SUSITNA HYDROELECTRIC PROJECT

PHASE II PROGRESS REPORT

BIG GAME STUDIES

Volume VII WOLVERINE

Jackson S. Whitman

and

Warren B. Ballard

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

This report summarizes data collected during Phase I, but is updated to include data and analysis through November 1982 of the Phase II studies. Since inception of the project in April 1980, 17 wolverine have been captured a total of 19 times. All were captured by darting from a helicopter and were fitted with transmitter-equipped collars to allow investigators to gather certain ecological data. A total of 303 point locations have been made on wolverine in the middle Susitna River Basin. One hundred ninety-four locations were gathered by radio telemetry, and the rest were from harvest records, track sightings and uncollared wolverine observations.

Calculations have shown that estimates of wolverine home ranges increase in size depending upon the length of time of radio contact. Thus, calculations that have relied on data gathered for less than 1 year probably underestimate annual home range size. Only one wolverine has been monitored for an entire year (adult male no. 116040) and he occupied a home range of 627 km^2 (242 mi^2). Using this figure, it was estimated that 78 wolverine inhabit the 16,319 km^2 (6301 mi^2) Susitna River Basin, averaging one wolverine per 209 km^2 (81 mi^2).

Elevational movements by instrumented wolverine showed significant differences between summer and winter ranges, averaging 969 m (3,178 ft) and 842 m (2,761 ft) elevation, respectively. It was suspected that this was due to differences in prey distribution and availability on a seasonal basis.

Potential impacts on wolverine residing in the Devil Canyon and Watana impoundment zones are difficult to quantify. Studies should continue in order to gather baseline data on all aspects of wolverine ecology, aiming primarily at home range size, distribution, population density and food habits.

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INTRODUCTION

As a licensing requirement for the Susitna Hydroelectric Project, the Alaska Power Authority contracted the Alaska Department of Fish and Game (ADF&G) to provide baseline data on big game species including wolverine (*Gulo gulo*). Baseline data on wolverine ecology were collected during Phase I feasibility studies (Gardner and Ballard 1982). Wolverine studies have continued during Phase II to provide additional information to be used by the Federal Energy Regulatory Commission in assessing the Susitna Project license application. This report summarizes data collected during Phase I (*op. cit.*) but is updated to include data and analyses from July 1981 through November 1982 of Phase II studies.

METHODS

Efforts to capture wolverine have continued from April 1980 to present. Capture methods followed Ballard *et al.* (1981b). Immobilization of wolverine (Ballard *et al.* 1982) was done utilizing one of three chemical combinations: (1) 0.25 cc phencyclidine HCl (100 mg/ml Sernylan, Bioceutic Lab., Inc.) and 0.20 cc Xylazine HCl (100 mg/ml Rompun, Barrett Division of Cutter Laboratories, Inc.); (2) 0.4 cc etorphine (1 mg/cc M-99, D-M Pharmaceuticals, Inc.) and 0.5 cc Rompun (100 mg/ml); (3) 0.5 cc Sernylan and 0.5 cc promazine HCl (50 mg/ml Sparine, Wyeth

Laboratories, Inc.). Once immobilized, each wolverine was fitted with a radio-collar (Gardner and Ballard 1982), measured, ear tagged, and sex and an estimate of age were recorded.

Instrumented wolverine were located an average of once every 10 days utilizing methods described by Mech (1974). Point locations were recorded on 1:63,360 U.S.G.S. topographical maps and the following parameters were recorded: date, time, activity, number of associates, elevation, aspect, slope, and vegetation type. From these locations, seasonal and annual home ranges were calculated (Mohr 1947). Habitat utilization calculations have been described by Gardner and Ballard (1982). Many of the data were insufficient for statistical analysis or revealed no preferences by the wolverine, and thus are not discussed herein.

Carcasses of harvested wolverine were purchased from trappers at $10/carcass in an effort to gain additional data on distribution, morphology and reproduction. Also, harvest records and track sightings by project personnel and the public were used to supplement tracking data.

Study Area

The study area boundary has been described by Gardner and Ballard (1982). Vegetation, topography and climate were described by Skoog (1968), Bishop and Rausch (1974), and Ballard and Taylor (1980), and by Subtask 7.12.

RESULTS AND DISCUSSION

Capture efforts resulted in 19 captures of 12 male and 5 female wolverine since April 1980. All have been outfitted with transmitter- equipped collars in order to monitor their movements, habitat use, elevational and spatial dispersion, and activities. Table 1 provides a synopsis of radio-telemetry data gathered thus far on the 17 instrumented wolverine.

Sex and Age of Captured and Harvested Wolverine

A total of 97 wolverine have been examined either alive during capture operations or as carcasses purchased from Unit 13 hunters and trappers (Table 2). Sex ratios were not significantly different ($Chi^2 = 0.269$, P‘0.05) from 1:1 (49 males, 44 females, 1 unknown).

The age structure of the population is not known. Data gathered from wolverine carcasses suggest that about 40 percent of the population is made up of juveniles (‘ 2 years old). However, weights of juvenile females (N = 7) were higher than weights of adult females (N = 20). This was not expected and may be due to incorrect aging of these carcasses. Investigators have relied on a subjective estimate of tooth wear to categorize wolverine into either juvenile or adult age classes. Until tooth sectioning or some other reliable aging technique is performed, reliable ages cannot be obtained.

Table 1. Wolverine capture and telemetry data from the middle Susitna River Basin from April 1980 through November, 1982.

Wolverine #	Sex	Age	Weight (kgs)	Date Instrumented	Contact Days*	No. Relocations	Home Range (km^2)	Present Status
116040	Male	Adult	14.5	10 April 1980	371	40	627	Dead - natural mortality
116041	Male	Adult	15.5	19 April 1980	---	---	---	Dead - tagging mortality
116042	Female	Adult	9.5	19 April 1980	114	18	86	Unknown
116043	Male	Unknown	17.7	6 May 1980	213	26	272	Unknown
116044	Male	Unknown	---	7 May 1980	177	13	378	Unknown
116050	Male	Juvenile	17.7	6 March 1981	19	5	89	Unknown
116066	Male	Adult	12.7	13 November 1981	53	7	244	Dead - trapper harvest
116067	Male	Juvenile	14.5	4 December 1981	167	13	259	Transmitter malfunction
116068	Male	Adult	16.3	4 December 1981	218	18	549	Transmitter malfunction
116069	Female	Adult	10.4	5 December 1981	38	4	---	Status unknown
116070	Male	Adult	17.2	6 December 1981	235	20	241	Transmitter malfunction
116071	Male	Juvenile	15.9	8 December 1981	8	3	---	Dead - trapper harvest
116088	Female	Adult	11.3	9 April 1982	67	8	145	Transmitter malfunction
116089	Female	Adult	11.8	9 April 1982	75	7	122	Transmitter malfunction
116090	Male	Adult	19.1	10 April 1982	84	6	479	Status unknown
116091	Male	Adult	16.8	10 April 1982	74	2	---	Status unknown
116092	Female	Adult (?)	13.2	14 October 1982	48	4	---	Monitoring continuing
Totals					1961	194		

* Number of days between date of instrumentation and date of final contact.

Table 2. Sex and age class, and method of harvest or capture of wolverine in the middle Susitna Basin, 1980-1982.

	Adult Males	Adult Females	All Adults	Juv. Males	Juv. Females	All Juveniles	Age Unknown Sex Unknown	Unknown Age - Male	Unknown Age - Female	Total Unknown Age	Total Males	Total Females	Total Unknown Sex	Total
Trapping	11	14	25	5	5	10	0	10	12	23	26	32	0	58
Helicopter tagging	8	3	11	2	1	3	0	2	1	3	12	5	0	17
Ground shooting	1	1	2	3	0	3	0	0	1	1	4	2	0	6
Suspected Aerial Shooting	0	1	1	0	0	0	0	1	1	2	1	2	0	3
Roadkill	0	0	0	0	1	1	0	0	0	0	0	1	0	1
Unknown	2	1	3	0	0	0	1	4	1	6	6	2	1	9
Totals	22	20	42	10	7	17	1	17	16	35	49	44	1	94
Percent	23	21	45	11	7	18	1	18	17	37	52	47	1	100

Movements and Home Ranges

Since April 1980, 17 wolverine (12 males, 5 females) have been located a total of 194 times from fixed wing aircraft (Table 1). At least 5 locations were gathered on each of 12 individuals (9 males, 3 females), and their home ranges were mapped (Fig. 1). The following results and discussion are based on those wolverine.

Problems with wolverine transmitters prior to November 1982 reduced the possibility of tracking those animals for more than 5 or 6 months. However, transmitter design modifications have been made, so long-term monitoring (’6 months) of the same individual, before transmitter replacement becomes necessary, is now possible. Recaptures of instrumented wolverine have shown that the antenna lead-in wire to the transmitter package was becoming worn, with subsequent erosion of the wire and transmitter failure. New transmitters with redesigned antenna lead-ins are now being attached to captured wolverine.

Because of these transmitter malfunctions, only one wolverine (adult male #116040) has been repeatedly monitored for a year. Wolverine utilize large home ranges (Magoun 1979, Hornocker and Hash 1981), and to accurately describe that area, location records probably should be obtained for at least an entire year. Thus, calculations of home range size based on less than one year's data are minimum areas (Table 1).

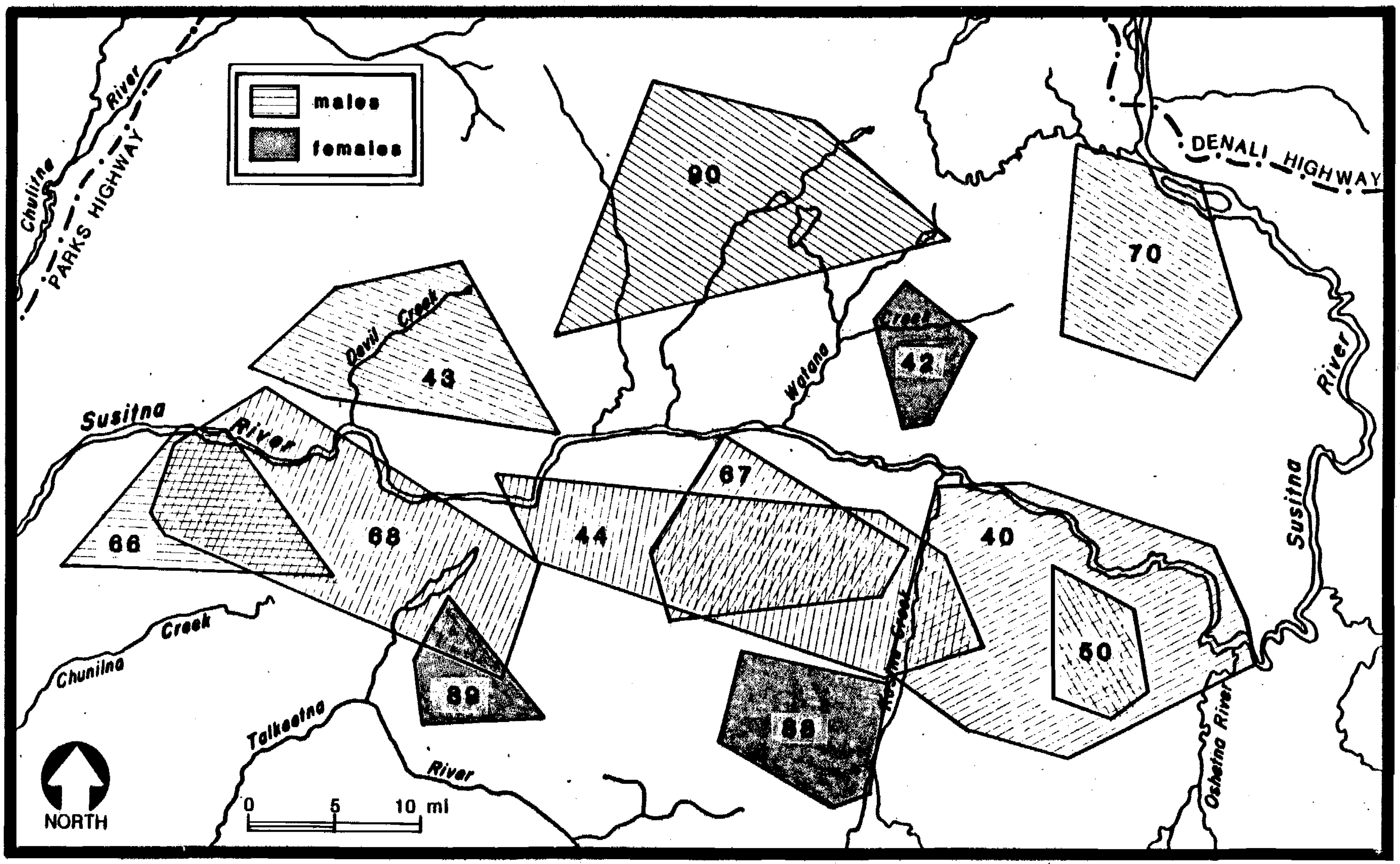

Figure 1. Minimum home ranges of twelve instrumented wolverine in the middle Susitna River Basin, 1980–1982.

In an attempt to quantify how long a wolverine must be monitored to determine an accurate home range size, two statistical methods were applied. In the first, the total number of contact days (number of days between instrumentation and date of last contact), was plotted with the area of their home range polygon, and a simple regression line was calculated (Fig. 2). All wolverine that were monitored long enough to gather at least 5 data points (locations) were used in the test. A positive correlation ($r = 0.696$) existed between length of contact and home range size, supporting the hypothesis that 5 or 6 months of radio contact is inadequate to accurately determine home range size.

In the second test, point locations of individual wolverine were plotted, and areas encompassed within these circumscribed polygons were successively calculated (i.e. locations 1 through 3, 1 through 4, and so on to 1 through n.) After the first 6 months of radio contact with male wolverine no. 116040, home range size continued to increase but at a decreasing rate (Fig. 3). When the curve becomes more horizontal with little or no area being added, an accurate home range is probably attained (Fuller and Keith 1980; Ballard *et al.* In Review).

Twelve instrumented wolverine were subjected to the second test, and all displayed similar increases in home range size. However, because of inadequate transmitter life, most calculated lines did not show indications of reaching an inflection point and therefore, the average home range size of Susitna wolverine has not been adequately described.

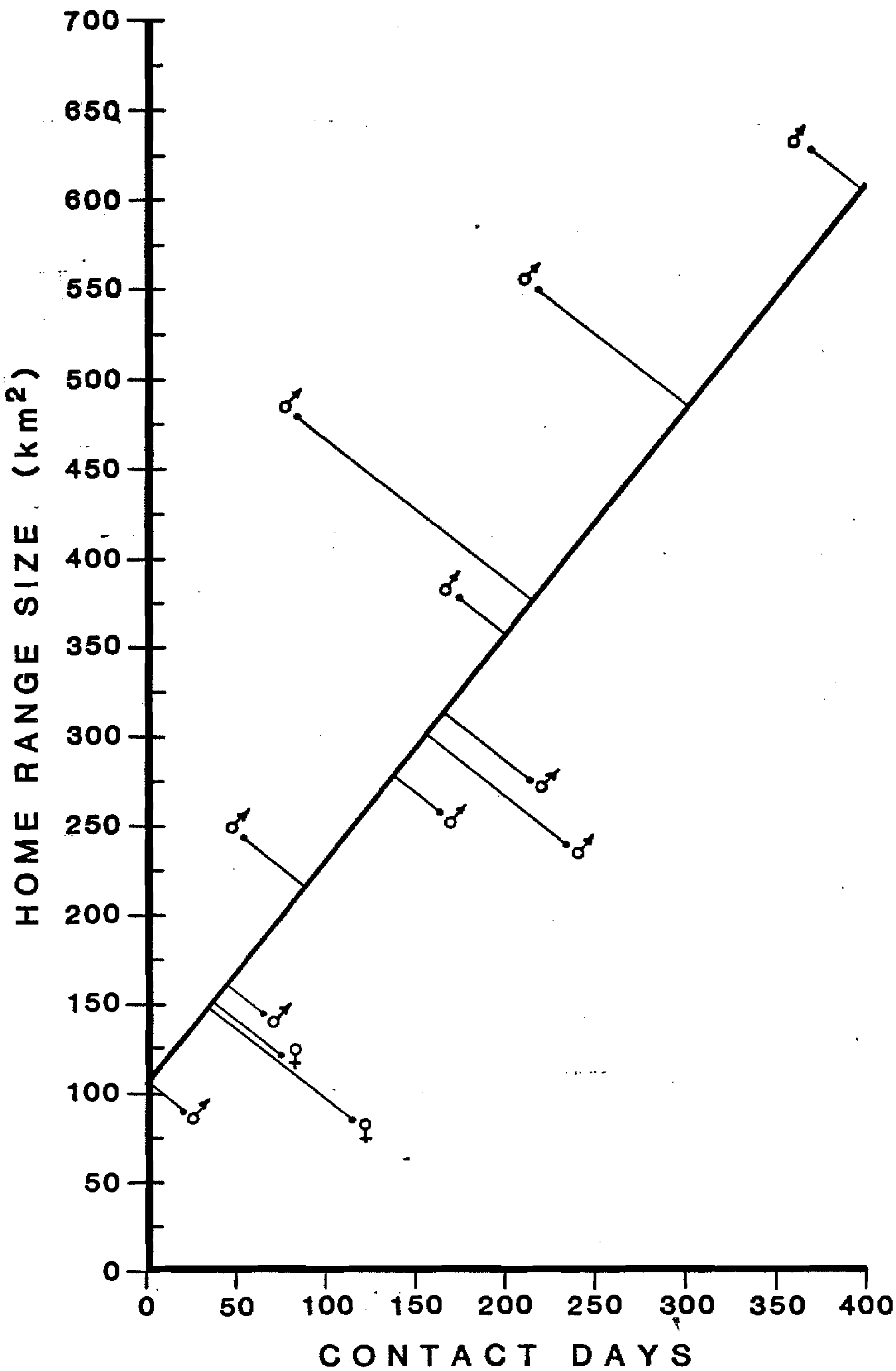

Figure 2. Regression line of home range size with length of time monitored for twelve wolverine instrumented on the Susitna Hydroelectric Project, 1980-1982.

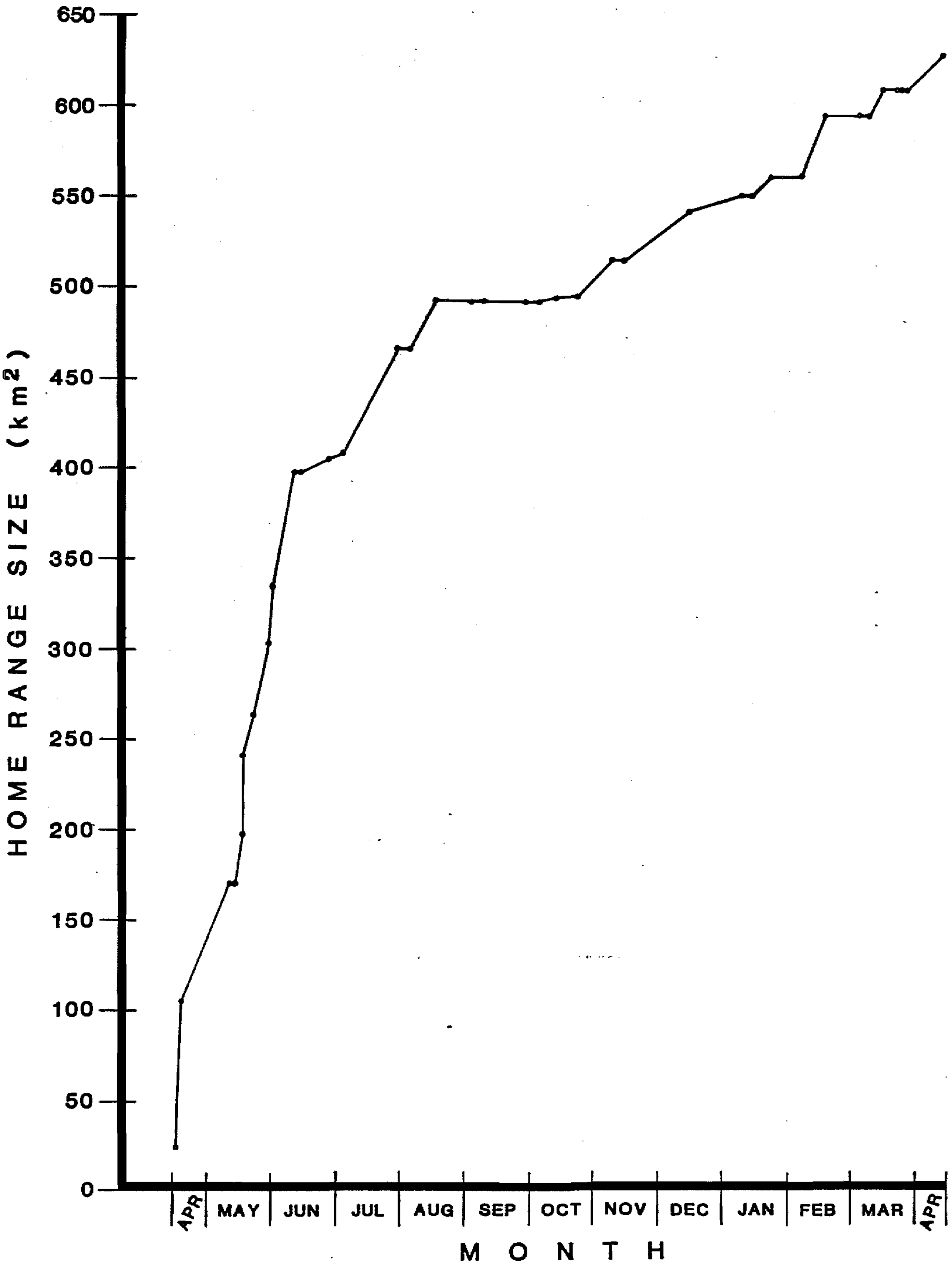

Figure 3. Number of locations and home range size for male wolverine #116040 from 15 April, 1980 to 15 April, 1981 in the middle Susitna River Basin, Alaska.

Distribution

A total of 303 locations of marked and unmarked wolverine have been collected within the middle Susitna Basin since April 1980 (Table 3). Available data suggest that wolverine, although never "abundant", are distributed throughout the basin.

Observations of instrumented wolverine indicate that annual fluctuations occur in distribution. In late spring through late summer (April through September) instrumented wolverine exhibited a tendency to inhabit upland mat-cushion tundra habitats. Monthly elevation averages were calculated for all instrumented wolverine (Fig. 4), and 95% confidence intervals were applied. Although sample sizes were low, the trend indicates an upward movement in spring followed by a downward trend in fall. When the sample was lumped, i.e. October through March, and April through September, and then subjected to the same statistical test, there was no overlap in the elevations used ($P<0.05$) (Fig. 5).

This elevational shift between seasons is probably induced by differences in prey distribution and abundance (van Zyll de Jong 1975, Gardner and Ballard 1982). Although we have not quantitatively sampled prey remains in gastro-intestinal tracts of wolverine, telemetry observations have led to some insights into seasonal diets. Gardner and Ballard (1982) suggested that wolverine may frequent caribou calving areas at the time of

Table 3. Data sources used to estimate wolverine distribution in the Susitna Basin, Alaska, 1980-1982.

Location Type	Year 1980	1981	1982	Total
Harvest points	21	7	5	33
Track observations	9	23	30	62
Radio-location points	85	42	67	194
Wolverine observations	6	3	5	14
Total point locations	121	75	107	303

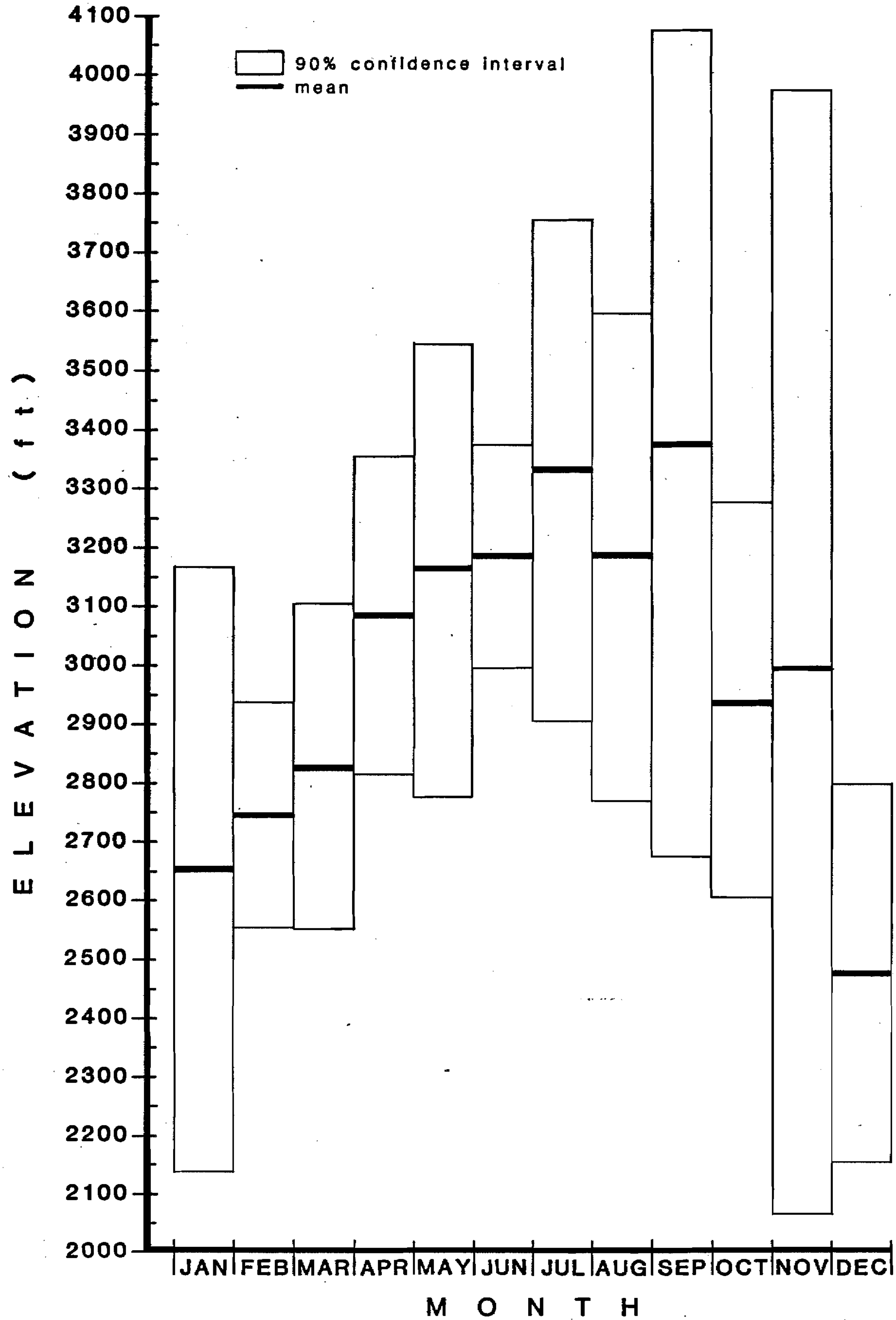

Figure 4. Monthly changes in elevational distribution for twelve instrumented wolverine on an annual basis in the Susitna River Basin, 1980-1982.

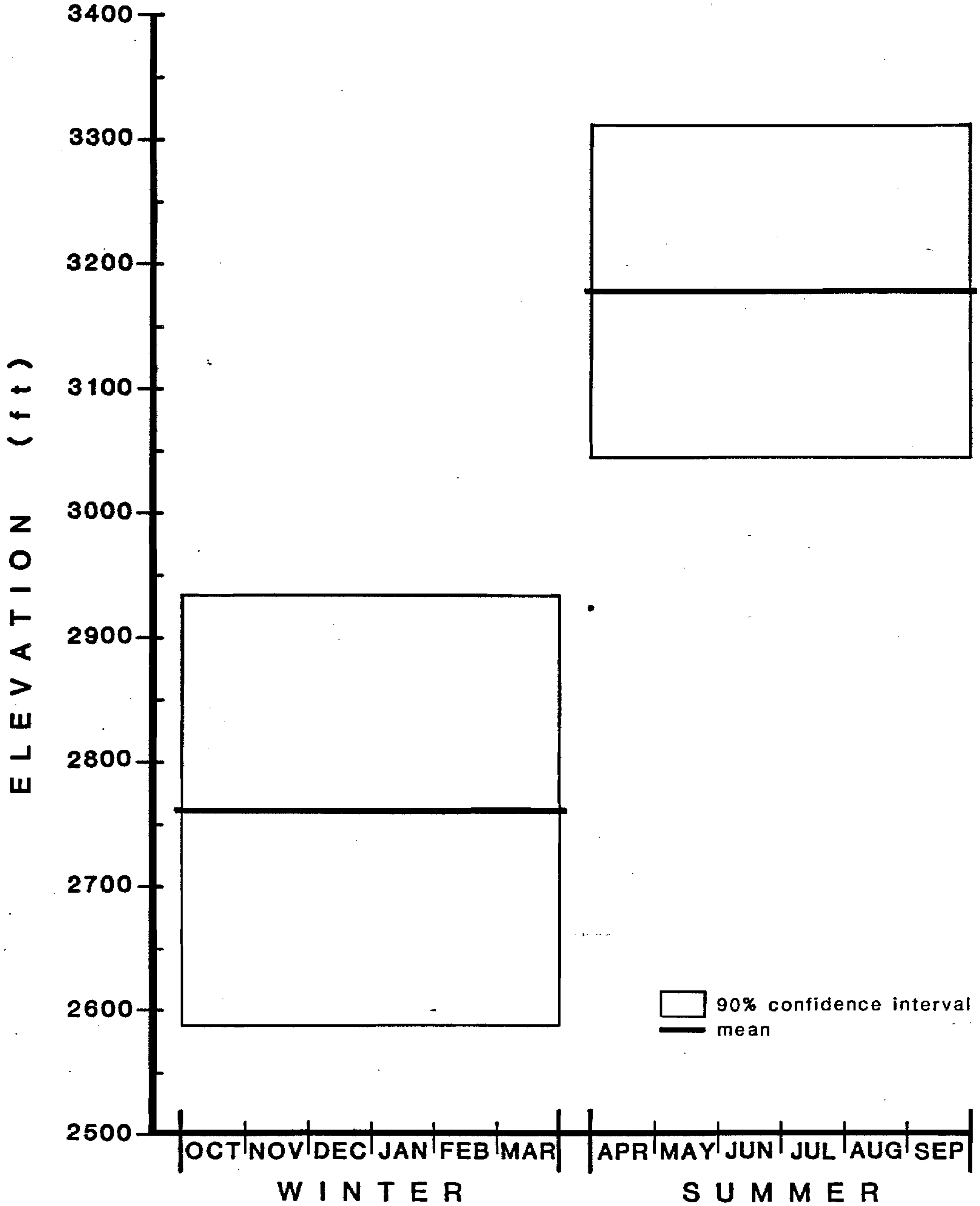

Figure 5. Winter and summer elevational distribution of twelve wolverine in the Susitna River Basin, 1980-1982.

calving to scavenge upon dead calves. They also described movements and observations of wolverine utilizing moose carcasses that died from wolf predation or winter-kills. These winter carcasses were located in the lower elevational areas with relatively high winter moose densities (Ballard *et al*. 1981a).

A third prey item that probably influences movements and consequent elevational distribution of wolverine is Arctic ground squirrels (*Spermophilus parryii*). We suspect, as did Gardner and Ballard (1982), that wolverine coincide their upward spring movements with timing of ground squirrel emergence from hibernation (MacDonald 1981). On many occasions in early spring, wolverine were found on open snow fields that contained many ground squirrel holes and trail networks, and indeed, we frequently observed wolverine carrying freshly captured squirrels (see Food Habits section).

Population Characteristics

Wolverine populations may exhibit different social structures depending on level of hunting and trapping. Hornocker and Hash (1981) and Magoun (1980) have suggested that in wolverine populations subjected to little or no exploitation, mutually exclusive home ranges may exist among adult females and among adult males, with territorialism exhibited among the sexes. However, when exploitation occurs, the strict territorialism probably breaks down to some degree as a result of behavioral instability. The social structure of the Susitna Basin wolverine population is not well known. A more concerted effort in the Susitna Basin should be undertaken to instrument and monitor additional wolverine of all sex and age classes with adjacent or overlapping home ranges to determine the social organization status.

Assuming that the level of hunting and trapping is low enough in the Susitna Basin to not disrupt territorialism among the sexes, and further assuming that the 627 km^2 home range exhibited by male No. 116040 is accurate, extrapolation for the entire middle Susitna Basin (16,319 km^2) yields an estimate of 26 adult male wolverine within the core area. Further, assuming that adult female wolverine occupy similar-sized home ranges that overlap the males', a total of 52 adults would be present. Approximately half (53%) of adult female wolverine in the Susitna Basin are reproductively active each year (Gardner and Ballard 1982), producing at least 2 kits per litter, (Rausch and Pearson 1972, Liskop *et. al.* 1980) which would add an additional 26 wolverine to the population, bringing the total to 78 individuals.

Arriving at the above estimate of 78 wolverine that inhabit the 16,319 km^2 Upper Susitna Basin (1 wolverine per 209 km^2) required several assumptions, some of which may not be entirely valid. Those assumptions, with discussions, are as follows:

Assumption 1: The estimate of a 627 km^2 territory for wolverine #116040 is indicative of the home range size of all adult males in the population. Because of transmitter failure, we have been unable to test this assumption. As indicated above, the transmitter problem has been rectified, and further monitoring will support or disprove this assumption.

Assumption 2: All habitats are used according to availability, i.e., there is no avoidance or preference for certain types. Research by Gardner and Ballard (1982) shows that certain types are avoided or preferred, which would probably serve to lower the population estimate.

Assumption 3: Home range sizes are constant regardless of sex and age of wolverines. Research has shown that female wolverine utilize smaller home ranges than males (Magoun 1979, Hornocker and Hash 1981, Gardner and Ballard 1982). We suspect that if female home ranges were known, the population estimate would probably be somewhat higher.

Assumption 4: The wolverine population in the Susitna Basin is relatively unexploited, and individuals of the same sex and age classes inhabit mutually exclusive territories. This is probably a valid assumption for the study area. Mapped territories do overlap (Fig. 1), but the overlap occurred during different time periods. Gardner and Ballard (1982) indicated that in the peripheral areas, exploitation was relatively high in comparison to the level within the study area. As mentioned above, social organization is dynamic depending on level of exploitation.

Our estimate of 1 wolverine per 209 km^2 compares favorably with Gardner and Ballard's (1982) estimate of one wolverine per 136 to 248 km^2 for the core study area. However, it is evident from the above assumptions that a paucity of data exists concerning wolverine population status in the Susitna Basin or elsewhere. To accurately determine the density of wolverine in the study area, research must be carried out to support or rebuke the above assumptions. If it is determined that mitigation practices are warranted, the dynamics of the population prior to construction must be better understood.

Food Habits

Although 48 digestive tracts have been collected from harvested wolverine, the contents have not yet been analyzed. However, during radio-tracking flights, 28 observations have been made of wolverine either actively pursuing prey or feeding. No quantitative analysis is possible because of the small sample size, but some trends are noticeable.

As mentioned in the "Distribution" section, wolverine show an altitudinal shift between winter and summer, undoubtedly in response to food availability. To test this hypothesis, all recorded kills or active pursuits were listed as being either in summer (April through September) or winter (October through March). Although sample sizes were small, it is evident that moose and caribou consumption (probably scavenged) is greater than 4 times more prevalent in winter than in summer (Table 4). Similarly, arctic ground squirrel and other small animal consumption is more than 10 times higher in summer, when wolverine are at higher elevations.

Potential Impacts

The inherent elusiveness and low densities of wolverine throughout their present range have made it largely impractical to conduct ecological studies (van Zyll de Jong 1975). However, throughout most of Alaska, wolverine numbers are probably comparable to what they were a century ago simply because of minimal human activity in the state. Additionally, technological advances in radio telemetry equipment and techniques have enabled researchers to gather previously unobtainable data on movements and other ecological parameters necessary for making sound management decisions regarding predators.

Van Zyll de Jong (1975) and Hornocker and Hash (1981) have suggested that one factor leading to decreased wolverine numbers is probably human disturbance. The recent focus on resource development in Alaska may cause parallel reductions.

Table 4. Summer and winter diets of wolverine based upon aerial observations of wolverine with prey in the Susitna Basin, Alaska, 1980-1982.

	(Oct. - March) WINTER	(April - Sept.) SUMMER	TOTAL
MOOSE	10	3	13
CARIBOU	3	0	3
GROUND SQUIRREL	1	9	10
OTHER	0	2	2
Total	14	14	28

Telemetry data suggest that the Susitna River presents no impediment to wolverine, and many crossings were documented. The use of elevations below the high pool level (2200 feet) was mainly during the period November through January, when scavenging on big game is an important portion of the diet, and that food source is distributed largely in the impoundment zone.

Although actual loss of habitat through inundation and facilities development will reduce habitable land areas, this factor alone is not likely to significantly alter the wolverine population. However, of much greater concern is the effect this will have on winter food supplies, thus secondarily impacting wolverine distribution, productivity and abundance.

Ballard *et al.* (1982) estimated that approximately 2,400 moose will be severely impacted by the proposed project. Three scenarios are possible to describe what that moose population will ultimately do. (1) Moose will be concentrated in the remaining habitat along the reservoir borders. This will probably lead to deterioration of the existing habitat, by overuse of the range, and ultimately, a reduction, through winter kill, of the moose population. Should this scenario happen, there would probably be an increase in wolverine numbers for a period of 3-5 years, followed by a substantial reduction in the population because of a lack of winter carrion. (2) Moose will migrate out of the Basin in search of better range. This would probably result in lower wolverine densities, as winter carrion would not be as available.

(3) Massive dieoffs of moose would occur during inundation and immediately after maximum pool level is attained, mainly from accidental deaths (i.e. shifting and thin ice, drownings, concentration of individuals with increased predation resulting). Should this occur, wolverine numbers will probably increase for 1-3 years following inundation, with subsequent reduction in numbers when carrion is no longer available in such quantities.

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