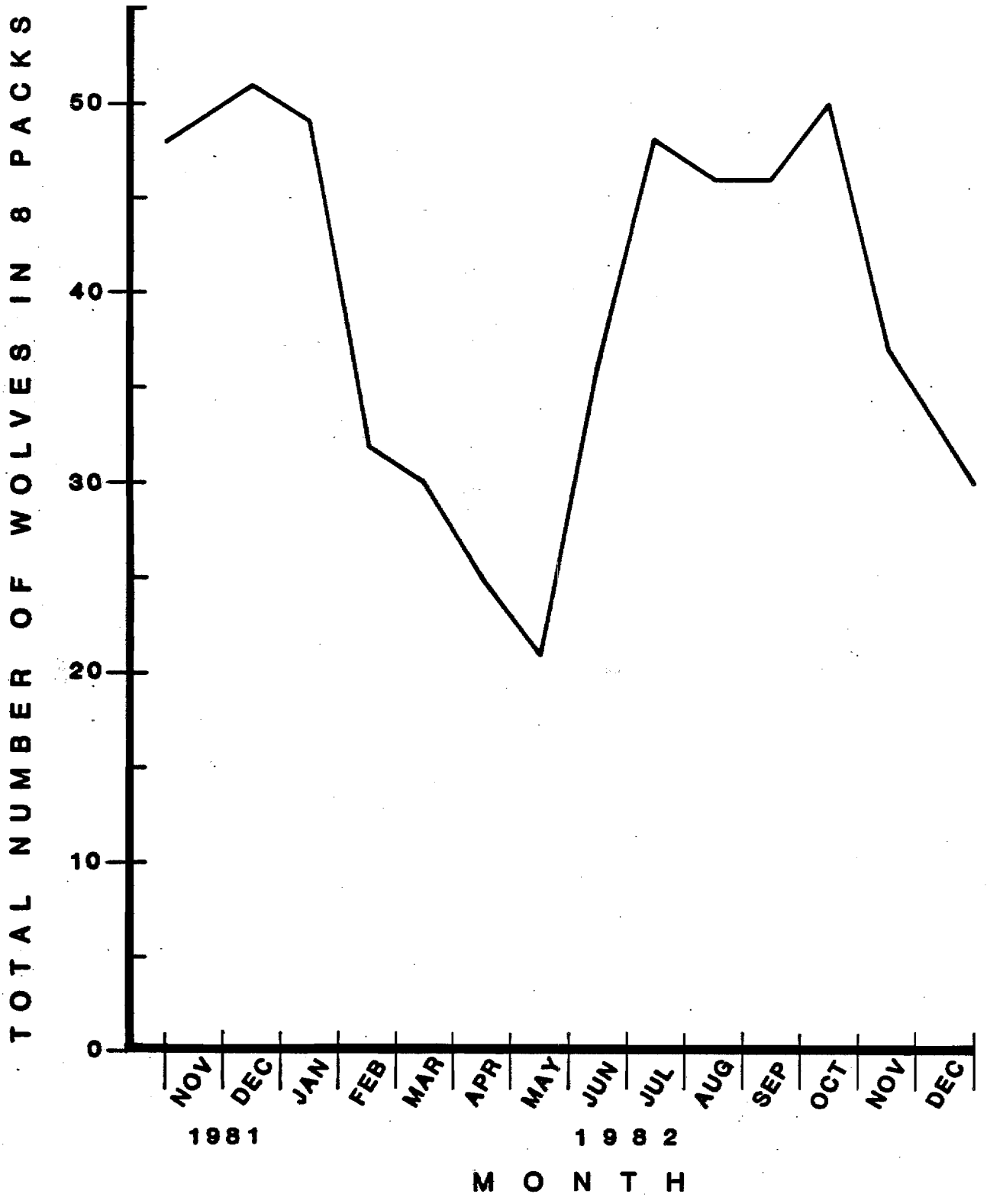

Figure 2. Combined monthly numbers of wolves in eight packs in the upper Susitna River Basin, 1982.

Table 3. Factors which led to changes in numbers of wolves in 8 packs in the upper Susitna River Basin from November 1981 through November 1982.

	1981		1982											
	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Total
Highest No. of Pack Members	48	51	49	32	30	25	21	36	48	46	46	50	37	
Illegal Harvest	0	-2	-15	0	-1	0	0	0	0	0	0	0	-3	-21
Dispersals	0	0	-2	0	-1	-4	-1	0	0	0	0	-8	0	-16
Trapped or Ground Shot	0	-1	0	-1	-3	0	0	0	0	0	0	0	0	-5
Unknown Attrition	0	-2	0	-1	0	0	0	-1	-2	0	0	-5	-4	-15
Immigration	+3	+3	0	0	0	0	0	0	0	0	+4	0	0	+10
Pup Production	0	0	0	0	0	0	+16	+13	0	0	0	0	0	+29
Total Change	+3	-2	-17	-2	-5	-4	+15	+12	-2	0	+4	-13	-7	-18

the upper Susitna River Basin was high. A minim
dispersed from the area to initiate new packs or
packs elsewhere in GMU-13 or adjacent areas. As m
individual pack descriptions, the Watana Pack was
many of the dispersing members.

The fates of 15 wolves were unknown. Because a l
wolves were known to have been illegally harvested
explains the fate of many of these. However, othe
also exist such as dispersal, radio failure, nat
etc.

DISTRIBUTION

Wolves currently occupy all available habitat
Susitna River Basin. Annual mapped territories ge
to some degree (Fig. 1) because of differences in
patterns of individual packs and from the manner i
tories were plotted.

Territory sizes of 5 wolf packs in the upper Susi
ranged from 127 mi^2 to 602 mi^2 (329 km^2 to 1559 k
aged 344 mi^2 (891 km^2) in 1982 (Table 4). This wa
smaller than earlier estimates (Ballard *et al*. 198
ritory sizes may have not yet been adequately des
some packs have only been located a few times.

Table 4. Pack numbers and corresponding territory sizes of 13 wolf packs which were found in the upper Susitna River Basin November 1981 through December 1982.

Pack Name	Pack Size		Territory		No. Pack Days
	Total	Adults	(mi^2)	(km^2)	
Broad Pass	12	?	--	--	2
B-S	7	3	248	642	35
Canyon Creek	1	1	--	--	4
Clearwater	2	2	--	--	3
Goose Creek	2	2	--	--	4
Jay Creek	12	2+	--	--	8
Maclaren	2	2	127	329	27
Portage Creek	6+	4+	262	678	20
Snodgrass Lake	7	2	602	1559	27
Susitna-Stephan	2	2	--	--	9
Talkeetna I	2	2	--	--	5
Talkeetna II	1	1	--	--	2
Watana	16	6+	482	1248	31
			$\bar{X}$ = 344	891	

Variation in observed teritory size for individual packs was due to adjacent pack boundaries, changes in distribution of prey, number & frequency of monitoring, and increases or decreases in pack size as a result of hunting mortality, dispersal, and natality. When a territory is vacant of wolves due to harvest or natural mortality, it is likely that that area will be recolonized by dispersing wolves within a short period of time (in most cases, less than a year) or will be usurped by an existing pack.

Elevational Distribution

Generally, wolves restrict their movements to elevations less than 4,000 ft. For example, the Watana Pack had only 2 of 56 (3.6%) observations greater than 4,000 ft. elevation in 1982.

Elevational distribution of wolves varies seasonally. We suspected that the changes in distribution were largely dependent on changes in prey distribution. For example, the Watana wolves rely heavily on moose (Ballard *et al.* 1982) as a source of prey and it was suspected that their differential elevational use was a reflection of availability of those moose. Mean monthly elevations of nine radio-collared moose that had annual home ranges that overlapped portions of the Watana pack territory were compared with elevations of the Watana Pack (Fig. 3). Lowest mean elevation for both wolves and moose was in February, with both species exhibiting a general increase in elevations occupied until October, with subsequent declines thereafter. This suggests that wolves were following the movements of their principal prey.

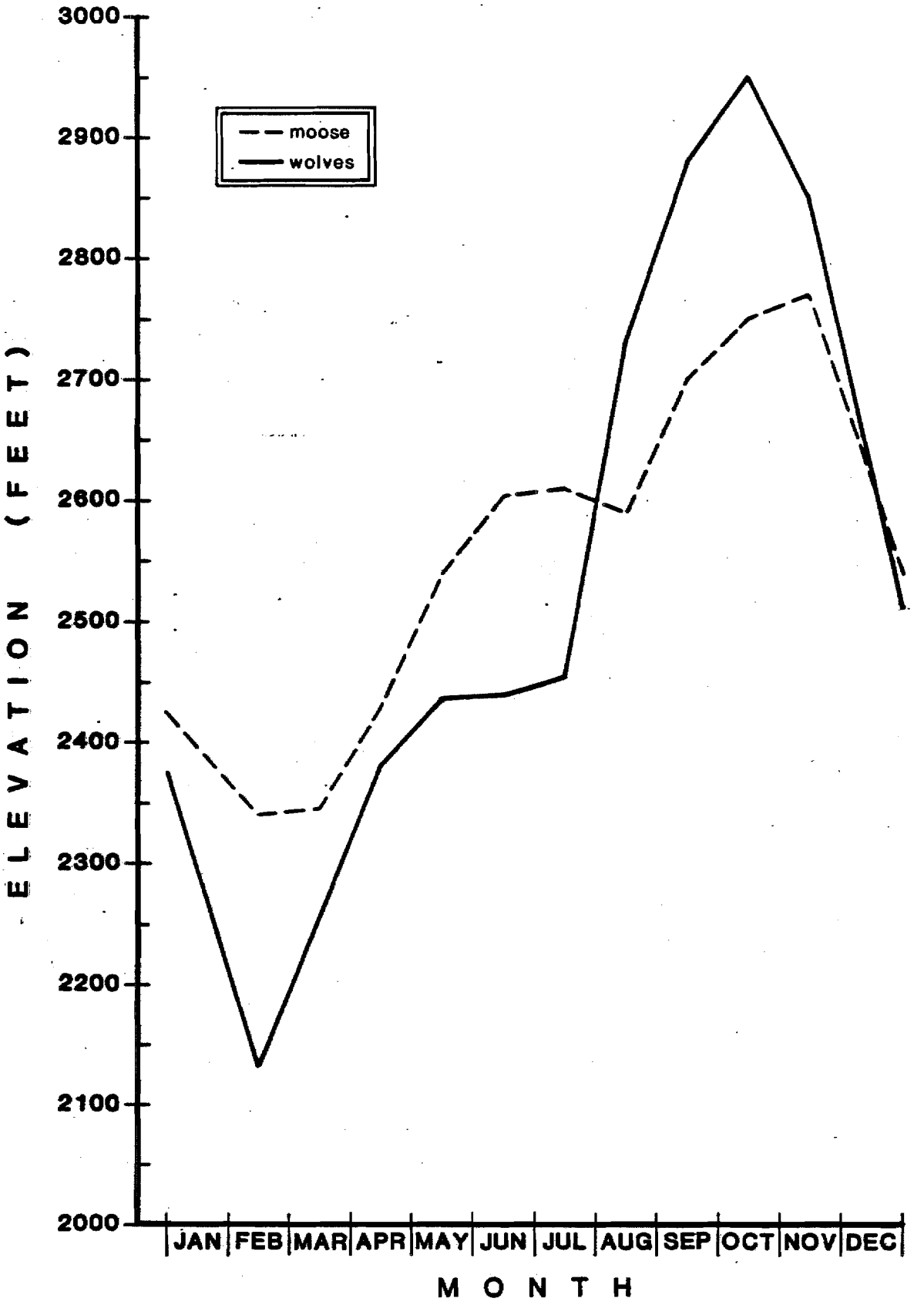

Figure 3. Watana Pack monthly elevations and monthly elevation averages of nine radio-collared moose within the Watana Pack territory during 1981 and 1982 in the Susitna River Basin, Alaska.

FOOD HABITS

Members of seven wolf packs in the Basin were observed at various kills during 1982. Observations of these packs resulted in 47 identified kills (Table 5). Moose of all age classes comprised 55% of the diet (26 observations). Caribou was the next most important item, being found on 17 occasions (36%). Only 3 observations were made of non-ungulate prey items.

Calf moose do not appear to be preferred prey in early summer but from November through May they represent a disproportionate portion of the diet (Ballard *et al*. 1981, 1982). Wolves appeared to select adult moose during most months of the year. There were no differences in wolf selectivity between adult cow and adult bull moose. Also both adult male and female caribou were selected in proportion to their presence in the caribou population. There appeared to be no selectivity for calf caribou.

Incidence of moose and caribou in the wolf diet is probably a reflection of availability due to population numbers. The Nelchina caribou herd reached a low of approximately 10,000 animals in 1973 (Pitcher, pers. comm.). By 1981, the population had increased to approximately 22,000 (*op. cit.*). We suspect the increase in the caribou population has made them generally more available to wolves. If true, this would suggest that as the herd grows, caribou will probably become more important in the diet. This may be beneficial to moose populations in the Basin if caribou populations become high enough to provide the major source of food for wolves.

Table 5. Kills at which 7 wolf packs were observed from November 1981 through December 1982 in the upper Susitna River Basin, Alaska.

	Pack Name															
	B-S		Fish Lk.		Jay Cr.		Portage		Snodgrass		Stephan		Watana		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Moose, Adult	3	33%	2	11%	2	100%	1	33%	1	20%	--	--	2	25%	11	23%
Moose, Yrlg.	--	0	2	11%	--	--	--	--	1	20%	--	--	--	--	3	6%
Moose, Calf	2	22%	2	11%	--	--	1	33%	--	--	1	50%	2	25%	8	17%
Moose, Unknown	2	22%	--	--	--	--	--	--	--	--	--	--	2	25%	4	9%
Total Moose	7	78%	6	33%	2	100%	2	67%	2	40%	1	50%	6	75%	26	55%
Caribou, Adult	1	11%	8	44%	--	--	--	--	2	40%	1	50%	2	25%	14	30%
Caribou, Calf	--	--	--	--	--	--	--	--	1	20%	--	--	--	--	1	2%
Caribou, Unknown	--	--	2	11%	--	--	--	--	--	--	--	--	--	--	2	4%
Total Caribou	1	11%	10	56%	--	--	--	--	3	60%	1	50%	2	25%	17	36%
Sheep, Adult	--	--	--	--	--	--	1	33%	--	--	--	--	--	--	1	2%
Total Ungulate	8	89%	16	89%	2	100%	3	100%	5	100%	2	100%	8	100%	44	94%
Other: Beaver	--	--	1	6%	--	--	--	--	--	--	--	--	--	--	1	2%
Snowshoe	--	--	1	6%	--	--	--	--	--	--	--	--	--	--	1	2%
Unknown	1	11%	--	--	--	--	--	--	--	--	--	--	--	--	1	2%
Total Other	1	11%	2	11%	--	--	--	--	--	--	--	--	--	--	3	6%
Grand Total	9	100%	18	100%	2	100%	3	100%	5	100%	2	100%	8	100%	47	100%

IMPACTS

Impacts of the proposed impoundments and their associated borrow pits, transmission corridors, work camps and facilities are difficult to quantify at this time. However, based on earlier research and that reported herein, some impacts can be estimated.

Probably the most significant impact the impoundments will have on wolves will result from a change in population density, distribution, sex and age composition and/or physical condition of moose and caribou. The majority of the wolf's diet in this area is moose, and any decrease in prey numbers will probably be reflected in both wolf density and distribution. Ballard *et al.* (1983) estimated that approximately 1,900-2,600 moose will be directly impacted by the impoundments. During the impoundment filling stage and for at least a year following inundation, there will probably be an increase in wolf numbers in response to higher concentrations of moose adjacent to the impoundments. There will be a high number of displaced moose which will be concentrated adjacent to the reservoirs due to the decreased availability of usable habitat. However, the duration of this relatively high moose concentration will probably be short, i.e. 2-3 years. After that, deterioration of the habitat will undoubtedly result in relatively lower moose numbers (see moose scenario table). Ultimately wolf numbers will be reduced but for a good period of time they will remain relatively high and further depress the moose population and prevent it from recovering.

Access roads and the proposed permanent village for project personnel will result in a significant increase in human use of the area. Correspondingly, there may be a higher incidence of man-caused mortality upon wolves. Trappers and hunters can be expected to harvest more wolves than current levels, but that harvest will probably be of minor importance to overall wolf population numbers. Indirect effects upon wolves resulting from higher human populations will probably also occur. Activity near den and rendezvous sites in early summer will certainly disrupt, and in some cases, will probably cause wolves to abandon den and feeding sites. Den site abandonment could lead to higher pup mortality.

Inundation of den and rendezvous sites, travel corridors and hunting/ feeding areas will eliminate portions of wolf territories. Loss of this habitat will force wolves to readjust territory boundaries and will probably result in increased inter-pack strife. Since present wolf mortality from some of the packs adjacent to the Susitna River are low (Watana Pack in particular) with subsequent high dispersals to surrounding areas, this area acts as a reservoir in supplying wolves to adjacent areas. Should mortality within these packs increase, there will probably be less dispersal away from the area. Consequently, the reduction of wolf numbers adjacent to the impoundments may well affect not only those packs immediately adjacent to the river, but also packs far removed from the area. Movements of over 50 miles (80 km) away from the Watana territory by wolves which either joined new packs or initiated new packs have been recorded.

To better describe the effects of habitat inundation on wolves, the Watana Pack (because of the relatively high number of relocations) was selected for a further analysis. As mentioned earlier, the Watana Pack occupied a territory of 482 mi^2 (1246 km^2) within and adjacent to both the proposed Watana and Devil Canyon impoundments in 1982. Indeed, 26 out of 58 (45%) of the relocations of Watana Pack members were at or below high pool level of the impoundments (Fig. 4). During the first half of the year (January through June) over half (57%) the recorded observations were at or below maximum pool level. Further, it was calculated that of the 482 mi^2 (1248 km^2) Watana Pack territory, 51 mi^2 (132 km^2) was in elevations over 4,000 ft. and thus used very little (‘4%) by pack members. Reducing the 482 mi^2 (1248 km^2) territory by 51 mi^2 (132 km^2) leaves 431 mi^2 (1116 km^2) of usable habitat. When the area inundated at high pool level (2200 ft. elevation for Watana, 1450 ft. elevation for Devil Canyon) was planimetered, an area of 55 mi^2 (142 km^2) would be lost to the pack. This would account for 13 percent of the land area utilized by the pack. Forty-five percent of the relocations were recorded on this 13% of the total territory, indicating that those elevations with their associated habitat are preferred by the Watana wolves. As mentioned in an earlier section of this report, this is undoubtedly due, at least in part, to higher concentrations of moose in this elevational stratum.

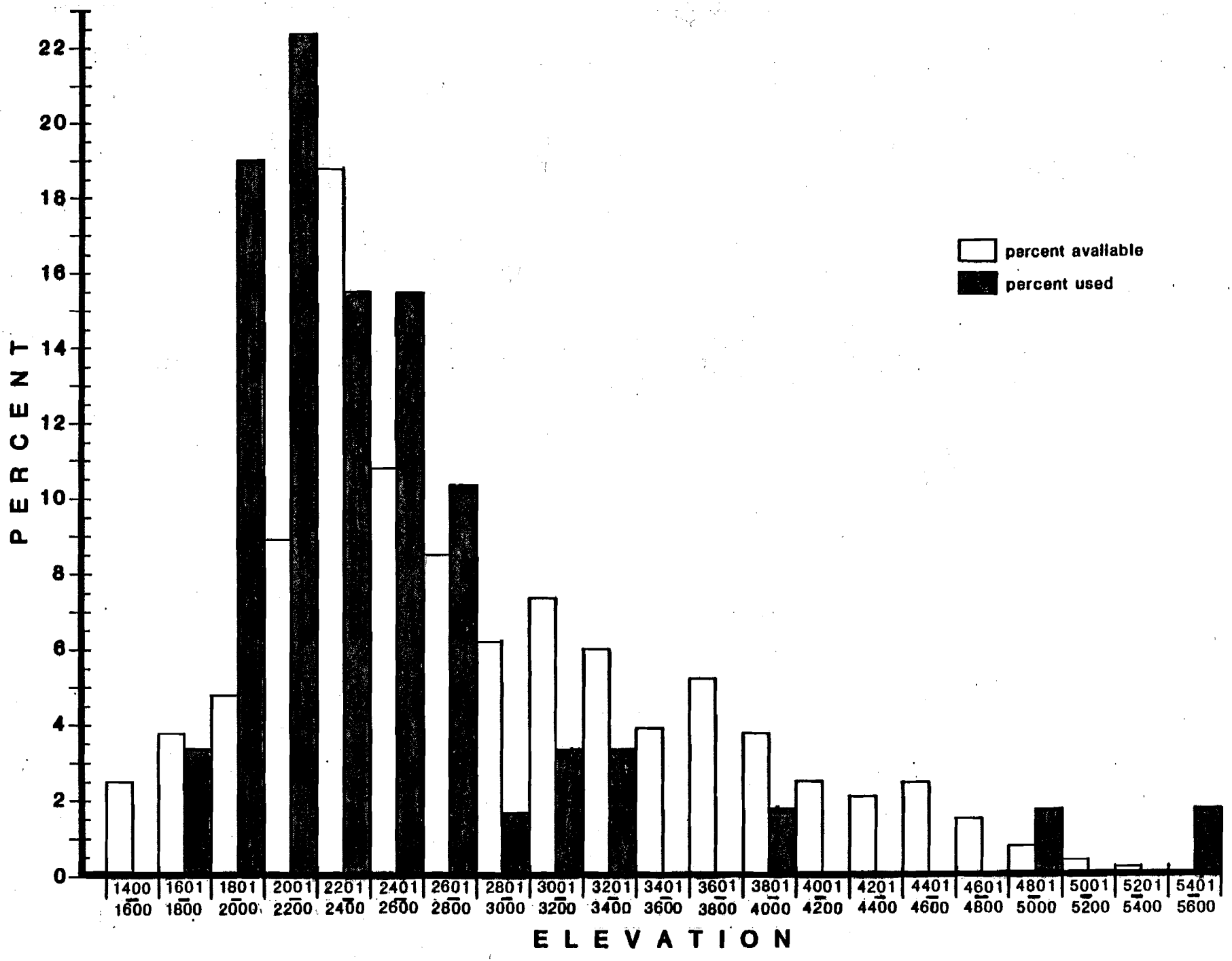

Figure 4. Use and availability of various elevational strata by the Watana Wolf Pack from November 1981 through December 1982.

At the time this report was prepared, information on exact locations and extent of area covered by encampments, borrow sites and road and transmission corridors was not available. However, preliminary site locations have been mapped, and their location will further limit the extent of the Watana territory. The exact percent of habitat loss of the Watana territory is not known. In particular, quarry sites A and B, and borrow sites D, E, F, I, J, and L will at least have portions within the Watana territory and will impact the Watana wolves during and/or after construction of Watana Dam.

The percent of various elevational strata available to the pack (calculated by random selection of 482 points within the Watana territory) compared to the percent of radio-locations at those various elevations shows that between 1801 and 2200 ft. were significantly preferred elevations ($P < 0.005$) (Fig. 4). These elevational strata were available to Watana wolves in 13 percent of their territory, yet were used on 45 percent of the locations. The inundation of this zone will undoubtedly affect the shape and extent of the Watana territory and subsequent recruitment and mortality.

PROPOSED STUDIES

Continuation of monitoring efforts of wolves already instrumented is important. Population and individual pack boundaries are highly dynamic and documentation of denning, rendezvous, and hunting/traveling areas should be continued. Efforts should be made to instrument numbers of additional packs, especially in the area from Devil Canyon to Sherman. Of particular concern is a better representation of preferred habitat types when higher resolution vegetation mapping is finished.

In conjunction with ongoing moose and caribou studies, investigations of calf consumption by wolves should be conducted. More accurate documentation of food habits could be gathered in this way.

Mitigation of the losses of major prey species (moose and caribou) is of major importance to the continued viability of wolf populations. Evaluation of those mitigation options include their impacts on wolves.

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LITERATURE CITED

Alder, H. L. and E. B. Roessler. 1968. Introduction to Probability and Statistics. W. H. Freeman & Co., San Francisco. 4th Ed. 33 pp.

Ballard, W. B., A. W. Franzmann, K. P. Taylor, T. Spraker, C. C. Schwartz and R. O. Peterson. 1979. Comparison of techniques utilized to determine moose calf mortality in Alaska. Proc. N. Am. Moose Conf. Workshop, Kenai, Alaska. (5):362-387.

Ballard, W. B., R. O. Stephenson and T. H. Spraker. 1981. Nelchina Basin Wolf Studies. Alaska Dept. Fish and Game. P-R Proj. Final Report, W-17-9 and W-17-10.

Ballard, W. B., C. L. Gardner, J. H. Westlund and J. R. Dau. 1982. Susitna Hydroelectric Project Phase I Final Report. Volume V - Wolf. 220 pp.

Ballard, W. B., J. S. Whitman, L. D. Aumiller and P. Hessing. 1983. Susitna Hydroelectric Project Phase II Progress Report. Vol. III Moose-Upstream. 61pp.

Ballard, W. B., R. O. Stephenson, S. M. Miller and K. B. Schneider. In Review. Submitted to Jour. Wildl. Manage. for Monograph Series.

Goodwin, E. and W. B. Ballard. Use of tooth cementum forage determination of timber wolves. J. Wildl. Manage: in press.

Mech, L. D. 1974. Current techniques in the study of elusive wilderness carnivores. Proc. XI Internat. Congress of Game Biol. P. 315-322.

Mohr, C. O. 1947. Table of equivalent populations of North American small mammals. Am. Midl. Nat. 37(1):223-249.

Neiland, K. A. 1970. Weight of dried marrow as indicator of fat in caribou femurs. J. Wildl. Manage. 34(4):904-907.

Rausch, R. A. 1967. Some aspects of the population ecology of wolves, Alaska. Am. Zool. 7:253-265.

Sergeant, D. E. and D. H. Pimlott. 1959. Age determination in moose from sectioned incisor teeth. J. Wildl. Manage. 23(3):315-321.

Skoog, R. O. 1968. Ecology of caribou (Rangifer tarandus granti) in Alaska. PhD. Thesis, Univ. of Cal., Berkeley, California. 699 pp.

Stephenson, R. O. and L. Johnson. Wolf Report. Alaska Department of Fish and Game. P-R Proj. Rept., W-17-4. 52pp.

Viereck, L. A. and C. T. Dyrness. 1980. A preliminary classification system for vegetation of Alaska. U.S.D.A. Forest Service. Pac. N.W. Forest and Range Expt. Sta. Report. PNW-106.

Viereck, L. A., C. T. Dyrness, and A. R. Batten. 1982. 1982 Revision of Preliminary Classification for Vegetation of Alaska. Proc. of Workshop on Classificaton of Alaskan Vegetation. 72 pp.