Wolverine Population Assessment in Glacier National Park

Progress Report

Spring 2004

Frontispiece: Female wolverine F4 followed by two kits (dots at photo center) crossing Swiftcurrent Glacier, 22 June 2004.

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Abstract

Eight wolverine (4 male & 4 female) were captured during the winters of 2002-2003 and 2003-2004. All study animals were instrumented with intraperitoneal VHF transmitters and/or ARGOS satellite collars. Male weights averaged 13.0 kg and females 8.9 kg. Study animals continue to be monitored on a daily basis and have been relocated approximately 500 times by ground triangulation and via aerial monitoring. We have lost contact with 2 male study animals, one of which we believed dispersed the study area. Efforts to relocate the individuals are continuing. Two reproductive dens complexes were identified and presence of kits confirmed. Two male kits were captured and instrumented at a maternal den in May 2004. Study animals were snow-tracked 31 kilometers to collect data on pattern of movement and habitat use. Genetic relatedness of study animals is currently under investigation.

Introduction

The wolverine (*Gulo gulo*) is one of North America's most rare mammals and least known large carnivore, with only two previous long-term field research projects in the lower 48 United States (Banci 1994). Lack of basic ecological information leaves the wolverine increasingly vulnerable to human impacts throughout its reduced present-day range.

A paucity of information on the basic ecology of wolverine, potential listing as an endangered species, and impending construction projects that may impact wolverine and their habitat make it imperative that research be undertaken to provide the scientific foundation for managing wolverine habitat in Glacier National Park (GNP) and other areas of the Rocky Mountain west. GNP is one of the few national parks with wolverine, and may have the highest density among park units. Wolverine distribution, abundance, survival, dispersal patterns, habitat use, food habits, and other ecological and demographic factors, as well as their sensitivity to human activity, are poorly understood in the park. Anecdotal sightings and records from periodic track surveys provide the basis for assessing general occurrence and distribution, while more in-depth knowledge, at the broad scale and site-specific level, is lacking. The National Park Service (NPS) has an obligation under the Organic Act (1916) to protect wildlife, including wolverine, "unimpaired for the enjoyment of future generations". NPS Management Policies (2001) clarify the mandate of "resource protection as the primary goal", and require that "decisions regarding the treatment and use of park resources will utilize scientific, technical, and scholarly analysis."

GNP is engaged in developing and implementing a Commercial Services Plan and EIS, and an EIS for reconstruction of the Going-to-the-Sun Road. These and other plans aimed at addressing infrastructure and other visitor service needs may have unintended impacts on wolverine. Therefore, information is needed to insure no impairment of the resource occurs. A specific concern is that cross-country skiers may inadvertently displace reproductively active female wolverine and, coupled with concurrent impacts, could reduce the survival of young or prevent reproduction altogether. Baseline information is also needed to assess the population status of wolverine and to assess long-term viability for park and region-wide management efforts.

Winter track surveys initiated in GNP in 1994 (Yates 1994), historical sighting records from park files, and subsequent track surveys (Buhler et al. 2001) provided insight into the seasonal distribution of wolverine especially along the eastern slope of the park, which initially formed the core of our study area. The Many Glacier Valley stood out as an area of high wolverine density. Logistically, the Many Glacier Ranger Station complex offered better access, housing, communication, and equipment storage and proved to be the focus of trapping operations during winters 2002/03 and 2003/04. Expansion of the study area to include a larger portion of GNP may be necessary given extensive movements of instrumented wolverine.

This reporting period occurs within the final year of GNP funding for this project. The project end date is September 30, 2004 with contract sunset extended to September 30, 2005 for data analysis and report writing. It is certainly in the interest of the Rocky Mountain Research Station to continue this project and we are presently pursuing additional funding. We recently received a Wilburforce Foundation Y2Y Grant, which was provided by the Northern Rockies Conservation Cooperative, and an Earth Friends Grant secured through the Glacier Fund, both of which convey an interest in wolverine research by the private sector. The Interagency Wolverine Committee recognizes GNP as an important research node for understanding variable, broad-scale ecological parameters of the wolverine. The committee charged the Rocky Mountain Research Station's Wildlife Ecology in Rocky Mountain Landscapes research unit with development of a Wolverine Action Plan, which will identify the critical issues and define science-based methods for a better understanding of wolverine ecology, which will assist in the development of tools for improved management.

Study Objectives

This two ½-year project is employing both conventional and satellite telemetry to monitor the movements and activity of wolverine, with a focus on the reproductive ecology of females. Efforts will also be made to document the distribution and movements of wolverine and to identify those habitats most critical to the species. Our objectives are to:

- Live-trap, radio-instrument and monitor wolverine to describe their distribution and reproductive status.
- Locate natal and maternal dens, and rendezvous sites, and characterize associated landscape features.
- Examine the feasibility of satellite telemetry, exploring wolverine demographics and social character.
- Describe wolverine spatial use, movement, and habitat associations.

Study Area

Glacier National Park encompasses over 1 million acres consisting of numerous, diverse habitats covering east and west slopes of the Continental Divide in northwestern Montana (Figure 1). Elevations range between 3,150 ft. and 10,466 ft. above sea level. The park is a core component of the biologically rich Northern Continental Divide Ecosystem, which has been characterized as a refuge for wolverine, serving as a source for immigration into surrounding areas of the Northern Rockies (Ruggiero, et al, 2000; Newby and Wright, 1955). Wolverine in Glacier also may serve as a genetic storehouse for the Northern Rockies, and as part of a source population for wolverine in other areas of Montana.

Methods

Capture, immobilization, and handling.--Wolverine were captured using log box-traps (Copeland et al. 1995). The number and location of traps was determined based on historical presence of wolverine in GNP and habitat values (Figure 1). Seven traps were constructed in 2002 and two additional traps in 2003. Traps were baited with trapper collected beaver (*Castor canadensis*) carcasses. Traps were fitted with remote trap monitors (TBT-600HC, Telonics, Mesa, AZ) that provided an electronic signal when the trap door shut allowing remote

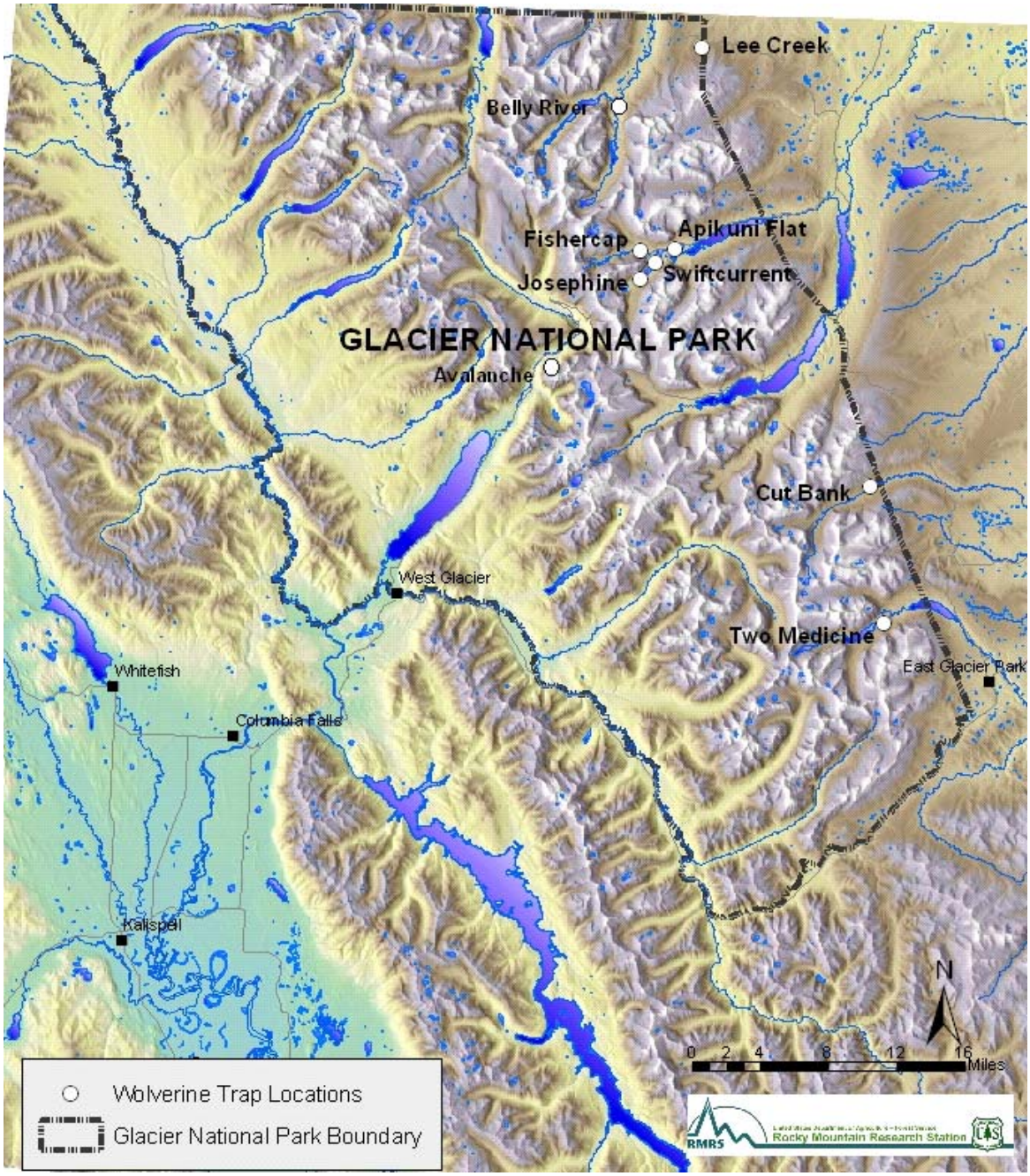

Figure 1. Glacier National Park wolverine project study area and trap locations, 2004.

monitoring on a daily basis. Prebaiting of traps began on 17 December 2002 and on 4 December 2003; trapping was conducted between 22 January and 10 April 2003 and from between 7 December 2003 and 21 March 2004. Trapping operations ceased with the emergence of bears from hibernation. Captured wolverine were immobilized by jab stick with a Domitor/Ketamine solution. Study animals were weighed and standard measurements taken; blood, hair, and tissue (DNA profiling) samples were collected. Heart rate, respiration, and body temperature were monitored during processing. Animals were inspected for injuries and ectoparasites. All captured wolverine were surgically implanted with intraperitoneal VHF radio-transmitters (Telonics Models 200 for kits, 400 for adults). Implant transmitter surgery was conducted on site by a licensed veterinarian using standard aseptic surgical procedures. Completing surgery and processing required about 40 minutes. In addition, radio collars, using a combination of *ARGOS* and/or GPS technology, were placed on 4 wolverine in 2003 and on a single individual in 2004 (Figure 2).

Figure 2. Female wolverine F4 with Argos/GPS collar in Glacier National Park, Montana, April 2003.

We attempted to capture and instrument young-of-the-year wolverine (kits) shortly after weaning in an effort to document kit survival, length of dependency period, maternal and conspecific association, and describe rendezvous sites. Once we believe the kits are weaned and mature enough to handle, we use intensive aerial and ground telemetry to monitor the adult female's position and locate the kits. Kits are then captured by hand.

Study animal monitoring.--We relied primarily on conventional VHF telemetry, supplementing relocation data with *ARGOS* satellite fixes. Due to concerns regarding fixed-wing aircraft over-flights and potential disturbance to park visitors, telemetry flights were kept to a minimum. Telemetry data gathering was done by ground-tracking methods whenever possible. Aerial telemetry occurred primarily in months of reproductive denning (March through May). Additional monthly flights may be necessary to monitor survival and general distribution of study animals.

Home range, movements, distribution, and habitat use.--Spatial use will be reported based on conventional home range estimators. Fine-scale movement data are collected by back-tracking study animals during winter. During snow-tracking sessions, a data-logging GPS is used to record movement trajectory including responses to habitat changes and other natural and human-related features in the environment. Broad-scale movements, including movement corridors, are documented by ground-tracking. Satellite collars will provide continual contact with individuals making long-distance dispersal movements. Habitat associations will be measured depending on the quality and accuracy of relocation data.

Reproduction.--Reproductive success is measured primarily by direct field evidence of reproduction gleaned during capture and handling, along with subsequent monitoring of reproductively mature females. Animals captured during late stages of pregnancy may be confirmed pregnant by palpation and may indicate such by inspection of teats or mammary tissue. Blood samples are collected from females during processing for measure of progesterone (Mead et al. 1991).

Denning.--Wolverine give birth from late February through early March. During that period, we closely monitor movements of reproductively mature females for localization at a potential den site. Once a specific site was identified and a den suspected, we continued to monitor the site via aerial and ground telemetry to record the female's duration of stay and movement to maternal dens (rearing dens other than the site of parturition used prior to weaning).

Food habits.—Wolverine scats were collected opportunistically and foraging sites documented and described. Food habit data gleaned from wolverine scat collection is generally biased toward winter when snow-tracking provides opportunity for collection, and toward denning females

whose activities tend to be concentrated. As such, our analysis will center on the foraging ecology of the denning female.

Results and Discussion

Capture results.--Six individual wolverine (3 male & 3 female) were captured in 80 trap nights, during winter 2003, (Table 1) in the Many Glacier Valley for a capture rate of 1 individual wolverine/12 trap nights. Including recaptures, 20 wolverine captures produced an overall capture rate of 1 wolverine/4 trap nights in 2003. All initial wolverine captures occurred in 2 of 4 traps at Many Glacier. During winter 2004, two additional wolverine were captured as well as all study animals from the previous year. Capture rates for 366 trap nights in 2004 included 1 individual wolverine captured per 40 trap nights and 1 wolverine per 12 trap nights. For all subadults and adults captured during both years weights of males ranged from 12.0 - 14.0 kg (mean =12.95 kg, n=4) and females 8.2 - 10.1 kg (mean =8.87 kg, n=4) (Table 2).

Table 1. Capture results for two winter seasons (2003 and 2004) live-trapping wolverine in Glacier National Park, Montana.

Year	Number of Traps	Trap Nights	Wolverine Captures Individuals/total	Non-target Captures		
				Marten	Red Fox	Lynx
2003	5	80	6/20	1	1	0
2004	6	366	8/30	8	4	11

Table 2. Capture and marking information, and collar results of 10 wolverine live-trapped and instrumented in Glacier National Park, 2003/2004. Ear tag colors are included to provide for identification of study animals observed and reported by Park visitors.

ID	Capture Date	Weight	Eartag (left/right/ear)	Estimated Age	Collared/duration of collar retention
M1	1/26/03	12.0	blue/blue/right	Adult	Yes/9 months
F2	1/30/03	8.2	red/green/left	Adult	no
M3	2/14/03	14.0	yellow/yellow/right	yearling	Yes/10days/4 months – still active
F4	2/17/03	10.1	green/red/left	Adult	Yes/6 months
F5	3/1/03	8.6	red/red/left	yearling	no
M6	4/8/03	12.6	red/blue/right	Adult	Yes/9 months
F7	1/27/04	8.6	blue/red/left	yearling	no
M8	2/13/04	13.2	none	yearling	no
M9	5/6/04	3.0	yellow/yellow/right	9-10 wks	no
M10	5/6/04	3.3	white/blue/right	9-10 wks	no

Transmitter and relocations.--During 2003, satellite collars were placed on 4 individuals. Wolverine kept collars on for periods ranging from 10 days to at least 9 months. A single individual (M3) continues to wear his collar. *ARGOS* and GPS functions on all collars deployed in 2003 ceased operation within several weeks of deployment. Approximately 500 relocations of all study animals have been collected to date. Locations were classified as *ARGOS* by class, and as aerial or ground locations with subjective estimates of accuracy (100 meter, >100 meter < 300 meter, & > 300 meter).

Trapping success for this study was the highest recorded in North America (9 trap nights per capture, Table 1). Studies using similar methods generally report capture rates of 30-40 trap nights per capture. Capture success in the Many Glacier Valley is probably related to the proximity of our trapping to wolverine winter presence. Frequent recapture of 67% of our study animals indicates that capture and processing were not deterrents to wolverine reentering traps.

Development and successful deployment of lightweight GPS or satellite collars for wolverine is still underway. While deployment of GPS technology has been unsuccessful, an *ARGOS* system deployed on male M3 is still on the animal and functioning. M3 is one of the 4 out of 5 study animals that have tolerated collars for 4 months or longer with no adverse effects noted during recaptures. Current satellite collar technologies will continue to be tested and programmed to improve fine-scale monitoring of study animals. In the absence of functioning satellite collars, the study will continue to focus on ground-based and aerial telemetry.

Movement.—Thirteen snow-tracking sessions provided 14.8 kilometers of movement data on 2 known individual wolverine and other unidentified individuals. Snow-tracking sessions are designed to provide insight into fine-scale movement along with data on marking behavior, foraging, inter and intraspecific interaction, and how wolverine respond to natural and human related features in the environment. We are finding systematic snow-tracking to be particularly challenging in GNP due to extreme environmental and physiographic conditions. Track sampling has been biased toward animals moving to and from the traps. Even track segments 2-3 kilometers in length are likely biased to the trap as a destination or an origin. While this might present an opportunity to test movement models designed to predict this sort of bias, track segments will have to be considerably longer than we have been able to document at present. We will consider a more directed effort at collecting lengthier track segments in future winters.

Male M8, believed to be a yearling at capture in February 2004, left GNP about a week after capture. He moved into the Whitefish range near Hungry Horse at which time we began closely monitoring his movement (Figure 3). He disappeared in early April, in spite of efforts to maintain daily contact, and remains at large. If this individual is still alive with an active transmitter, his whereabouts are of critical importance to our understanding of broad-scale movement and dispersal. Continued attempts to locate M8 are planned in the upcoming weeks.

Spatial Relationships.—Home range size varied from 458 km^2 for male M3 to 159 km^2 for female F2. Home range analyses presented herein constitute only a portion of our relocation data and should be considered preliminary. Only minimal shifts in distribution from 2003 to 2004 are apparent thus far (Figures 4 and 5).

Reported wolverine home range sizes vary from 422 km^2 to over 1400 km^2 for male wolverine in northwest Montana (Hornocker and Hash 1981) and central Idaho (Copeland 1996), respectively. Wolverine are reportedly polygnous with spatial exclusivity among resident females and somewhat more spatial tolerance among males. Spatial structuring of wolverine in GNP appears consistent with that reported from other studies. Adult females F2 and F4 maintain relatively exclusive home ranges and are most closely associated spatially with resident adult male M1. During our efforts to capture kits this past May, male M1 walked to within 10m of us as we were excavating F4's den. He remained close to the work area for several minutes. Preliminary DNA analysis points to M1 as the father of the kits. Subsequent to the kit capture, M1 was found in

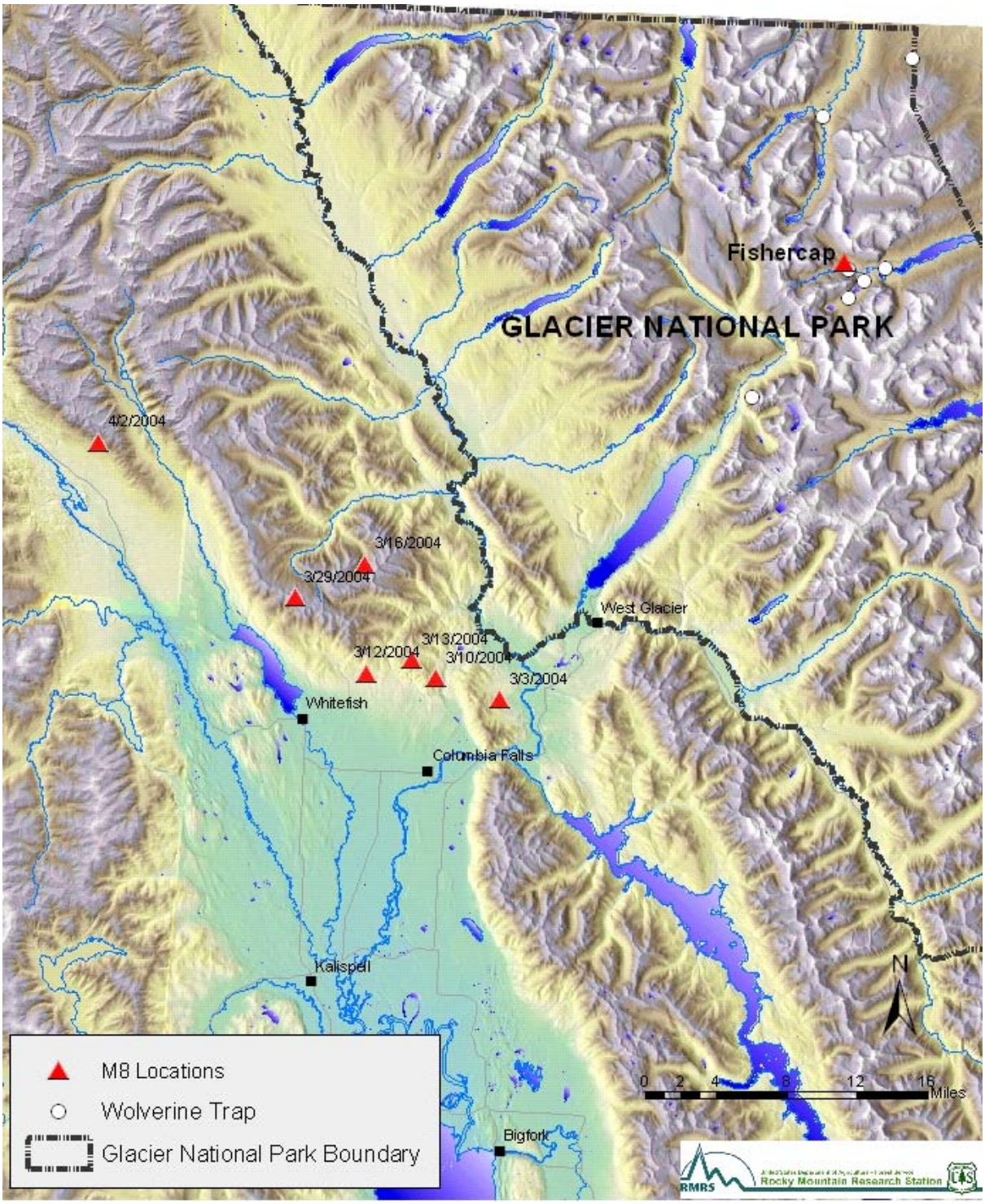

Figure 3. Locations of male wolverine M8 west of Glacier National Park, March-April, 2004.

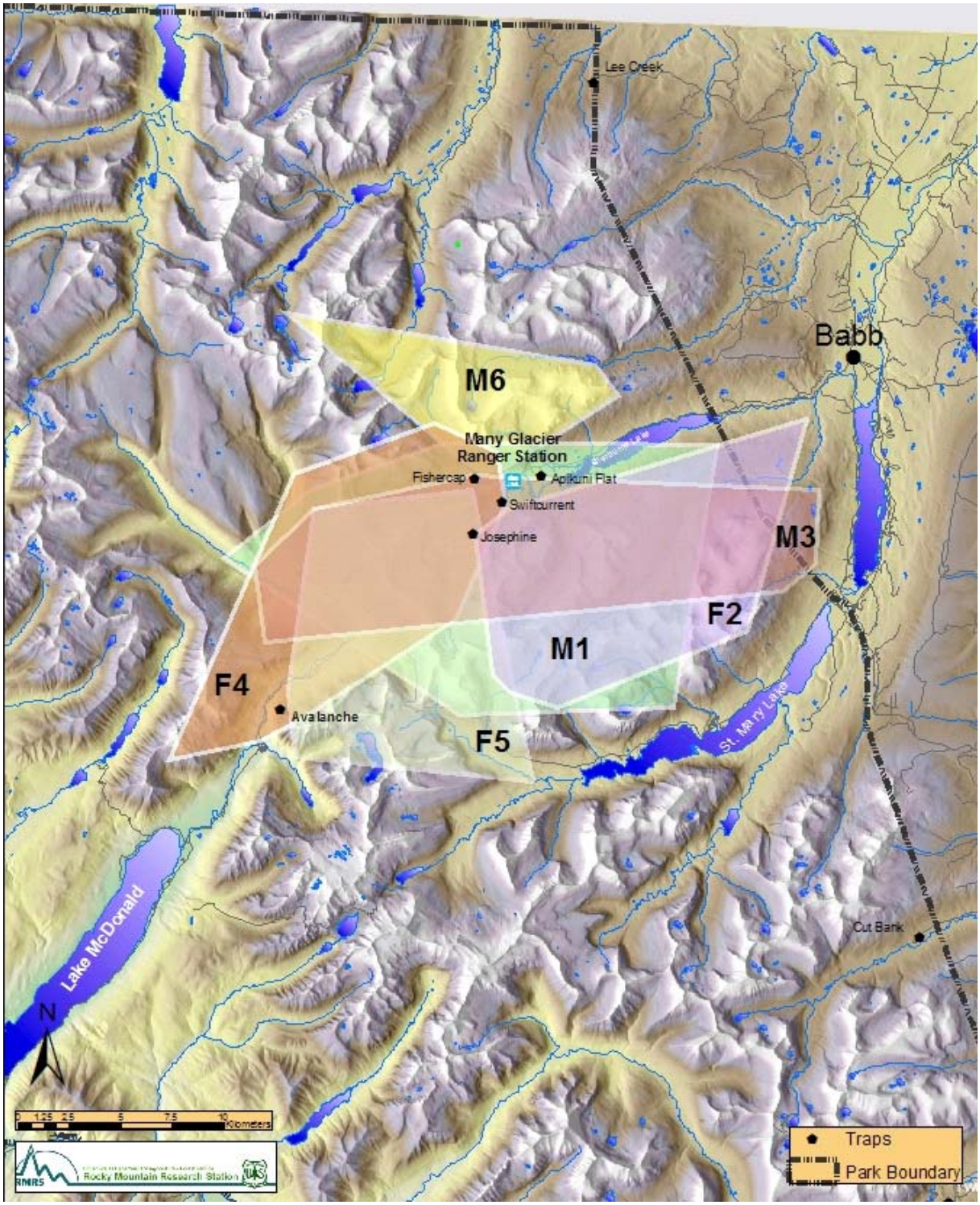

Figure 4. Home ranges of wolverine in Glacier National Park, data period ending July 2003. M1 and M6 are adult males, F2 and F4 are adult females, M3 and F5 are subadults, male and female respectively.

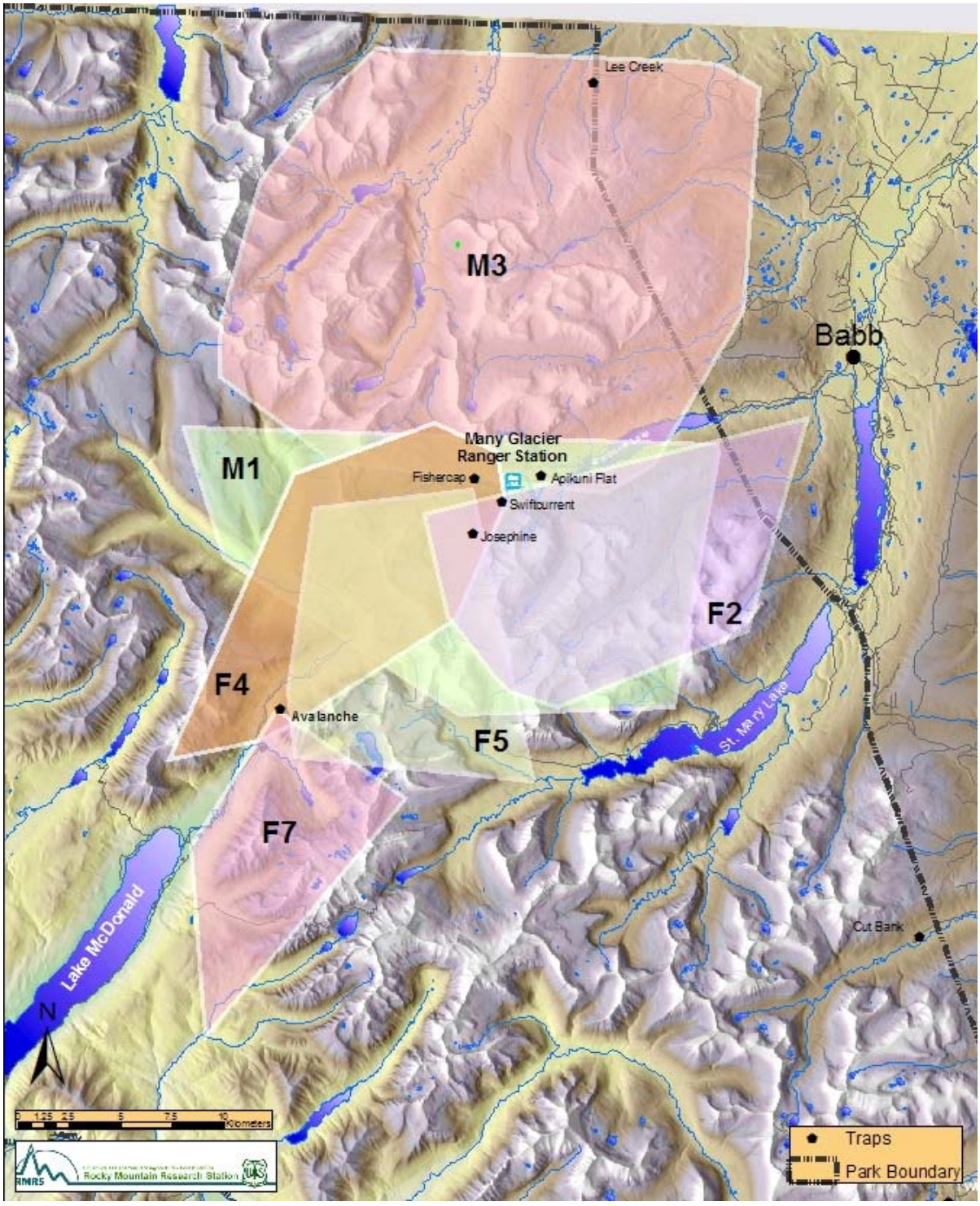

Figure 5. Home ranges of wolverine in Glacier National Park, data period ending July 2004. M1 and M3 are adult males, F2, F4, and F5 are adult females, F7 is a subadult female.

close proximity to F4 and the kits and to the kits alone on multiple occasions. Male-offspring association has not been a focal point of wolverine research but anecdotal accounts of such are not uncommon in the literature. The prospect of male parental care as a fundamental constituent of wolverine sociality suggests significant implications vis-à-vis offspring viability and pair bonding of mated pairs (Copeland 1996). DNA analysis will help us recognize relatedness, thereby improving our understanding of relationships. We will continue to watch for and record instances of association amongst all age and sex classes.

Male M6, believed to be an old age adult at his initial capture in April 2003, was last located near Lower St, Mary Lake on 10 March, approximately 12 km from any of his previously recorded locations. He has not been relocated since that date and subsequent to his disappearance, male M3, captured as a young adult in 2003, shifted his distribution into the area of M6's home range (Figure 5). This, and the movement of M6 away from his home range, may indicate that M6 was compulsorily displaced by the younger M3.

Reproduction and denning.—Assessment of the reproductive status of adult females indicated that two females were likely pregnant at capture in 2003, and potentially four in 2004. Female F4 was determined pregnant by palpation at capture on 17 February 2003. At a recapture on 21 March she exhibited no evidence of lactation and also displayed evidence of a possible rib dislocation. Association of this injury and her loss of kits is possible but speculative.

Elevated serum progesterone (11ng/ml) indicated pregnancy in F2 at her initial capture on 30 January 2003. Subsequent aerial locations pointed toward a possible den on Wynn Mountain. A recapture on 20 March confirmed the presence of lactation. F2 consistently used two den sites prior to weaning. Both sites were visited in early summer and each contained evidence of wolverine presence in the form of bedding, latrine, and foraging sites. We were never able to observe kits in her presence although DNA analysis of two juveniles captured the following winter indicated that one of the individuals, F7, was likely an offspring of F2.

In 2004, all females showed elevated serum progesterone based on blood collections at captures, all of which occurred after 31 January. During ground tracking and fixed-wing flights in February and March, both F4 and F5 localized at suspected den sites. We were able to track F4 to a maternal den where we excavated and captured the kits. Both kits were males weighing 3.0

and 3.3 kg (Table 2); age was estimated at 10-weeks-of-age based on tooth eruption. Each was instrumented with an intraperitoneal implant transmitter.

In both years, reproductive dens occurred in natural cavities under fallen trees covered by deep snow. Females excavated tunnels into the den chambers in all cases excepting the maternal den in which F4 and her kits were captured. In this case, access was gained via a natural tunnel created by tree limbs in which little excavation was evident. Sites occurred on gentle sparsely treed slopes of either eastern or southwestern aspects above 6,000 ft. elevation. Rendezvous sites used this spring by F4 and her kits were primarily boulder talus. A detailed habitat analysis of all dens and rendezvous site will be completed.

In 2003, female F5 was considered a yearling at capture so was not expected to reproduce this year. *In utero* studies of trapper collected carcasses in Yukon (Banci 1987) showed that reproductive activity was indicated in <10% of 2-year-old females. Our best indicator for determining pregnancy in mammals is thought to be a measurement of serum progesterone. Mead et al. (1993) reported serum progesterone levels elevated above 1 ng/ml as indicative of pregnancy in captive female wolverine hormonally stimulated into a state of pseudopregnancy. They reported a rapid elevation of serum progesterone from normal levels immediately post-implantation, followed by an equally rapid decline followed by leveling off to normal levels post-parturition. In 2004, all 4 of our females tested for serum progesterone levels above 1 ng/ml (range 4-11) even though the likelihood of pregnancy in F7, an 11-month-old female at the time of capture and blood collection, would seem highly unlikely. The lab that conducted the assay assured us that while a false negative is always a possibility; a false positive is an extremely unlikely outcome. F5 (believed to be 2-years-old) strongly displayed denning behavior by localizing near Mount Cannon in early March. Telemetry locations and signal strength indicated she was spending some time below the snow surface. She consistently remained in this area until early April, after which she began to spend more time east of the divide. The area of localization is comprised of extremely dense brush on a steep rocky slope making den searches difficult. We have yet to find positive indications of reproductive denning at the site. At this point, we can only speculate that we aged these individuals incorrectly, or females are breeding at a much earlier age than has yet been reported, which results in pseudopregnancy and/or an aborted or resorbed fetus.

DNA Analysis.--Tissue samples of all study animals were provided to the genetics laboratory at the Rocky Mountain Research Station in Missoula, MT. Genotyping and relatedness analysis are currently underway.

Scheduling

A schedule of field operations for the next 9 months follows.

July – September '04

- Radio track and monitor study animals – focus on locating rendezvous sites of F4 and kits, and confirmation of kit presence with other females
- Test satellite transmitters
- Habitat data at reproductive dens and rendezvous sites

September - December '04

- Radio track and monitor study animals
- Trap maintenance
- Logistical preparation for winter field season
- Report preparation

December '04 – April '04

- Radio track and monitor study animals
- Capture and marking of wolverine
- Snow-tracking

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