STATUS SURVEY FOR WOLVERINES (GULO GULO) ON THE SAWTOOTH NATIONAL FOREST AND ADJACENT AREAS

By

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ABSTRACT

A winter survey for wolverines was conducted on the Sawtooth NF and adjacent areas. Areas where wolverines had previously been reported were searched on snowmobile, skis, and snowshoes for sign of wolverines. Hair "traps," which were baited with venison and scented with mustelid lure, were used in two areas in an attempt to draw in wolverines. A poster describing wolverines and our survey was widely distributed in the vicinity of the Sawtooth Mountains. Two confirmed and two probable sets of wolverine tracks were located during field surveys. Twenty-four additional reports (1 confirmed, 23 probable) were also collected during the survey period. Results of this survey indicate that wolverines are still present on the Sawtooth NF and adjacent areas, but the viability of the population as well as important aspects of wolverine ecology and life history remain unknown. The need for an additional investigation of this Sensitive Species is outlined and discussed.

INTRODUCTION

The wolverine is an Idaho Department of Fish and Game Species of Special Concern, a U.S. Forest Service Sensitive Species, and a candidate for listing as Threatened or Endangered under the Endangered Species Act. In 1985 the Natural Heritage Program mailed questionnaires on the status and distribution of wolverines (Gulo gulo) to biologists and trappers statewide. Responses to the questionnaire resulted in 10 confirmed and 89 probable sightings of wolverines between 1960 and 1986 (Groves 1987, 1988). At least three areas in the state appeared to contain wolverines as indicated by clusters of confirmed (photo or carcass) and probable sightings. These areas were the Selkirk Mountains, the Kelly Creek and Lochsa River drainages, and the Sawtooth-Smoky Mountains Complex.

There were three confirmed and 15 probable reports of wolverines from the Sawtooth-Smoky Mountains and adjacent areas (Figure 1 and Table 1). Based on these reports, the Sawtooth National Forest (NF) appeared to be the most likely area in Idaho with an extant wolverine population. We initiated field surveys in 1989 to better determine the distribution and population status of wolverines on the Sawtooth NF. The purpose of this report is to summarize the results of those field survey efforts and to report on additional confirmed and probable sightings obtained during the survey period. Background information on wolverine taxonomy, description, distribution, life history, ecology, behavior, and management is provided in Appendix A.

METHODS

In September 1988, a letter was sent to all trappers who trapped on the Sawtooth NF and adjacent areas (Appendix B). The trappers were asked to send the Fish and Game Department any recent information they had on wolverine sightings or sign in the study area. A postage-paid postcard with questions on wolverines was included with the letters; all trappers were asked to return the postcard. Outfitters and guides were also sent a similar letter with a postage-paid postcard that they were asked to return (Appendix C).

A "wanted" poster on wolverines was produced. This poster contained information about our survey, a description of wolverines and their tracks, and a notice of who to contact if wolverines or wolverine tracks were observed (Appendix D). This poster was sent to all U. S. Forest Service (USFS) offices of the Sawtooth, Boise and Challis national forests, Department of Fish and Game (IDFG) offices, IDFG conservation officers, and distributed in the towns of Gooding, Jerome, Bellevue, Hailey, Ketchum, Stanley, Fairfield, and Lowman. In addition, a press release on the survey was sent statewide to newspapers, TV stations, and radio stations.

Telephone interviews were conducted with all individuals who reported seeing wolverines or wolverine sign. Confirmed wolverine reports consisted of either a photograph or carcass. Following the methodology in Groves (1987), individuals reporting sightings of wolverines or tracks were asked for a description of

the animal, the distance and amount of time of their observation, whether they had previously seen a wolverine, their confidence in the wolverine sighting, and their amount of experience as a wildlife observer. If the observer lacked confidence in the sighting, poorly described the animal, or saw it at a great distance and/or for a short time, I did not include the observation as a probable report of wolverines.

Wolverine experts Howard Hash (MT Department of Fish, Wildlife, and Parks), Craig Gardner (U.S. Fish and Wildlife Service - Alaska), and Jim Halfpenny (Arctic and Alpine Research Institute - Colorado) were consulted on how to conduct field surveys for wolverines.

Hair "traps," consisting of hardware cloth cylinders (1′ diameter, 2′ length) with barbed wire interiors (Halfpenny 1981) were employed at two locales (see Appendix E for picture of hair trap): Beaver Creek in the Sawtooth Valley and the upper portion of the South Fork Boise River near the Methodist Camp. At each site, eight traps were each placed approximately 0.5 mi apart along a snowmobile transect. These traps were baited with venison meat, scented with fisher-marten lure, and nailed approximately 5′ high on trees. These traps were checked periodically during January and February.

Additional areas were surveyed for wolverine tracks by snowmobile, cross-country skis, and snowshoes. We concentrated our survey efforts in areas where wolverines had previously been reported. Areas surveyed and dates of surveys are provided in

Table 2 (see Appendix F for maps of survey areas).

RESULTS AND DISCUSSION

Survey Efforts

During field surveys, two confirmed sets and two probable sets of wolverine tracks were located (Table 3). Fresh wolverine tracks were discovered crossing back and forth on Beaver Creek (Sawtooth NF) on January 20 1989, when we were first placing hair traps in the drainage. The animal appeared to be investigating marten traps belonging to Tim Kemery (Bellevue, ID) as it moved up the drainage. Kemery (pers. comm.) has seen wolverine tracks in Beaver Creek regularly during November and December of 1988 and 1989. Wolverines have been known to occupy Beaver Creek over at least the last 13 years as evidenced by two confirmed reports (Table 1).

We observed some probable wolverine tracks on the Decker Flats Rd. of the Redfish moraine. Again, this is an area where others have previously reported seeing both wolverines and their tracks (see Table 1 and later discussion). The tracks we observed were partially melted. However, their size and shape were indicative of wolverine tracks.

Like the tracks on the Redfish moraine, we observed some probable wolverine tracks around the Camp Bradley Scout Camp. Tim Kemery (pers. comm.) caught a wolverine in a fox set at Camp Bradley in December 1985, and has observed tracks in the area while trapping since 1984.

Fresh wolverine tracks were found on the Seafoam Rd. (Challis NF) where Bear Creek crosses the road. The tracks came down the road from just below Vanity Summit, and then headed to the east from the Bear Creek intersection with the Seafoam Rd. About 1/4 mi to the east of this intersection, the tracks led to a cache of porcupine which appeared to be repeatedly visited by the wolverine. The tracks continued heading to the southeast. We assumed that the tracks we observed on Beaver Creek (Challis NF, not the Beaver Creek on the Sawtooth NF) were probably the same animal since the animal was headed in that direction. Tim Kemery (pers. comm.) has observed tracks of several wolverines in the same vicinity while marten trapping in the area since 1984. In December 1988 he placed out bait piles along the Seafoam Rd. to draw wolverines away from his marten traps.

The three areas where we found fresh wolverine tracks (Table 3: Beaver Creek - Sawtooth NF, Seafoam Rd., Beaver Creek - Challis NF) were dominated by lodgepole pine (Pinus contorta) cover types. All three sets of tracks were located adjacent to streams in the mid to lower portions of drainages. Hornocker and Hash (1981) reported a pronounced trend of wolverines in western Montana to use lower elevational areas in winter compared to spring and summer. Although the sample size is very small (n=3), this may also be a trend in the Sawtooth area.

Hash (1988) describes wolverines as predatory scavengers who tend to cache surplus food items. We did locate one cache of a porcupine which had been repeatedly visited by a wolverine.

The porcupine was stored under approximately two feet of snow and ice. In other areas, big game carrion makes up a substantial portion of a wolverine's diet, and their movements may be related to the movements of this food source (Hash 1988). However, wolverines occupying the Beaver Creek and Redfish Lake area of the Sawtooth NF as well as the Cape Horn area of the Challis NF must be relying on other food sources since these areas are not big game winter range.

Hair Traps

No wolverine hair was captured by the hair traps at either Beaver Creek or the South Fork Boise River sites. Pine marten (Martes americana) hair was found in several traps in Beaver Creek, and pine marten scats were collected beneath four traps on the South Fork Boise River site. These preliminary results suggest that hair traps are not a promising technique for determining the presence of wolverines. However, because few traps were used, the traps covered only a small area relative to the distribution of wolverines, and time and funding did not permit us to bait or check the traps very often, it would be premature at this point to conclude that the traps are ineffective.

Reports of wolverines

Twenty-four of the reports we received on wolverine sightings or tracks were judged to be confirmed or probable sightings (Table 4). Only one of these, a sighting in the Decker Creek drainage near Atlanta, Idaho, was confirmed by a

photograph. Figure 2 combines the reports from the 1985 questionnaire (Table 1), the results of this winter's surveys (Table 3), and the new reports received during this project (Table 4) to yield the most up-to-date picture we have of the distribution of the wolverine on the Sawtooth NF and surrounding area.

This figure provides information on where we believe wolverines occur, but it does not tell us where there are not wolverines. Data on sightings are easily biased by the visitation frequency of observers such as skiers, hunters, hikers, trappers, and outfitters. Thus, the lack of sightings in the Boulder, Pioneer, and White Cloud Mountains compared to the Sawtooth and Smoky Mountains could be attributed to a relatively lower number of observers in these areas. In addition, it is not surprising that a considerable number of the probable and confirmed sightings occurred in areas which are easily accessed by roads or trails such as the Methodist Camp, Bradley Scout Camp, Redfish Lake, and Beaver Creek drainage.

Because wolverines have such large home ranges (163 mi - males, 150 mi - females; Hornocker and Hash 1981 - western Montana study), one animal may account for several sightings over a large area. For example, it is possible although not necessarily likely, that the sightings in the Beaver Creek drainage near Galena Summit and those in the vicinity of the Methodist Camp on the South Fork Boise River were made by the same individual. Based on Hornocker and Hash's (1981) home range

data, it is likely that the sightings of tracks and animals in the Cape Horn, Redfish Lake, Yankee Fork, Beaver Creek, Middle Fork Boise River, and South Fork Boise River represent different individual animals.

CONCLUSIONS AND RECOMMENDATIONS

This survey has determined from field efforts and the collection of additional sightings that the wolverine is still present in the Sawtooth NF and adjacent areas. However, the viability of the Sawtooth population remains unknown. The Sawtooth wolverine population is on the southern limit of the species' breeding range; only Colorado (where the species' status is unknown) and California may contain more southerly populations. Wolverine sightings in the vicinity of the Sawtooth NF indicate that they are using roadless and/or wilderness areas, at least part of the year. Hornocker and Hash (1981) indicated that wilderness appeared essential to the maintenance of viable wolverine populations. Although they found wolverines using non-wilderness areas, use of these areas was primarily restricted to the winter when human activity was limited. In this survey, we also found wolverines using non-wilderness areas in winter.

The population size, reproduction, mortality, food habits, movements, and habitat use of the Sawtooth wolverines remain essentially unknown. These important aspects of wolverine ecology and life history must be determined if this Sensitive Species is to be properly managed on the Sawtooth and adjacent national forests. Because only one study of the wolverine has been conducted in the lower 48 states (i.e., Hornocker and Hash 1981), there is little information available for wildlife managers. Although there are some similarities in the habitat of the western Montana study area and the Sawtooths, there are

substantial differences in vegetative cover type, elevation, and prey base between the two areas.

Wolverine populations are inherently difficult to study due to relatively low population densities and inaccessible terrain. Because of these factors and the large home ranges of wolverines, radiotelemetry and aerial monitoring are a necessity for any wolverine investigation (Hash 1988). We recommend that such an investigation be conducted on the Sawtooth and adjacent Boise and Challis national forests. Only through such a study will the critical question of wilderness/roadless land use and wolverine/Sensitive Species management be properly addressed. We suggest that all three national forests cooperatively fund and conduct this study with the Idaho Department of Fish and Game. The Wilderness Society and/or the Idaho Conservation League may also be interested in helping fund such a study.

ACKNOWLEDGMENTS

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Table 1. Summary of wolverine reports for Sawtooth National Forest and adjacent areas from Groves (1987).

Date	Site Name (TRS)	Land Owner
Confirmed Reports (carcass or photograph)		
1976	Beaver Creek (T7N R14E S33)	Sawtooth NRA
5-1985	Paradise Lake (T5N R14E S31)	Sawtooth NF
9-1987	Beaver Creek (T6N R13E S15)	Sawtooth NRA
Probable Reports		
1962	Decker FLats (T9N R14E S31)	Sawtooth NRA
1970	Goat Lake (T5N R20E S12)	Challis NF
10-1976	Bear Valley (T13N R9E S27)	Boise NF
12-1976	Dutch Creek R.S. (T6N R9E S35)	Boise NF
10-1978	Rock Creek (T7N R12E S34)	Sawtooth NF
8-1979	Galena Summit (T6N R14E S12)	Sawtooth NRA
8-1980	Ross Fork Lakes (T5N R12E S16)	Sawtooth NF
3-1981	M. F. Boise River (T7N R12E S21)	Sawtooth NRA
1982	Bear Valley (T13N R9E)	Boise NF
1984	Bradley Scout Camp(T12N R11E S2)	Private
12-1984	M. F. Boise River (T6N R11E S31)	Boise NF
8-1986	Five Mile Creek (T12N R15E S1)	Challis NF
11-1986	Vienna (T6N R14E S31)	Sawtooth NRA
1-1987	S. F. Boise River (T5N R13E S21)	Sawtooth NF
2-1987	Roaring River (T5N R9E S7)	Boise NF

Table 2. Areas surveyed for wolverine tracks during January-February 1989 on and adjacent to the Sawtooth National Forest.

DATE	SITE SURVEYED	MODE OF TRAVEL
1-20-89	Beaver Creek-Sawtooth NRA	Snowmobile
1-22-89	" "	"
1-26-89	" "	"
2-10-89	Decker Flats Rd.-Sawtooth NRA	Snowmobile
2-10-89	Elk Meadows-Sawtooth NRA	X-C Ski
2-10-89	Asher Creek/Knapp Creek Challis NF	Snowmobile
2-11-89	Seafoam Rd./Vanity Summit/ Seafoam G.S./Seafoam Lakes -Challis NF	Snowmobile & Snowshoes
2-13-89	Beaver Creek-Sawtooth NRA	Snowmobile
2-14-89	S.F. Boise River, Big Smoky Cr.	Snowmobile
2-23-89	Beaver Creek-Sawtooth NRA	Snowmobile
2-28-89	S.F. Boise River, Big Smoky Cr.	Snowmobile
3-1-89	Beaver Creek-Sawtooth NRA Pole Creek-Sawtooth NRA	Snowmobile

Table 3. Confirmed (C) and probable (P) wolverine tracks resulting from field surveys, January - March 1989.

Location	Date	P/C
Beaver Creek (T16NR13E S11,14)	1-20-89	C (Photos)
Decker Flats Rd. (T9NR13E S9)	2-10-89	P
Camp Bradley (T12NR11E S2)	2-10-89	P
Seafoam Rd/Bear Intersection (T13N R11E S18)	2-11-89	C (Photos)
Beaver Creek (T13N R11E S14) (same animal as Seafoam tracks)	2-11-89	C

Table 4. Reports of wolverines on the Sawtooth NF and adjacent areas resulting from dissemination of wolverine poster in 1989. The first report listed is a confirmed one; all others are probable. If the report is not on the Sawtooth NF, the forest or land owner is given in parentheses under location (e.g. BNF = Boise National Forest).

Observer	Location	Date
Paul Poorman	Decker Creek (BNF) (T5NR12ES18)	3-26-88
John Randles	Redfish Lake (T9NR13E)	1960
Gary Hall	Dandy Lake (T7NR12ES20)	1977
Nancy Shaw	Sawtooth Lake (T10NR12ES21)	8-81
Bob Jonas	Upper Redfish Lakes (T8NR12ES2)	4-30-83
Bob Hamilton	Methodist Camp (T4NR13ES3)	1984
Bob Jonas	Bench Lake trail (T9NR13ES16)	4-16-85
Rudolph Miller	Johnstone Pass (T5NR2ES34)	7-86
Greg Unruh	Stanley Lake trail (T11NR12ES32)	7-87
Dick Keller	Bayhorse Lake (CNF) (T13NR18ES32)	9-87
Tom Rogers	Decker Flats Rd. (T10NR13ES36)	9-87
Sid Brisbin	Custer Lookout (CNF) (T12NR16ES20)	11-87
Don Stamp	North F. Big Wood R. (T6NR17ES17) (tracks only - both dates)	12-87 11-88
Tim Kemery	Warm Springs Creek (T4NR16E) (tracks only - both dates)	12-87 12-88
Cal Myers	Methodist Camp (T4NR13ES3)	1-88
Dave Yeats	Croy Creek (T2NR18ES18)	2-88
Barney Craig	Croy Creek (BLM) (T1NR17ES4)	6-88
Michael Scott	W. Fork Yankee Creek (CNF) (tracks only) (T12NR14ES7)	10-15-88
Dan Fisher	Hermit Mine (T10NR16ES33) (tracks only)	12-88

Table 4 (continued)

Tim Kemery	Beaver, Smiley & Frenchman Creeks (tracks only) (T6NR14E)	12-88
Tim Kemery	Elk Meadows (T11NR12ES19) (tracks only)	12-88
Tim Kemery	Fir Creek - Bear Valley (BNF) (tracks only) (T12NR10ES5)	12-88
Rick Raddue	Silver Creek (T5NR16ES4)	4-1-89
Doug Holme	Stanley Lake (T11NR12ES33)	4-89

Figure 1. Distribution of wolverine reports in Idaho, 1960-1987. See text for definition of confirmed and probable reports.

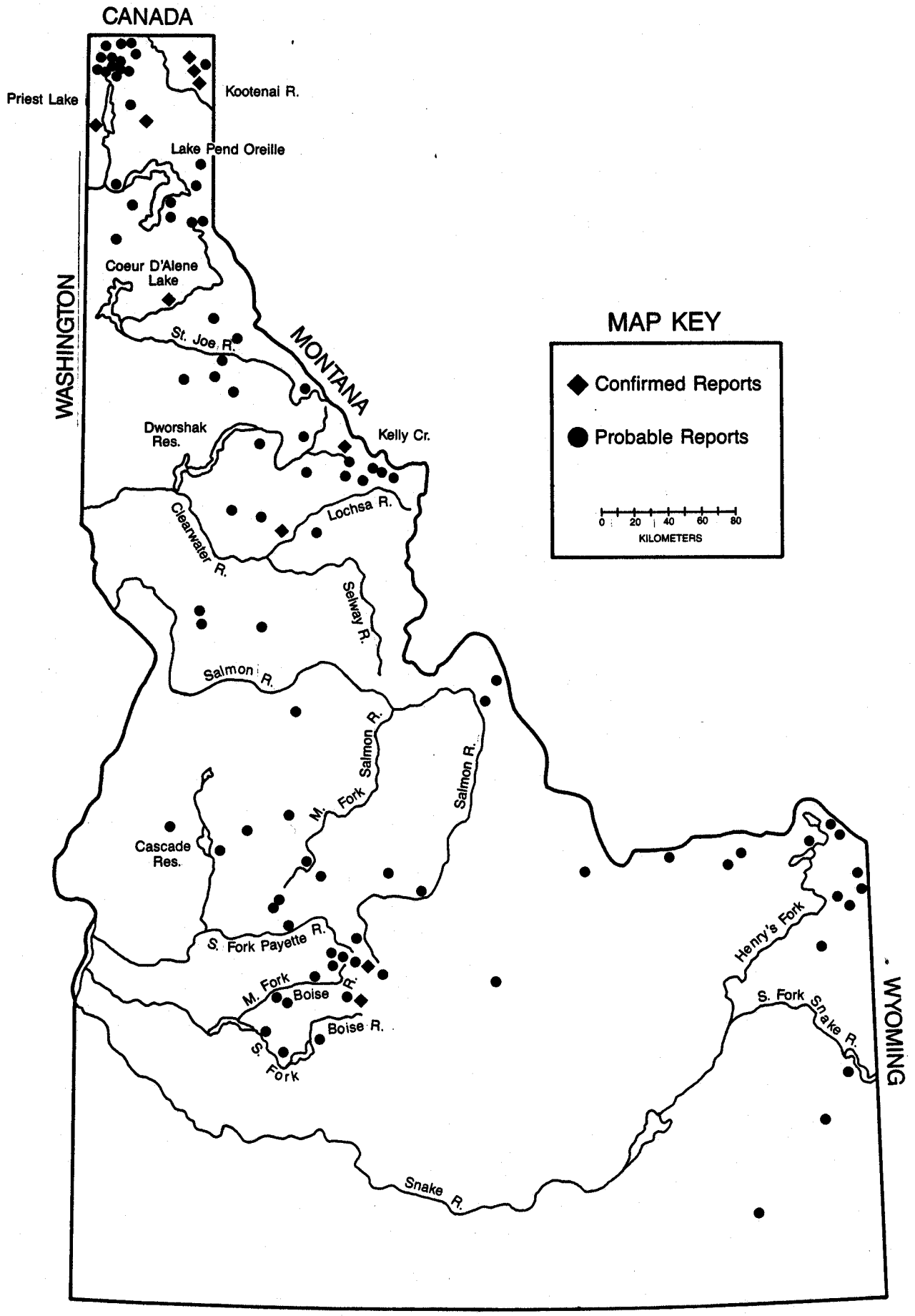
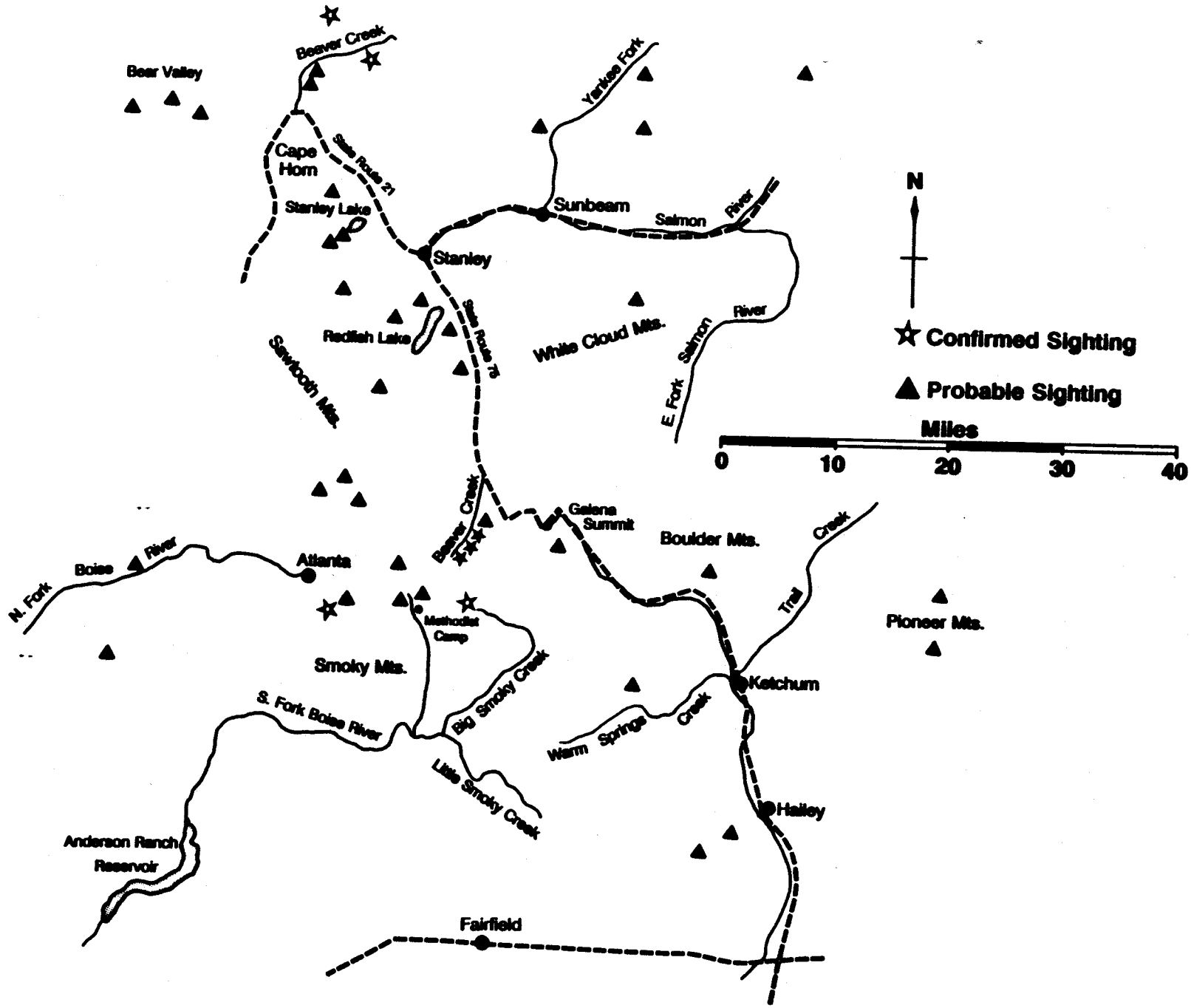

CANADA
Priest Lake
Kootenai R.
Lake Pend Oreille
Coeur D'Alene Lake
WASHINGTON
St. Joe R.
MONTANA
Dworshak Res.
Kelly Cr.
Clearwater R.
Lochsa R.
Selway R.
Salmon R.
M. Fork Salmon R.
Salmon R.
Cascade Res.
S. Fork Payette R.
M. Fork Boise R.
Boise R.
S. Fork
Henry's Fork
S. Fork Snake R.
WYOMING
Snake R.
MAP KEY
Confirmed Reports
Probable Reports
0 20 40 60 80
KILOMETERS

Figure 2. Distribution of wolverine reports on the Sawtooth National Forest and adjacent areas, 1960 - 1989. See text for definition of confirmed and probable reports.


Bear Valley
Beaver Creek
Cape Horn
State Route 21
Stanley Lake
Stanley
Yankee Fork
Sunbeam
Salmon River
Redfish Lake
State Route 75
White Cloud Mts.
Sawtooth Mts.
E. Fork Salmon River
N
Confirmed Sighting
Probable Sighting
Miles
0
10
20
30
40
Galena Summit
Boulder Mts.
Trail Creek
Pioneer Mts.
N. Fork Boise River
Atlanta
Methodist Camp
Smoky Mts.
S. Fork Boise River
Big Smoky Creek
Little Smoky Creek
Warm Springs Creek
Ketchum
Hailey
Anderson Ranch Reservoir
Fairfield

APPENDIX A

Hash, H. 1988. Wolverine. In Wild Furbearer Management and Conservation in North America. M. Novak, J.A. Baker, M. E. Obbard, and B. Malloch, editors. Ministry of Natural Resources, Ontario.

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WOLVERINE

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The wolverine (*Gulo gulo*) is the largest terrestrial member of the Mustelidae. The scientific name originated from the Latin word *gulosus* (gluttonous) from *gula* (throat). Taxonomists historically recognized differences between animals from North America and Eurasia, but authorities now acknowledge only one species (Walker 1975, Honacki et al. 1982). Various common names include devil bear, carcajou, skunk bear, and devil beast.

DESCRIPTION

The wolverine resembles a small bear in general appearance except for the bushy tail. It is compact and strongly built, with short thick skeletal structures and heavy musculature, and has a broad head, a short stout neck, and relatively short legs. Adult head-body length ranges from 65 to 105 cm (25.6–41 inches) and tail length ranges from 17 to 26 cm (6.7–10 inches) (Stroganov 1969). The feet are proportionately large and well adapted for deep snow travel, digging, and climbing. Each foot has five toes with strong semiretractile claws that are sharply curved and about 23 cm (0.8–1.2 inches) long. Dense, stiff, bristlelike hair occurs between the toes and around the pads during winter but is quite diminished during summer. Adult forefeet leave circular tracks (Fig. 1) that may be 7–8 cm (2.8–3.2 inches) × 8–9 cm (3.2–3.5 inches) long. The hindfeet are slightly smaller and lack the characteristic division of the primary sole pads of the forefeet (Jackson 1961). The third digit is longest on the hindfeet and the fourth is longest on the forefeet (Wilson 1982).

The pelage is composed of dense, woolly, kinky underfur about 2–3 cm long and coarse, stiff guard hairs about 6–10 cm (2.4–4 inches) long. The fur is short, thick, and uniform on the head and becomes progressively longer posteriorly. The ears are fully furred with extremely short underfur and somewhat longer guard hairs. Wolverine fur has long been valued and widely used in the Arctic and Subarctic as ruffs or trim on parkas and other garments. Hardy (1948) compared the icing characteristics of wolverine, coyote (*Canis latrans*), and gray wolf (*Canis lupus*) fur, and showed that ice crystals formed in the underfur of wolverine fur but that guard hairs remained free from ice. In contrast, wolf fur and coyote fur became matted and covered with chunks of ice. Quick (1952) reported that rime ice or frost from a person's breath forms on wolverine fur parka trim but may be easily brushed away; frost on other furs cannot be brushed or shaken off. Its relative rareness, beauty, and frosting characteristics combine to make wolverine pelts unique and quite valuable.

The background color of wolverine fur varies considerably among individuals, from a medium brown to almost black. Body markings are less variable. A lighter contrasting facial mask sometimes appears with a lighter upper body stripe that extends from the head or shoulders to the rump area and may merge into the tail. Color of the lateral stripe is generally blondish, but the degree of contrast varies among the body color, facial mask, and body stripe. Most specimens display white or light tan patch markings on the throat and chest; these range from one or more small spots to larger, irregularly shaped areas. Occasionally, one or both forepaws and legs may be marked with white or blond areas. Wolverines with one or more white toes are relatively common in the Northwest Territories, and white wolverine pelts are sometimes taken (A. Gunn, pers. commun.). Such pelts are cream-yellow with brownish feet.

Wolverines have anal musk glands characteristic of the mustelids which emit a tannish yellow, highly odoriferous secretion through small lateral openings located just inside the anal orifice. Coues (1877) commented that the glands are about the size of a walnut and that the scent is highly fetid.

Sexual dimorphism in body size exists, with females averaging 10% less in linear measurements and about 30% less in weight (Hall 1981). Adult weights range from 14 to 27.5 kg (31–61 pounds) for males and from 7 to 14 kg (15–31 pounds) for females (Walker 1975). The average weight for a Montana sample of 24 livetrapped research animals was 12.7 kg (28 pounds) for males and 8.3 kg (18 pounds) for females; the largest male was 15.9 kg (35 pounds) (Hornocker and Hash 1981). Twenty-six wolverines captured in northwestern Alaska weighed an average of 14.1 kg (31 pounds) and 9.9 kg (22 pounds) for males and females respectively; the largest male weighed 15.9 kg (Magoun 1985).

Wolverines have small eyes and their sight is relatively poor (Jackson 1961). An acute sense of smell enables the detection of humans or food over long distances with favorable air currents. Wolverines can locate carrion beneath 1–2 m (40–80 inches) of snow (Hornocker and Hash 1981).

The wolverine's skull is massive compared with that of other mustelids, canids, or felids of similar size. Its dental and mandibular structure is extremely strong and capable of crushing all but the larger bones of mammals up to the size of an adult moose (*Alces alces*). The teeth are generally thicker and stronger than those of similar-size predators. The upper/lower dental formula is: incisors, 3/3; canines, 1/1; premolars, 4/4; molars, 1/2; a total of 38 teeth, the same as the marten (*Martes americana*) and fisher (*M. pennanti*). Broken incisors and canines are commonly seen in older animals, apparently the result of chewing on bones or traps. General tooth wear is apparent in adults more than 5–6 years old.

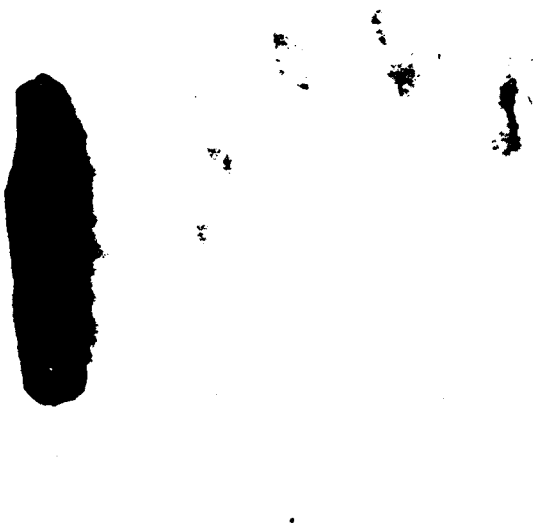

Fig. 1. Impression of a wolverine's forefoot in snow. (Photo: H. Hash.)

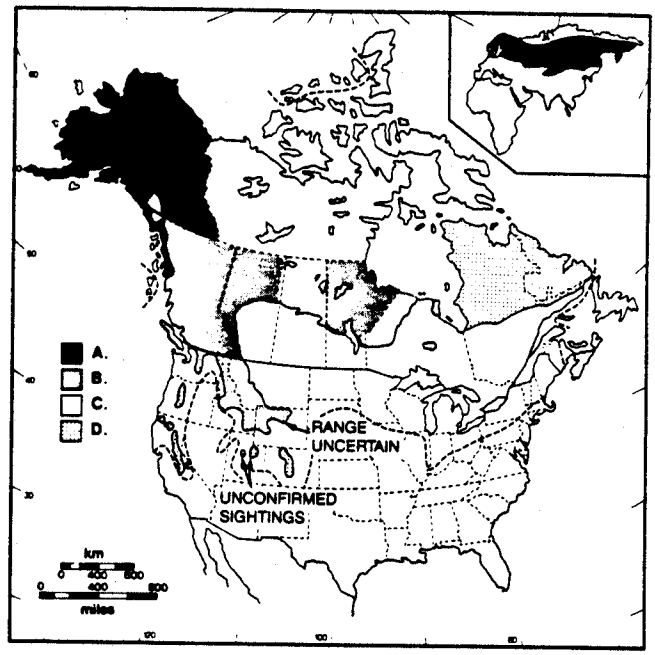

Fig. 2. Distribution and harvest density of the wolverine (*Gulo gulo*) in Canada and the United States for the 1983–84 trapping and hunting seasons (based on a survey by M. Novak and A. J. Satterthwaite, Ontario Minist. Nat. Resour.). *Legend:* (A) ≤ 2,500 km²/animal harvested (area = 1,933,000 km²); (B) 2,501–10,000 km²/animal (1,669,000 km²); (C) ≥ 10,001 km²/animal (3,621,000 km²); (D) no harvest (1,203,000 km²). Total current North American range is 8,426,000 km². Historical (c. 1700) distribution, shown by dashed line, occupied 12,600,000 km². (Sources: Jackson 1954, Peterson 1966, Schorger 1968, Nowak 1973, Van Zyll de Jong 1975, Johnson 1977, Kelsall 1981, Wilson 1982). Inset shows Eurasian distribution (Source: Banfield 1974). (2.59 km² = 1 mile²)

DISTRIBUTION

The wolverine has a vast circumboreal distribution (Fig. 2). Wolverines occur from Scandinavia across the taiga and forest-tundra zones of Eurasia (Wilson 1982). Ognev (1935) and Stroganov (1969) presented extensive distribution records for the Soviet Union. Kvam et al. (1984) reported on the status and distribution of wolverine populations in Norway, with reference to connections with neighboring Swedish populations.

The wolverine is believed to have evolved in Eurasia and migrated from Asia to North America across the Bering Strait during the mid-Pleistocene era (Kurtén 1968, Irving 1972). The historical North American distribution included much of the northern part of the continent southward to the northernmost tier of the United States from Maine to Washington state (i.e., the southern boundary of the range was roughly the 38th parallel) (Fig. 2). The historical range apparently extended southward in conjunction with the prairie-forest ecotones down the Rocky Mountains to Arizona and New Mexico at the higher elevations. Wilson (1982:644) stated that "southern range extensions were probably limited to montane boreal regions, with conspicuous gaps in the Great Basin and Great Plains areas." Bailey (1926) categorized the wolverine as an animal of the boreal forests and barrens. Hall (1981) noted historical occurrence in California, Colorado, Idaho, Indiana, Maine, Michigan, Minnesota, Nebraska, New Hampshire, New Mexico, New York, North Dakota, Oregon, Utah, Washington, and Wisconsin. Allen (1942) included Pennsylvania and Vermont along with most of the above states in a detailed discussion of historical occurrence. Schorger (1948) presented further records of wolverines in Wisconsin and Michigan.

The northward diminution of the historical wolverine range apparently began about 1840, the period of extensive exploration, fur trade, and settlement, and of the decline of the northern bison (*Bison bison*) herds. Bailey (1926) described the wolverine as "an animal of the solitudes, shunning human occupation, vanishing with the spread of civilization."

The current North American distribution is considerably reduced but still covers most of Canada, Alaska, and parts of the northwestern conterminous United States (Fig. 2). Only small, isolated wolverine populations occur in eastern Canada (Novak 1975, Prescott 1983), but the species is present over much of the remaining forest area of Canada (Van Zyll de Jong 1975, Kelsall 1981). Most of the Northwest Territories, the Yukon Territory, and Alaska support viable wolverine populations (Manville and Young 1965, Hall 1981, Wilson 1982).

Occasional recent observations have been reported from California, Colorado, Idaho, Nevada, Oregon, Utah, Washington, and Wyoming (Ingram 1973, Yocom 1973, Hornocker 1974, Johnson 1977, Deems and Pursley 1978, Kovach 1981, Hoak et al. 1982, Nead et al. 1984). Some of these areas probably have small viable populations, but the actual status and range remains uncertain. Generally, authentic observations are increasing in some of the more remote areas of the historical range, and numbers are thought to be increasing slowly. Most jurisdictions have protective regulations, and Colorado has started a reintroduction program.

The most viable and widespread population of wolverines within the conterminous 48 states occurs in the Rocky Mountains of Montana. This population, which was near extinction during the early 1900s, recovered through dispersal from Canada and from Glacier National Park in northern Montana (Newby and McDougal 1964). A limited legal harvest is allowed in Montana, which reclassified the wolverine from an unprotected predator to a furbearer in 1976.

LIFE HISTORY

Reproduction

Wolverines are generally solitary animals except during the breeding period. They do not mate for life, and males are seldom associated with females or young during the rearing period (Jackson 1961, Liskop et al. 1981).

Breeding periods vary but generally occur from late spring through early fall. Rausch and Pearson (1972) noted that spermatogenesis commenced during late winter and was active by early spring. Wolverines primarily breed during early summer and carry the dormant, unimplanted blastocyst until the following December or January, when implantation and embyro development begin (Wright and Rausch 1955, Danilov 1965, Pulliainen 1968, Rausch and Pearson 1972). Two Alaskan female carcasses obtained during June had developing follicles in the ovaries and

a third female killed on 24 June had recently conceived (Rausch and Pearson 1972). Magoun and Valkenburg (1983) observed breeding of three pairs of wolverines in northwestern Alaska, two in early June and one in early August. A pair of wolverines were observed during breeding in May 1972 in the Dakota Zoo and the female gave birth 272 days later (Mehrer 1976). Mohr (1938) estimated that the gestation period was 217 days, based on breeding observations at the Copenhagen Zoo. Rausch and Pearson (1972) placed the active gestation period following delayed implantation at 30–40 days. Mead (1981) estimated that delayed implantation lasted 175–230 days and that total gestation took 215–272 days.

Litters are born from February through April. Magoun (1985) reported March litters in arctic Alaska. In the Northwest Territories, litters are probably born during late March and early April (A. Gunn, pers. commun.). Myrberget and Sorumgard (1979) reported that the birth of Scandinavian litters occurred during February and March. Two pregnant females killed in Montana during early March contained fully developed fetuses (Greer et al. 1979). Several litters 2–3 weeks old have been observed in Montana during March (R. Belston, pers. commun.).

Wolverine litters are born in a protected den site frequently associated with an uprooted tree, cave, burrow, overhanging bank, or snow tunnel. Magoun (1985) found that snow tunnels are the most characteristic natal dens used by wolverines in northwestern Alaska. Pulliainen (1968) described 31 den sites found by hunters in Finnish Lapland. Most of these dens (25) were located on the fells (moors); 10 were situated in deep ravines. The remaining 6 dens were found on spruce (*Picea* spp.) and pine (*Pinus* spp.) peat-bogs. All dens had the same general structure—an entrance hole beside a tree or bush, a tunnel in the snow extending to ground level, and lateral tunnels up to 40 m (130 feet) long radiating out at ground level. One of the lateral tunnels contained a shallow, unlined cavity for the young. Dens in Siberia are found in caves, under boulders and tree roots, and in accumulations of woody debris consisting of broken or rotted logs and dry twigs (Stroganov 1969). Similar den sites associated with snow and rocks have been described in Norway (Myrberget 1968) and the Yukon Territory (Youngman 1975). Natal dens of wolverines in Montana are most commonly associated with snow-covered tree roots, logjams, or rocks and boulders (H. Hash, unpubl. data) (Fig. 3).

Wolverine litters may contain from one to five young, but two or three is the usual litter size. Liskop et al. (1981) in British Columbia reported a mean litter size of 2.6 based on five reproductive tracts that had detectable embryos. Rausch and Pearson (1972) reported a mean of 3.5 embryos from an Alaskan-Yukon sample of 54 females. Pulliainen (1968) combined data from seven studies in northern Europe and reported a mean of 2.5 young from 161 litters. Hornocker and Hash (1981) found a mean of 2.2 embryos in a sample of six females from Montana.

Juvenile mortality and poor breeding success apparently contribute to a relatively low reproductive output in wolverine populations. Rausch and Pearson (1972) estimated a ratio of about two kits per adult female in a harvest sample and suggested that this implied an average mortality of 1.5 young per litter during the first summer. Ingles (1965) stated that females produce litters only every second or third year; however, Magoun (1985) reported that females can have litters in successive years. Magoun (1985) observed kits with only 38% of adult females in northwestern Alaska and reported a mean litter size of 1.75 at about 12 weeks old, when kits have abandoned the natal den. Only two of eight mature females monitored during a Montana study were known to produce litters (Hornocker and Hash 1981). Liskop et al. (1981) reported a much higher pregnancy rate for mature females in British Columbia; 23 of 26 females 2 years of age or older were reproductive (the 3 nonreproductive females were estimated to be 6–7 years old). In the same study, all yearlings (N = 16) and 2 of 13 two-year-old females were immature.

Mehrer (1976) described three newborn kits from a captive female as fully covered with fine white fur and having their eyes closed and teeth unerupted. They averaged 84 g (3 ounces) in weight, 12.1 cm (4.8 inches) in crown-rump length (Mehrer's paper gave this as 121 cm, surely a typographical error), and 2.9 cm (1.1 inches) in tail length. Shilo and Tamarovskaya (1981) reported body weights of 84–94 g (3–3.3 ounces), body lengths of 15–16 cm (6–6.3 inches), and tail lengths of 2.6–3.0 cm (1–1.2 inches) for three 1-day-old wolverine kits. Growth and development occurs rapidly (Iversen 1972, Shilo and Tamarovskaya 1981). Kits are weaned at 7–8 weeks, approximately when tooth eruption occurs (Myhre and Myrberget 1975). Young begin to leave the den at 12–14 weeks (Magoun 1985) and often attain weights equal to those of adults by early winter (Rausch and Pearson 1972).

Mortality

Wild wolverines have a variable life expectancy. Jackson (1961) reported longevity in the wild at 8–10 years. Magoun (1985) reported that the tooth cementum age of a wild wolverine was 11 years and that a reproductively active, radio-collared female was 8 years old. Wild wolverines harvested in Montana rarely exceed 8 years of age, with an average of 4–6 years (H. Hash, unpubl. data). Well-cared-for captive wolverines often live longer than wild wolverines. Woods (1944) presented records that showed that the average longevity was about 5.5 years and that some animals could live for 15 years. Jackson (1961) believed that captive animals could reach 18 years of age.

ECOLOGY

Habitat

Wolverines occur within a wide variety of habitats consistent with their broad distribution, but primarily occur in boreal forests and tundra areas of the Far North.

The Pacific coastal forest types dominate the wolverine's range along the coast from Washington to British Columbia and southern Alaska for approximately 150 km (93 miles) inland (Bailey 1980). The coastal composition is also present throughout interior Washington and the Idaho panhandle into extreme northwestern Montana. This complex forest type is primarily composed of western white pines (*Pinus monticola*), lodgepole pines (*P. contorta*), ponderosa pines (*P. ponderosa*), grand firs (*Abies grandis*), Douglas-firs (*Pseudotsuga menziesii*), western hemlocks (*Tsuga heterophylla*), Engelmann spruces (*Picea engelmannii*), red cedars (*Thuja plicata*), and western larches (*Larix occidentalis*). Stringers and groves of black cottonwoods (*Populus trichocarpa*) are present along the lower parts of primary drainages. From south to north, and from lower to higher elevations, dominance generally shifts from the pine-fir types to the spruce-alpine types.

The Rocky Mountain forest types dominate the occupied wolverine range in Colorado, Montana, southwestern Alberta, and most of interior British Columbia (Bailey 1980). The primary species are the firs (*Abies* spp.), pines, and larches (*Larix* spp.). Most of the white pines, cedars (*Thuja* spp.), and hemlocks (*Tsuga* spp.)

Fig. 3. Location of a wolverine den under a logjam. (Photo: G. Kohler.)

characteristic of the coastal types are absent. Trembling aspens (*Populus tremuloides*) are common along many slopes and cottonwoods are prevalent along most streams. Many ecotonal areas occur in conjunction with marshes, lakes, cliffs, transition zones between primary cover types, and elevation gradients that appear to be important habitat components. Wolverines prefer marshy areas (Wilson 1982).

The great boreal forest comprises the largest geographic area of occupied wolverine habitat and covers much of Alaska, the southern Northwest Territories, the Yukon Territory, Alberta, and parts of British Columbia (Bailey 1980). Except for the prairie in the southern third of Manitoba and the southwestern corner of Saskatchewan, the wolverine range in Canada is covered by boreal forest types. The black spruce (*Picea mariana*) and white spruce (*P. glauca*) are the dominant species in this type, but balsam firs (*Abies balsamea*), jack pines (*Pinus banksiana*), and tamaracks (*Larix laricina*) are also common in portions of the central and eastern areas. Alpine firs (*Abies lasiocarpa*) and lodgepole pines are present in association with the spruces in the western and northwestern zones. Deciduous species are present in the central and southeastern sections, including the white birch (*Betula papyrifera*), balsam poplar (*Populus balsamifera*), trembling aspen, and a variety of shrubs. This is primarily a lowland forest with an abundance of streams, lakes, and marshes, and it does not have the same ecological variety in terms of vegetative and ecotonal composition as the Rocky Mountain types. Elevational gradients are essentially absent. Much of the northern boreal forest area is remote and has not been significantly influenced by development.

Tundra constitutes the remaining predominant vegetative zone within the northern distribution of the wolverine. Grasses, sedges, lichens, and willow (*Salix* spp.) shrubs primarily constitute the vegetation associated with permafrost. Southward the vegetation changes into birch–lichen woodland, then into boreal forest (Bailey 1980). Species diversity, precipitation, and fertility are low.

Wolverines generally occupy back country or wilderness areas that have little human activity or development. They cross areas of human habitation and development during long-range travels but are only occasionally seen, trapped, or killed in these areas, which are usually fringe zones adjacent to substantial remote habitats. Wolverines usually visit these fringe areas at night. However, occasionally wolverines have been observed scavenging near areas of human occupation (B. Boles, unpubl. rep., Gov. Northwest Territ. Environ. Soc. Program, 1975). Hornocker and Hash (1981) reported that wolverines inhabiting forested areas in Montana appeared reluctant to cross large openings, often skirting the edges or running and loping across in a straight line, in contrast to the meandering travel patterns commonly displayed within timbered areas. Gardner (1985) suggested that rocks may be important cover for wolverines within tundra areas. Rivers, highways, rugged mountain ranges, or other geographic barriers do not appear to limit the travel of wolverines.

Population Density and Dynamics

Reported natural densities of wolverine populations are low compared with those of other carnivores or predators, even under optimal habitat conditions (Quick 1953*a*, Krott 1959, Van Zyll de Jong 1975). Quick (1953*a*) based his estimate of 1 wolverine/207 km² (80 miles²) on returns from a registered Canadian trapline. Hornocker and Hash (1981) estimated that 20 wolverines inhabited a 1,300-km² (500 miles²) study area in northwestern Montana (1 wolverine/65 km² [25 miles²]). Many fringe areas adjacent to the core study area supported wolverines at densities of about 1 wolverine/150–200 km² (58–77 miles²).

Wolverine densities are closely related to the diversity and abundance of food supplies. The wolverine can use a wide range of food resources through its predatory capabilities and its efficiency as a scavenger. Its capacity to cover great distances in relatively short periods, ability to withstand severe cold and to defend a food source against larger predators, keen senses of smell and hearing, a caching instinct, and strong teeth and jaws enable the wolverine to survive as a solitary animal.

Van Zyll de Jong (1975:436) wrote that wolverines remain common where there are large and diverse ungulate populations and that wolverine densities appeared to be directly related to overall biomass and especially to the turnover of large herbivore populations.

Hornocker and Hash (1981) reported that the areas of greatest wolverine densities in Montana supported diverse ungulate populations of elk (*Cervus elaphus*), mule deer (*Odocoileus hemionus*), white-tailed deer (*O. virginianus*), moose, mountain goats (*Oreamnos americanus*), and mountain sheep (*Ovis canadensis*). This area also supported large populations of small mammals such as the snowshoe hare (*Lepus americanus*), red squirrel (*Tamiasciurus hudsonicus*), hoary marmot (*Marmota caligata*), and a variety of mice (*Peromyscus* spp.) and voles (*Microtus* spp.). Extremely high densities of Columbian ground squirrels (*Spermophilus columbianus*) were documented within certain habitat types on the study area (Ramirez and Hornocker 1981). Winter activity was primarily centered around occupied areas of big game range. Several efficient predators were present in conjunction with the big game and small mammal populations, including coyotes, mountain lions (*Felis concolor*), lynx (*F. lynx*), bobcats (*F. rufus*), fishers, martens, and badgers (*Taxidea taxus*). Although wolverine attacks on caribou (*Rangifer tarandus*) have been reported (Burkholder 1962), Ognev (1935) and Haglund (1966) reported that wolverines followed more efficient predators to scavenge food.

The greatest numbers of wolverines in North America occur in the Yukon Territory, the Northwest Territories, and Alaska. These remote areas support a variety of big game and small mammal populations as well as a complex of efficient predators. The vast nomadic caribou herds and the high population turnover rates caused by hunting, wolf predation, and natural mortality create an ideal niche for the wolverine.

Sex ratios of wolverines are approximately equal at birth; however, in exploited populations the ratio shifts towards females in the middle to older age-classes. Pulliainen (1968) reported that 15 of 37 kits taken from dens in Finland were females. Rausch and Pearson (1972) found that 8 of 14 fetuses were females. Nine of 19 fetuses recovered from harvested females in Montana were males (D. Palmisciano, pers. commun.). The overall male : female ratio was 1.53:1 for 576 wolverines trapped in Alaska (recalculated from Rausch and Pearson 1972). They also reported ratios of 1.28:1 for kits and 1:1 for animals more than 5 years old. Montana harvest records show about a 2:1 ratio (H. Hash, unpubl. data). Rausch and Pearson (1972) attributed the imbalance in the sex ratio of harvested animals to the males' tendency toward larger home ranges and greater travel than females. Magoun (1985) theorized that in Alaska the disproportionate male harvest resulted partly because fewer male home ranges than female home ranges were available, causing males to remain as transients for longer periods than females; transients travel further with increasing vulnerability to hunting and trapping. She further stated that abundant food resources may influence the proportion of males in the harvest by increasing the number of denning reproductive females, leaving fewer females vulnerable to ground shooting or trapping.

Home Ranges

Home ranges of the wolverine are large, and reports of individual wolverines covering long distances within 1–3 days are common (Krott 1960, Hornocker and Hash 1981, Wilson 1982). Magoun (1985) reported an average yearly home range of 666 km² (257 miles²) for adult males in Alaska, and resident females maintained average summer home ranges of 94 km² (36 miles²). On average, male wolverines were found four times farther from their relocation site of the previous day than were females (Magoun 1985). Whitman et al. (1986) estimated a mean home range of 535 km² (207 miles²) for males (N = 4) and 105 km² (41 miles²) for females (N = 3) in south-central Alaska. Hornocker and Hash (1981) calculated average annual home ranges of 422 km² (163 miles²) and 388 km² (150 miles²) for males and females respectively. One female radiotracked for 2.5 years occu-

pied a total home range of 963 km² (372 miles²), whereas two lactating females used much smaller spring and summer ranges of 100 km² (39 miles²) each (Hornocker and Hash 1981). Thus, home ranges covered by males are considerably larger than those covered by females.

Several factors influence the wolverine's movements and home range size. This species has exceptional stamina for sustained travel over rough terrain and deep snow, and may cover distances up to 65 km (40 miles) without rest if pursued (Wilson 1982). As scavengers, much of the wolverine's travel involves the constant search for carrion. Populations of prey species lose only a small percentage of their total numbers at any given time, and successful predators may have consumed the prey to the point where only limited food remains for the wolverine to scavenge.

The nomadic and migratory nature of many of the big game species that are the wolverine's primary food sources dictates large home ranges and extensive movements for both primary predators and associated wolverines. It is not uncommon for deer and elk to migrate 50–80 km (30–50 miles) from their summer to winter ranges. The nomadic caribou herds of Alaska, the Yukon, and the Northwest Territories travel fairly constantly and their annual movements frequently cover long distances. Wolverines do not closely follow moving game herds on a daily basis, but their overall movements are directly related to food sources.

The daily travel patterns of male wolverines expand during the breeding season. In Montana, males traveled about 30% farther during the spring than during the rest of the year. The movement patterns of male wolverines in Alaska were influenced by breeding behavior from late winter through summer (Magoun 1985).

While finding a suitable home range, young adults of most predatory species commonly exhibit longer and more frequent movements than do older adults. Dispersal phenomena are usually associated with the degree of territoriality displayed by the species. Data show that the dispersal of young adults may contribute to the impression of the use of large home ranges by wolverines (Koehler et al. 1980, Hornocker and Hash 1981). Magoun (1985) specifically noted that dispersal by several young wolverines in Alaska accounted for greater travel distances. However, Gardner et al. (1986) documented a record 378-km (235 miles) movement by an adult male wolverine.

FOOD HABITS

The wolverine is an entirely opportunistic feeder, taking a wide variety of food items depending on their availability within specific locations and habitats. The wolverine is generally a carnivore, but other matter such as fruits, berries (Rausch and Pearson 1972), insects (Krott 1959), and fish (salmonids) (J. Whitman, pers. commun.) may be taken infrequently when more preferred foods are unavailable.

Wolverines tend to cache surplus food items. Ognev (1935) reported as many as 20 foxes and 100 ptarmigans (*Lagopus* spp.) stored under snow and ice. Krott (1960) described the practice of caching food items in detail. Large pieces of carrion may be placed in tree branches. Magoun (1985) also described the caching of arctic ground squirrels (*Spermophilus parryii*), caribou remnants, and a duck in Alaska. Marking with urine, scent, or both occurs at all caches (Wilson 1982).

Wolverines are best described as scavenging predators. They are well adapted for this lifestyle; Haglund (1966) noted that their massive skull structure, powerful jaws, strong teeth, and overall strength enable them to successfully use large bones and frozen meat. The wolverine is strong for its size and can drag large food items several times its own weight over considerable distances to areas of cover and security for the purposes of feeding, caching, or defense. Reports of elk and moose quarters being dragged from hunter kill sites or camps are fairly common. Once a large wolverine takes a prized food item, there are few instances where other animals can successfully interfere. An acute sense of smell enables the wolverine to locate food items under deep snow cover, further increasing its efficiency as a scavenger.

Many authors have recognized the importance of carrion as a primary food source for the wolverine (Teplov 1955, Krott 1959, Pulliainen 1968, Rausch and Pearson 1972, Wilson 1982, Magoun 1985). Analysis of 56 scats collected in Montana showed that deer and elk carrion occurred in 27% of the samples (Hornocker and Hash 1981). Magoun (1985) stated that caribou and arctic ground squirrel carrion were the most important winter foods in northwestern Alaska. Individual wolverines may become skilled at robbing previously captured furbearers and baits from traplines. Reports of robbed cabins and food caches are also common.

The wolverine can kill animals many times its own size, especially when deep snow hinders the prey (Wilson 1982). There are reports of effective predation on North American caribou (Magoun 1985) and European reindeer (*Rangifer tarandus*) (Wilson 1982), and instances of moose being killed by wolverines (Haglund 1966). However, actual first-order predation on large animals probably accounts for a small percentage of the overall wolverine diet except in special situations. Magoun (1985) observed wolverines chasing caribou during summer, but the wolverines were easily outdistanced. Jackson (1961) stated that wolverines run slowly and heavily and can be overtaken by a fast human runner. No instances of predation on moose, deer, or elk were observed during the 5-year Montana study; however, kills of these species made by mountain lions had been used by wolverines.

On the other hand, wolverines are successful predators on a variety of small mammals and birds. Snowshoe hares, grouse, ptarmigan, ground squirrels (*Spermophilus* spp.), tree squirrels (*Sciurus* spp. and *Tamiasciurus* spp.), mice, and voles are important food items. Wolverines in the Mackenzie Valley feed on porcupines (*Erethizon dorsatum*), muskrats (*Ondatra zibethicus*), and fish (Boles, unpubl. rep., 1975). Porcupine quills were found embedded in the chest and forelegs of healthy wolverines in Montana and elsewhere (Rausch and Pearson 1972). Quick (1953*b*) also reported the occurrence of embedded quills. Dead wolverines have been found with their stomachs and digestive tracts impacted with masses of porcupine quills (Grinnell et al. 1937).

Magoun (1985) observed Alaskan wolverines successfully hunting for ground squirrels and for ptarmigans (adults, eggs, and chicks) during spring and summer. Hornocker and Hash (1981) reported that ground squirrels were a primary food source during spring and summer. They also noted that wolverines successfully hunted mice and voles in tree wells formed by deep snow.

BEHAVIOR

The general behavior of the wolverine is comparable with that of other predators, particularly other mustelids. The popular literature has often depicted the wolverine as having a mean disposition and an abnormally ill temper, but most of these observations have apparently been based on wolverines in traps or enclosures. However, under these circumstances, few other animals display the defensive aggression of the wolverine. Wooden and wire live traps will not hold a wolverine, and large-jaw leghold traps frequently fail to hold wolverines.

The wolverine can climb trees, log cabin walls, and rocky cliff or slide areas. It can gnaw, dig, climb, or rip its way into all but the most secure buildings and caches in search of food (Anderson 1929).

Wolverines exhibit extensive marking behavior either by glandular scenting or the biting and scratching of various-size trees (Pulliainen and Ovaskainen 1975, Koehler et al. 1980, Hornocker and Hash 1981, Magoun 1985). Scenting and scratching are frequently combined (Koehler et al. 1980). Buskirk et al. (1986) discussed plantar glands of the feet in North American mustelids, which may serve as an additional scenting and marking mechanism.

Musk, urine, or scats are frequently deposited on trees, rocks, tussocks, logs, or other prominent objects. Jackson (1961) suggested this behavior is used to signal ownership of a food supply. Ewer (1973) thought that anal musk was emitted only during alarm and that marking was performed with the ventral gland. Wolverines have ventral abdominal glands (Fig. 4) similar to

Fig. 4. Howard Hash holding an immobilized wolverine. Note the light-colored patch on the belly that marks the location of the ventral abdominal gland. (Photo: S. Hash.)

those of martens (Hall 1926). However, the ventral glands of the wolverine have not been studied in detail.

The social behavior of wild wolverines resembles that of other solitary, intrasexually territorial carnivores (Powell 1979, Magoun 1985). These animals are primarily solitary except during the breeding season and the spring–fall period associated with the rearing of young. Occasionally, two or more adult wolverines, apparently family members, may travel together during the winter or spring. However, J. Whitman (pers. commun.) argued that during late spring in Alaska adult pairs are probably breeding pairs and not family associations. Observations of wolverines in Montana yielded only one record of two adult wolverines traveling together during winter deep-snow conditions and about 15% of observations described two or more wolverines in summer or fall family groups (H. Hash, unpubl. data). Bee and Hall (1956) reported 17 of 20 observations of solitary animals, 2 of pairs, and 1 of three animals. Wolverines apparently do not engage in any type of cooperative hunting.

Ewer (1973) stated that male wolverines appear to be territorial, excluding other males from their home range but permitting females to enter. Krott (1959) stated that females are mutually intolerant within territories but that more than one female may occur within the typically larger territories of the males. Powell (1979) examined the general spacing patterns of mustelids and found that they used designated intrasexual territories where males are territorial against males and females against females, with extensive territory overlap between sexes. However, Schaller (1972) and Macdonald (1980) pointed out that territoriality is difficult to measure for most carnivores and therefore is, at present, a less useful measure than home range. Magoun (1985) documented the exclusive use of summer home ranges by adult female wolverines in northwestern Alaska. However, data were insufficient to determine if adult male home ranges overlapped; overlap did occur between adult and juvenile males. In south-central Alaska, Gardner (1985) found a varying amount of range overlap between two resident males, between a juvenile and a resident adult, and between a transient adult and a resident adult. The percentage of overlap was least between the adults, irrespective of residential status. Wolverine home ranges frequently overlapped between individuals with unknown residential status of the same and opposite sex in Montana (Hornocker and Hash 1981). The aggressive defense of territories was essentially nonexistent in Montana wolverines; however, extensive scenting and marking behavior appeared to be a social mechanism to maintain individual spacing in time (Koehler et al. 1980). Wolverines, especially adult males, have home ranges that are much too large to actively defend, and regimented territorialism would be detrimental in terms of energy balance to an animal that depends on widespread carrion for much of its food source (Hornocker et al. 1983).

Hornocker and Hash (1981) suggested that a social system that enables greater flexibility of movement to carrion and other food sources would be a more successful strategy for wolverines. They also suggested that high mortality rates contributed to a lack of regimented territorial behavior by eliminating enough animals to impart a "state of flux" (i.e., by removing individuals before they could establish tenure). Similarly, comparatively unexploited populations of Idaho mountain lions showed a highly refined system of territorialism (Hornocker 1969, Seidensticker et al. 1973), whereas individuals in heavily exploited populations were not territorial at all (Hornocker 1976). Gittleman and Harvey (1982) showed that home range size increases with metabolic needs and that carnivores with a large proportion of flesh in their diets have particularly large home ranges.

Wolverines are primarily nocturnal but may be active during daylight hours (Jackson 1961, Wilson 1982). Magoun (1985) noted greater activity during the middle of the long summer days at far northern latitudes in conjunction with ground squirrel activity. Most of the wolverine activity observed during the Montana study occurred at night (Hornocker and Hash 1981). Krott (1960) described a continuous activity cycle comprised of alternating periods of activity and sleep 3–4 hours long that may be disrupted by inclement weather, when more sleeping occurs. Hunger may also disrupt the cycle and cause extended periods of activity. Wolverines are active year-round throughout their range and are nonmigratory.

MANAGEMENT

The wolverine has been heavily exploited by humans throughout much of its holarctic range. The species' unique and valuable fur, its predation (especially on wild and domestic animals in Eurasia), and its raiding of traplines, food caches, camps, and cabins have resulted in virtually unlimited hunting and trapping seasons and even the payment of bounties (Hornocker and Hash 1981). The primary impacts of exploitation in North America apparently occurred from about 1840 to 1925, as manifested by range reductions and extirpation from many areas (Newby and Wright 1955, Jackson 1961, Newby and McDougal 1964, Van Zyll de Jong 1975). Early management-related activities primarily consisted of recording and monitoring the harvest of wolverines by hunters and trappers. Few conservation measures were implemented prior to the 1960s. Totally protective regulations have been adopted by jurisdictions where the species appears to be reoccupying its historical range. However, few jurisdictions have developed specific wolverine management plans or harvest objectives (Munroe and Jackson 1979). Most management decisions regarding seasons and regulations have been based primarily on harvest data, best professional judgement, subjective information, and the results of limited research projects conducted in specific areas.

A general lack of management-oriented information exists largely because wolverine populations are inherently difficult and expensive to study. Densities are relatively low and the wolverine occurs in some of the most inaccessible areas of North

America. The extremely large home ranges make radiotelemetry a necessity in order to maintain reasonable contact with study animals. Aerial monitoring requirements further complicate research efforts. Wolverine populations seldom warrant high priority on the agenda of wildlife agencies charged with managing many species.

Sexing and Aging Techniques

The sexing of wolverines is straightforward because the genitalia of both sexes are apparent on the live animal, carcass, or pelt. Other methods of assigning sex are primarily based on sexual dimorphism. Magoun (1985) studied a collection of 535 Alaskan wolverine skulls and determined that the condylobasal length measurement can be used to separate males from females; only a 6% overlap occurred. A successful technique for determining sex based on the cross-sectional area of the lower canine teeth has been applied to black bears (*Ursus americanus*) by Sauer et al. (1966) and to bobcats by Friedrich et al. (1983). This technique can probably be successfully used to sex wolverines.

Annuli in the cementum of teeth probably provide the most accurate means for determining year-class of most mammals (Larson and Taber 1980). Rausch and Pearson (1972) concluded that while reproductive organs, long bones, and cranial sutures provided an adequate separation of young of the year 10–11 months of age or less, only cementum deposition provided a reliable estimate of age beyond 1 year. Weight of the baculum was easier and less expensive to use than the cementum technique and more accurate than the long bone–cranial ossification technique. However, Rausch and Pearson (1972) believed that material for this method would be no easier to obtain than for the cementum annuli method. Dry lens weight was judged unsuitable for determining age (Rausch and Pearson 1972). D. Palmisciano (pers. commun.) determined that annuli in wolverine canines are readable to an age of 6–8 years, beyond which annuli become generally indistinct. Johnston and Watt (1981) described a direct method of obtaining annuli counts from undecalcified, unstained sections of carnivore canine teeth that can probably be applied to wolverines. D. Palmisciano (pers. commun.) applied the foramen diameter method described by Crowe (1972) for bobcats to a sample of Montana wolverine teeth previously aged by annuli counts and determined that the ratio of the overall tooth diameter to the inside diameter of the longitudinal pulp canal gives a valid year-class up to age three. Whitman et al. (1986) used body weight, overall condition of teeth, general physical condition, and physiological signs of aging as criteria to classify immobilized live animals or carcasses as juveniles, young adults, adults, or old adults. Magoun (1985) estimated the ages of live-trapped wolverines using several criteria: extracted tooth cementum annuli, general condition of teeth, length of teats for females, length of testes for males, extent of scarring and wounds, and observations of breeding. Based on the time of year that capture occurred, wolverines were categorized as adults, subadults, or juveniles. Similar factors were used to categorize 24 animals studied in Montana; extensive tooth wear and breakage were generally evident in what appeared to be old adults (Hornocker and Hash 1981).

Censusing and Estimating Population Numbers

Most conventional methods that have been successfully used to assess population numbers of furbearers present difficulties when applied to the wolverine. Actual counts, sample counts, and transect counts are essentially precluded by naturally low densities, reclusive and nocturnal habits, habitation of remote and forested areas, and widespread distribution. Various mark-recapture methods would require an impractical trapping effort to capture a valid sample because of low densities, low capture success, and logistical constraints.

The most satisfactory estimates of wolverine population numbers have been obtained in conjunction with extensive radiotelemetry research projects. Home range size and degree of exclusivity, population structure, and mark-recapture data were used to derive estimates of population numbers. Based on an average female summer range of 94 km^2 (36 miles^2), a male home range of 625 km^2 (241 miles^2), and a reproductive rate of 0.6 kits/year/female, Magoun (1985) calculated a resident fall population of 821 wolverines for a specific management unit in Alaska. Hornocker and Hash (1981) combined data from radio-tracking, mark-recapture, and snowtracking to estimate a minimum population of 20 wolverines on their 1,300-km^2 (502 miles^2) study area, a density of one animal/65 km^2 (25 miles^2). Satisfactory estimates of wolverine numbers could probably be derived by carefully extrapolating density values to other areas with similar habitat, food resources, harvest pressure and yield, and general predator–prey ecology. Extrapolation would be greatly enhanced by companion indices such as track counts or bait-station surveys.

A procedure for estimating harvest rate and associated population size, which uses data on differential harvest by sex and age categories as well as information on accumulated harvest effort, has been described by Fraser (1976), Paloheimo and Fraser (1981), and Fraser et al. (1982). The method considers the progressive decline of males relative to females because of unequal harvest vulnerability of the sexes in population cohorts with initial sex ratios of 1:1. The fundamental assumption supporting this technique is that harvest changes sex ratios with age; however, initially balanced sex ratios and nonharvest mortality are also assumed. Since disproportionate harvests distinctly occur in wolverine populations (Rausch and Pearson 1972, Hornocker and Hash 1981, Magoun 1985), this method can probably be applied to wolverines successfully. Fraser et al. (1982) cautioned that changes in harvest methods or timing affect the differential vulnerability of the sexes and the validity of the estimation method.

Golden (1986) conducted aerial furbearer track counts in Alaska. Because wolverine tracks and trails are distinctive, aerial surveys can probably be applied to unforested northern areas to obtain estimates of wolverine numbers. However, Hornocker and Hash (1981:1300) stated: "Regional, rather than local, populations must be considered in any management program.... By traveling widely in a short period of time, individual wolverines give a false impression of abundance. Tracks encountered in widely separated major drainages, often divided by high mountain ranges, may in fact be made by the same individual. This should be taken into account when unit or area harvest regulations are set."

Estimating Population Growth

Valid estimates of changing population numbers for most wildlife species are best derived by several complementary techniques that assess fecundity and mortality, and which serve to check and improve final results. Although few of the various methods used to successfully monitor population growth in furbearer populations have been applied to wolverines, some of the techniques may be practically applied to this species with little or no modification.

Widespread and long-term radiotelemetry investigations can yield excellent information on survival, density, and reproduction (Hornocker and Hash 1981, Magoun 1985); however, inherent economic and logistical constraints render them largely impractical as a management tool for the sustained assessment of wolverine population parameters.

The most reliable information on fecundity is obtained from the analysis of female reproductive tracts acquired from harvested animals. The tracts can be examined for corpora lutea and placental scars (Wright and Rausch 1955, Greer and Palmisciano 1982, Magoun 1985). Placental scars persist for 1 year or more but become progressively less distinct following birth, and bleaching and clearing techniques may be required (Wright and Rausch 1955). Counts of corpora lutea accurately reveal the number of ripe ova or eggs released from the ovary during estrus, which translates into an estimate of litter size at birth. Counts of placental scars combined with counts of corpora lutea provide a more reliable estimate of fecundity (Johnson and Holloran 1985) particularly for wolverines, which may not produce litters every year

(Ingles 1965, Hornocker and Hash 1981). Recruitment can be estimated by applying quantitative survival data to basic fecundity measures. Magoun (1985) obtained survival rates of 1.75 kits per litter by directly observing radiotagged females.

Indirect indices provide more feasible means of monitoring changes in population levels. A modification of the scent-station survey (Linhart and Knowlton 1975, Roughton 1982, Roughton and Sweeny 1982, Conner et al. 1983) conducted under snowtracking conditions is suitable for wolverines, which readily visit winter bait stations. A linear transect of bait stations located at intervals of 15–20 km (9–12 miles) will reduce the possibility of several stations being visited by one animal. This method will yield an index of the relative abundance of wolverines over time. The number of stations per transect and the number of days over which each transect is visited can be varied to determine the most efficient sampling procedure (Roughton and Sweeny 1982).

Depending on snow cover conditions, systematic track counts (Fig. 5) may also provide information on the relative abundance of wolverines (Mauer 1985). Zezulak (1980) reported that track-count transects conducted after fresh snow may depict changes in bobcat population levels more accurately than scent-station surveys. However, wolverines appear to be much more responsive to bait or scent than bobcats; as a result, bait stations may be more useful. Population data on primary food-source species should also be collected in conjunction with bait-station or track-count surveys.

Furbearer population trend indices are frequently maintained by monitoring harvest level and harvest effort data through pelt tagging or sealing, trapper mail questionnaires, fur dealer transactions, or trapper reports. Because the total wolverine harvest is comparatively small, this method should be quite feasible.

Knowledge of the wolverine is likely inadequate to enable realistic computer population modeling as applied to many other species. However, this method will become more applicable as data bases and knowledge of the species increase.

Regulating the Harvest

Wolverine harvest levels are difficult to closely control; however, harvest rates have remained relatively stable. The incidental take of this species in traps primarily intended for other species accounts for part of the harvest. Wolverines are difficult to release in good condition without special equipment and some are lost through unintentional captures. The wolverine is also hunted as a game animal throughout parts of its range. Harvest and incidental losses are difficult to document because of processing delays and possible poor compliance with tagging regulations (as reported in Alaska by Magoun 1985).

Fig. 5. Track of a wolverine in fresh snow. (Photo: H. Hash.)

Furbearer harvests are regulated by the duration and timing of open seasons, individual trapper limits, and geographic harvest quotas. Pelt tagging or registration is needed to provide current knowledge of numbers harvested. Alaska requires that all wolverine pelts taken by trapping be sealed within 30 days following the closure of the trapping season and that those taken by hunting be sealed within 60 days (Hinman and Kramer 1986). All wolverine pelts taken in Montana must be tagged within 10 days after season closure. Erickson (1982) suggested that rigorously enforced pelt registration programs were particularly applicable to species with small total harvests.

There are insufficient data to properly evaluate whether populations in most jurisdictions can sustain present harvest levels; however, in Alaska, an apparent decline in the wolverine harvest has occurred from 1971–72 to the present (J. Whitman, unpubl. rep., Alaska Dep. Fish and Game, 1984). Whitman recommended that the trapping season be reduced to enable populations to recover.

Live Capture Methods

The wolverine is a difficult animal to capture and handle humanely without special equipment. A system combining sturdy live traps, a portable squeeze chute, and prompt immobilization with aqueous ketamine hydrochloride (Ketalar) has been successfully used (Hash and Hornocker 1980). Animals were captured in live traps with a sliding dropdoor and weatherproof trigger mechanism. Traps were baited with approximately 1 kg (2 pounds) of fresh meat, and a visual attractor (a piece of cloth) was suspended from a branch or pole near the set. On capture a portable squeeze chute made from metal mesh with a movable top section was attached to mounting lugs adjacent to the trap door. The chute was covered with canvas to darken the interior and the trap door was raised to enable the animal to move into the chute. The door and the moveable top section of the squeeze chute were then lowered, forcing the animal to the floor until drugs could be administered with a jabstick or syringe. Immobilization usually occurred within 5 min, recovery began within about 45 min, and full recovery required 3–8 hours (Hash and Hornocker 1980).

Wolverines were immobilized with dosages of Ketalar that ranged from 17.2 to 25.5 mg/kg body weight (Hash and Hornocker 1980). Generally, dosages of less than 16 mg/kg did not produce adequate periods of immobilization and dosages of more than 25 mg/kg induced immobilization beyond that required for normal research or transport purposes. Muscle relaxants as described by Ramsden et al. (1976) or general tranquilizers such as xylazine (Rompun) might be carefully combined with Ketalar to reduce muscle rigidity. Moderate muscle rigidity and excessive salivation were noted in all animals, necessitating the maintenance of an adequate airway. Wolverines were positioned to facilitate the gravitational flow of saliva to prevent aspiration. Anesthetized animals were particularly susceptible to sudden tactile stimulation, so all were handled as gently as possible. Each immobilized animal received 2 ml bicillin (Wyeth) prophylactically, and no animal deaths were attributable to the effects of immobilization.

Wolverines have been immobilized with ketamine (Hash and Hornocker 1980), a combination of phencyclidine and promazine (Seal and Erickson 1969, Seal et al. 1970), and a combination of etorphine and xylazine (Ballard et al. 1982).

Immobilized animals should not be released until fully recovered, as they are susceptible to predation and accidents (Fig. 6). Drugged animals were removed from the chute for processing and dilated eyes were covered with a dark cloth to prevent damage and reduce sight responses.

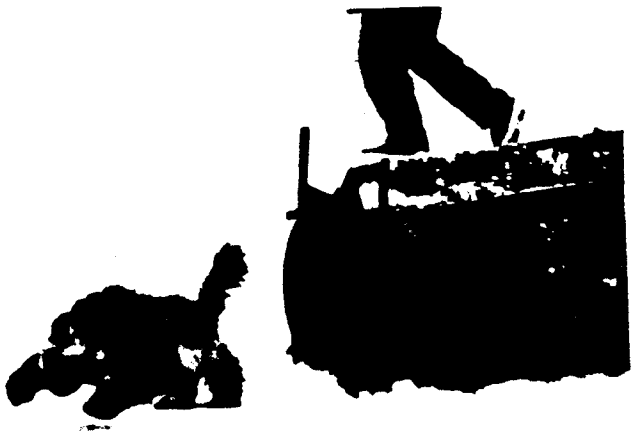

Fig. 6. Fully recovered wolverine released from a live trap after handling. (Photo: H. Hash.)

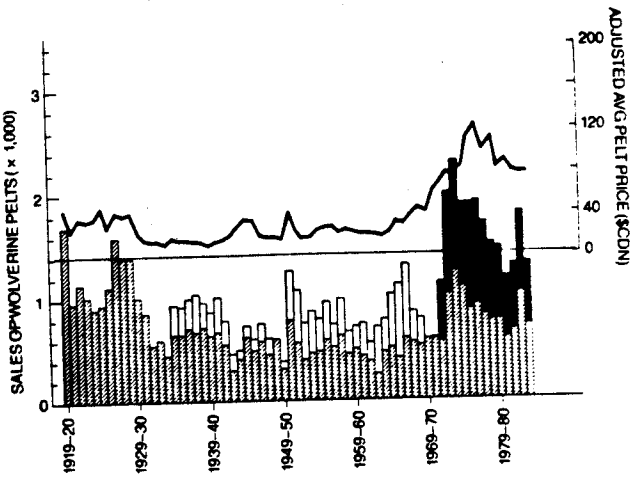

Fig. 7. Sales of wolverine pelts in Canada (hatched bars) and the United States (pre-1970, open bars; post-1970, stippled bars). Solid line shows adjusted average price (1970 $CDN = 1.0). Source: Obbard et al. (1987).

Wolverines that will not enter a live trap may be captured using a conventional leghold trap with padded or offset jaws. A typical cubby or bait set may be prepared in conjunction with a radiotelemetry transmitter connected to the trap chain so that the event of capture is known immediately. It is essential to immobilize and remove the animal from the trap as soon as possible to prevent damage to the foot, leg, and teeth.

Whitman and Ballard (1984) and Magoun (1985) successfully captured wolverines with cagelike live traps, by using a dart gun from a helicopter or snowmobile, and by darting animals in caves or snow tunnels. It is possible to capture litters by digging out the den site (Pulliainen 1968; R. Belston, C. Garland, H. Kitchens, pers. commun.). This is an arduous task and is not always successful because of rocks or other obstructions.

The use of specially selected and trained trailhounds may be useful for the capture and handling of wild wolverines, much as they are commonly used to capture mountain lions. Jackson (1954) stated that the wolverine is easily treed by a barking dog, yet when cornered will outfight any dog. Animals pursued this way will climb a tree or stop in some protected site and thus may be immobilized with a dart gun. C. Garland (pers. commun.) treed a Montana wolverine in deep snow conditions with trailhounds. This capture method has not been widely practised and further development is required.

Economic Importance

The wolverine is not an economically important furbearer on the international market; however, pelts are often valued beyond sale or barter in many local communities of the Far North, especially among Eskimos and Athabascan Indians. Recent North American harvests in the 1980s have been approximately 1,200–1,800 animals annually (Fig. 7). From 1973–74 to 1981–82 the average price of wolverine pelts was exceeded only by brown bear (*Ursus arctos*), polar bear (*U. maritimus*), and lynx pelts, and occasionally by mountain lion pelts. However, because of low numbers, the total value of the wolverine harvest is smaller than that of many furbearers (Obbard et al. 1987). The average price of wolverine pelts has risen greatly since the early 1960s (Fig. 7). Wolverine fur is primarily used by local and native enterprises for parka ruffs and trim for outer garments. It has not been widely sought for fashion garments by the international fur industry, but the full pelt of the wolverine is highly valued as a trophy when processed into a rug or mount.

Despite a reputation for being a nuisance animal, the wolverine cannot represent any serious conflict with human interests, except on rare occasions. Its overall natural low densities and remote distribution provide limited opportunities for significant conflicts, except for some areas in Alaska and possibly Canada. The occasional incident is rarely serious and can best be handled on a local basis.

CONCLUSIONS

Recent research and field studies have improved our understanding of the wolverine. Although considerable progress has been made, further work is needed to test and develop reliable and practical density indicators. Status and occurrence verification programs should be implemented by jurisdictions where wolverines are reported or suspected. There are many areas where the range is uncertain, but general reports (Hornocker 1974, Novak 1975, Johnson 1977, Kovach 1981, Hoak et al. 1982, Nead et al. 1984) have indicated reoccupancy of some parts of its historical range where suitable habitat occurs.

Hunting and trapping appear to be the primary sources of mortality for adult wolverines, as the species has few natural enemies. Wolverines are vulnerable to bait trapping because their scavenging nature and long-distance travel patterns increase the overall probability of their encountering traps, even in remote areas. In contrast, females with newborn young are limited in their ranging and foraging and as a result become especially vulnerable to easily obtained trap baits (Hornocker and Hash 1981). Bait trapping for all species should be prohibited in areas where expansion of wolverine populations is desired. Harvest seasons should be closed during late winter and early spring (Feb–Apr) to protect females with kits. Wolverines are susceptible to traps intended for other species; any set made for a coyote, lynx, bobcat, or wolf can effectively take a wolverine.

Much of the general wolverine population decline and extirpation that occurred during the late 1800s and early 1900s on many ranges, particularly the conterminous United States, has been attributed to overtrapping and habitat degradation. It is essential that the harvest of a species with a naturally low density and relatively low reproductive potential be monitored closely. Any actual or contemplated harvest program should be directed only towards viable populations that are producing surplus animals. General populations or localized subpopulations that are expanding their ranges or that are in the process of reestablishment should be fully protected. Areas of the wolverine's historical range with suitable habitat which are currently vacant or only occasionally occupied would be ideally suited to reintroduction programs. Healthy wild wolverines should be released at a ratio of two or four females per male, which would facilitate the restoration of this species in areas that can support viable wild populations.

The future of the wolverine appears bright. The species has survived the pioneer periods of unregulated trapping, hunting,

and predator control, accelerated and irresponsible natural resource development, and widespread habitat degradation. The designation of vast national park and wilderness areas has greatly benefited the wolverine. Our greater awareness and responsibility toward environmental issues and threatened species will favor the survival of the wolverine, as well as many other wildlife species. Carefully regulated harvest programs, the implementation of refined monitoring techniques, appropriate reintroduction programs, and the preservation of adequate suitable habitat should ensure the survival of the wolverine for future generations.

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HOWARD S. HASH is fur resource biologist with the Montana Department of Fish, Wildlife and Parks. He received a B.S. in wildlife management and an M.S. in big game management from the University of Idaho, and worked for the Idaho Fish and Game Department, the University of Idaho, and as a commercial pilot before joining the Montana wildlife program. Hash has published several papers on the ecology and management of wolverines in Montana.

APPENDIX B

Letter to trappers from Idaho Department of Fish and Game

IDAHO FISH & GAME
600 South Walnut / Box 25
Boise, Idaho 83707

September 15, 1988

Dear Trapper:

In 1985 the Department of Fish and Game conducted a survey of trappers and wildlife biologists throughout Idaho to determine the distribution and status of the wolverine. Many of you responded to the questionnaire that we sent to you concerning wolverines, and your response was appreciated.

In 1987, the Department published a report entitled "Distribution of the wolverine (Gulo gulo) in Idaho, 1960-1987." Information compiled from sightings of wolverines by trappers and biologists is summarized in this report. Based on sightings, incidental trappings, and a few carcasses, the report concludes that at least three areas in the state still contain wolverines: the Selkirk Mountains, the Lochsa and Kelly Creek drainages, and the Sawtooth-Smoky Mountains.

This winter, the Department in cooperation with the Sawtooth National Forest (NF) will be trying to determine the status of the wolverine on the Sawtooth NF. WE NEED YOUR HELP! If you did not respond to our 1985 survey or have seen wolverines or wolverine sign since then, please take a minute and fill out the enclosed postage-paid postcard and return it to us. Please be as specific as possible about the date and location where you observed a wolverine or sign. Your telephone number will be most helpful in case we have any follow-up questions. If you know of anyone else who has seen a wolverine, we would appreciate their name and address or phone number.

We will be trying various field techniques this winter to locate wolverines on the Sawtooth NF. If you observe wolverine sign while trapping this winter, I would appreciate it if you could notify Craig Groves as soon as possible. Craig can be reached in Boise at 334-3402. If you would like a copy of our 1987 wolverine report or have any questions about the survey, just drop Craig a note or give him a call. Many thanks for your assistance.

Sincerely,

Jerry M. Conley
Director

JMC/CG/sa

Enc.

APPENDIX C

Letter to outfitters and guides

IDAHO FISH & GAME
600 South Walnut / Box 25
Boise, Idaho 83707

October 17, 1988

Dear Outfitter/Guide:

In 1985 the Department of Fish and Game conducted a survey of trappers and wildlife biologists throughout Idaho to determine the distribution and status of the wolverine. In 1987 the Department published a report entitled "Distribution of the Wolverine (Gulo gulo) in Idaho, 1960-1987." Information compiled from sightings of wolverines by trappers and biologists is summarized in this report. Based on sightings, incidental trappings, and a few carcasses, the report concludes that at least three areas in the State still contain wolverines: the Selkirk Mountains, the Lochsa and Kelly Creek drainages, and the Sawtooth-Smoky Mountains.

This winter, the Department in cooperation with the Sawtooth National Forest (NF) will be trying to better determine the status of the wolverines on the Sawtooth NF. WE NEED YOUR HELP! If you have seen wolverines or wolverine sign in the Sawtooth, Smoky, Boulder, or White Cloud Mountains in the last 10 years, we would appreciate hearing from you on the enclosed postage-paid postcard. Please be as specific as possible about the date and location where you observed a wolverine or sign. Your telephone number will be most helpful in case we have any follow-up questions. If you know of anyone else who has seen a wolverine, we would appreciate you providing us with their name and address or phone number.

We will be trying various field techniques this winter to locate wolverines on the Sawtooth NF. If you observe wolverine signs while outfitting or guiding this fall or winter, I would appreciate it if you would contact Craig Groves, a staff biologist in our Wildlife Bureau, as soon as possible. He can be reached in Boise at 334-3402. If you would like a copy of our 1987 wolverine report or have any questions about the survey, just drop Craig a note or give him a call. Many thanks for your assistance.

Sincerely,

Jerry Mallet

for Jerry M. Conley
Director

JMC/CG/ps

APPENDIX D

Wolverine poster

NEWS RELEASE

Idaho Department of Fish and Game

P. O. Box 25 / Boise, ID 83707 / (208) 334-3700

IN THIS EDITION:

- **Wolverine Search in Idaho**
- **Bighorn Sheep Disease Confirmed**
- **Nongame Tax Checkoff**
- **Commissioners Profiled**

Editor's Note: The accompanying photograph (when applicable) was produced with an 85-line screen and is ready for reproduction in your publication. Please credit "Idaho Department of Fish and Game."

CONTACT: **Jack Trueblood**

FOR RELEASE: **December 26, 1988**

Wolverine posters are being placed in communities in and near the Sawtooth National Forest in an effort by Idaho Department of Fish and Game and the U.S. Forest Service to learn where wolverines live and how many there are. They are extremely rare in Idaho. IDFG illustration

50 years for wildlife

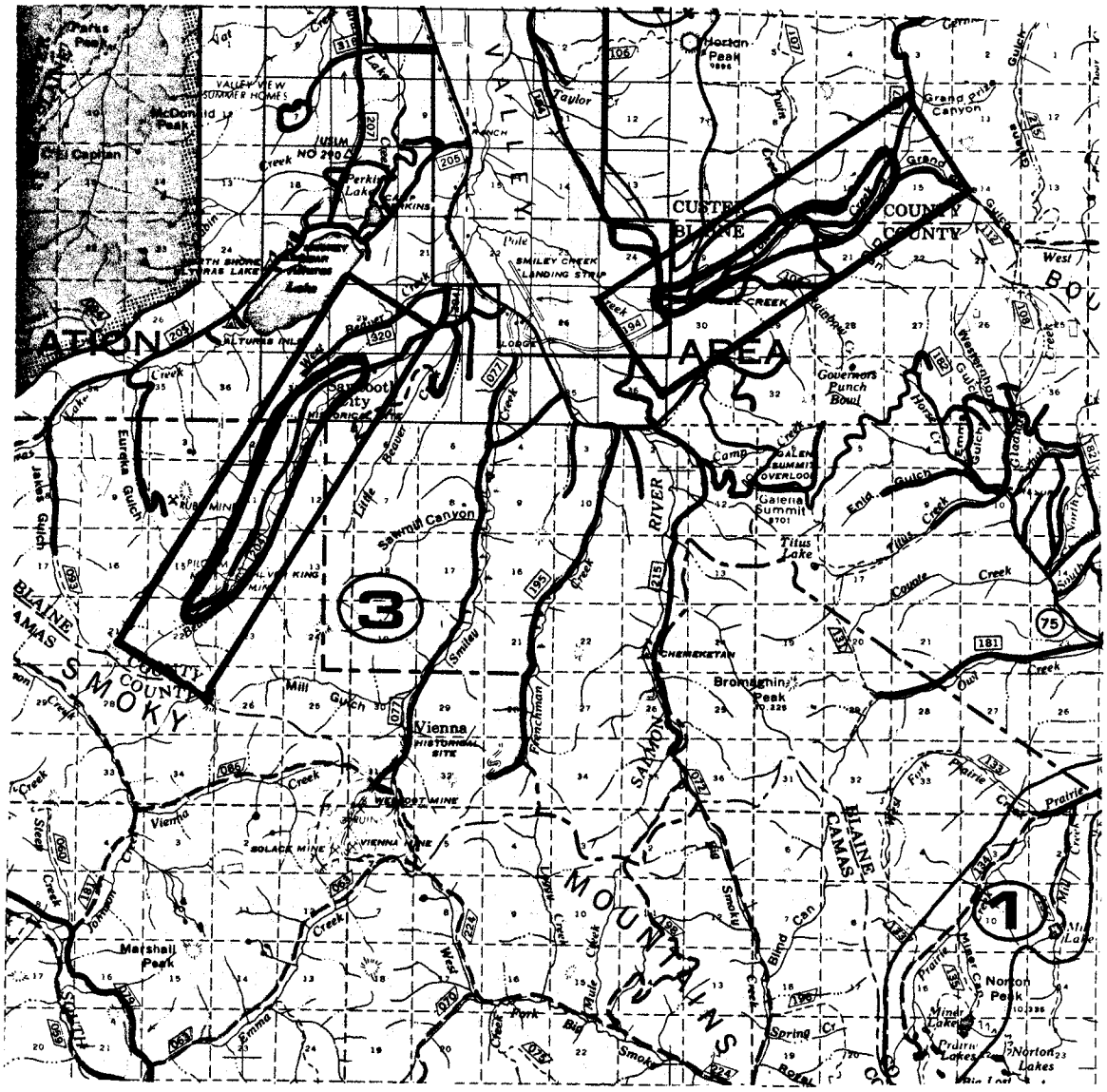
APPENDIX E

Picture of hair trap used in wolverine survey

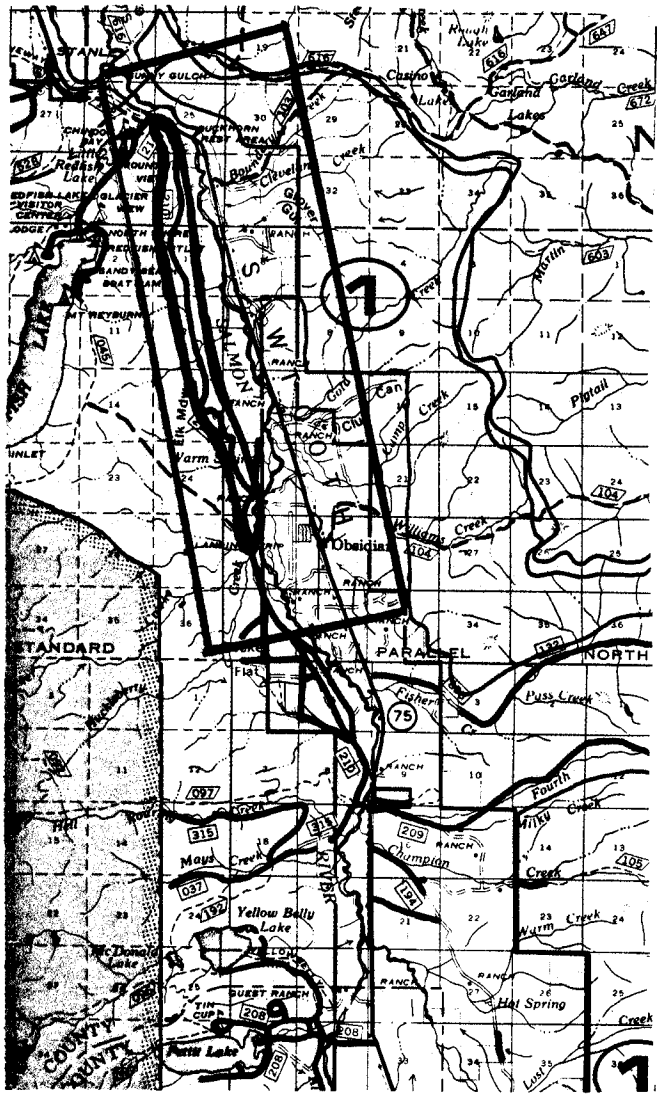
Hair snags--hardware cloth cylinders with barbed wire interiors--were used in an attempt to obtain evidence of wolverine occurrence.

APPENDIX F

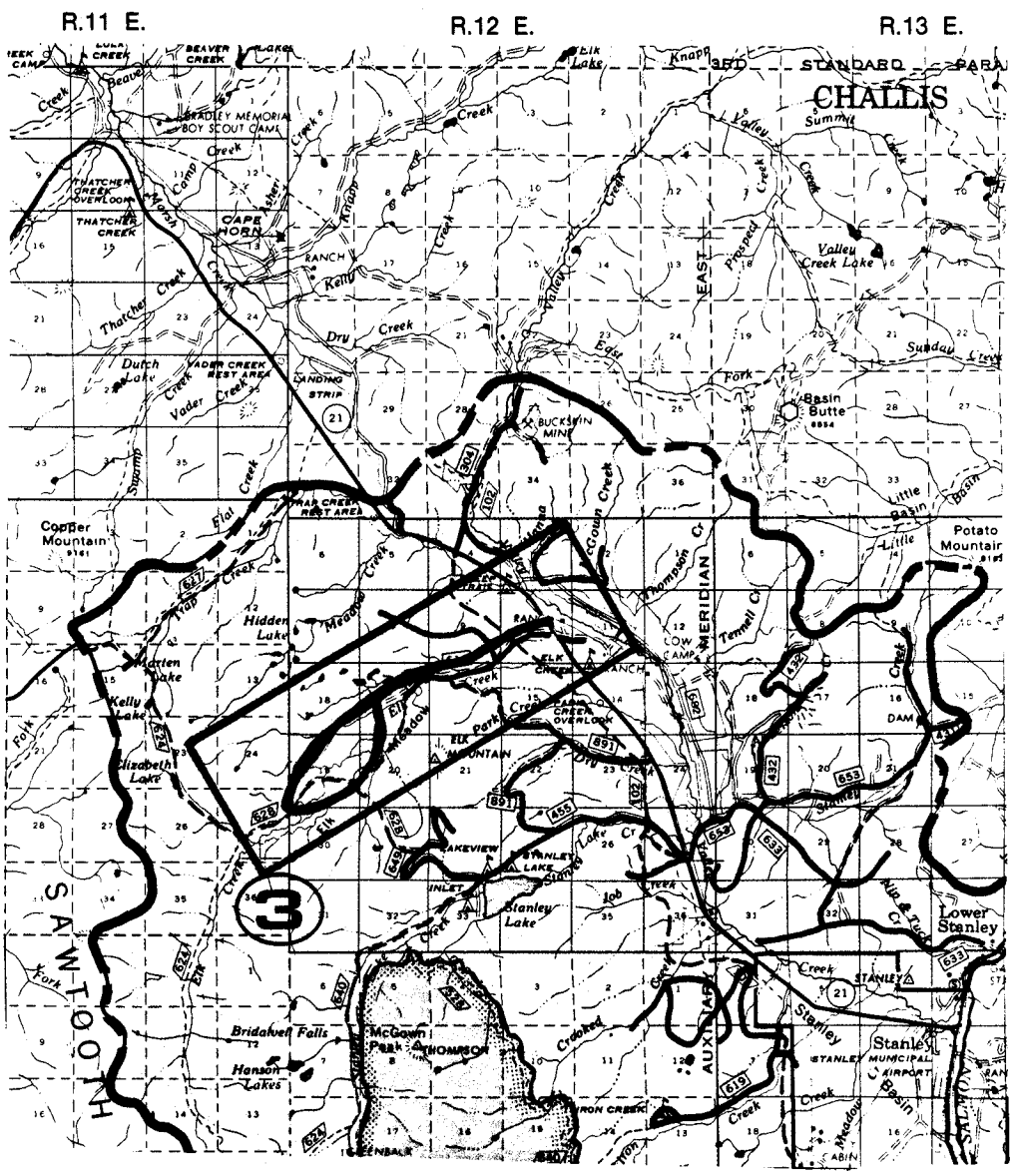
Maps of areas surveyed for wolverines



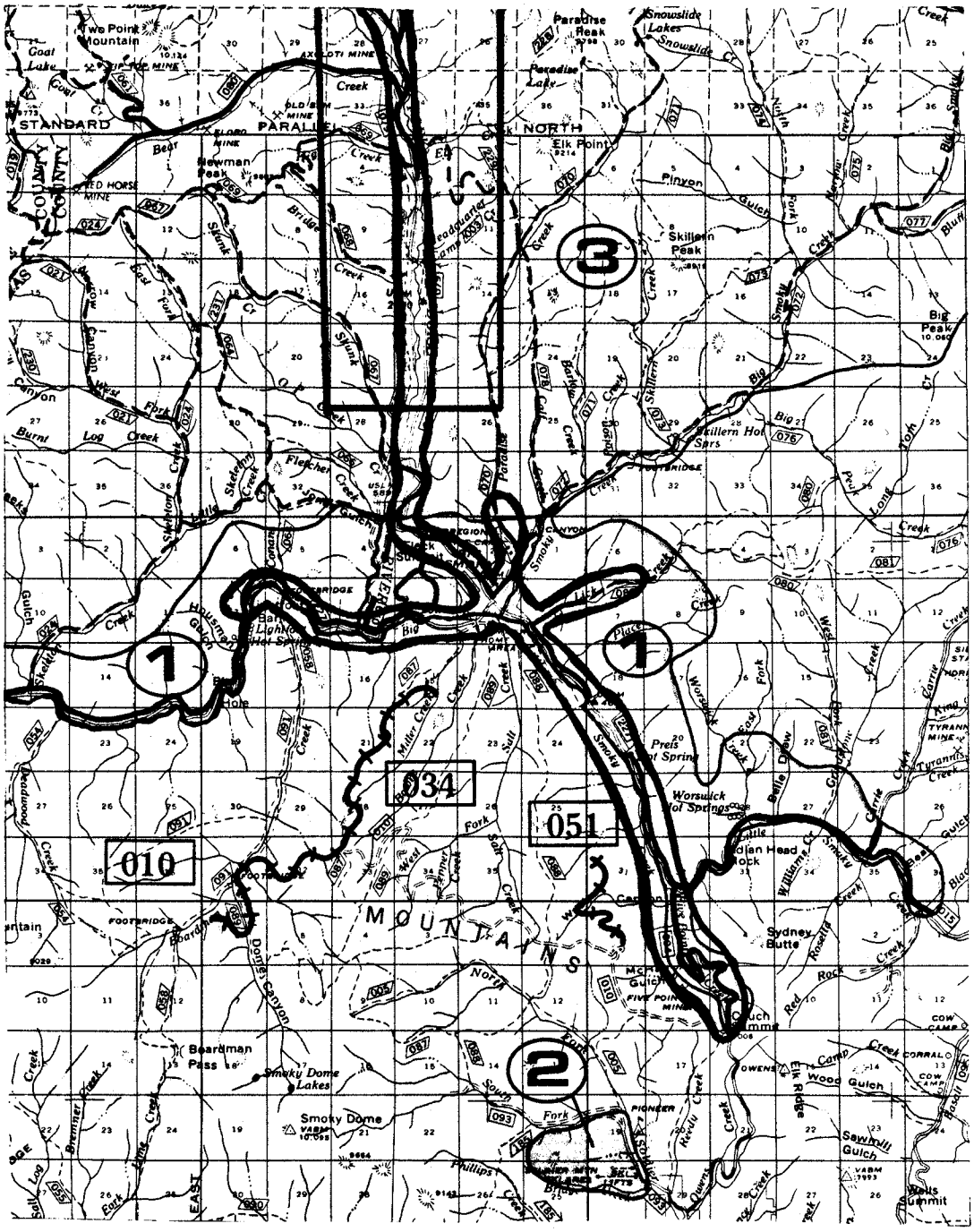
Beaver Creek Hair Traps and Survey Route,
Pole Creek Survey Route, Sawtooth NRA



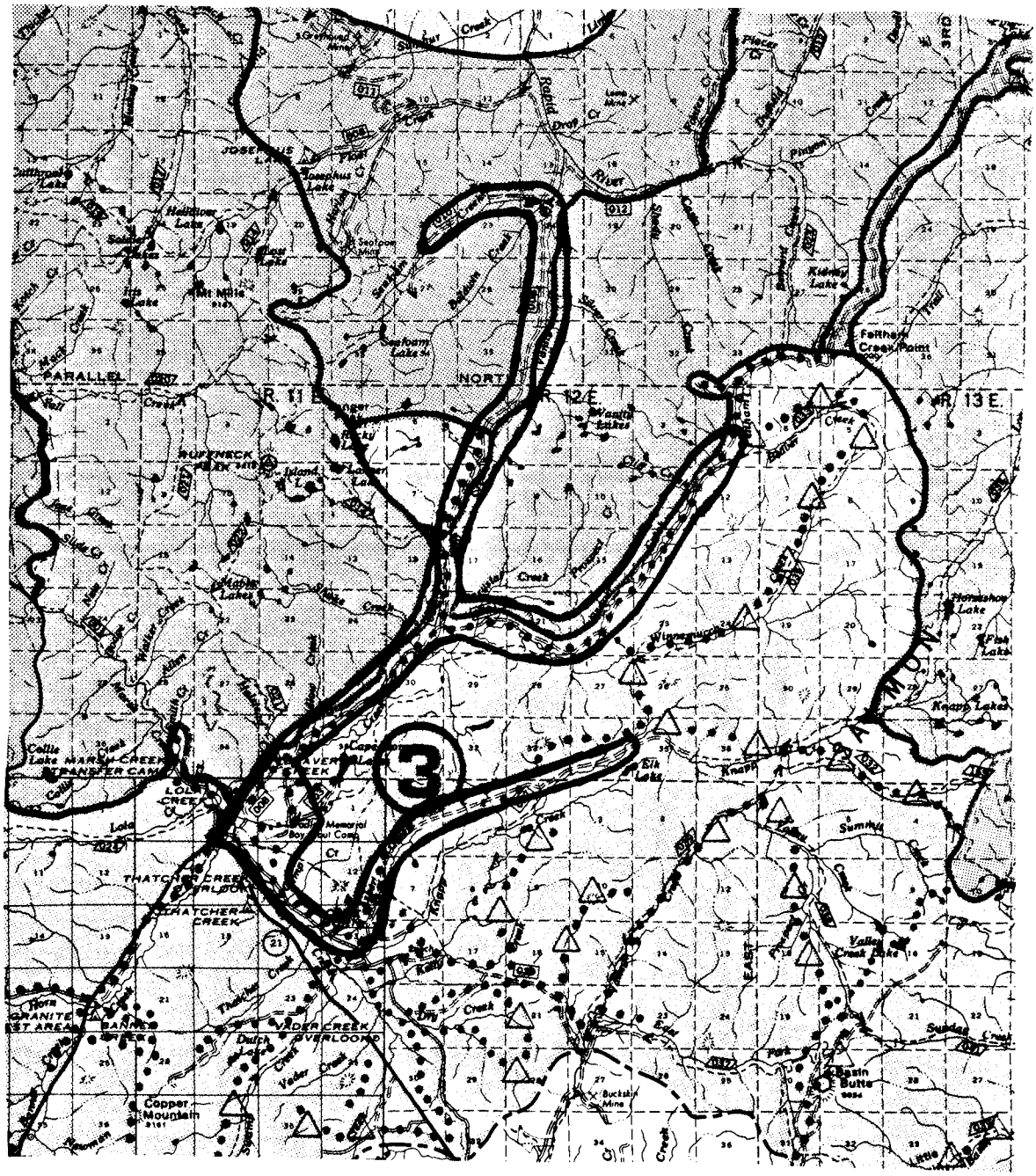
Redfish Moraine, Decker Flats Survey Route, Sawtooth NRA



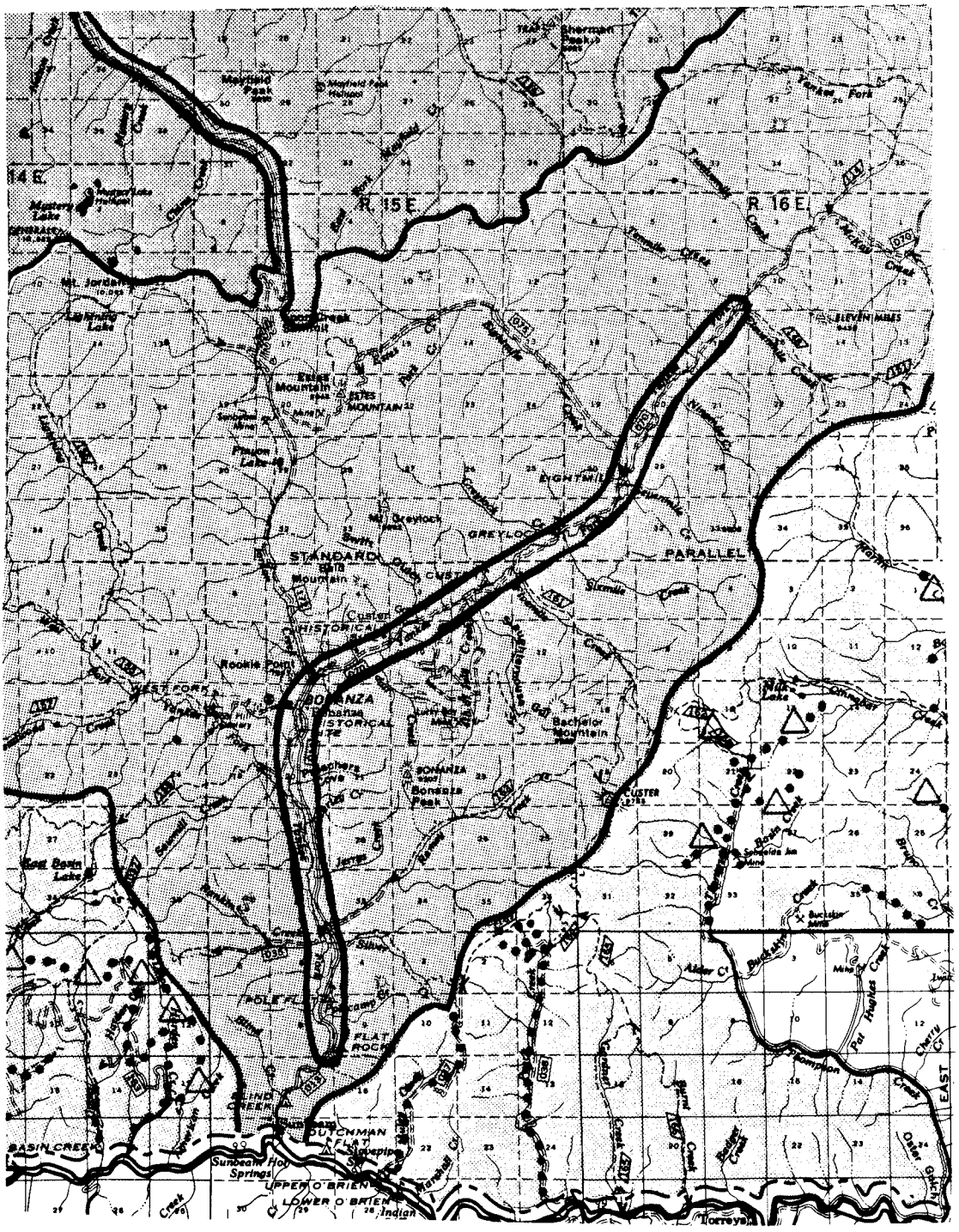
Elk Meadows Survey Route, Sawtooth NRA



South Fork Boise River drainage hair trap locations (in box) and survey routes, Sawtooth NF



Cape Horn and vicinity survey routes, Challis NF



Yankee Fork Survey Route, Challis NF

Submitted by:

Craig Groves

Craig Groves
Staff Biologist
Nongame Program

Approved by:

IDAHO DEPARTMENT OF FISH AND GAME

Jerry M. Conley, Director

for John Beecham

Tom Beinecker, Chief
Bureau of Wildlife

Wayne Melquist 6/30/89

Wayne Melquist
State Nongame Manager