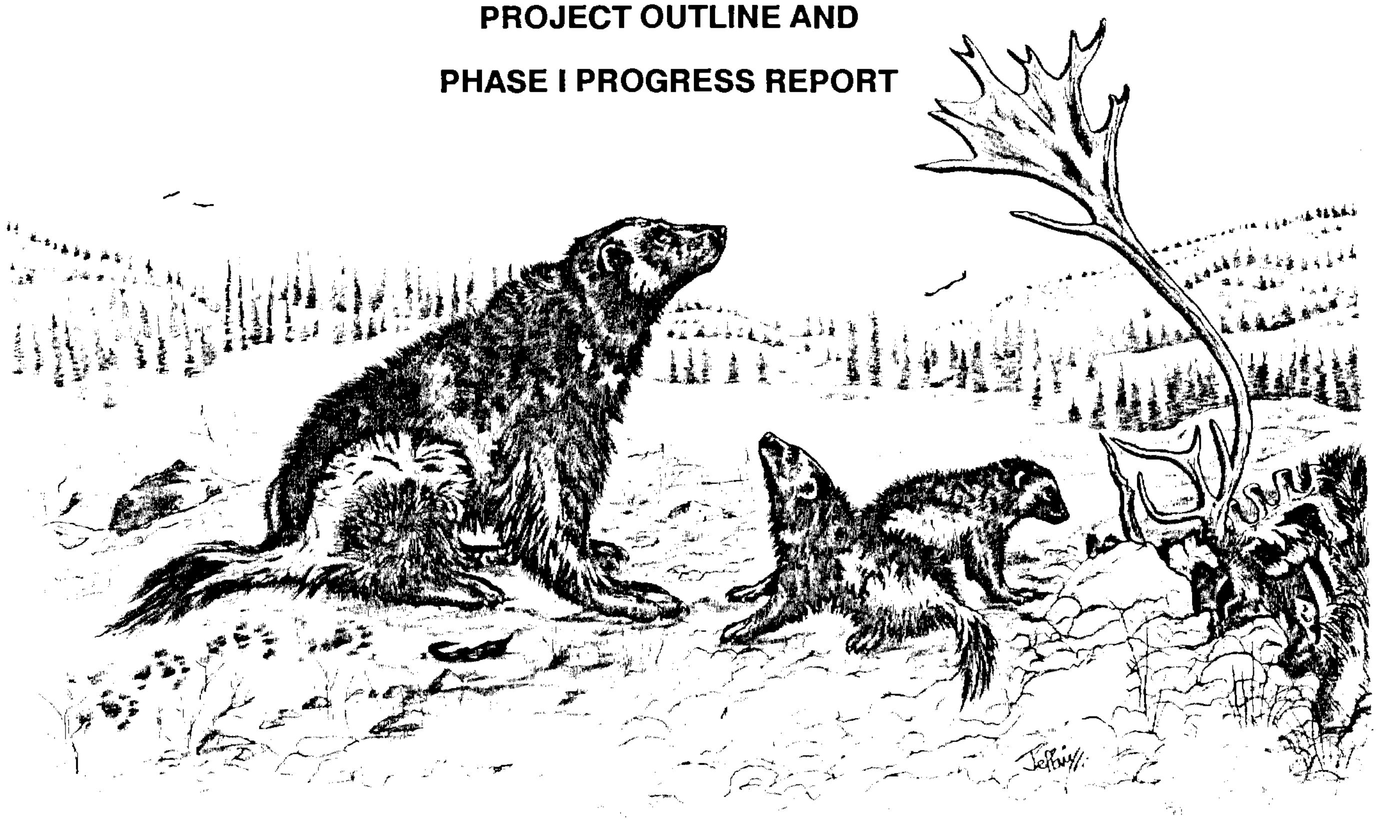
PALMER ADFG

Alaska Department of Fish and Game
Division of Wildlife Conservation
and
National Park Service
Wrangell-St. Elias National Park and Preserve

Cooperative Research Project

WOLVERINE DEMOGRAPHY AND ECOLOGY IN SOUTHCENTRAL ALASKA

PROJECT OUTLINE AND PHASE I PROGRESS REPORT



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SUMMARY

In autumn 1991, the Alaska Department of Fish and Game (ADF&G) and the National Park Service (NPS) began a cooperative investigation of wolverine (Gulo gulo luscus) demography and ecology in Southcentral Alaska. This investigation is in response to a possible decline in wolverine numbers in Southcentral and other areas of Alaska and to the lack of quantitative information on wolverine densities, population trends, and sustainable harvests needed to properly manage them. Similar concerns about wolverines in other countries within the wolverine's circumpolar range may prompt an international response to list the species to a protected status through the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) as soon as spring 1994. This action could substantially affect wolverine management in Alaska.

The cooperative project will be conducted in three phases within the Nelchina River basin and the western Wrangell Mountains of the Wrangell-St. Elias National Park and Preserve (WRST). Phase I began in 1991 as a 2-year pilot study to: (1) determine wolverine distribution and relative abundance; (2) evaluate the logistic requirements of capturing, marking, and monitoring an adequate sample of wolverines; (3) establish baseline density estimates; (4) analyze harvest patterns and levels and document prey and predator abundance; and (5) construct a wolverine population model. Phase II will begin in July 1993 as a 5-year study designed from the results of Phase I. We intend to gather data in the Talkeetna Mountains on wolverine reproduction, natality, survival, dispersal, and population growth, and in both the Talkeetna and Wrangell Mountains on density, habitat and food availability and use, and harvest. Phase III will begin two to three years after the start of Phase II and will last about three years. It will focus on gathering demographic data on wolverines in the Wrangell Mountains, which are different in terrain and vegetation cover and have higher harvest levels than the Talkeetnas.

In the first year of Phase I, we conducted aerial counts of wolverine tracks in winter to determine their distribution and relative abundance. Our surveys resulted in track densities of 11.88 tracks/1,000 km^2 for the northern Chugach Mountains, 25.91/1,000 km^2 for the eastern Talkeetna Mountains, and 19.57/1,000 km^2 for the western Wrangell Mountains. Based on those densities, the latter two areas were chosen as future study sites. We captured and radio-collared four wolverines (two males and two females) in the Talkeetna Mountains, and determined that helicopter darting was the most efficient technique for capturing wolverines in that area.

Wolverine harvests declined substantially between 1971 and 1991 in Game Management Unit (GMU) 11 (including the Wrangells) and GMU 13 (including the Nelchina River basin). Since 1983 GMU 13 has had about twice the wolverine harvest per area as GMU 11, but harvest of males has averaged approximately 60% in both GMUs. The number of wolverines caught per successful trapper varied relatively little from means of 1.78 (SD $\pm$ 0.31) for GMU 11 and 1.46 (SD $\pm$ 0.25) for GMU 13. Most wolverines in both GMUs were taken by trapping. For the 24 carcasses purchased from trappers, the ratio of males:females was 7:1 in GMU 11, 4:1 in GMU 13, and 3:1 overall. Wolverine carcasses were generally in good condition.

Prey and predator abundance was relatively high in the Nelchina River basin in recent years. Caribou (Rangifer tarandus), moose (Alces alces), and wolves (Canis lupus) were especially abundant in the eastern Talkeetna Mountains. Brown bears (Ursus arctos) were also plentiful in the area, although their population appears to have been declining for many years.

Work for the second year of Phase I will focus on radio collaring up to 10 more wolverines in the eastern Talkeetna Mountains to test the accuracy of density estimations calculated from line-intercept sampling of tracks in winter. We will conduct two density estimates each in the Talkeetna Mountains and Wrangell Mountains. We will also attempt to capture and radio-tag kits to determine the feasibility of monitoring their production, survival, movements, and dispersal. Wolverine harvests and the abundance of prey and predators will be examined for the Talkeetnas and Wrangells. We will construct a population model to guide research in Phases II and III and to begin estimating sustainable harvest.

Key words: Alaska, wolverine, Gulo gulo, demography, ecology, density estimate, population model.

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BACKGROUND

The wolverine has a circumpolar distribution, occupying taiga and forest-tundra zones in Scandinavia, eastern Europe, Asia, and northern North America (Wilson 1982). Wolverines are generally solitary and tend to occur at low densities, even compared with other carnivores (van Zyll de Jong 1975). There have been few studies of wolverines despite their importance as a furbearer and, in some areas, a predator of livestock. Consequently, accurate data on their abundance are lacking. Assessments of population trends, based mainly on track counts and harvest records, indicate that although some wolverine populations are stable and perhaps increasing, others have declined across large areas around the world. International concerns about declining populations, particularly in Europe, may prompt the listing of wolverines to a protected status through CITES as soon as spring 1994.

Wolverine populations in Europe are reported to be greatly reduced from historical levels, having been bountied and nearly extirpated in some countries, e.g., Finland (Pulliainen 1988) and Norway (Overrein and Fox 1990, Bevanger 1992). In contrast, wolverines are widely distributed in Siberia (Wilson 1982) and numbers appear to be stable (Filonov 1980). Van Zyll de Jong (1975) reported wolverine populations in Canada had been reduced to the point of being rare in the eastern provinces of Ontario, Quebec, and Newfoundland. In the area comprising the prairie provinces of Manitoba, Saskatchewan, and Alberta, wolverines are limited now to the most northern and western portions. However, the species is relatively abundant and stable or increasing in British Columbia, Yukon Territory, and Northwest Territories (van Zyll de Jong 1975). Wolverines once populated most of the northern and western contiguous United States. They occur now in remnant populations in some of the western states (Hoak et al. 1982, Nead et al. 1985, Hash 1987, Groves 1988), with the largest numbers of wolverines in the Rocky Mountains of Montana where there is a limited legal harvest (Hash 1987).

Little is known about wolverine population densities, trends, and sustainable harvests in Alaska. Most information used to manage wolverine populations in the state have come from harvest records and trapper observations. Reported wolverine harvests since 1910 have fluctuated greatly about an 81-year mean of 427 animals, with the lowest take occurring during World War II and the highest in the mid 1970s (Fig. 1). In the last 20 years, there was a 38% drop in wolverine harvests statewide ($r = -0.84$; $P < 0.001$). Concurrent reductions in the harvest of wolverines in Southcentral and Interior Alaska caused Whitman (1987a,b) to express concern about the possible downward trend of wolverine populations. Trappers also reported through the 1989-90 Trapper Questionnaire that wolverine numbers were declining or scarce in many areas of interior Alaska (Melchior 1991). However, the catch per successful wolverine trapper since 1979 was relatively constant at 1.58 (SD $\pm$ 0.10).

The problem with information from harvests or trappers is that its relationship to wolverine populations levels cannot clearly be determined. Rather than indicating population trends, any changes in harvests or trapper observations of wolverines over time may actually reflect pelt prices, access to trapping areas, or the incidental catch of trappers targeting lynx (*Felis lynx*) or some other species. Fluctuations in reported harvest levels over the years may also be attributed to the different methods of data collection used. Prior to 1952 harvest data came from reports of pelts exported for sale. Data accuracy probably improved when wolverines were taken under a bounty system ($15/pelt) between 1953 and 1968. Since 1972 wolverine harvests statewide have been documented through pelt sealing, which is probably the most accurate measure of annual take.

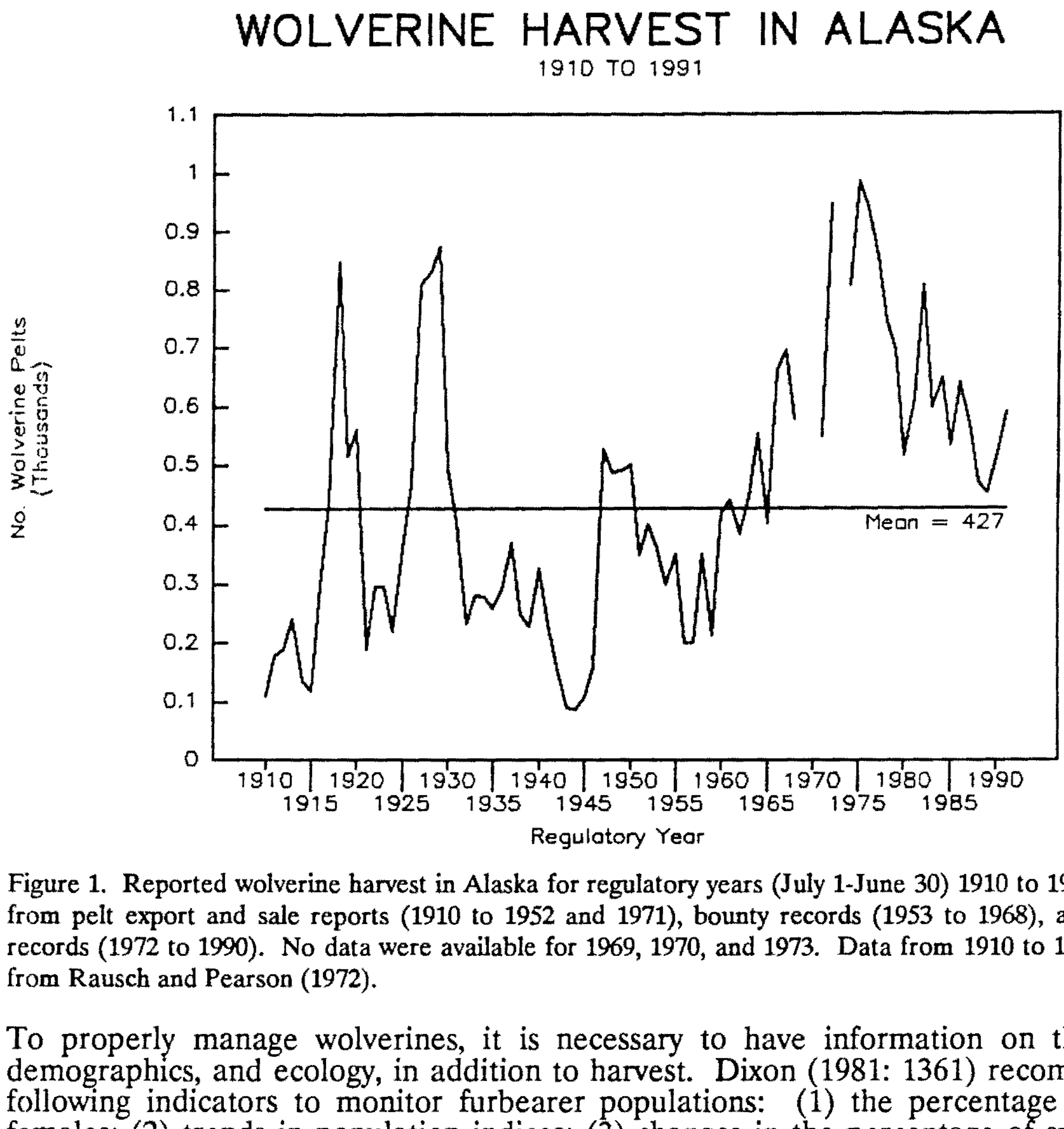

Figure 1. Reported wolverine harvest in Alaska for regulatory years (July 1-June 30) 1910 to 1991. Data were from pelt export and sale reports (1910 to 1952 and 1971), bounty records (1953 to 1968), and pelt sealing records (1972 to 1990). No data were available for 1969, 1970, and 1973. Data from 1910 to 1968 were taken from Rausch and Pearson (1972).

To properly manage wolverines, it is necessary to have information on their density, demographics, and ecology, in addition to harvest. Dixon (1981: 1361) recommended the following indicators to monitor furbearer populations: (1) the percentage of pregnant females; (2) trends in population indices; (3) changes in the percentage of species in the harvest relative to other harvested species; (4) changes in the shape of the survival curve; and (5) measures of population growth rate.

Results from past studies of wolverines reveal they are generally solitary as adults except during breeding and, for adult females, when kits are dependent. Wolverines mark their areas of use or home ranges (Koehler et al. 1980) but are not strictly territorial (Hornocker and Hash 1981). This flexibility in their spacing mechanisms permits opportunistic use of food when seasonally available, which consists primarily of large ungulate carrion (e.g., caribou and moose) in winter and a more varied summer diet (e.g., arctic ground squirrels (Spermophilus parryi), microtine rodents, snowshoe hares (Lepus americanus), beavers (Castor canadensis), and birds) (Myhre and Myrberget 1975, Hornocker and Hash 1981, Gardner 1985, Banci 1987, Magoun 1987, Zyryanov 1989).

Wolverine home ranges tend to be large but variable. Hornocker and Hash (1981) estimated home ranges in Montana at 422 km^2 for males and 388 km^2 for females. Magoun (1985) reported average home ranges of 666 km^2 for males and 94 km^2 for females in northwestern Alaska. In Southcentral Alaska, average home range size for males was 535 km^2 and for females was 105 km^2 (Whitman et al. 1986). Banci and

Harestad (1990) reported the smallest wolverine home ranges of 209-269 km^2 for males and 76-269 km^2 for females in southwestern Yukon Territory.

Most density estimates were derived from home range and movements data supplemented with track counts. Hornocker and Hash (1981) reported 15.4 wolverines/1,000 km^2 in Montana. Magoun (1985) estimated 20.8 wolverines/1,000 km^2 in the Brooks Range foothills and 7.2/1,000 km^2 along the coast of the North Slope of Alaska. Banci and Harestad (1990) reported minimum wolverine densities of 3.8 females/1,000 km^2, 1.9 males/1,000 km^2, and 5.6 residents /1,000 km^2 in southwestern Yukon Territory.

Becker (1991) used a density estimation technique based on probability sampling of tracks in winter to obtain an estimate of wolverines in the Nelchina River basin. The estimate for part of the northern Chugach Mountains in Subunit 13D was 9.69 (SE = 1.97) wolverines for a 1,871-km^2 area (5.2 wolverines/1,000 km^2). Gardner and Becker (1991) obtained a density estimate in the eastern Talkeetna Mountains in Subunit 13A of 12.66 (SE = 1.64) for a 2,700-km^2 area (4.7 wolverines/1,000 km^2). These estimates were lower than densities reported elsewhere but they were based on a new technique that was statistically rigorous.

Although basic reproductive information have been documented for wolverines, the literature contain few references on the population indicators recommended by Dixon (1981). It is known that wolverines exhibit delayed implantation (Wright and Rausch 1955), breed in May-August with a peak in June (Mead et al. 1991), and have an average of 2.5 young (Pulliainen 1968) in dens in February-April (Hash 1987). Rausch and Pearson (1972) reported most wolverines were born between mid February and mid March. Females are not reproductively active before 12 months of age (Banci and Harestad 1988) and usually not before 24 months (Liskop et al. 1981, Banci and Harestad 1988). Mature females may not breed every year (Rausch and Pearson 1972). Magoun (1985) found a reproductive rate of 0.6 kits/female(>1yr)/year among her radio collared wolverines in northern Alaska, resulting in an observed pregnancy rate of 40%. Banci and Harestad (1988) reported from carcass analysis that 53.5% of females $\geq$ 2-years-old in Yukon Territory were pregnant or postpartum. Krott (1981) believed some of the wolverine's relatively low production of kits was due to cannibalism.

Van Zyll de Jong (1975) suggested the distribution and abundance of wolverines may be closely linked to harvest by humans, to the availability of large ungulates, and to the presence of wolves or other large carnivores that would provide carrion. He concluded the apparent selection for a low intrinsic rate of natural increase in wolverines makes them particularly sensitive to exploitation. This sensitivity in combination with declining harvests and meager population data raised concerns by the ADF&G and NPS that there is insufficient data with which to manage wolverine populations and their harvests in Alaska. Correcting this deficiency and improving management will require better density and demographic data for wolverines and an understanding of their ecological relationships in addition to harvest data.

PROJECT OUTLINE

Field studies of wolverines in North America, including three in Alaska, have expanded knowledge about wolverine movements, behavior, ecology, reproduction, and harvest (Hornocker and Hash 1981, Whitman and Ballard 1984, Gardner 1985, Magoun 1985, Banci 1987). However, there is still a substantial lack of data on wolverine demographics and how their ecological relationships influence population dynamics. The ADF&G and the NPS have agreed to cooperate in conducting a long-term investigation of wolverine demography and ecology. Field work will take place in the Nelchina basin and western Wrangell-St. Elias National Park and Preserve (WRST) in Southcentral Alaska. Our goal is to substantially increase our knowledge of wolverine natality, survival, dispersal, recruitment, and density relative to food and habitat conditions and harvest levels. We will use this information to construct a population model. The model will allow managers to recommend sustainable harvests based on standardized estimators of wolverine density. To develop an effective research project and to meet fiscal constraints, the study will be conducted in three phases.

Study Phases

Phase I is a 2-year pilot study focusing on the requirements of conducting the demographics study and on developing a detailed plan for carrying out the full project. General objectives are: (1) to determine the distribution and relative abundance of wolverines in three potential study sites; (2) to capture up to 14 adult and 6 kit wolverines to assess capture techniques and to test the accuracy of a technique for estimating wolverine density; (3) to establish baseline density estimates; (4) analyze harvest patterns and levels and document prey and predator abundance, and (5) to construct a wolverine population model based on those density estimates and available literature that will serve as a guide for developing specific objectives for Phases II and III.

We will develop plans for Phase II from the results of Phase I, building on information from the available wolverine literature, our own estimates of wolverine density, and the population model begun in Phase I. In Phase II we will attempt to gather data on population and environmental characteristics that our modeling effort indicates are most important for understanding wolverine demography and ecology. These characteristics may include, but are not limited to, the following:

(1) Age and sex ratios;
(2) Age of first reproduction, reproductive interval, and percent breeding females;
(3) Fecundity and natality rates;
(4) Survival rates of all sex and age classes;
(5) Recruitment of juveniles;
(6) Dispersal of juveniles and adults;
(7) Population density;
(8) Rates of population growth;
(9) Habitat and food availability and use; and
(10) Trapper and hunter harvest patterns and levels.

Demographic information will be gathered in the eastern Talkeetna Mountains, because of the relatively high number of wolverines in that area and its favorable conditions for capturing animals. We will estimate the density of wolverine populations, determine habitat and food availability, and determine harvest patterns and levels both in the eastern Talkeetna Mountains and in the western Wrangell Mountains in WRST. Phase II is expected to begin in July 1993 and have a projected life of at least five years to adequately address all objectives.

Phase III will expand on the demographics and ecology work in the eastern Talkeetna Mountains with a similar investigation of the wolverine population in the western Wrangell Mountains of WRST. The Wrangell Mountains study area is more heavily forested, has steeper terrain, is subject to greater harvest pressure, and probably has a lower food base than the Talkeetna Mountains study area. These contrasts should provide an opportunity to compare the abilities of each area to support sustainable harvests of wolverines. The efficacy of conducting Phase III will be determined during Phase II. We hope to initiate work on Phase III two to three years after Phase II begins and expect this portion of the project to last three to five years.

Cooperators and Responsibilities

Cooperators in this project for ADF&G are Howard N. Golden, Earl Becker, and Mark McNay, and for NPS are William Route, Kurt Jenkins, and Layne Adams. The ADF&G will have lead responsibility for designing, conducting, and funding this project. It will also have primary authorship of the study plans, reports, and publications. Howard Golden will be the project leader and principal investigator. Earl Becker will assist in further testing of the density estimation technique during Phase I and will be a statistical consultant throughout this project. Mark McNay will cooperate with this project by sharing results of wolverine density estimates he conducts in trend areas in Interior Alaska and by assisting in population model development during Phase I. The NPS will have substantial involvement in all aspects of this project, including funding, planning, data collection and analysis, and report writing. Bill Route of WRST will be the NPS coordinator and co-investigator throughout all phases of the project. Kurt Jenkins from WRST and Layne Adams from the regional NPS will give technical and fiscal support.

Budget

Phase I: Year 2 of 2 (FY 93 ending 6/30/93):

The ADF&G and NPS will share the cost of the $55,600 budgeted for FY 93 of the study in proportions of 63% ($35,000) for ADF&G and 37% ($20,600) for NPS.

Job No.	Activity	Person Days/Yr	Est. FY 93 Costs
1	Distribution and relative abundance (conducted in FY 93)		$0.00
2	Adult radio collars and captures (10 animals)	30	$30,600
	Kit captures (2-4 animals)	20	$5,000
3	Density estimation	15	$13,000
4	Telemetry flights (Feb.-June)	20	$5,000
5	Harvest/carcass analysis	10	$1,000
6	Prey and predator abundance	10	$500
7	Final report, model, and Phase II study plan	40	$500
	Total	145	$55,600

Phase II:

Budget responsibilities for the ADF&G and NPS during Phase II will follow an approximate 60:40 split. Phase II will run for at least five years. The minimum FY 94 cost expected for Phase II will be $100,000 ($60,000 from ADF&G and $40,000 from NPS). Budgets for succeeding years will probably be close to FY 94, for a projected 5-year total of $500,000 ($300,000 from ADF&G and $200,000 from NPS). A detailed budget will be included in the Phase II study plan to accompany the Phase I final report.

Phase III:

Phase III will expand on Phase II with the additional work in the western Wrangell Mountains of WRST. Phase III will begin two to three years after the start of Phase II (i.e., in 1995 or 1996) and will run for three to five years. Minimum annual costs for Phase III are expected to be $60,000, again to be shared on a 60:40 basis by ADF&G and NPS. Total cost for Phase III, depending upon duration, will be $180,000-$300,000 ($108,000-$180,000 for ADF&G and $72,000-$120,000 for NPS).

Implementation of Phases II and III will be contingent on availability of adequate funds. During years when Phases II and III run concurrently, combined annual costs will be approximately $160,000. Total projected cost to complete both Phase II and Phase III is $680,000-$800,000 ($408,000-$480,000 for ADF&G and $272,000-$320,000 for NPS).

PHASE I PROGRESS REPORT

Objectives

(1) To determine the distribution and relative abundance of wolverines in the northern Chugach Mountains, eastern Talkeetna Mountains, and western Wrangell Mountains in WRST.

(2) To determine the costs and logistic requirements for capturing, marking, and monitoring the movements of wolverines, including kits.

(3) To assess, through the use of radio collared wolverines, the accuracy of wolverine density estimates calculated from a technique based on line-intercept sampling of tracks in winter.

(4) To develop a system for monitoring wolverine population trends across large areas.

(5) To assess the sex, age, reproductive status, and body condition of harvested animals.

(6) To determine the distribution and trend in harvest of wolverines caught in and near the study objective areas.

(7) To determine current and historical patterns of the availability of food items for wolverines (e.g., moose, caribou, Dall sheep (Ovis dalli), ground squirrels, and snowshoe hares), and of the distribution and abundance of large predators (e.g., wolves, brown bears, and black bears (Ursus americanus)).

(8) To construct a wolverine population model that will guide further research efforts and help direct management.

Study Area

The area comprising the Nelchina River basin (within GMU 13) and western Wrangell Mountains (within GMU 11) was chosen for the Phase I study area because: (1) it appeared to have relatively high numbers of wolverines; (2) it had a well-recorded harvest history; (3) it represented wolverine habitat comparable to many parts of Southcentral and Interior Alaska; (4) it was logistically attractive; and (5) it was near the Susitna River basin where previous work on wolverines was conducted (Gardner and Ballard 1982, Whitman and Ballard 1984, Gardner 1985, Whitman et al. 1986).

The Phase I study area lies between 61°15' and 63°00' N latitude and 142°30' and 148°30' W longitude. The study area is lightly populated with people, primarily in the communities of Glennallen, Gulkana, and Copper Center. However, the area receives heavy hunting, fishing, and other recreational use (e.g., snow machining), especially by residents of Anchorage and the Matanuska-Susitna Valley. The Nelchina River basin is bisected east-west by the Glenn Highway, and the Richardson Highway runs perpendicular to it on the east side along the Copper River basin.

The Nelchina River basin runs east-west and is bordered on the north by the Alaska Range, on the south by the Chugach Mountains, on the west by the Talkeetna Mountains, and on the east by the Copper River basin. The latter runs north-south along the west side of the Wrangell Mountains and south past the Chitina River valley. Elevations range from approximately 450 m along the Nelchina and Copper Rivers to over 2,100 m in the rugged mountains on the periphery of the basins where permanent ice fields and glaciers are common. Temperatures average -14.6° C to -21.6° C in January to 6.3° C to 15.7° C in July (Gardner 1985). Vegetation in the area is similar to that described by Gardner (1985) with conifer, deciduous, or mixed forests generally below 1,000 m and shrub or alpine tundra zones at higher elevations. Caribou, moose, Dall sheep, brown bears, black bears, wolves, marten (Marten americana), lynx, and other furbearers, squirrels, and microtine rodents are relatively numerous in the area.

Methods

Distribution and Relative Abundance (Objective 1):

Aerial surveys were flown in three portions of the Phase I study area to document the distribution and quantity of wolverine tracks encountered. The areas surveyed were (1) the northern Chugach Range east of the Tazlina River drainage to the Copper River; (2) the eastern Talkeetna Mountains lying west of Lake Louise and between the Glenn Highway and the Susitna River; and (3) the Wrangell Mountains north of the Chitina River and between McCarthy and the Copper River.

Surveys were flown 19-21 February 1992 under good light and snow conditions. There was 0.75-1.0 m of snow cover, and the last significant snowfall (2.5-5.0 cm) was 14 February 1992. Temperatures ranged from -29° C to -40° C overnight to -10° C to -15° C during survey flights. Two teams of an observer and pilot in PA-18 Super Cubs flew in different portions of the same survey areas along contours at or above treeline in all drainages and mountainous terrain except where the wind was too strong. Wolverine tracks that intercepted the flight line were recorded on 1:250,000-scale maps as an observation of one track or a group of two or more tracks if it was suspected they belonged to more than one animal. Possible den sites, kill sites, the presence of moose, caribou, sheep, or other prey, and observations of wolverines and wolves were noted.

Data from both survey teams were summarized and plotted on a master map. The approximate areas actually surveyed during flights were measured using a planimeter. The number of track intercepts counted per square kilometer were then calculated and compared among the three areas surveyed.

Capture, Marking, and Telemetry (Objectives 2 and 3):

The purpose of the work in April 1992 was to determine the logistic requirements of capturing wolverines in the Talkeetna Mountains study site and to estimate costs of a large-scale capture project. Darting from a helicopter was the primary method of capture. A PA-18 Super Cub was used as a spotter plane first to search for wolverines and then to assist the capture crew in the helicopter with locating the animal to be darted. Prior to and during helicopter capture operations, we set 15 live traps across a 2,300-km^2 area south of our camp on Clarence Lake at the north end of the study area (Fig. 2). We used three types of livetraps to capture wolverines: wire cages with drop doors, steel box traps with drop doors, and a prototype wire cage with a spring door. We placed traps in drainages and areas where we had seen fresh wolverine tracks and other sign such as suspected den sites. Ptarmigan (Lagopus sp.), beaver, and road killed moose were used as bait. Each trap was checked daily from a Super Cub.

Captured wolverines were immobilized with tiletamine HCl and zolazepam HCl (Telezol, Aveco Co., Inc., Fort Dodge, Iowa) at a concentration of 100 mg/ml and a dosage of 11 mg/kg. Each animal caught was fitted with MOD-315 radio collars (140 gms) (Telonics, Mesa, Ariz.). A male (TM1) was also instrumented with a radio implant (IMP/400/L; 90 gms; Telonics) to determine the implant's utility in relocating animals in rugged terrain. TM1 was sedated and flown to Glennallen in a Super Cub and the radio transmitter was surgically implanted in TM1's abdominal cavity by Area Biologist Bob Tobey at his private veterinary clinic.

Besides being radio-collared, captured wolverines were ear tagged with small, numbered plastic rototags (Nasco West, Modesto, Calif.). We estimated ages based on tooth wear, teat and testes size, and scarring. We also took blood samples (whole and serum); measured each animal's total, body, and hind foot lengths and neck, head, and chest circumferences; and weighed them.

Movements of all wolverines were monitored twice each month until mid June 1992 and then once in October. Location data recorded for each observation were latitude and longitude, whether or not there was a visual sighting, vegetation, terrain, activity, and association. We calculated average distances between successive locations for each animal. There were insufficient locations to calculate home ranges (Magoun 1985).

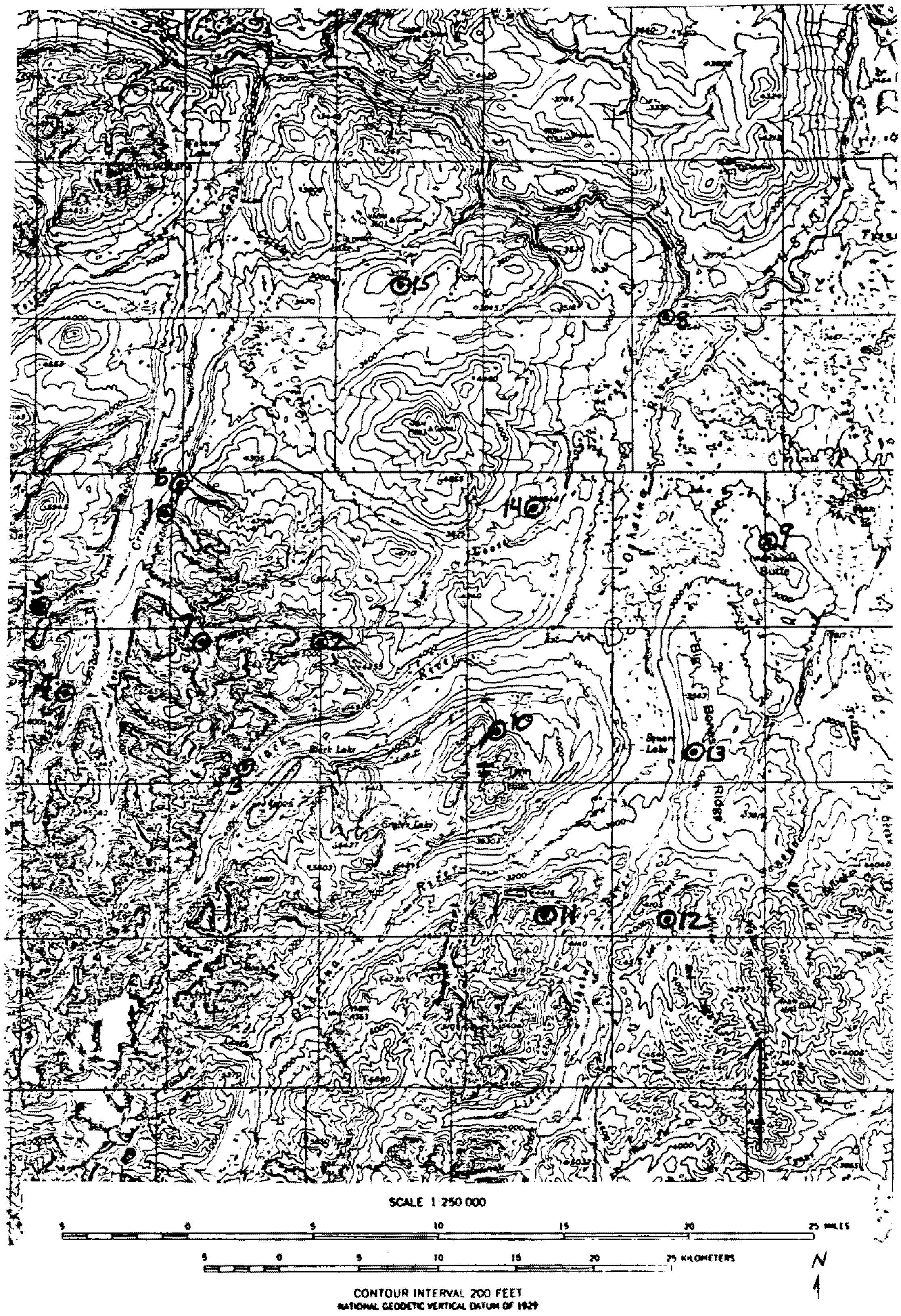

Figure 2. Locations of wolverine live traps used in the eastern Talkeetna Mountains, 17-22 April 1992.

Harvest Analysis (Objectives 5 and 6):

Harvest data from pelt sealing certificates and trapper questionnaires were analyzed to determine where and when captures occurred and the existence of trends in harvest over time. Twenty-four carcasses of wolverines harvested in 1991-92 in GMUs 11 and 13 were purchased from trappers for $25 each. We recorded the following data for each carcass: sex, date and location of kill, trapper information, body and tail lengths, chest and neck circumference, xiphoid fat depth, visceral fat content (none, scarce, moderate, and abundant), presence of parasites, and any obvious infirmities. We did not weigh carcasses because their varying states of desiccation would confound the data. Wolverine skulls, reproductive tracts (if female), and fecal samples were saved.

Prey and Predator Abundance (Objective 7):

At the time this report was prepared, we had reviewed ADF&G survey and inventory records only for GMU 13, which includes the Nelchina River basin, for caribou, moose, brown bears, and wolves. These records were examined to determine the availability of food for wolverines and the presence and abundance of large predators, which may provide carrion for wolverines or be a source of mortality.

Results and Discussion

Distribution and Relative Abundance:

Of the three areas surveyed, the Chugach Mountains area had the lowest density of wolverine tracks (Table 1). We counted the most tracks there between 600 m and 1,200 m elevation in the drainages of Tazlina Lake, Kiana Creek, Hallet River, Klutina River, and Tonsina River (Fig. 3). We also observed three wolf-kill sites and two possible wolverine den sites. The Talkeetna Mountains area had by far the highest density of tracks (Table 1), which were mostly found at or below 1,200 m elevation in the drainages of Kosina Creek, Black River, Oshetna River, Little Oshetna River, and the Little Nelchina River (Fig. 4). We also found five wolf-kill sites and four possible wolverine den sites. The Wrangell Mountains area was intermediate in density of tracks (Table 1). Most tracks there were observed along the Dadina River, Kuskulana River, Gilahina River, and Lakina River below 1,200 m elevation in the steeper terrain typical of this range (Fig. 5). We found no wolf-kill sites and only one possible wolverine den site in this area. Based on the above results, we chose the Talkeetna Mountains as the primary study site and the Wrangell Mountains as the secondary study site for the remainder of Phase I and for Phases II and III.

Table 1. Summary of wolverine track counts and track densities observed during aerial surveys in the Chugach, Talkeetna, and Wrangell Mountains, 19-21 February 1992.

Mountain Range	Date	Survey Area (km^2)	Number Tracks Counted	Track Density (No./1,000 km^2)
Chugach	2/19/92	3,030	36	11.88
Talkeetna	2/20/92	3,860	100	25.91
Wrangell	2/21/92	1,993	39	19.57

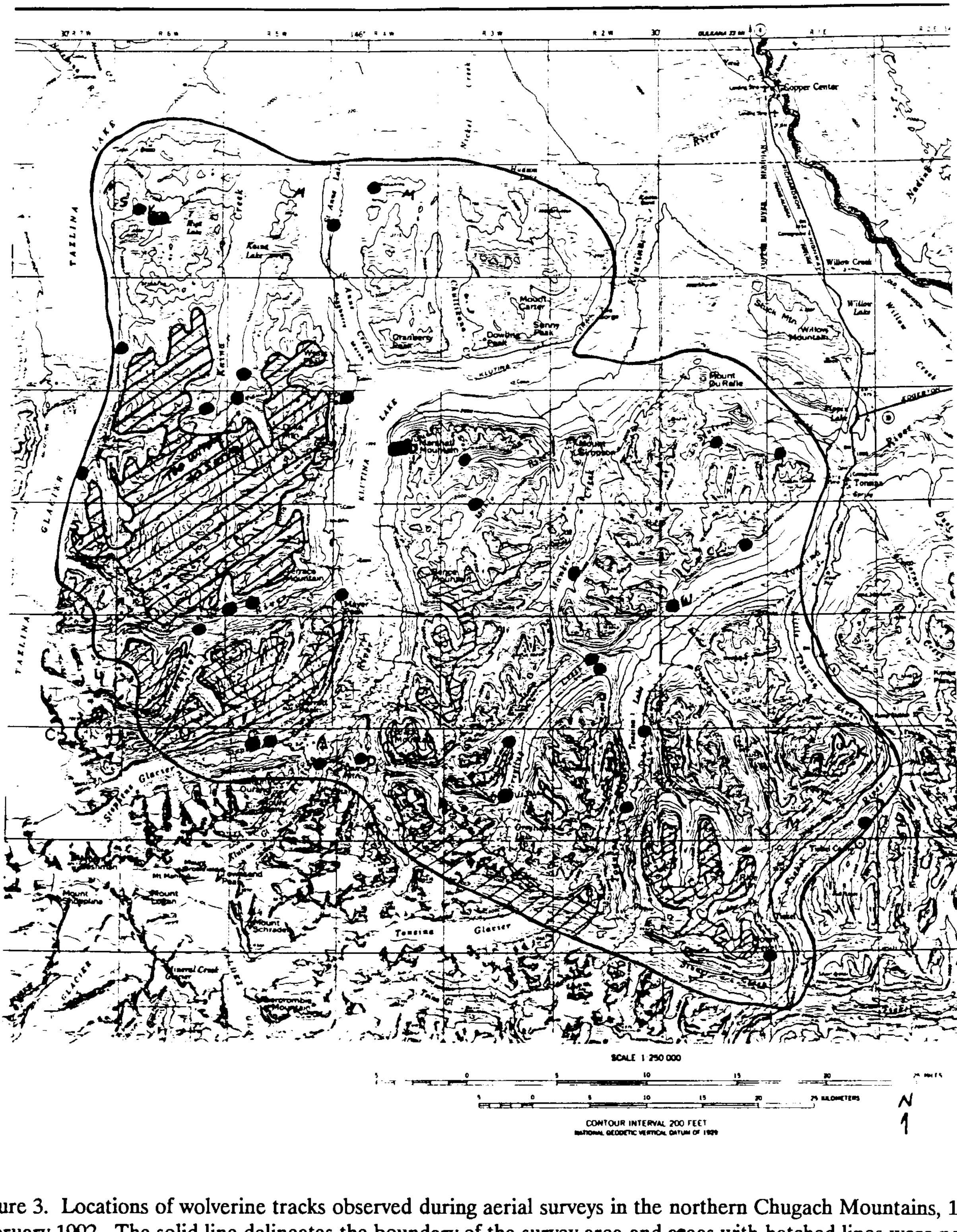

Figure 3. Locations of wolverine tracks observed during aerial surveys in the northern Chugach Mountains, 19 February 1992. The solid line delineates the boundary of the survey area and areas with hatched lines were not flown due to wind. Locations of moose (M), sheep (S), caribou (C), wolf (W), ptarmigan (P), kill sites (K), and possible den sites (D) were also noted.

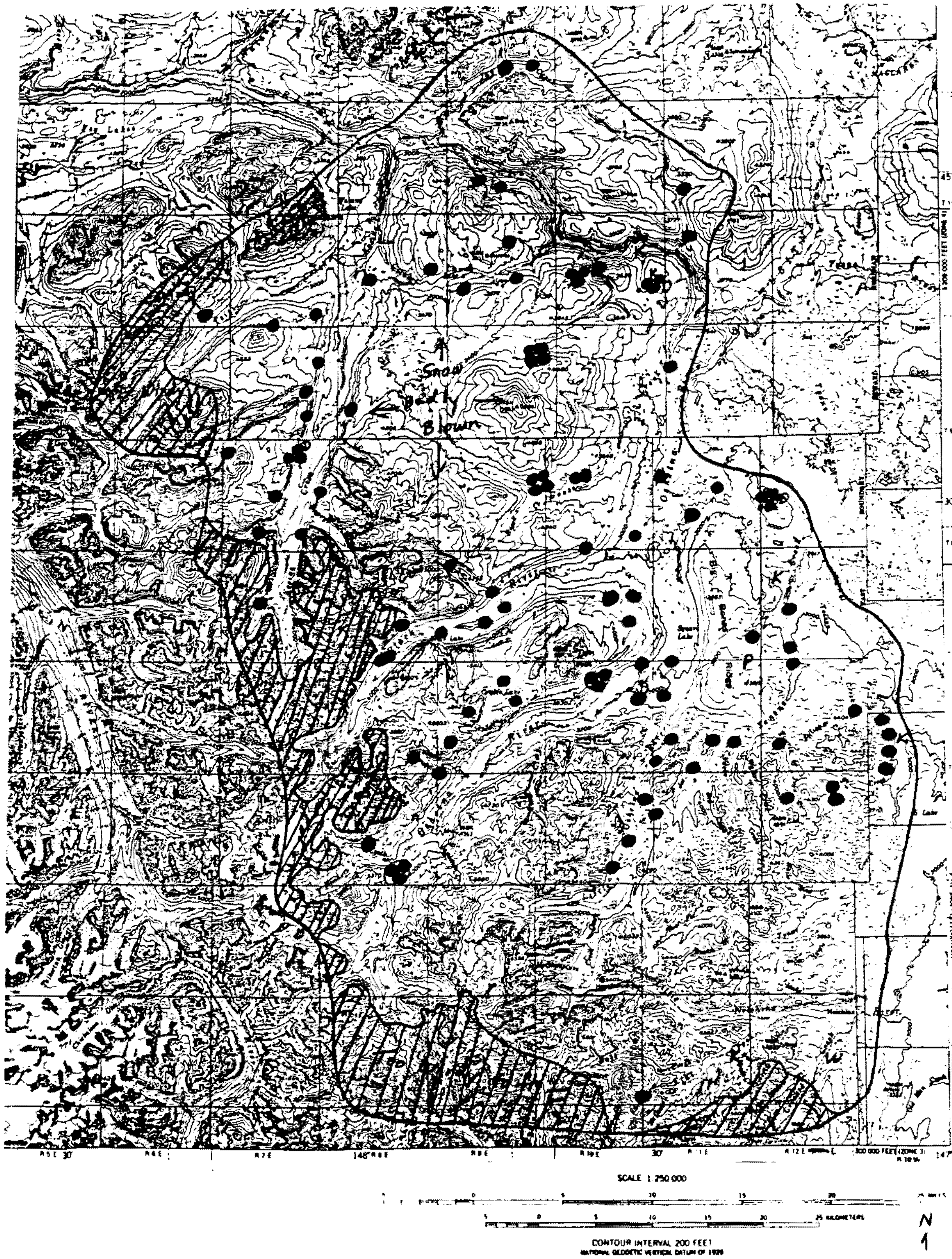

Figure 4. Locations of wolverine tracks observed during aerial surveys in the eastern Talkeetna Mountains, 20 February 1992. The solid line delineates the boundary of the survey area and areas with hatched lines were not flown due to wind. Locations of moose (M), sheep (S), caribou (C), wolf (W), ptarmigan (P), kill sites (K), and possible den sites (D) were also noted.

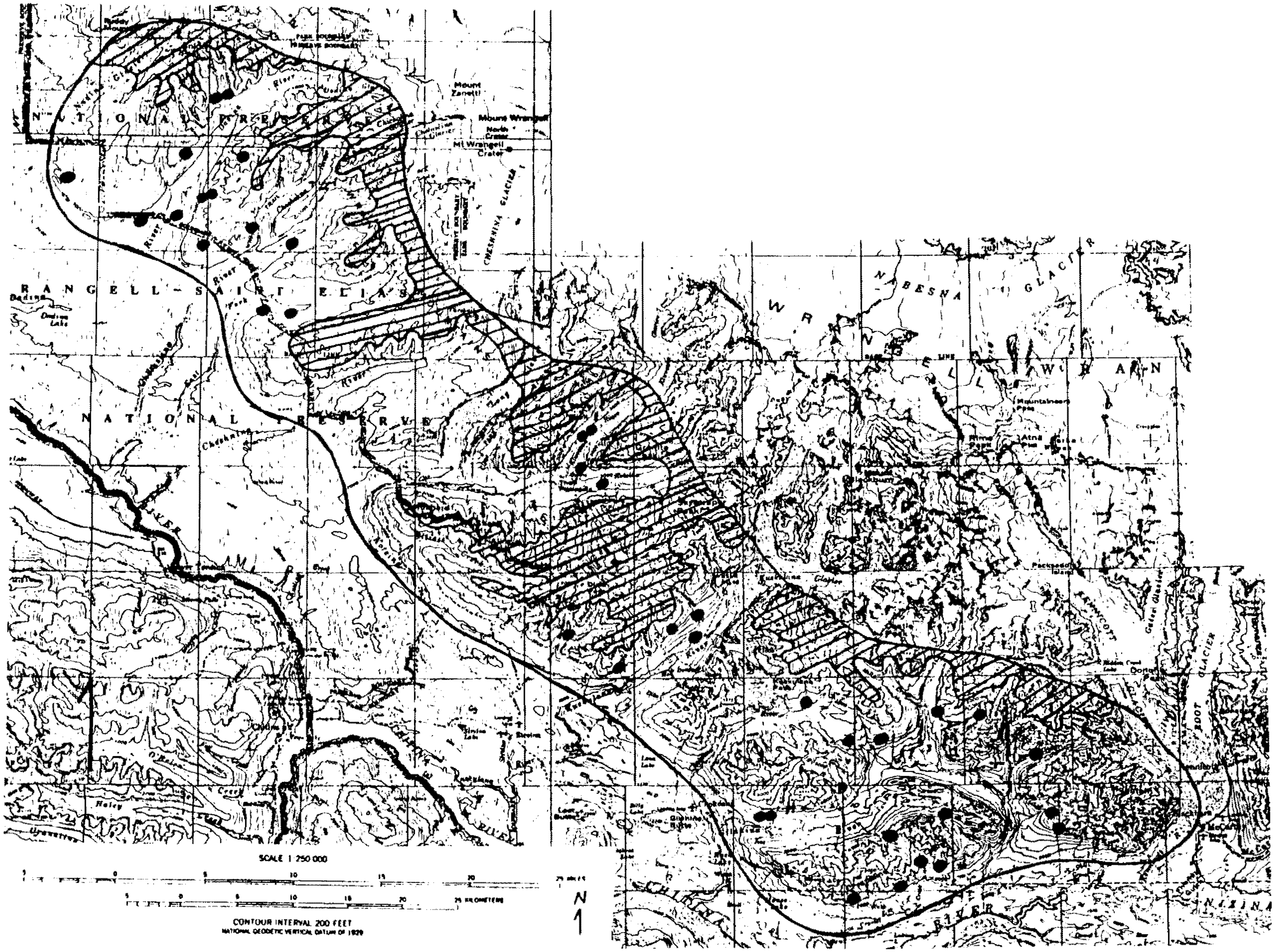

Figure 5. Locations of wolverine tracks observed during aerial surveys in the western Wrangell Mountains, 21 February 1992. The solid line delineates the boundary of the survey area and areas with hatched lines were not flown due to wind. Locations of moose (M), sheep (S), caribou (C), wolf (W), ptarmigan (P), kill sites (K), and possible den sites (D) were also noted.

Capture and Marking:

We captured four wolverines (two females and two males) in the eastern Talkeetna Mountains on 18-21 April 1992 (Table 2). A yearling (12-24-months-old) and an adult ($\geq$ 24-months-old) were caught for each sex. The first three wolverines (TM1, TM2, and TF1) were caught by darting with a Cap-Chur rifle and 2-cc aluminum darts from a Hughes 500 helicopter. These captures were usually made within 30 minutes after notification from the spotter plane that an animal had been sighted. Traps were set for a total of 55 trap nights between 17 and 22 April 1992. We caught the yearling female, TF2, in a wire cage box trap with a drop door after 41 total trap nights but after her trap had been set only one night.

The tagging procedures went smoothly and without incident, including the implant of a radio transmitter in TM1. The adult female, TF1, was lactating when captured and was quite thin but responded well to capture and marking. TF2 was probably in the live trap overnight and suffered heavy damage to her teeth in trying to get out of the trap (see Table 2). The damage to her teeth did not appear to have substantial effect on her activity subsequent to her capture.

Others have used live traps (Hornocker and Hash 1981, Magoun 1985, Banci 1987) and helicopter darting (Whitman and Ballard 1984, Gardner 1985) to capture wolverines with varying success. In this study, setting out and picking up traps took approximately 7 hours of helicopter time ($515/hr + fuel) plus 5 hours to check them with a Super Cub ($130/hr + fuel). This resulted in one capture at a cost of approximately $4,500/capture. In contrast, helicopter darting took a total of about 4 hours of helicopter time and 15 hours of Super Cub time. This resulted in three captures at a cost of approximately $1,500/capture, or about one-third the cost of live trapping. Based on our experience, we believe helicopter darting is the most efficient procedure for capturing wolverines in the eastern Talkeetna Mountains. We will continue to use live traps when more effort is needed to catch animals suspected of being in an area, e.g. females at possible den sites.

Movements:

We located the four radio collared wolverines a combined total of 33 times among 10 days between 18 April and 16 October 1992 (Table 3). We found the wolverines most often in tundra and shrub vegetation that prevailed between 700 m and 1,300 m elevation. They were frequently found in boulder fields or rock outcrops and on flat to moderate slopes of no particular aspect. They were in holes or bedded for about 40% of the locations and were usually standing, walking, or loping at other times (see Table 3 for other activities).

Only the adult female, TF1, was ever seen in association with other wolverines. However, we made more effort to locate her and to obtain visual sightings because we wanted to determine if she had kits. We saw her with one kit on 18 May and with two kits on 5 June. She spent most of her time on the southwest slope of Goose Peak where there was an average of 5.5 km between observed locations for her (Fig. 6). The yearling female, TF2, was regularly found in a hilly area south of the Susitna River and north of Gilbert Creek (Fig. 6). There was an average of 7.7 km between the seven locations recorded for her. The yearling male, TM1, had a more linear pattern of locations, ranging between the northeast slope of Goose Peak and Coal Creek north of the Susitna River (Fig. 6). Distances between his eight locations averaged 10 km. The adult male, TM2, was located five times in rugged terrain on the south side of the Oshetna River with an average of 3.9 km between locations (Fig. 6). We did not detect his radio signal after 18 May, but we will attempt to relocate him again in early winter 1993.

Table 2. Capture data for wolverines in the eastern Talkeetna Mountains, 18-21 April 1992.

ACCNO	Name	Sex	Radio Freq.	Collar Serial No.	Lt. Ear Tag	Rt. Ear Tag	Capture Date	Method of Capture	Estimated Age	Total Length (cm)	Body Length (cm)	Hind Foot Length (cm)	Neck Circ. (cm)	Head Circ. (cm)	Chest Circ. (cm)	Weight (kg)
TF1[a]	Digger	F	150.640	41533	7	6	04/20/92	Darting	Adult	98.0	76.0	16.0	29.0	32.5	--	10.0
TF2[b]	Goldie	F	150.890	41534	9	8	04/21/92	Livetrap	Yearling	96.0	76.0	14.8	28.0	31.0	41.0	9.5
TM1[c]	Primo	M	150.600	41531	2	3	04/18/92	Darting	Yearling	111.0	91.0	17.0	36.0	38.0	46.0	15.0
TM2	Bruiser	M	150.610	41532	5	4	04/19/92	Darting	Adult	111.5	91.0	18.0	37.0	38.0	47.0	18.0

[a]TF1 was lactating when captured and was quite thin, probably due to the demands of pregnancy and lactation.

[b]The capture of TF2 in a wire cage trap resulted in extensive wear and breakage to her teeth; the upper right canine was broken off half-way, the posterior side of the other canines were worn deeply, and her incisors were chipped and worn.

[c]TM1 was also fitted with a radio implant, frequency 151.760.

Table 3. Location data for four radio collared wolverines in the eastern Talkeetna Mountains, 18 April-16 October 1992.

Anim. No.	Radio[a] Freq	Date	Latitude Deg Mn Sc	Longitude Deg Mn Sc	Vis.	Veg. Comp.	Veg. Cov.	Other	Slp.	Asp.	Elev.	Act.	Ass.
TF1	0.640	04/20/92	62 29 05	147 46 25	Y	ST	L		G	G	1242	C	S
		04/21/92	62 36 30	147 45 45	Y	T		B	G	SW	1197	D	S
		04/21/92	62 33 00	147 49 55	N	T		B	G	N	1227	H	U
		04/22/92	62 32 52	147 57 12	Y	T		B	G	N	1303	S	U
		05/01/92	62 34 10	147 46 15	Y	T			M	SW	1394	L	S
		05/01/92	62 31 10	147 50 35	Y	T			G	NE	1333	L	S
		05/18/92	62 32 15	147 54 15	Y	T		B	G	NE	1364	H	U
		05/18/92	62 33 30	147 54 16	Y	T		B	M	N	1197	H	K1
		06/05/92	62 32 49	147 52 20	N	T	L	B	F	F	1242		
		06/05/92	62 32 49	147 52 20	Y	T		B	F	F	1242	H	K2
		06/18/92	62 33 58	147 54 30	N	T		B	F	F	1152	H	U
		06/18/92	62 32 27	147 48 17	Y	T		B	F	S	1227	W	S
		10/16/92	62 32 37	147 54 10	Y	T	L	B	G	N	1303	S	U
TF2	0.890	04/21/92	62 39 35	147 46 20	Y	ST	L		G	E	1000	C	S
		04/22/92	62 45 05	147 46 05	N	FC	M	R	M	NW	727	H	U
		05/01/92	62 43 15	147 52 42	Y	T			G	SE	1000	W	S
		05/18/92	62 43 46	147 50 00	Y	T			G	E	1106	L	S
		06/05/92	62 38 19	147 48 47	Y	SL	L		F	F	1000	W	S
		06/18/92	62 42 35	147 54 37	N	SL	L		F	F	1030	H	U
		10/16/92	62 44 37	147 47 10	N	ST	M	R	M	NE	909	H	U
TM1	0.600	04/18/92	62 37 20	147 38 17	Y	T		B	G	N	1091	C	S
		04/19/92	62 39 00	147 32 50	N	T		R	G	G	939	H	U
		04/22/92	62 43 05	147 24 50	N	FM	L		M	SW	1030	B	U
		05/01/92	62 37 40	147 39 20	Y	T			G	N	1045	S	S
		05/18/92	62 48 25	147 30 20	Y	SL	L		G	N	1106	S	S
		06/05/92	62 51 10	147 28 18	N	T	L	B	F	F	939	H	U
		06/18/92	62 53 10	147 27 55	N	SL	L		F	F	833	H	U
		10/16/92	62 48 54	147 29 20	N	SL	L		F	F	1061	H	U

Table 3. (Cont'd).

Anim. No.	Radio[a] Freq	Date	Latitude Deg Mn Sc	Longitude Deg Mn Sc	Vis.	Veg. Comp.	Veg. Cov.	Other	Slp.	Asp.	Elev.	Act.	Ass.
TM2	0.610	04/19/92	62 17 20	147 35 40	Y	T			G	NE	1364	C	S
		04/20/92	62 19 05	147 38 10	Y	SL	L		M	W	1182	L	S
		04/22/92	62 19 05	147 36 00	Y	T		B	M	W	1242	R	S
		05/01/92	62 20 30	147 34 42	Y	FC	L		F	G	939	L	S
		05/18/92	62 18 20	147 28 20	N	T		B	M	SW	1212	H	U

[a]Radio frequencies are in the 150-151 MHz range; TM1 has a radio implant (151.760) in addition to the collar.

<u>Description of Characteristics</u>

Vis - Visual observation: (Y)es or (N)o.

Veg. Comp. - Vegetation Composition: (F)orest - (C)onifer, (D)eciduous, (M)ixed; (S)hrub - (T)all, (L)ow; (T)undra; (M)eadow.

Veg. Cov. - Vegetation Cover (trees and shrubs): (B)are = none; (L)ight = 1-25%; (M)oderate = 26-59%; (D)ense = 60-100% (Viereck et al. 1992).

Other - (R)ock outcrop, (B)oulder field, (G)ravel bar, (S)now or ice.

Slp. - Slope: (F)lat = 0-10^{o}; (G)entle = 11-30^{o}; (M)oderate = 31-60^{o}; (S)teep = 61-90^{o}.

Asp. - Aspect: 8 compass points; (F)lat; (G)ully; (R)idgetop.

Elev. - Elevation (m).

Act. - Activity: (H)ole/den; (B)edded; (S)tanding; (D)igging; (F)eeding; (W)alking; (L)oping; (R)unning; (C)apture.

Ass. - Association: (S)olitary; (A)dult(#); (K)it(#); (U)nknown.

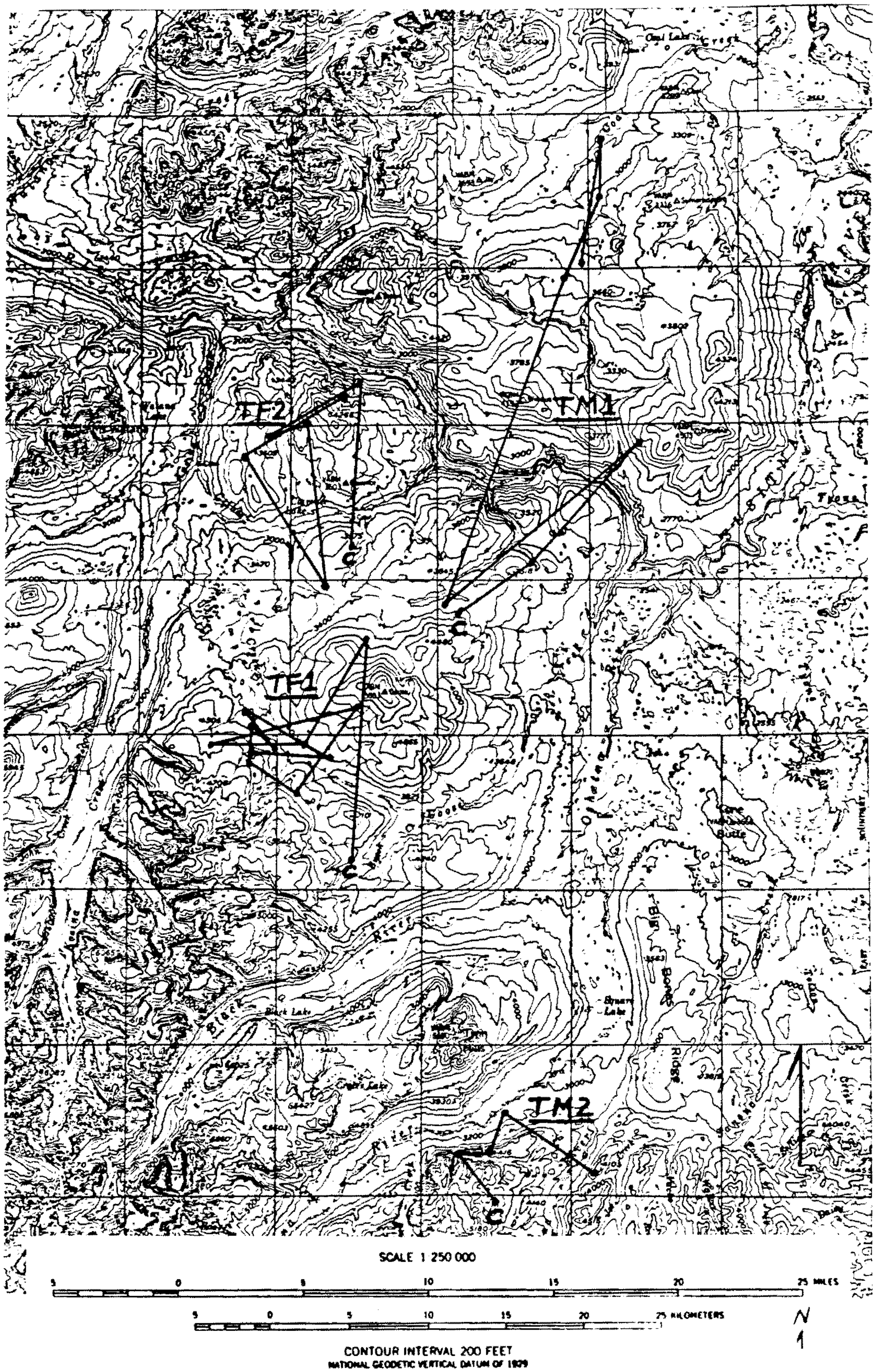

Figure 6. Capture sites (C) and movements of two female (TF1, TF2) and two male (TM1, TM2) radio collared wolverines in the eastern Talkeetna Mountains, 18 April 1992 to 16 October 1992.

Harvest Analysis:

Since the start of pelt sealing in autumn 1971, both GMU 11 and GMU 13 have had decreasing harvest trends (Fig. 7), similar to the statewide trend. Between 1971 and 1991, wolverine take declined in GMU 11 by 64% (28 to 10) ($r = -0.76$, $\underline{P} < 0.001$) and in GMU 13 by 52% (75 to 36) ($r = -0.82$, $\underline{P} < 0.001$). Since 1962 2.8 times the number of wolverines have been taken in GMU 13 (1,799) than in GMU 11 (631), with a respective catch per 1,000 km^2 of 6.57 and 3.96. Between 1983 and 1991, GMU 11 accounted for 30% of the combined harvest of wolverines in GMUs 11 and 13, whereas GMU 13 accounted for 70% of the take with over 40% from Subunits 13D and 13E (Fig. 8). There were no clear trends in proportions of males in harvests for either GMU from 1971 to 1991. Males in the harvest for the 20-year period averaged 60.7% (SD $\pm$ 10.13) for GMU 11 and 59.8% (SD $\pm$ 6.34) for GMU 13.

The number of wolverines harvested in GMUs 11 and 13 between 1979 and 1991 generally varied with the number of trappers who caught wolverines, which averaged 9.08 (SD $\pm$ 4.01) in GMU 11 and 30.46 (SD $\pm$ 10.14) in GMU 13 (Figs. 9 and 10). Consequently, the number of wolverines caught per successful trapper varied relatively little from means of 1.78 (SD $\pm$ 0.31) for GMU 11 and 1.46 (SD $\pm$0.25) for GMU 13.

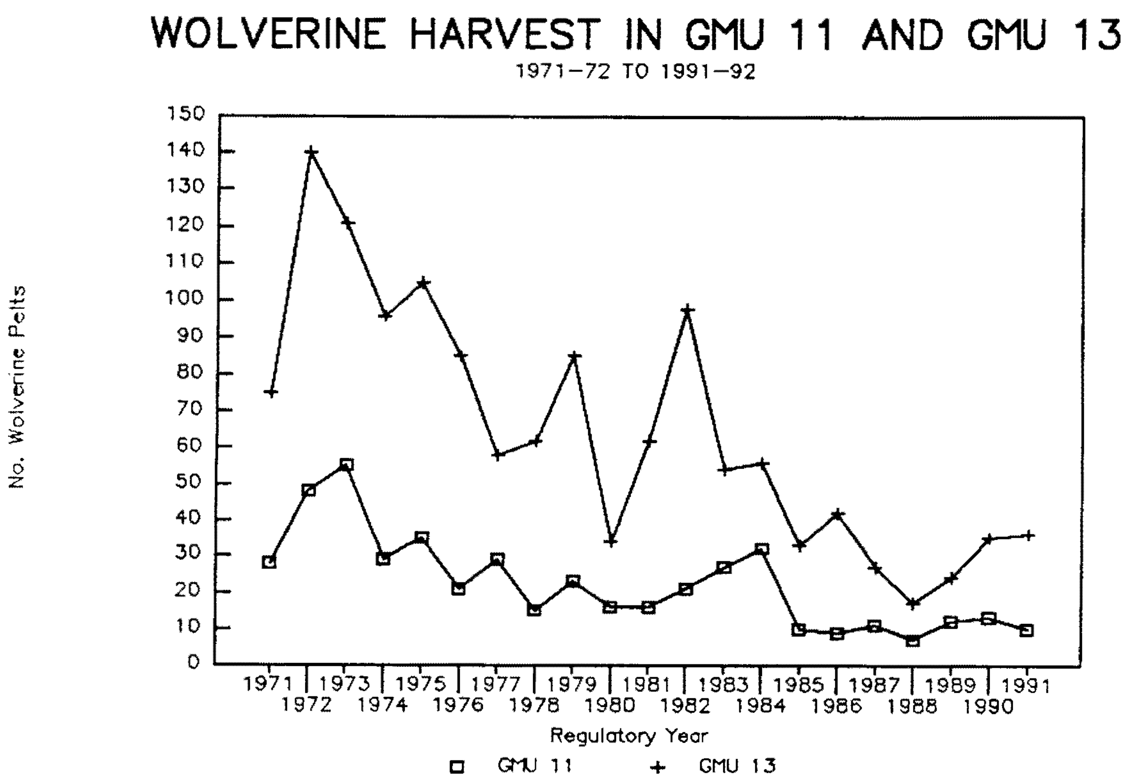

Figure 7. Reported wolverine harvest, based on pelt sealing records, in GMUs 11 and 13 for regulatory years (July 1-June 30) 1971-1991.

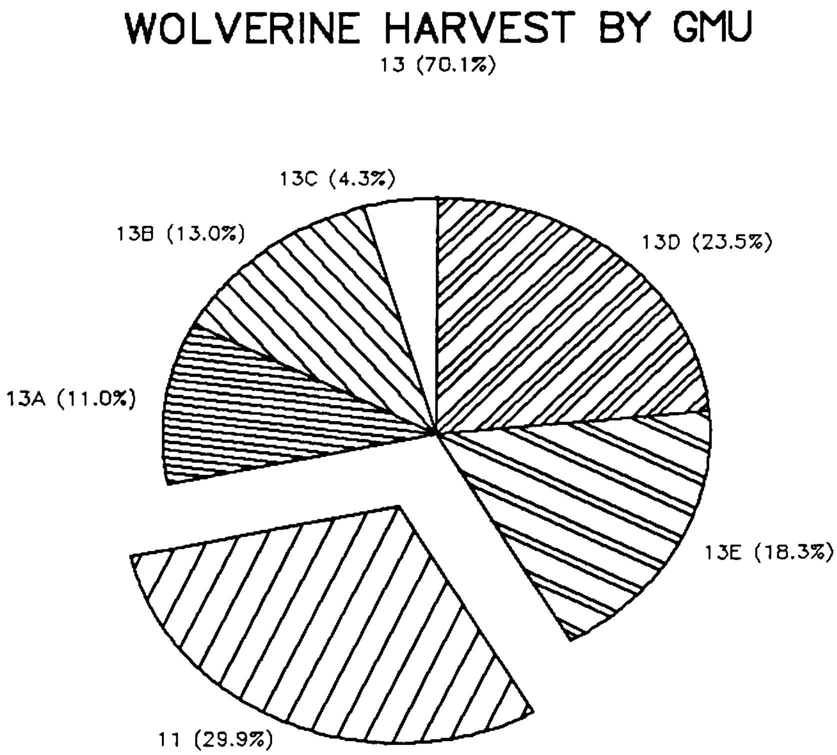

Figure 8. Proportion of combined wolverine harvests in the Nelchina River and Copper River basins by GMU for regulatory years (July 1-June 30) 1971-1991.

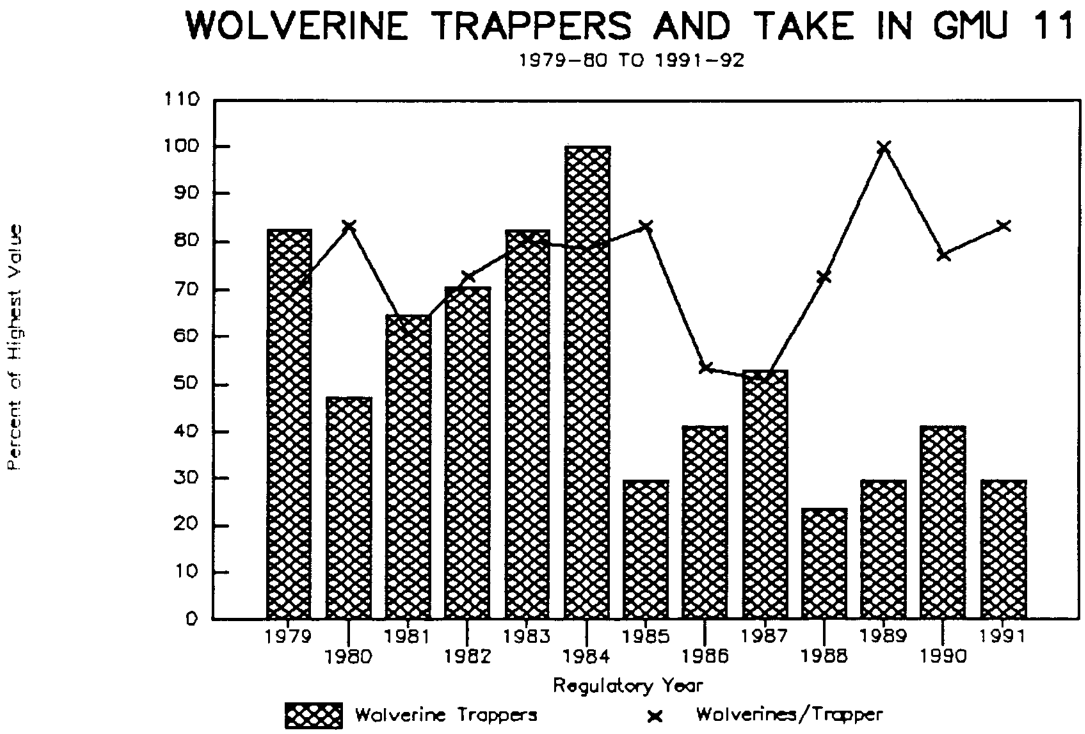

Figure 9. Trends in the number of successful wolverine trappers and catch per successful trapper in GMU 11 for regulatory years (July 1-June 30) 1971-1991. Data are presented as percentages of the highest value for each category to be able to equate units.

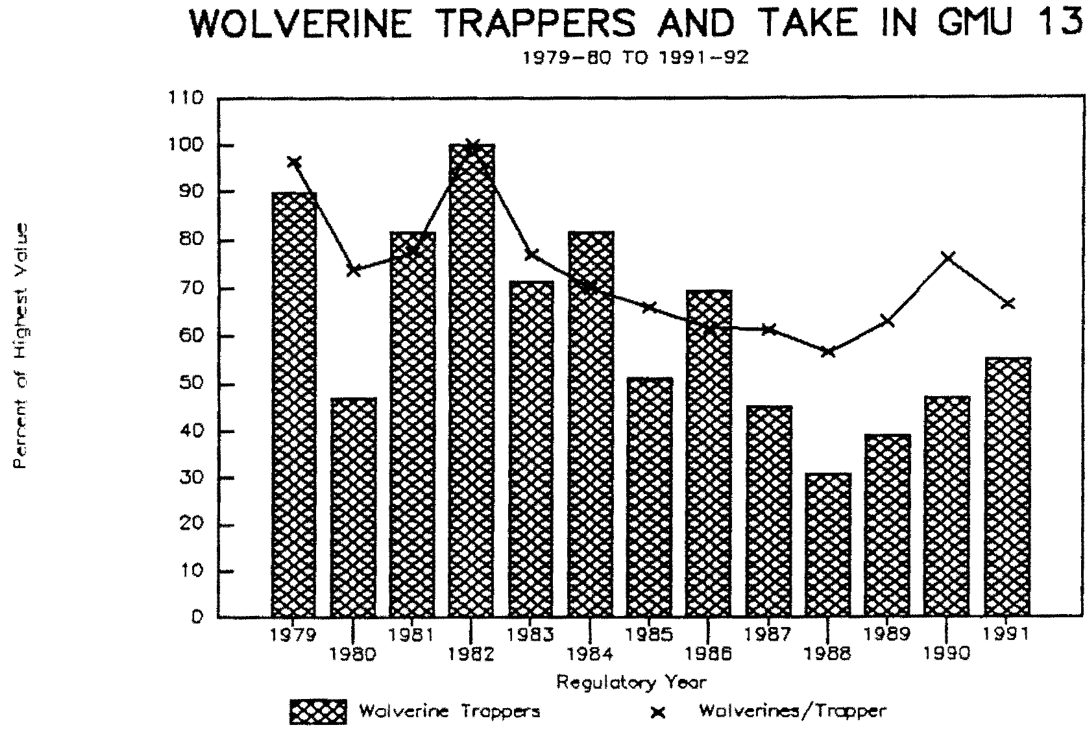

Figure 10. Trends in the number of successful wolverine trappers and catch per successful trapper in GMU 13 for regulatory years (July 1-June 30) 1971-1991. Data are presented as percentages of the highest value for each category to be able to equate units.

Since 1983 more wolverines were shot from the ground in GMU 13 than GMU 11, but most wolverines in both units were taken by traps (Table 4). Of 50 trappers who responded to a questionnaire about their trapping in GMUs 11 and 13 in 1991-92, 44% (22) reported they had tried to catch wolverines by using an average of 10.7 trap sets. Only 12% (6) of the trappers said they caught wolverines incidentally to other species they were targeting. The 25 wolverines caught by 23 of the trappers who answered the questionnaire resulted in an average catch of 1.1 wolverines/successful trapper.

Table 4. Percent method-of-take for wolverine harvests in GMUs 11 and 13, 1983-84 to 1991-92.

GMU	Ground Shoot	Trap	Snare	Air Shoot	Unknown	N
11	6	87	7	0	0	130
13	27	69	3	0	1	318

We purchased 24 wolverine carcasses from trappers during the 1991-92 trapping season in GMUs 11 and 13 (Table 5). Eight carcasses were from GMU 11, ten were from GMU 13, and six had no location data. The ratio of males:females was 7:1 in GMU 11, 4:1 in GMU 13, and 3:1 overall (including those with unknown location).

Body measurements of the carcasses indicated a pronounced sexual dimorphism (Table 5). Average body length and heart girth measurements from this collection were very similar to those of wolverine carcasses from Yukon Territory (Banci 1987). Overall condition of the wolverines was good. Fat indices showed no real distinction between the sexes, except that females tended to have more xiphoid fat (Table 5). Caution must be used in interpreting fat indices because fat reserves may be depleted in individuals that are left in traps for several days, as some of the animals examined may have been.

Table 5. Average body measurements (SD) and fat levels of skinned female (N = 6) and male (N = 18) wolverine carcasses purchased from trappers in GMUs 11 and 13, 1991-92.

Sex	Total Length (cm)	Body Length (cm)	Heart Girth (cm)	Neck Circ. (cm)	Xiphoid Fat Depth (mm)	No. Per Visceral Fat Index[a]			
						N	S	M	A
F	94.3 (4.32)	73.7 (3.88)	31.8 (1.60)	24.8 (1.60)	7.3 (5.27)	2	1	1	2
M	102.0 (11.94)	80.0 (3.79)	37.1 (3.71)	29.8 (2.76)	5.8 (3.90)	5	3	9	1

[a]Visual estimate of fat amounts: N = none, S = scarce, M = moderate, and A = abundant.

Prey and Predator Abundance:

Caribou and moose were plentiful in the Nelchina River basin. The Nelchina Caribou Herd was estimated at 45,484 animals during the fall 1992 estimate. Portions of the herd regularly over-winter in the eastern Talkeetna Mountains. Tobey (1989) believed moose were especially abundant there as well. Fall 1991 composition counts estimated between 0.54 and 0.62 moose/km^2 (540-620 moose/1,000 km^2) in the eastern Talkeetna Mountains.

Wolves and bears were also relatively abundant in the Nelchina River basin. The population estimate of wolves in GMU 13 was 357-443 (6.03-7.48/1,000 km^2) in autumn 1990 (Tobey and Gardner 1991) and 227-251 (3.83-4.24/1,000 km^2) in spring 1991 (Tobey 1991). They were particularly abundant where moose densities were high as in Subunit 13A West, which encompasses the Talkeetna Mountains study site (Tobey and Gardner 1991). Gardner (1985) believed that wolves were beneficial to wolverines in the nearby Susitna River basin because they provided food in the form of kills. Miller (In Press) estimated brown bear density for Subunit 13A in 1991-92 at 9.54-18.58/1,000 km^2. This may have been high relative to bear densities in other areas of Alaska, but it was part of a consistent decline in that area since the 1978-79 estimate of 20.91-25.71/1,000 km^2.

Work Plans for FY 93

Capture, Marking, and Telemetry (Objectives 2 and 3):

We will attempt to radio-collar a sufficient number of new wolverines (up to 10) in the eastern Talkeetna Mountains to test the accuracy of density estimations calculated from line-intercept sampling of tracks in winter. Captures will be made primarily by helicopter darting as described in the Methods section. We may also use live traps and will test the effectiveness of a capture net deployed from the skid of a helicopter to catch wolverines. Wolverines caught in February 1993 will be fitted with MOD-335 radio collars (155 gms; Telonics) rather than last year's MOD-315 collars because of a design change. We intend to locate all radio collared animals twice each month.

In mid May 1993, we will attempt to capture and radio-tag wolverine kits belonging to radio collared females. Radio marking kits, if feasible, will provide important data on kit production and survival. Kits should be large enough (3-5 kg) to capture and instrument by mid May because the peak parturition period is estimated to be in early March. We will catch kits at dens or rendezvous sites with live traps, nets, or by hand, depending upon their size, mobility, and location (Magoun 1985). Each kit, up to six in number, will be immobilized with Telezol and fitted with a radio implant (IMP/210/L; 40 gms; Telonics) surgically placed in the abdominal cavity. Kits will need to be recaptured and fitted with adult-sized collars the following winter. To determine survival, movements, and dispersal of kits, we intend to monitor them weekly for the first two months and then twice each month until they are recaptured.

Density Estimation and Trend Areas (Objectives 3 and 4):

We will estimate wolverine densities both in the eastern Talkeetna Mountains and western Wrangell Mountains study areas in February and again in March. We will follow procedures described by Becker (1991) and Gardner and Becker (1991). The technique is the transect-intercept probability sampling estimator (TIPS estimator) developed for furbearers by Becker (1991). It is based on line-intercept sampling of tracks in winter along randomly selected transects within an area of 2500-5000 km^2. Wolverine population densities are estimated from the calculated probability of intercepting observed animal tracks on a transect.

Count areas in each of the two study areas will contain randomly-selected transects from a systematic sample distribution. We will fly the transects in each count area with three teams of an observer and pilot in PA-18 Super Cubs beginning 2 days after a fresh snowfall $\geq$ 7.5 cm (Gardner and Becker 1991). Wolverine tracks that intercept a transect will be followed to the animal and backtracked to the animal's location when the snowfall ended. Track routes will be recorded on 1:250,000-scale maps. TIPS estimates and 80% confidence intervals will be calculated from the mapped track routes as per Becker (1991). Results from the TIPS estimates will be used to establish permanent trend count areas. Similarity of the results from the two sample periods for both study areas will be compared with 2-sample t-tests ($\underline{a}$ = 0.10) (Snedecor and Cochran 1980).

In the Talkeetna Mountains, we will determine the accuracy of the TIPS estimates by testing the assumption that all wolverine tracks crossing a transect are observed. We will test that assumption using 12-14 radio collared wolverines, the 2-4 still in the area plus up to 10 additional animals to be captured in February 1993. Based on a hypergeometric distribution having a population size of 20 and a sample size of 10-14 radio collared wolverines, if one wolverine in the population violates the model assumption, we would have a probability of 0.50-0.70 of observing this assumption failure.

Harvest Analysis (Objectives 5 and 6):

We will continue to analyze wolverine harvest data from pelt sealing certificates, trapper questionnaires, and carcasses purchased from trappers. Individual trappers will be contacted to request more detailed information about their trapping effort and success. We will pay particular attention to relationships between wolverine harvest and the number of trappers, pelt prices, and harvest of other species. We will analyze age from cementum annuli in teeth (upper or lower first premolar) and reproductive activity from corpora lutea and placental scars in reproductive tracts for carcasses bought in 1991-92 and 1992-93. Fecal material will be analyzed for food habits.

Prey and Predator Abundance (Objective 7):

Survey and inventory records of large ungulates and of bears and wolves will be examined for GMU 11, and the database for GMU 13 will be expanded and updated. In addition, we will record prey and predator abundance ad libitum in the Talkeetna and Wrangell study sites during the remainder of Phase I of the project in preparation for a more thorough and systematic assessment during Phase II.

Wolverine Population Model (Objective 8):

We will initiate development of a population model to help determine the approach of the demographics and ecology research in Phases II and III and to begin estimating sustainable harvest. The model will be based on previous modeling efforts for wolverines (e.g., Magoun 1985, Banci 1987), other available literature on wolverine biology, harvest data, and density estimates calculated in this study. As it develops, we expect the model to be an important tool in improving our understanding of wolverine population dynamics and in designing management strategies for wolverines in Alaska.

Final Report and Study Plan:

As part of the Phase I final report, we will prepare a detailed study plan for Phase II of this project by 30 September 1993.

ACKNOWLEDGEMENTS

The investigators and cooperators thank the many people who have assisted us so far in this project. Fixed-wing pilots Harley McMahon, Jerry Lee, Chuck McMahon, and Al Lee, and helicopter pilot Carl Richter of Soloy Helicopters provided safe and skilled flying. Audrey Magoun assisted greatly with our initial capture work and shared her experience and knowledge of wolverines. Adele Conover helped with capture work and camp chores. Sterling Miller gathered telemetry data. Area Biologist Bob Tobey provided logistic support, discussions, data, and surgical skill. Assistant Area Biologist Jim Woolington helped with logistics and shared his home with wayward biologists. Kathy Adler provided office assistance and helped in purchasing carcasses from trappers. Harvey Jessup with Yukon Department of Renewable Resources loaned us several wolverine live traps. Nick Steen allowed us to use his cabin on Clarence Lake as a field camp. The Point of View Lodge at Lake Louise let us stage our aircraft fuel in their parking lot. Suzan Bowen and Dennis McAllister helped with equipment and supplies. Boyd Porter and King Career Center students Eric Mullen, Shane Jolly, Tom McCormick, and Aaron Hill, and instructor Mike Woods helped process carcasses. Kiana Koenen and Ken Holt made special efforts to process carcasses and compile data. Karl Schneider and Russell Galipeau put their fiscal skills to work to make sure we had funding.

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