

Greater Yellowstone Wolverine Program

North American Program of The Wildlife Conservation Society



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EXECUTIVE SUMMARY

Wolverine ecology in the lower 48 United States is not well documented. Federal and state resource managers need information in order to make well-informed policy decisions that affect land-use practices and populations of wolverines. Wolverines are currently on the U.S. Fish and Wildlife Service list for consideration as a threatened or endangered species. This determination will be a particularly difficult task. This project is designed to provide needed information and answer specific questions relevant to wolverine management and related land-use policies.

A successful conservation strategy for wolverines in the Greater Yellowstone Ecosystem (GYE) requires documentation of population demographics and determination of the human and ecosystem influences that affect population dynamics. Two areas, the Madison Range of southwestern Montana and the Teton Range of northwestern Wyoming, have been selected for intensive study. These areas were chosen because they are representative of the land management jurisdictions and human-use impacts that are common to the GYE. Variation in jurisdiction, management policies, and human-use impacts between these two study areas will facilitate our ability to compare and contrast influences on wolverine population dynamics.

During this first year of full implementation of the wolverine program, we accomplished many objectives necessary to begin field research. We created a detailed study plan, equipped and organized two field offices, and obtained various permits necessary to conduct the research. We purchased field equipment and created data-forms, field protocols, and databases. We secured funding and in-kind support for the program. We researched and purchased four GPS collars for use on wolverines. We developed kit capture and summer recreational survey methodologies and protocols. Numerous other first-year accomplishments were made.

On the Madison Range Study Area (MRSA), we constructed eight new wolverine traps. Seven traps were open for a total of 428 trap-nights, during which time six wolverine visits occurred (likely by two to three individuals). One sub-adult female was captured two times, resulting in a low capture rate of one wolverine capture per 214 trap-nights.

Approximately three weeks after her capture, F102 was harvested by a recreational fur trapper, two days before the close of the furbearer trapping season. Two additional wolverines, an adult male and a sub-adult female, were harvested within the MRSA this year prior to our traps being opened. Preliminary winter recreational surveys proved useful and will be adapted to a full-scale effort on both study areas next winter. Peek snowmobile activity occurred between 11 am and 4 pm, weekend use was greater than weekday use, and use during holiday weekends was greatest.

On the Teton Range Study Area (TRSA), we constructed four new wolverine traps. Nine traps were open for a total of 677 trap-nights, during which time five wolverines (3 females and 2 males) were captured nine times. Capture rate for the TRSA was one wolverine capture per 75.2 trap-nights. We fitted a male wolverine with a GPS collar, and retrieved the collar after it had been on the wolverine for approximately one month. This is the first ever GPS collar to be placed on a wolverine to our knowledge. We are awaiting data from the store-on-board collar. We documented the mortality of an adult male wolverine who was killed in an avalanche.

We will continue to pursue development of GPS technology for use in the study. We will expand trapping coverage and implement recreational surveys during the upcoming year. We will continue to pursue financial and in-kind support for the program. Full implementation of the study may require additional personnel.

WOLVERINE ECOLOGY IN THE NORTHERN ROCKY MOUNTAINS

The wolverine (*Gulo gulo*) is a medium size carnivore that inhabits the most remote areas of the Northern Hemisphere and is arguably one of the least understood carnivores in North America. Wolverine habitat normally encompasses large areas of rugged, remote terrain, and populations naturally exist at relatively sparse densities. In the lower 48 United States, the wolverine's unobtrusive nature and the difficulties associated with studying such an inaccessible and uncommon creature has resulted in a lack of documentation of wolverine status and ecology.

This void of available information is hindering state and federal natural resource managers who face a number of difficult decisions. Wolverines are currently on the U.S. Fish and Wildlife Service list for consideration as a threatened or endangered species. This determination will be a particularly difficult task. Even in historically occupied range that has not been subjected to human encroachment, wolverines naturally exist at very low densities. Therefore, an assessment of a "low number" of individuals in the Northern Rockies will not be conclusive evidence of a population in danger of extinction. To ensure adequate protection of wolverine populations and that limited endangered species funding is being used most effectively, careful assessment of wolverine status and viability is required.

Many other decisions impact land-use policies, and managers are required by law to

consider wolverine ecology and sustainable population management in their decisions. Agencies charged with the sustainable management of wolverine populations on multiple-use lands are currently wrestling with issues such as the impacts of winter recreation on wolverine reproduction, habitat management, sustainable trapping quotas, and methodology for assessing population status and trend. In all cases, the paucity of information regarding wolverine ecology limits the ability of managers to make well-informed, defensible decisions that can advance conservation of this species. The primary goal of this study is to provide managers with the information necessary to make informed decisions. All documentation that this study will provide in regard to population dynamics, denning habitat, and human-use impacts will be relevant to many management decisions.

Wolverines are also an important component of the carnivore guild in the Greater Yellowstone Ecosystem (GYE). A comprehensive land management plan for the GYE will benefit from knowledge of the relationship that wolverines have with other carnivore populations, prey species, and ecosystem dynamics. This research effort is designed to be compatible with The Wildlife Conservation Society's Living Landscapes Program. The purpose of the Living Landscapes Program is to utilize landscape, or umbrella, species to 1) define an ecologically meaningful conservation landscape across jurisdictional boundaries, 2) identify locations in time and space where the needs of people and wildlife clash, and 3) define land management strategies that can help people and wildlife share these valued areas (Weber et al. 2001). The wolverine, because of its wide-ranging use of remote habitats, potential susceptibility to disturbance, and relatively vulnerable population demographics, is one of several species being considered for designation as a landscape species. Healthy wolverine populations may indicate overall ecosystem health to a greater degree than most species. Their scavenging habits likely benefit from the consistently high turnover rate of ungulate biomass that would result from healthy ungulate populations and habitats along with intact carnivore assemblages (Van Zyll de Jong 1975, Hornocker and Hash 1981). Thus, management for wolverine persistence is a logical component of a large scale, multi-species conservation effort.

PROJECT PERSONNEL

The wolverine program falls under Dr. John Beecham's duties as WCS' Western Field Coordinator. Dr. Beecham oversees project development, directs study design, coordinates multi-agency interests, regulates budgets, and reviews reports and publications. Kristine Inman, M.S. and Robert Inman, M.S., are coordinators of the wolverine program and lead the research on the Madison Range Study Area. As coordinators they are responsible for study design, developing data forms and protocols, ensuring consistency in data collection between the two wolverine study areas, and providing guidance to the TRSA. Their duties also include MRSA budget development and monitoring of monthly expenditures; live capture of wolverines, data collection; database management; authoring reports and scientific publications; selecting, training, and directing other field personnel; and representing WCS at meetings and conferences. Rachel Wigglesworth, M.S. leads the research on the Teton Range Study Area. Her duties include developing protocols; budget development and monitoring monthly

expenditures; live capture of wolverines, data collection; database management; authoring reports and scientific publications; selecting, training, and directing field personnel on the TRSA; and representing WCS at meetings and conferences. Dr. Kathy Quigley is the veterinarian coordinator for the western field studies and is responsible for providing all aspects of veterinarian oversight, selecting and coordinating other veterinarians who will provide surgical immobilization of radio-implanted animals on the Wolverine Program. Craig and Eli Burr conducted trap building efforts and established, maintained, and checked the TRSA western slope traps. Heath Smith conducted trap building efforts and established, maintained, and checked the MRSA traps. Ted Chu, provided training for trap construction and helped build TRSA traps.

COLLABORATORS AND OTHER INSTITUTIONAL AFFILIATIONS

- Montana Department of Fish, Wildlife, and Parks
- Grand Teton National Park
- Wyoming Department of Game and Fish
- Caribou-Targhee and Bridger-Teton National Forests, Wyoming and Idaho
- Beaverhead and Gallatin National Forests, Montana
- Idaho Department of Fish and Game
- Alta, Wyoming 4H Natural Resource Club
- Grand Targhee Ski Resort, Alta, Wyoming
- Turner Endangered Species Fund
- The Wolverine Foundation

PROJECT DURATION

Full implementation of the wolverine research project began September 15, 2001 and is targeted as a 5-10 year field effort to document wolverine ecology, determine the impacts of various human activities on wolverines, and assimilate information for use as a component of a large scale, multi-species conservation effort in the Greater Yellowstone Ecosystem.

APPROVED BUDGET

During fiscal year 2002, the Madison Range Study Area had an approved budget, including all associated salaries, of \$125,500; the Teton Range Study Area had an approved budget, including all associated salaries, of \$122,500.

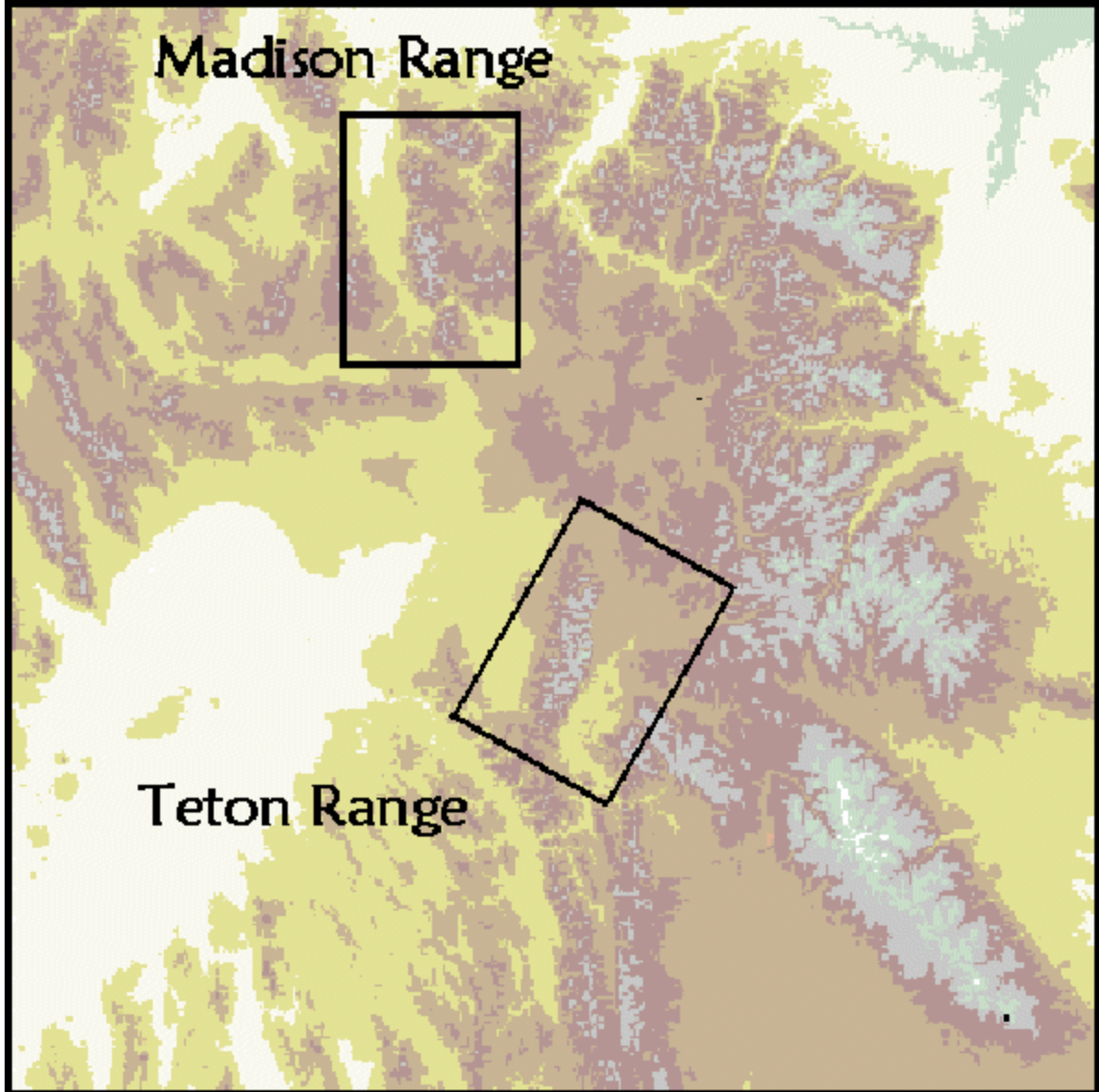
STUDY AREAS

A successful conservation strategy for wolverines in the GYE requires documentation of population demographics and determination of the human and ecosystem influences that affect population dynamics. Two areas, the Madison Range of southwestern Montana and the Teton Range of northwestern Wyoming, have been selected for intensive study (Figure 1). These areas were chosen because they are representative of the land

management jurisdictions and human-use impacts that are common to the GYE. Variation in jurisdiction, management policies, and human-use impacts between these two study areas will facilitate our ability to compare and contrast influences on wolverine population dynamics.

Figure 1.
Greater Yellowstone Ecosystem with the Madison and Teton Range Study Areas,
Montana and Wyoming.

Greater Yellowstone Ecosystem



Madison Range

The Madison Range Study Area (MRSA) covers approximately 1,800 square miles (4,662 km²), and contains a mosaic of ownership and land use designations. The majority of the MRSA is U.S. Forest Service (USFS) land that is managed by two National Forests, the Beaverhead and the Gallatin National Forests. These USFS lands include the three separate sections of the Lee Metcalf Wilderness (LMW) that total approximately 250,000

acres. These three wilderness areas are separated by multi-use National Forest lands. Within the multiple-use lands, a variety of travel restrictions exist. Restrictions range from areas designated as non-motorized throughout the year, to non-motorized at specific time periods, to no restrictions at all. The privately owned Big Sky ski resort and associated housing developments also separate sections of the LMW. Almost 20% of the MRSA is privately owned. The vast majority of ungulate winter range is on the west slope of the Madison range and is privately owned; livestock operations are present on most of these lands. Approximately 1/3 of the MRSA has been affected by timber harvest and road construction activities (U.S. Forest Service 1997).

A variety of human recreational uses occur on the MRSA. This study area is in close proximity to West Yellowstone, MT, one of the nation's hot-spots for snowmobile recreation. Much of the National Forest provides unrestricted use of snowmobiles, and this study area is subjected to heavy snowmobile activity. Of additional concern, is the potential that more restrictive regulations on snowmobiling inside Yellowstone National Park (YNP) will cause that pressure to shift into the nearby Madison Range. We are not aware of any helicopter skiing on the MRSA. Wolverines in the MRSA are subject to recreational fur trapping. While harvest numbers are typically low, sex-age ratios appear normal, and snow-track indices have indicated a consistent presence within the area, a greater understanding of the level and type of impact this activity has on the population will be valuable. The MRSA is an important ungulate hunting area. During the fall hunting season, elk herds move from YNP, through the MRSA, and onto west slope wintering grounds. Moose, sheep, and goat hunting also occurs within the area. Over 40 outfitter camps exist in the southern portion of the MRSA alone. Wolverines may be positively influenced by the presence of carcass remains due to hunting. Other recreational uses on the MRSA include hiking, backpacking, horseback riding, backcountry skiing, and fishing.

The MRSA is believed to have one of the highest densities of grizzly bears (*Ursus horribilis*) within the GYE (personal communication, Montana Fish, Wildlife, & Parks; Inter-Agency Grizzly Bear Study Team). The area is also regularly utilized by wolves (*Canis lupus*) after their successful reintroduction to and expansion from YNP. The presence of these large carnivores may influence wolverine ecology and population success.

Because of the large size of the MRSA, we will initially focus on the southern half of the area, with the intention of expanding to include the northern half.

Teton Range

The Teton Range Study Area (TRSA) covers approximately 1,500 square miles (3,885 km²), and is located within several differing land management jurisdictions. The majority of the TRSA is located in Grand Teton National Park (GTNP) and the adjacent Jedediah Smith Wilderness (JSW). As a result, over 427,000 contiguous acres are highly restricted with regard to motorized access. Portions of the TRSA fall within the multiple-use lands of the Caribou-Targhee National Forest and the Bridger-Teton National Forest. Wyoming Highway 22 (Teton Pass) is located at the southern end of the TRSA and may serve as a barrier to wolverine movements. Two ski areas exist in the TRSA, Teton Village on the

east slope and Grand Targhee on the west slope. The mountains on the east slope of the Tetons rise steeply from the valley floor, while the west slope is characterized by rolling foothills that lead into the mountains. Wolverines use areas north of the Tetons, which are heavily timbered but are lower elevation and are not in the rugged peaks. Ungulate winter range is primarily the National Elk Refuge, close to the town of Jackson, Wyoming.

Winter recreational use in the Tetons is characterized by backcountry skiing on the east slope concentrated in the southern portion of the range and both backcountry skiing and snowmobiling on the west slope. Helicopter skiing occurs in the southern part of the TRSA. Recreational use increases during the summer mainly in the form of day and overnight backcountry travel. The northern portion of the Tetons receives relatively little winter or summer recreational use, especially on the east slope. The northern portion of the study area receives relatively little human use in comparison to the southern portion of the study area. Ungulate hunting occurs primarily on the west slope of the Teton Range. Wolverines are not subject to recreational fur trapping in the TRSA.

Grizzly bears and wolves exist within the TRSA, but at relatively low densities. Their populations are likely to continue to expand into the TRSA.

Multi-Area Study Design

Studying wolverines in these varied landscape will allow us to understand which activities and management designations affect wolverines. The ability to compare and contrast those findings between study areas will expedite our understanding of how human-use and ecosystem variation impact wolverine populations. While both study areas contain a multitude of human impacts, preliminary indications are that levels of various uses will differ between areas. Recreational fur-trapping of wolverines occurs on the MRSA but not the TRSA. Snowmobile use is likely greater on the MRSA, however back-country ski use is likely greater on the TRSA. Summer recreational use is very likely to be greater on the TRSA. However, motorized forms of summer recreation are likely greater on the MRSA. Both study areas contain ski resorts, yet the level of accompanying development differs greatly between study areas. While hunting of ungulates during the fall occurs on both areas, this use is likely greater and at higher elevations in the MRSA. Grizzly and wolf densities are greater on the MRSA. By utilizing two study areas which contain a variety of types and differing levels of human use, we should be able to gain a better understanding of which, if any, human-uses impact wolverine populations, and what we can do to mitigate those impacts.

ACTIVITIES/PROGRESS

Madison Range Study Area

Office Related Accomplishments.-We collected and reviewed wolverine literature in order to complete the GYE Wolverine Program study plan which includes detailed literature review, objectives and methodology. The study plan was written so that it will serve as the basis for a final report with sub-sections serving as eventual peer-reviewed publications. This study plan was distributed to more than 25 interested state, federal,

and NGO biologists for informative purposes and feedback. We equipped and set-up the MRSA field office. We obtained permits from MFWP and USFS to capture wolverines, collect bait for captures, and construct log box-traps. We purchased field equipment, created data forms, established and recorded protocols, and created databases for use on both study areas. We made numerous contacts with state and federal agency personnel, interested NGO's, and local businesses. We secured financial and in-kind support from MFWP, USFS, and private ranches in the Madison Valley. We established a memorandum of understanding with the Turner Endangered Species Fund (TESF) and secured major in-kind support of our research project by TESF. We initiated discussions and began the application process for significant funding via the federal-state Wildlife Conservation & Restoration Program (WCRP) and State Grants Funds (SGF). We researched available GPS and satellite technologies available for use on wolverine, and purchased four GPS collars. We monitored budgets and completed accounting duties for all MRSA expenditures. We attended the Western Forest Carnivore Committee Conference in Spokane, WA, a veterinary immobilization course at the Henry Doorley Zoo in Omaha, NE, and the WCS North American Program meeting in Blue Lake, NY. We determined methodologies for summer recreational surveys, and secured in-kind support from the USFS and NPS. We established a relationship with Gary Hoshide of the USFS Technology and Development Center and received training and equipment for recreational surveys. We purchased and set-up recreational survey equipment, and hired and trained personnel to complete the surveys. We secured permits for recreational use surveys in four National Forests and in the Grand Teton National Park. We made contact with several private ranches that border USFS lands and the LMW, and acquired permission to access the property for trap construction and winter capture efforts.

Winter Capture Effort.-We constructed eight log box-traps for wolverine capture. We operated our wolverine trap-line from the second week of January through the third week of March. Although we had constructed eight traps, only seven were opened due to logistical constraints. Seven traps were open for a total of 428 trap-nights, during which time six wolverine visits occurred (likely by two to three individuals). Two of the seven trap sites were visited by wolverines. These two sites were two of the three sites that were visited by wolverines during the previous winter's preliminary season. One sub-adult female wolverine, F102, was captured and handled on two occasions. F102 was initially captured in late January in an area that receives heavy use by snowmobiles. Approximately three weeks after her capture she was harvested by a recreational fur trapper, two days before the close of the furbearer trapping season. Poor weather conditions resulted in only one aerial telemetry location for this wolverine. One pine marten (*Martes americana*) and eight red fox (*Vulpes vulpes*) were incidentally captured and then released. Wolverine capture rate was low on the MRSA, one wolverine per 214 trap-nights.

Den Locations & Spring Capture Effort.-Our pilot located a potential wolverine den or rendezvous site from the air in June. He observed a hole in the snow with tracks leading in from several directions. This observation occurred in a cirque basin at 9,600 ft. elevation, just over the continental divide into Idaho. We put together a team to approach the site and attempt to capture wolverines if they were present. We were equipped to

attempt a free-range darting of any adults present, and net capturing of any kits. Unfortunately, we found no sign of a wolverine den in the area marked by the pilot. A heavy rain occurred the night before and morning of our arrival and may have washed out any tracks.

Wolverine Harvest.-Two additional wolverines were harvested from within the MRSA this year. The furbearer season opens December 1 and closes February 15. Both wolverines were taken in December prior to our traps being opened. The first was a 32 lb. adult male and the second was a sub-adult female taken in a drainage where we later opened two traps; F102 was later harvested in this same drainage. Nine wolverines were harvested in Region 3 (southwestern Montana) this winter, an unusually high number (typically 0-2).

Winter Recreation Surveys.-We conducted a preliminary winter recreation survey and found that the methodology will be useful for determining snowmobile activity patterns and relative use levels. We sampled one parking area that serves as one of the major access points for snowmobile activity in the southern portion of our study area. We counted the number of available places on snowmobile trailers at random times of the day, all days of the week, including holidays. As expected, the peak hours of use occurred between 11 am and 4 pm, weekend use was greater than weekday use, and use during holiday weekends was greatest (Figures 2 & 3). Based on this past winter's preliminary sampling we are adapting the winter recreation methodology and will apply it to both study areas next year. Data on snowmobile activity pattern and relative use levels will allow us to compare recreational use patterns with wolverine activity patterns, and snowmobile use levels between the MRSA and TRSA.

Figure 2.
Peak times of snowmobile activity in the southern portion of the Madison Range Study Area, MT, 2002.

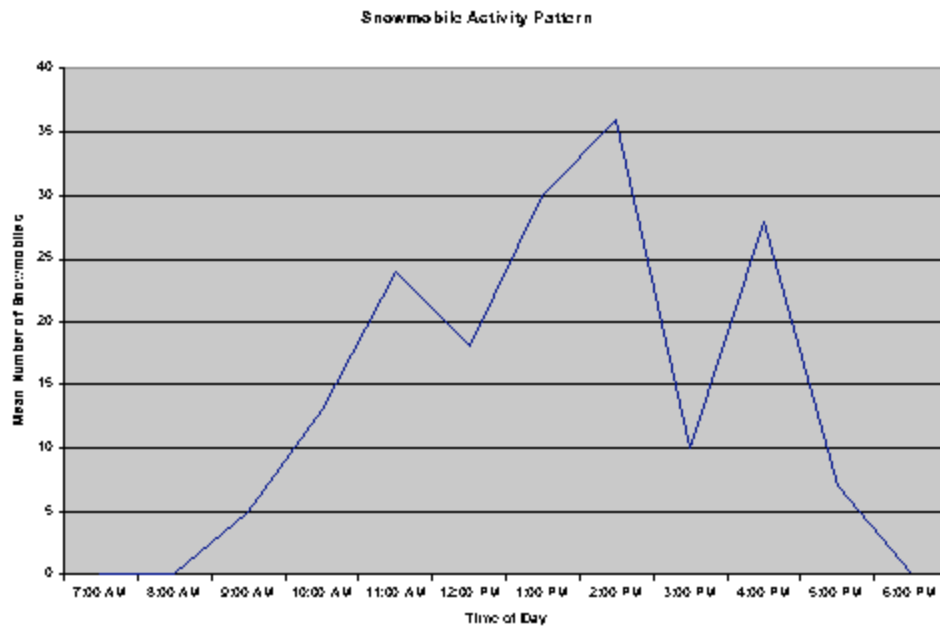
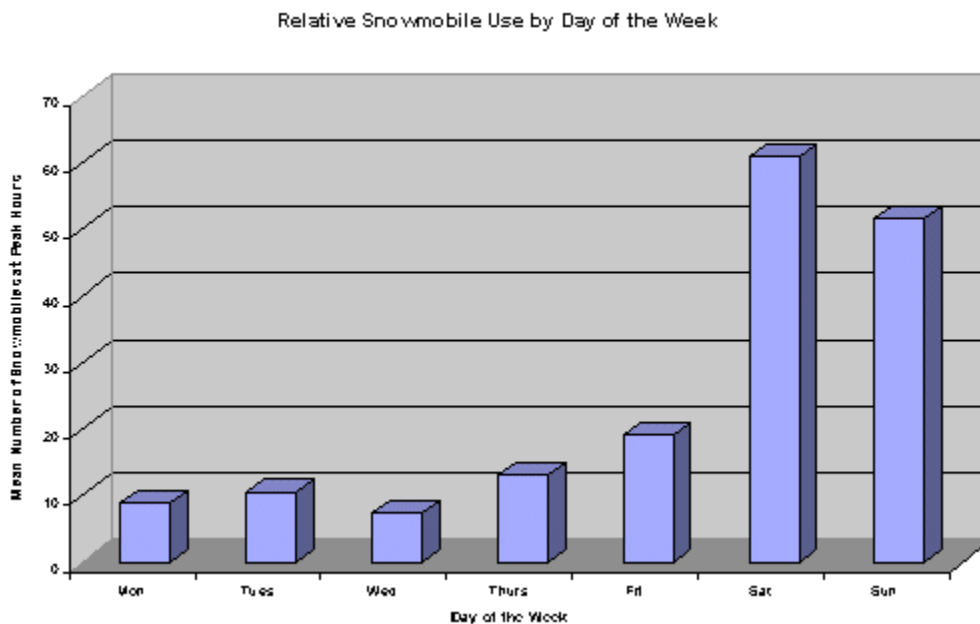


Figure 3.
Peak days of snowmobile activity in the southern portion of the Madison Range Study Area, MT, 2002.



Teton Range Study Area

Office Related Accomplishments.-We equipped and set-up the TRSA field office. We obtained permits from WDGf and USFS to capture wolverines, collect bait for captures, and construct log box-traps. We purchased field equipment and established and recorded field protocols. We made numerous contacts with state and federal agency personnel, interested NGO's, and local businesses. We monitored budgets and completed accounting duties for all study area expenditures. We attended the Western Forest Carnivore Committee Conference in Spokane, WA, a veterinary immobilization course at the Henry Doorley Zoo in Omaha, NE, and the WCS North American Program meeting in Blue Lake, NY. We hired personnel to complete TRSA recreational surveys. A proposal for the necessary permit to build traps within GTNP was written and approved. Financial and in-kind support was secured from the Bridger-Teton National Forest, the Caribou-Targhee National Forest, and the Greater Yellowstone Coordinating Committee. A Memorandum of Understanding was established with the Caribou-Targhee National Forest. Logistical aspects of a new study, including hiring technicians, developing protocols, and purchasing field equipment were completed. A draft protocol for determining the behaviors of reproductive females was developed and tested. A proposal for the necessary permit to capture wolverine kits within GTNP was written and approved.

Winter Capture Effort.-Two of four approved log box traps were constructed in GTNP, and two additional traps were built on the West slope of the study area, bringing the total number of traps on the TRSA to nine. Nine log box traps were opened in the TRSA between late December 2001 and early January 2002 and were closed in late March 2002 for a total of 677 trap nights. Two of these traps were located in the southern portion of Grand Teton National Park on the east slope, and seven were on the west slope, three of which were operated by the Alta Wyoming 4H Natural Resources Club. We captured five wolverines nine times. All but one of these captures occurred on the east slope. Twenty-one marten, nine red fox, and one coyote (*Canis latrans*) were incidentally captured (Table 1). One red fox was killed as a result of a trap injury.

For the 2001-2002 winter trapping season the number of trap nights to capture one wolverine was 75.2 nights when including wolverine recaptures and was 135.4 nights for initial wolverine capture (Table 1). The two traps located on the east slope, both within Grand Teton National Park, had a higher success rate of not only wolverine captures but also incidental captures than traps located on the West slope.

Table 1:

Trap nights for wolverine captures during the 2001-2002 winter trapping season in the Teton Range Study Area.

Trap Location	Trap ID #†	Trap Nights	Wolverine (initial 2002 capture) *	Red			# of wolverines as first capture †	# of trap nights per wolverine 1st capture	# of trap nights per all wolverine captures
				Marten	Fox	Coyote			
W slope (4H)	1	81	0	0	1	0	0		
W slope (4H)	2	72	0	0	0	0	0		
W slope (4H)	3	72	0	0	0	0	0		
Subtotal		225	0	0	1	0	0	0	
W slope	5	78	1	0	0	0	1		
W slope	6	73	0	1	0	0	0		
W slope	8	79	0	2	2	0	0		
W slope	9	69	0	0	0	0	0		
Subtotal		299	1	3	2	0	1	299	
E slope	10	81	3	9	3	0	1		
E slope	11	72	5	9	3	1	3		
Subtotal		153	8	18	6	1	4	38.25	
TOTAL		677	9	21	9	1	5	135.4	
								75.2	

† Traps #4 and #7 were not in operation during this season. Both are located on the west slope.

* Does not include wolverine recaptures.

We captured five wolverines, three females and two males during the winter 2001-2002 capture season (Table 2). Three of these wolverines were recaptures from previous years that had been lost due to transmitter failure or departure from the study area. All wolverines were fitted with radio transmitters, which were surgically implanted by Don Betts, DVM and Colin Gillin, DVM. F401 was confirmed pregnant by visual observation of one fetus during surgery. Serum progesterone levels were determined for the three females that were captured. F401, F404, and F402 had serum progesterone levels of 8.06ng/ml, 4.26ng/ml, and 0.12ng/ml respectively. M304 was originally captured in January 2001, and disappeared in April 2001, and after extensive searches the pilot could not locate him. We recaptured him on March 23, 2002 with a functioning transmitter, indicating that perhaps he had left the study area during the period that we could not locate him. We replaced his radio transmitter and fitted him with a GPS collar (see below).

Table 2:

Wolverine capture information for the Teton Range Study Area, Winter 2001-2002, and capture history from 1998 to present.

ID	Initial Capture Date - Location - Slope	Age at 2002 Capture†	2002 Weight (kg)	Recapture Dates - Trap ID # - Slope	Comments
M399 M561	3/7/99 - #2 - W	4 in 1999	-	1/25/01 - #2 - W	Originally captured by J. Copeland/ 4H group. Mortality signal heard on 1/29/02. Investigation on 1/31/02 appears to have died in avalanche. Retrieved carcass under 2.4 m of snow on 4/19/02.
M302	1/10/02 - #11 - E	2-3*	14.1	1/25/02 - #11 - E	
F402	1/13/02 - #11 - E	1*	9.5	1/26/02 - #10 - E	
F404	4/15/99 - #4 - W	5	10.5	2/1/02 - #10 - E 2/10/02 - #11 - E 3/15/02 - #10 - E	Originally captured by J. Copeland/ 4H group in a barrel trap as F379. We replaced her non-functioning transmitter.
F401	4/17/98 - #2 - W	7	10.5	2/1/02 - #5 - W 1/15/99 - #2 - W 4/21/99 - #2 - W	Originally captured by J. Copeland/ 4H group as F46 in 1998. We replaced her non-functioning transmitter. Confirmed pregnant during surgery.
M304	1/23/01 - #11 - W	2*	15.5	3/23/02 - #11 - E	Originally captured on 1/23/02 as M621. Prior to the 2002 capture he was last located on 4/23/01. We replaced transmitter and fitted him with a GPS collar which fell off around May 1, 2002.

† Age in years.

*Asterisks indicate results from aging by tooth cementum annuli have not yet been received, thus age is an estimate.

Den Locations & Spring Capture Effort.-Telemetry locations of both F401 and F404 became localized at the end of February indicating that perhaps both these females were denning. One month after localizing, F401 began making extensive movements, which led us to believe that perhaps she had lost her kits, if in fact she had given birth. F404 remained in the same area with only small movements throughout the spring. On three trips into her localized area we found many wolverine tracks but never made a visual observation nor heard her radio signal. On one occasion we saw what we thought might be one set of kit tracks with adult tracks, but because of the snow conditions, this could not be confirmed. The adult tracks led into and out of a series of tunnels made from downed logs and snow. For fear of disturbing a potential den site, these structures were not thoroughly investigated.

In early June, Gary Lust from Mountain Air Research located F404 three times a day for two consecutive days in the same area. On June 5 we went in on the ground in an attempt to locate her with her potential kits. We tracked her to a snow tunnel but were not successful in trying to dig her out. Instead, we sat on a hill and watched her leave the tunnel. Five hours later we observed another unmarked adult wolverine also leave the tunnel. Likely this adult was a male wolverine and the two were paired for mating purposes. We saw no evidence of kits.

On May 24, on our first attempt to retrieve M304's dropped GPS collar, we hiked into the area where F401 had localized during late February through March. We followed wolverine tracks to a tunnel made from downed logs and snow, and saw what could have been kit tracks in the tunnel. These tracks, however, were also not confirmed. We saw ungulate hair and scat in this tunnel, both of which we collected for identification.

Home Ranges.-Each wolverine was located approximately once per week between the animal's capture date (Table 2) and June 30, 2002. Home ranges have not yet been calculated.

Mortalities.-On January 29, M561's radio transmitter was found signaling mortality in Cascade Canyon within GTNP. A trip into the mountains indicated that the signal from his radio transmitter was coming from a recent avalanche path. Because avalanche danger was still high, we did not attempt to pinpoint his location and dig him out on that date. Various attempts to retrieve his body during the winter were canceled due to safety concerns. Finally, on April 19 his body was retrieved from under 2.4m (8 ft.) of snow. When he was uncovered he was found lying on his side with his eyes open, three of his feet curled toward his mouth, and his front left leg twisted to the side. His last active signal was located on January 23. Avalanche danger during the six days when he could have died was rated as "considerable" to "high" by the Bridger-Teton National Forest Backcountry Avalanche Hazard and Weather Forecast. Additionally, an earthquake rated 3.7 on the Richter Scale occurred on January 28 at 9:30 PM, epicenter Kelly, WY, approximately 29 km from Cascade Canyon. A necropsy performed by Kathy Quigley and Neil Anderson of Montana Fish, Wildlife, and Parks on June 26 showed no indication that the wolverine died from trauma, nor any obvious signs of bruising. We found white striations in the wolverine's intercostal muscles indicating that the muscles may have been stressed in trying to breathe and that perhaps the wolverine died from suffocation. The wolverine's stomach was empty.

Winter Recreation Use.-Winter recreational use surveys were completed from the air approximately once per week. During these surveys the pilot marked the location of any snowmobile or ski tracks seen from the air with a GPS unit. During these surveys the approximate age of the tracks was also recorded. These data have not yet been analyzed, but we plan to compare winter recreational use with wolverine locations and habitat use using GIS software during Fall 2002. These methods will be meshed with those tested on the MRSA this winter in order to complete the winter recreation survey methodology.

EXPLORATORY ACTIVITIES

We collected information on the potential utility of GPS and satellite technology for wolverine research. We spoke with numerous producers about the specifics of collar mechanics and deployment, and with individuals who have experience collaring wolverines or using GPS/satellite technology. We determined that GPS collars would be most appropriate for adult wolverines and that satellite collars would be most appropriate for dispersing age wolverines. Based on our findings, we selected and purchased four Televilt store-on-board POSREC GPS collars. Funding for purchase of collars became available late in the year, thus we did not have them available to deploy during the entire capture season. We elected to use the battery life of the GPS collars quickly during this experimental stage. We chose this option because we were not sure that the collars would stay on the wolverines for a long period or withstand the battering that wolverines

may place on them. We also wanted to get the data back in time to assess the success, choose an appropriate sampling program for the next group of collars, and order them in time for next season. We were not able to purchase any satellite collars in time for deployment this year.

On March 23, we deployed a GPS collar on M304, a sub-adult male wolverine in the TRSA. The collar was programmed to acquire a location once every two hours, seven days/week, for four months. We were not able to locate M304 via his VHF implant for the 20 days subsequent to his release, even after extensive searches. This same dispersing aged wolverine had been captured and implanted last season, only to disappear soon thereafter. On April 23, M304 was located in GTNP and has been located within the TRSA since that time. The drop off mechanism on the GPS collar fired and the collar dropped off between April 24 and May 11. The collar was retrieved on June 1 and has been sent back to the manufacturer (Televilt of Sweden) for the data to be downloaded. We are currently awaiting the results.

PROBLEMS AND CONSTRAINTS

Several challenging obstacles lie in the way of gaining sound knowledge about this elusive carnivore. Wolverines exist at low population densities, reside in relatively inaccessible terrain, exhibit large home range sizes, and probably make long-range movements related to dispersal and gene flow. All of these characteristics will require an intensive effort, backed with sufficient personnel, excellent logistical planning, and use of available technology.

Current budgets do not provide enough personnel with supporting equipment to overcome the logistical obstacles inherent with wolverine research and meet all goals of the wolverine program. A mosaic of vehicular access restrictions exist within both study areas, and greatly affect our ability to conduct the study. Large portions of both study areas are accessible by non-motorized methods only. Obviously, such common and important tasks as capture effort, reproductive den locations and habitat measurements, and timely mortality investigations are impacted by access. Good logistical planning (especially personnel and equipment needs) regarding access will be absolutely essential to effectively collect appropriate data. Additional personnel will be valuable aids in putting forth a complete capture effort, collecting human recreation data, mortality investigations, observation sequences, and many other tasks. Lack of snowmobiles for use in the Teton Range will hamper winter data collection efforts.

Keeping track of a number of radio-implanted wolverines may become difficult and expensive. In more northern climes, where documentation of wolverine habits is available, wolverines are known to occupy extremely large home ranges, and make long movements. These habits have become problematic using conventional VHF telemetry systems on our study as exemplified by M304. We were unable to locate M304 for 11 months beginning April 2001. He was captured this winter in the TRSA with a working radio-transmitter, only to disappear for 20 days immediately after his release. Aerial flight time is expensive, and large numbers of extensive searches to find missing wolverines

could deplete budgets quickly. Additionally, inclement weather, especially during winter months, has prevented the pilot from flying to locate wolverines during critical times (i.e., denning period). We are also limited in the number of over-flights that can occur within GTNP. We are currently looking into satellite and GPS technology appropriate for wolverines.

GOALS/ACTIVITIES FOR THE NEXT YEAR

During the next year project personnel will continue to proceed toward full implementation of the study. We will shift operating budgets from the equipment purchasing stage of an initial year toward hiring more temporary personnel. We will continue to monitor all radioed wolverines. We will implement a preliminary season of summer recreation surveys on both study areas from July - September. We will construct additional traps and organize the trap season logistics. We will attempt to capture and radio-instrument additional wolverines in both study areas from December thru March. Assessment of methodologies for determining winter recreational use will begin in the fall and will be implemented in December. If time and personnel allow, observation sequences will be implemented to collect information on winter habitat use, movements, food habits, inter-specific interactions, and social behavior. Pregnant females will be monitored during the denning period (March-June) to determine den-site habitat and movements of den-sites. Presence of kits will be determined during May and June and when possible kits will be captured and radio-instrumented. Data will be collected for as many aspects of the research effort as possible, however current budgets will allow us to meet the basic level of the research effort only. When possible, we will use field biologist time to help raise funds for the program.

PUBLICATIONS

A final version of the study plan has been submitted to WCS; Montana Department of Fish, Wildlife, and Parks; Wyoming Game and Fish Department; Idaho Department of Fish and Game; United States Forest Service, and the National Park Service. We have submitted an abstract for a presentation at the Carnivores 2002 conference in Monterey, CA during November 2002. If selected for a presentation, we will present a project overview and some information on the success of our GPS collar. No other publications have occurred at this time as the study is in its initial stages.

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