Research Studies Related to Snowmobiling Impacts

WILDLIFE – Wolverine

Wolverines are generally classified as a Sensitive Species by the U.S. Fish and Wildlife Service (not Endangered or Threatened at the federal level; however some individual states do currently classify it as Threatened) and are the focus of several current scientific research efforts. Since its habitat sometimes overlaps with popular winter recreation areas, questions about potential impacts from snowmobiling have emerged over recent years. It is therefore important that snowmobilers and snowmobile trail managers pay close attention to wolverine research to help understand the issues and research findings.

The Wolverine Foundation in particular is associated with numerous research efforts currently in progress and is a good source of information pertaining to recent efforts. Since several research projects are currently on-going, monitor the Foundation's website to track new activities and findings as they are posted at http://wolverinefoundation.org/resources/research-reports/ . A summary of recent Wolverine research reports includes:

Central Idaho Wolverine Winter Recreation Research Project

1. **Project Update: February 2012** http://wolverinefoundation.org/wp-content/uploads/2011/02/ci_winter_rec_2012update_feb.pdf

Summary: Project Expands in 2012: The wolverine-winter recreation project was initiated with aerial surveys across the Payette, Boise and Sawtooth National Forests in 2009 to examine the distribution and potential overlap between winter recreation and wolverine presence. Finding this overlap in several areas, the ground-based research effort began in January 2010 on the Payette National Forest outside of McCall, Idaho.

That first season was truly an experiment. Could we successfully capture and collar wolverines within these recreated landscapes using new GPS collar designs? And, while we felt relatively confident about this, even more uncertain was the reception we might receive from the recreating public as we asked for their help and cooperation. That first season was remarkably successful, due to the hard work of a committed team of field technicians, an open-minded and supportive recreation community and state and federal agency cooperation. We collected excellent information on winter recreation and monitored 6 wolverines that reside in the landscapes used by this public.

In 2011, we returned to McCall for a second year of data collection, and expanded the scope of the study to include the Warm Lake area east of Cascade. We also undertook a preliminary study on the Sawtooth National Forest on wolverine presence and recreation distribution. Again, the second season went better than we dared hope, with wolverines and recreationists critically assisting in our successful data collection efforts. We invite you to read prior Project Updates at www.forestcarnivores.org.

For the project to be able to understand the potential responses of wolverines to recreation, we need to look at a minimum of three landscapes with different and diverse recreation use patterns to monitor wolverines under a variety of conditions. Therefore, the work in our new study areas on the Sawtooth and Boise National Forests are as important as our initial work on the Payette National Forest has been.

Thus, this year – the winter of 2012 – is our most ambitious season yet. We have continued wolverine monitoring and selected winter recreation monitoring across our 2011 study area on the Payette and Boise National Forests. We have initiated a full wolverine and winter recreation study on the Sawtooth National Forest, with crews in Stanley and Fairfield, Idaho. And we are conducting preliminary data collection in the Trinity Mountains of the Boise National Forest, with a crew based in Featherville. So far, the season is going well – we provide some updates for the season here.

Recreationists Are Critical to Success of Research: We have a very ambitious recreation monitoring effort underway this year in the Stanley, Fairfield and Featherville areas where we are asking recreationists to voluntarily and anonymously carry small GPS data loggers. These data loggers provide us with a path the recreationist took that day, time-stamped so that we can match it with where our collared wolverines were at the same time. The data collected will help in various

modeling and analyses we hope to complete as part of the study looking at wolverine responses and interactions with recreation of all types.

We cannot overstate how valuable the participation of the recreation community is in these efforts. Because of the cooperation of the recreating community in McCall, we have collected excellent information in that study area on both recreation and wolverines over the last two winters. From this we have found that wolverines in this area are permanently residing even in some of the most highly recreated portions of the study area. This is excellent news, but we still need further information that will allow us to look at reproduction and other indicators of health in the wolverine population – in McCall and in other recreated landscapes.

Again this year, we are really pleased at the interest and willingness to participate that folks have shown when approached by our technicians. This winter is proving to be another example of how team work, collaboration and transparency are a winning combination for all of us invested in ensuring that winter recreation and wolverines both continue to use our beautiful Idaho landscapes.

2. **Project Update: July 2011** http://wolverinefoundation.org/wp-content/uploads/2011/07/ci_winter_rec_2011update.pdf

Summary: Successful Second Winter Season! The Central Idaho Wolverine and Winter Recreation Study undertook its second field season this last winter. In 2011, we repeated work in the same areas north and west of McCall on the Payette National Forest, and also expanded our study area to include through the Warm Lake area east and southeast of Cascade on the Boise National Forest. The focus of our efforts again this year included live-trapping and GPS collaring wolverines to monitor their movements and behaviors and simultaneously asking winter recreationists to carry a GPS data loggers while recreating in the study area. This larger study area certainly meant extra effort, but it was well worth the investment. Over the winter, we monitored 10 wolverines and collected data from hundreds of volunteer winter recreation enthusiasts.

In addition to the intensive efforts undertaken on the Payette and Boise National Forests, we also completed a preliminary study on the Sawtooth National Forest near Stanley, Idaho. In this study, we collected hair for DNA analyses from wolverines visiting potential future trap sites, we monitored trail use using remote trail use counters and we undertook parking lot counts.

Recreation Monitoring: Again this year, we are appreciative and impressed by the generous support of the winter recreationists who volunteered to carry our little orange data loggers. Our crews routinely visited 6 trailhead parking areas throughout our study area. They approached recreationists to provide information and ask for their help with the study. This year, approximately 80% of the folks approached agreed to cooperate with the study by carrying a data logger, and of those, we had about a 70% return rate on the data loggers. This is lower than last year, but still an impressive show of support by the region's recreationists. Over the winter, we collected over 1,200 tracks of winter recreationists through this voluntary participation!

Diversity of Winter Recreation Information: Again this winter, we undertook a diversity of efforts to document winter recreation activities. As previously mentioned, the critical information we have gained through the volunteer participation of recreationists went exceptionally well. In addition, we established 30 infra-red trail use counters across the Payette-Boise NF study area and another 10 on the Sawtooth NF. These units provide great information on the total number of users passing by, and record this information for us 24/7 – providing us with excellent use. A preliminary evaluation of the trail use data shows that this was another busy year and the number of users leaving the major parking areas is similar or higher than last year. We are looking forward to delving into this information further in the 2011 Annual Report.

It is great to see that the recreation information that we are collecting is starting to be recognized for the value it has in documenting the popularity and importance of winter recreation in the area. We have had a request to potentially collaborate with the Avalanche Center to use some of our data to evaluate whether avalanche conditions alter the way folks recreate or where they choose to travel on those high avalanche days. This may assist the Avalanche Center in refining their avalanche monitoring and communication work to most effectively keep us aware and safe in the backcountry. We are considering this opportunity and will be discussing this further with our partners

3. **Investigating the Interactions Between Wolverines and Winter Recreation Use: 2010 Annual Report.** Heinemeyer, K., Squires, J. and Copeland, J. (2010) Round River Conservation Studies and U.S. Forest Service Rocky Mountain Research Station

Executive Summary: BACKGROUND AND MOTIVATION – Backcountry winter recreation is one of the fastest growing sectors of the recreation industry. This growing popularity combined with increasingly powerful snowmobile technology has resulted in winter recreation use expanding onto public forest lands that were largely undisturbed during winter months. This expanding recreational use is increasingly overlapping habitats preferred by wolverines during winter and reproductive denning seasons and may potentially represent a novel and growing impact on the species. The wolverine is currently being considered for listing under the Endangered Species Act and has been a species of management priority for National Forests and state wildlife departments throughout its current range in the United States. The potential effects of winter recreation on wolverine reproduction, behavior, habitat use and ultimately, on populations are unknown and the management of winter recreation for wolverine persistence has little scientific foundation.

The Rocky Mountain Research Station, in collaboration with a number of government and non-government organizations, has initiated research to understand the interaction between wolverine and winter recreation. We are using a unique combination of approaches to simultaneously and intensively monitor both wolverines and winter recreation including GPS monitoring of wolverines and winter recreationists, and additional recreation monitoring through aerial surveys and trail use counts.

Project Goals and Approach: The over-arching project goal is to increase our understanding of the spatial and temporal interaction between winter recreation and wolverine habitat use, movements, and denning. Specific objectives of the research include: 1) assessing the spatial and temporal patterns of wolverine movements and habitat use relative to the distribution and relative intensity of recreation; and 2) investigating denning behavior in relation to recreation patterns.

The study is located in central Idaho including the Payette, Sawtooth and Boise National Forests. A significant challenge to any research on a rare species such as wolverine is the inherently low density of animals and subsequent small sample size. We will address this issue by establishing multiple study areas with each study area monitored for 1-3 years. The first study area was established north and east of McCall, Idaho in an area popular for backcountry winter recreation that also had confirmed presence of wolverines.

The goal and objectives of the project require that, from a logistical standpoint, two simultaneous and spatially-overlapping projects be conducted: an intensive monitoring of wolverines; and an intensive monitoring of winter recreation. During the first year of the study, we focused on the development and refinement of methodological approaches.

Wolverine Monitoring Methods and Results: Seven log box-traps were built during the fall and trapping was initiated on 8 January 2010. Traps were closed during early denning from late February through 20 March. Traps were re-opened through April to replace or remove collars. Captured wolverines were immobilized and instrumented with GPS collars that also had VHF beacon transmitters. Collars were programmed to recorded GPS locations every 20 minutes for 24-hour periods for 4 days each week. Two of these days represented higher recreation use days (Saturday, Sunday) and 2 days represented lower recreation use days (Tuesday, Wednesdays).

We captured and collared 3 adult female and 3 adult male wolverine. Over the course of the trapping season, all animals were captured at least twice and some animals were captured relatively frequently. The average number of trap-nights per wolverine capture was 11.2, with a total of 416 trap-nights and 37 wolverine captures through the season. In addition to wolverine, red fox (*Vulpes vulpes*) were captured 26 times (16 trap-nights/capture) and American marten (*Martes americana*) were captured 13 times (32 nights/capture).

Given the expected small sample size of wolverines from any single study area and year, we must be careful to not over-extend the analyses of the data. Thus, we have focused primarily on summarizing the data collected to date, providing initial data exploration and assessing and refining the usefulness of the field methods.

All 3 females initiated denning in mid- to-late February. One female (F1) stopped denning in March, and her teats were documented to dry up by late April. The other two females maintained dens throughout the monitoring period and were

actively lactating when collars were removed in late April. Dens were visited during the summer to document evidence of wolverine presence and denning activity.

Minimum convex polygons (MCP) were calculated to estimate home range extent and overlap with winter recreation. The estimated home ranges for the 6 wolverines showed strong intrasexually-exclusive territories (i.e., territories are largely non-overlapping within a sex) but extensive intersexual overlap. Home range sizes varied, with female home ranges (ranging from 93.8 mi2 to 141.6 mi2) smaller than male home ranges (ranging from 170 – 383 mi2).

The locations of animals were used to calculate the distances moved, and from this, to calculate the hourly movement rates of animals. This information was used to look for patterns in diel activity within and across individuals. Movement rates varied by individual wolverine, but overall, males had higher average (+ st. dev.) movement rates (4380.9 + 1404.4 m/hr) than females (1393.8 + 855.9 m/hr). There is a general pattern of higher movement rates during daylight hours implied by the average movement rates of males and females classified by light conditions. One female (F2) showed a shift in hourly movement rates to move more during night and early morning hours during denning compared to pre-denning movements. The movement rates and daily distance travelled by the two females that maintained dens increased through time and were eventually higher than those observed during the pre-denning.

Winter Recreation Monitoring Methods and Results: We implemented and evaluated 4 independent and complementary methods to gather data on spatial and temporal recreation use across the study area: GPS tracking of recreation groups; aerial surveys; trail use counts; and, parking lot vehicle counts. Parking lot counts were of minimal utility compared to other methods, and we do not present parking lot information in this report to focus on more informative data.

To collect GPS tracks of recreationists, we identified access points commonly used by winter recreationists and stationed 1-2 technicians at a parking lot to ask recreationists to in carrying a small GPS data logger. We undertook the sampling on Saturday and Sunday as relatively high recreation days and Tuesday and Wednesday as relatively low recreation days. Over 90% of the recreationists asked to carry a GPS data logger were willing to do so and the return rate of the units was also over 90%. In addition, we collected GPS tracks of guided cat-skiing that originated at Brundage Ski Resort. Between early January and mid-April, we collected 714 GPS tracks carried by recreationists in our study area. Of these, 34 tracks were backcountry skiers, 12 were backcountry snowboarders, 24 were from the guided cat-skiers and 644 were snowmobilers. The average size of recreation groups varied by type of recreation with the guided cat-skiers having the largest groups (9.9 people per group), the backcountry skiers having the smallest group size (2.9 people) and the snowmobile groups averaging 4.6 people. The number of recreationists represented by a GPS unit averaged 1.7 people/GPS for backcountry skiers and 3.2 people/GPS for snowmobilers. Overall, the 714 tracks represent monitoring of a sample of 2,398 recreationists clustered into 539 groups. The cumulative spatial density of recreation intensity through the field season varied across the study area with the highest density recreation in the Goose Lake area, and more generally, higher density recreation along groomed routes and closer to access points.

We used aerial surveys as an independent data source to validate the relative intensity of recreation use across the study area indicated by the GPS monitoring of recreationists. We also used aerial surveys to identify the spatial extent of the recreation footprint, which we might expect to be under-estimated with the GPS monitoring of a sample of recreationists. To remove potential observer biases, we used repeated presence-absence observations to score the relative intensity of recreation use across the study area. The sampling was conducted based on a grid of 6.25 km2 (2.5 km x 2.5 km) cells with 30-second intervals between sequential observations that allowed an average of 3 independent observations within each grid cell. The relative intensity of recreation use within each grid cell was scored as the number of "presents" out of the total samples taken within each cell. Over the course of the winter, 3 aerial surveys were completed. The observed relative intensity of recreation across the study area estimated by the aerial surveys is reflective of the GPS recreation track sampling. As expected, the aerial surveys generally show a larger recreation footprint with some sampling units showing recreation use in areas where there are no GPS samples.

Infra-red trail use counters (trial counters) provided our third primary source of data on recreation use. We established 20 trail counters along snowmobile routes and on access routes for backcountry skiers. The counters were programmed to summarize the number of times the infra-red beam was broken each hour and we assume each count represents a recreationist. Here, we focus on data from 5 of the trail counters that best represent the number of recreationists entering the study area from the 3 primary access points. We assumed that each recreationist entered and left the study area by the same route on the same day and is double-counted in the data. Therefore, we divided the hourly counts by 2 to estimate the number of recreationist that travelled by any trail counter. Over the monitoring period (January 20 – April 27), 7,014

recreationists are estimated to have accessed trails north of the Upper Elevation Parking area, 6,595 were recorded on roads and trails likely accessed by the Warren Wagon Road parking area, and 549 were recorded along the Lick Creek Road. Saturday had the highest daily averages and Saturday averages were highest in February, when an average of over 200 winter recreationists estimated to be using each of the Upper Elevation Parking area and the Warren Wagon Parking Area. Peak activity for backcountry skiers using the Lick Cr Road was also highest on Saturday with an average of 10 recreationists/day in January and February. Use declined in March and April with the lowest daily averages in April. The lowest recreation days were Monday and Tuesday with each day representing less than 10% of the weekly use for both snowmobile and non-motorized recreation activities. For both types of recreation, there is a peak in activity at 1000 hours, as people left trailheads to enter the study area, and an additional peak in activity at 1600 hours, as people are returning to trailheads and passing by the trail counters for a second time.

Preliminary Results of Wolverine and Winter Recreation Patterns: With only a single year of data on 3 female and 3 male wolverines, limited analyses can be done and conclusions cannot be reached regarding any potential interactions between wolverines and winter recreation. Still, the monitoring indicates that the home range boundaries estimated for the 6 wolverines contained variable amounts of winter recreation including areas of the highest intensity recreation as well as large areas of no recreation use. The home ranges of 4 animals contained extensive recreation use, with recreation intensity ranging from high to nil within different regions. The home range of 2 other animals contained low levels of recreation based on our recreation monitoring efforts. The den sites chosen by two females were within landscapes that support lower levels of recreation intensity, but were within several hundred meters of pockets of higher recreation activity. The den site of the third female was within an area with no recreation activity.

There appears to be no difference in wolverine movement rates between high recreation days (i.e., Saturday and Sunday) and lower recreation days (i.e., Tuesday and Wednesday). Movement rates of 2 females show a daily pattern of low movement rates during peak recreation times. The third female had no recreation within the large drainage where her den was located and had increased movement rates during daylight hours.

Conclusions and Next Steps: We had high success in all the field methodologies we invested in. In particular, the quality and amount of data provided by the intensive GPS monitoring of recreationists, combined with the aerial surveys and the trail counters, provides an unparalleled opportunity to investigate potential interactions between wolverine and winter recreation. Data analyses will be on-going, and will require additional years of data to increase sample size and evaluate potential variability in responses. This initial year has shown the utility of the study design and field methods. It has also provided an initial opportunity to evaluate questions regarding potential interactions between wolverine and winter recreation.

The study will be repeated in the McCall, Idaho study area during the winter of 2011. In addition, we will be expanding the study area to the south onto the Boise National Forest in the Warm Lake area with the establishment of additional trapping and recreation monitoring. We are also initiating a study area on the Sawtooth National Forest near Stanley, Idaho. Refinements to the study design, based on the information presented here, will be incorporated into the efforts in 2011.

4. **Central Idaho Wolverine - Winter Recreation Research Project: Summary.** Heinemeyer, K., Squires, J. and Copeland, J. (2009) Round River Conservation Studies and U.S. Forest Service Rocky Mountain Research Station. http://wolverinefoundation.org/wp-content/uploads/2011/02/ciwp_20Dec09.pdf

Project Description: This project will undertake research to increase our understanding of potential interactions between winter recreation and wolverine demography and habitat use. In the first phase of this effort, winter aerial surveys were undertaken in 2008 to provide information on the distribution of wolverine and both motorized and non-motorized winter recreation across the 3 National Forests (Copeland et al. 2009). These surveys indicated that, at a regional scale, there are areas of extensive recreation use within potential wolverine denning habitat, and also that, in some of these areas, wolverine are present (Figure 2).

Phase II of the project will focus on understanding the spatial and temporal interactions between wolverine and recreation within these regions of overlap.

This Phase of the study will focus on an area north and east of McCall, Idaho, that was identified during the Phase I surveys as an area of known wolverine presence overlapping both snowmobile and backcountry ski recreational uses

(Figure 3). After 2 years of focused effort in this study area, it is anticipated that the project would either move or expand to other suitable areas within the central Idaho region.

The over-arching goal of the proposed research project is to: *Increase our understanding of the spatial and temporal interaction between winter recreation and wolverine habitat use, movements and denning.*

Specific project objectives include:

- Document potential high quality habitats for wolverines across the study area
- Understand the spatial and temporal patterns of recreation use, including the distribution and intensity of use
- Assess the spatial overlap between winter recreation and wolverine potential habitats and known winter home ranges
- Assess the spatial and temporal patterns of wolverine movements and habitat use relative to the distribution and relative intensity of recreation use
- Document denning behaviors and locations, particularly in relation to recreation patterns

Most importantly, increasing our scientific understanding of the potential effects of winter recreation should provide managers increased flexibility in developing management recommendations and help ensure that both wolverine and winter recreation are healthy and sustained values in the Rocky Mountains.

The project will focus on understanding the spatial and temporal interactions between wolverine and winter recreation. Intensive GPS tracking of both wolverines and winter recreationists will provide data matched in space and time. This will allow us to examine wolverine responses to varying levels and types of recreation, including spatio-temporal overlap at local scales and monitoring a diversity of wolverine response indicators, such as shifts in habitat use and movement patterns relative to the distribution and intensity of recreation across seasonal, weekly and daily periods.

East Slopes Predator Project – Alberta, Canada

1. **East Slopes Predators: Mammalian spatial distribution and habitat selection in a heterogeneous mountain landscape, Year-End Report 2011-2012.** Fischer, J.T. & Heim, N. (2012) Alberta Innovates Technology Futures http://wolverinefoundation.org/wp-content/uploads/2011/02/esp_yerf_2012.pdf

Project Summary: Alberta's East Slopes are a unique mosaic of protected areas, oil and gas development, recreational activity, forestry, and grazing land. The Slopes are also home to a diverse predator community, including grizzly and black bears, wolves, cougars, and wolverines, among others. Although the Rocky Mountains anchor predator populations, some species are known (grizzlies) or suspected (wolverines) to be declining. Oil and gas activity is often cited as a primary stressor on predator populations, but combined landscape footprints from multiple human activities, including recreation and road access, likely have cumulative effects on predators. The relative contribution of each of these sectors is controversial, and need to be discerned to allow effective management. Therefore, research that investigates how different human activities and footprints affect landscape-scale predator occurrence will inform long-term conservation of predator communities. To meet this goal, we are surveying predator occurrence (grizzly bear, black bear, wolverine, fisher, lynx, cougar, wolf, *etc.*) on the East Slopes using non-invasive detection methods, with a more in-depth focus on wolverine genetics. We will model the occurrence of predators in relation to natural habitat features and landscape alteration *via* (1) commercial forestry; (2) oil and gas development, including seismic line density; (3) recreational activity, including off-road vehicle routes; (4) livestock grazing and other agriculture; and (5) roads. We will examine the relative contribution of each landscape activity in explaining predator occurrence, and identify key stressors for each species, to inform management of landscape development that will allow effective carnivore conservation.

Greater Yellowstone Wolverine Program

1. **Progress Report – December 2009** http://wolverinefoundation.org/wp-content/uploads/2011/02/WCS_WP_Progress_Report_Dec_2009.pdf

Research Summary: We started the 2008/2009 winter season with 11 wolverines on the air, 6 of which were adult females. As a result of our den survey efforts during spring 2008, we also had information on areas that may hold an additional 18 wolverines – 10 adult females, 5 adult males, and 3 dispersing-aged wolverines. Based on the locations of these unmarked wolverines we ran a small but targeted capture effort during December '08-February'09. These efforts resulted in 7 wolverine captures (5 new captures, 2 recaptures) during a total of 138 trap-nights (1 wolverine capture/20

trap-nights for this targeted effort). One of these individuals was not radio-implanted due to a heart condition. We also radio-implanted and GPS collared an additional wolverine that was incidentally captured by a recreational trapper on Menan Buttes in Idaho, and we recaptured a dispersing-aged female in Montana. A total of 7 wolverines were handled during the winter, including 6 new individuals. At present we are radio-monitoring 9 wolverines (5 adult females, 3 dispersing-age wolverines, and 1 adult male). We lost 4 due to expiration of their implant batteries (3M 1F), and are currently unable to relocate another 4 (2M 2F) who have either moved large distances or their implants have failed prematurely.

We adapted our handling protocol to include use of a pulse-oximeter, administration of oxygen, and improved thermal regulation. We also decided to end targeted box-capture efforts by February 15 in areas known to contain reproductive aged females in order to avoid capturing late-term pregnant females and/or lactating females with cubs.

This spring's den detection test was successful in that the blind search using the fixed-wing technique matched exactly with what the telemetry and follow-up data indicated. However, it was less informative than we had hoped because both techniques indicated that none of the 6 adult females successfully reproduced this year. So, although the technique determined what actually happened, we did not come away with a den detection rate. So the question remains – If 10 wolverine dens are present, how many can we detect with blind, fixed-wing surveys? We were however able to show that the technique can provide a relatively inexpensive method of aerial track detection and thus wolverine distribution.

Over the spring/summer we monitored 3 individuals during their dispersal movements. This included the movement of a subadult male from northwestern Wyoming to Colorado, making him the first confirmed wolverine in Colorado since 1919.

During calendar years 2008 and 2009 we radio-monitored 20 different wolverines for a total of 23-wolverine-years. This included reproductive observations of 7 different females during a total of 12 reproductive opportunities with one reproduction documented (1 cub of unknown sex). We also recorded one mortality during this period (a juvenile male).

2. **Progress Report – November 2008** http://wolverinefoundation.org/wp-content/uploads/2011/02/WCS-WP-Update-Nov-2008.pdf

Excerpt: GPS Collars on 5 Adult Female Wolverines Provide Valuable Data Related to Winter Recreation; during the winter of 2006-07, we were able to place GPS collars on 5 adult female wolverines. These collars were provided Montana Dept. of Fish Wildlife and Parks. The collars were programmed to collect a location once every hour. We obtained a total of 2,066 locations of the 5 females. So we ended up with over 75,000 5-min samples of wolverine activity level (some reported in McCue et al. 2007).

The data from these collars provides further evidence that wolverines utilize their exceptionally large annual home ranges over a very short period of time (on the order of weeks: Fig. 7) The data also provide further evidence for territoriality (Fig. 7 bottom middle). More importantly, we can use these data to compare movement rates, activity patterns, and locations of these females in relation to winter recreation (snowmobiles and ski activity).

3. **Greater Yellowstone Wolverine Program Update: December 2006—March 2007.** Inman, B., & McCue, T. (2007) Wildlife Conservation Society. http://wolverinefoundation.org/wp-content/uploads/2011/02/gyws06-07.pdf

Summary: This winter we focused on the Montana region of our study area. Our goal was to replace aging transmitters and instrument all females with GPS collars. The winter trapping effort began December 28 and ended March 15. One field crew operated 11 traps in the Madison, Gravelly, Henrys Lake, and Centennial Ranges for a total of 371 trap-nights. We recaptured 5 female wolverines a total of 9 times. Implants were replaced and each was fitted with a GPS collar. We did not capture any new individuals.

Report includes a photo that shows an important aspect of the wolverine/winter recreation interaction that we would like to learn more about. F121's natal densite is marked with the arrow on the right. The snowmobiling shown in the picture occurred while the den was active (relatively close to the densite). She has remained at this densite to date.

We have started our spring effort to collect reproduction data. Only one of our seven radioed adult females has given an indication of denning this spring. We will continue to monitor all of the females throughout the spring and early summer

to verify their reproductive status. On 2/28/07 we verified the location of F121's den in the Gravelly Range. We will attempt to capture the kits in May.

We are also searching the north end of the Teton Range for a densite from the female we believe is occupying this area. Other areas scheduled to be searched for possible densites are the Snowcrest, Gallatin, and Snake River Ranges.

We documented one mortality during this update period. F405, a known age female captured as a kit in the Teton Range, was killed in an avalanche in Grand Teton National Park in mid-December.

The kit we captured last spring, F133, is currently dispersing. F133 spent the majority of last summer in the north end of the Gallatin Range. Beginning in the fall, she starting spending more time in the southern portion of the Gallatin. In late February she began showing signs that she might disperse with a move to the southern tip of the Gallatin Range. Her first move outside the Gallatin was to the Madison Range across US Highway 191 in Yellowstone National Park (YNP). We were able to document the location where she crossed back into the Gallatin Range a few days later. After a short stay in the southern Gallatin, her next location was in the Thorofare Creek area southeast of YNP. We will attempt to monitor her throughout her dispersal.

4. **Greater Yellowstone Wolverine Program Update: December 2005—February 2006.** Inman, B., & McCue, T. (2006) Wildlife Conservation Society. http://wolverinefoundation.org/wp-content/uploads/2011/02/gyws05-06.pdf

Excerpts: Recreation Monitoring: Jenny Bell was once again conducting recreation surveys around the Madison, Gallatin, and Gravelly mountain ranges. Parking area surveys (vehicle and snowmobile trailer space counts), parking area validations, and trail counters are being utilized to develop a technique to monitor levels of winter recreational use. Recent analysis of recreational data has helped us identify areas to improve our survey methodology. We determined that trail counters can more accurately assess recreational use in areas where snowmobiling does not originate at a central parking area and at ski areas where peak time parking lot counts are not as effective. The number of trail counter validations was increased to estimate and assure counter accuracy. Twice weekly, parking area surveys were performed during peak hours at high use areas. Frequency of parking area validations was also increased to approximately two per week. Validations are conducted by stationing an observer at one parking area all day to record the number of vehicles, snowmobile trailer spaces, snowmobiles on each trailer, and/or skiers in each vehicle along with entry and exit times of users. The purpose of increasing parking area validations was three-fold: first, to accurately predict the number of actual snowmobiles represented by each trailer space, or the number of skiers represented by each vehicle; second, to determine the peak hours of parking area use; third, to determine the amount of day-long parking area use that is represented by peak hours. We increased the sample size of parking area validations due to their importance in estimating actual user numbers from survey results. This improvement in sampling accuracy will enhance our ability to determine annual rates of change in winter recreational use at each site.

5. **Absaroka-Beartooth Wolverine Project: Spring 2006 Newsletter.** Copeland, J., Murphy, K., & Wilmot, J. (2006) The Wolverine Foundation.

Project Overview: The Absaroka-Beartooth Wolverine Project began this past January in the eastern portion of Yellowstone National Park and on the Shoshone and Gallatin National Forests. The project, which is a cooperative effort developed by Yellowstone National Park and the Forest Service's Rocky Mountain Research Station, is designed to increase our understanding of one of the rarest carnivores in North America. Prompted by elevated public concerns regarding the presence, abundance, and status of wolverine across the northern Rocky Mountains, researchers hope to aid management by clarifying the wolverine's dependence on habitats in Yellowstone National Park and surrounding National Forest lands. The project will study wolverine distribution and movements, habitat and food associations, and population indices such as survival rates, birth rates, and dispersal movements. Also, we seek to clarify the wolverine's relationship with other carnivores in the Yellowstone ecosystem.

Wolverine will continue to be live-trapped using log box traps and instrumented with implant transmitters, and in some cases, GPS collars capable of collecting high precision, fine-scale information on wolverine movement and habitat use. The project is designed to operate in and around Yellowstone National Park through a 4-year study period with primary funding support provided by the Yellowstone Park Foundation and the Forest Service.
Twenty-seven log box-traps border the rugged Absaroka-Beartooth and Gallatin Mountain ranges in northern Wyoming and southern Montana. The traps are designed to lure the rare and elusive wolverine

to the promise of a fresh meal of beaver and venison. The wolverine inhabits the most rugged, inaccessible country in the western United States. Its lifestyle demands that it remain in almost constant movement in search of a food source that is rarely predictable and often little more than hide and bones—a situation researchers hope to exploit with their well-stocked bait sites. Wolverine occur at naturally low densities (generally about 1 wolverine/150 km2) and exhibit a tenacious adherence to daily foraging routines. This makes wolverine trapping a tenuous undertaking. "Wolverine captures will be rare and unpredictable with success requiring diligence and constant attention to detail," says Jeff Copeland, Rocky Mountain Research Station biologist and co-principal investigator on the project.

In early 2006, four trap lines operated for a total of 1,827 trap nights that produced 71 red fox, 41 American marten, and 2 wolverine captures. Both wolverines were adult males; M1 was captured on the Gallatin Forest just north of the park, and M2 was captured near Sylvan Pass on the eastern interior of the park. Both individuals were implanted with a VHF transmitter and fitted with a GPS collar. Unfortunately, both individuals have since shed their collars due to apparent collar malfunctions. However, data collected and stored on the collars has been retrieved, providing insight into the daily movements of both individuals. VHF implant transmitters will provide continued contact with the animals through aerial and ground-based telemetry, which will continue throughout the year.

Male M1 was instrumented with a GPS collar on March 22. His collar began collecting data early on the morning of March 23. Over the next 26 days his collar collected 194 locations as he traveled 453 kilometers across the Gallatin National Forest. The collar was programmed to attempt a GPS fix every 2 hours, which would have tallied 308 locations for this period. The 194 locations collected represent a fix success rate of 63%. While he was on the move, M1 traveled at a rate of 1.4 km/hour. During one articular 2-hour foray on March 31, he moved 9.1 kilometers.

6. **Wolverine Population Assessment in Glacier National Park: Spring 2006 Progress Report.** Copeland, J.P. & Yates, R.E. (2006) USDA Forest Service, Rocky Mountain Research Station, Missoula, MT.

Executive Summary: The Glacier National Park Wolverine Project has just completed its third full year of study. During that time, 19 wolverines have been captured and instrumented providing over 3,000 telemetry-location points. Reproductive den sites, documented for two adult females, occurred on upper slopes in sparse timber beneath downed, woody debris. Females used 2-3 dens prior to weaning of kits. These dens represent nearly 50% of all wolverine dens ever found in the continental U.S. Four kits were captured and instrumented at den sites and monitored through their first summer to document 17 rendezvous sites; these occurred primarily in boulder talus and cliff areas. Kits separated from their mother at 6-7 months-of-age in late September. Kit survival to adulthood has been low as evidenced by 3 of 4 kits dying during their first year. GPS collars were tested at 4-hr, 2-hr, 30-min, and 5-min fix acquisition intervals providing insight into capabilities of documenting patterns and rates of movement, habitat use, and social interactions. GPS data from 2 males indicated movement rates averaging 2 km/hr in a pattern of long-distance movements (commonly exceeding 10 km) interspersed with localization periods of up to 20 hrs. Wolverines traverse the landscape apparently indifferent to topographic features. Glacier National Park wolverine home ranges averaged 496 km2 for males and 141 km2 for females. DNA analysis for 20 individuals suggests less genetic structure than expected with relatedness contained by 2 distinct genotypic groups within our study population.

The 3-year study period provided by the Natural Resources Protection Program grant ended in 2004. Glacier National Park and Rocky Mountain Research Station staff met in 2005 and agreed to continuation of the project for 3 additional years pending funding. Additional funding provided by agencies, private grants, and private donations will allow continuation into FY 2007.

Mortalities — Both 2004 kits died during their first year. One was legally taken by a trapper outside the park boundary, and the second of unknown cause at approximately 9 or 10 months of age. One of the 2005 kits was killed by an unknown predator at 8 months of age. A 3-year-old female (F5) died in an avalanche in 2005. We are currently conducting a formal survivorship analysis of our study population.

In our 2004 progress report, we described the disappearance of subadult male M8. Believed to be a yearling at capture in February 2004, M8 left GNP about a week after capture. He moved into the Whitefish Range near Hungry Horse at which time we began closely monitoring his movements. He disappeared from the Whitefish Range in early April, in spite of efforts to maintain daily contact. In late July, researchers conducting a grizzly bear flight in the northern portion of the Kootenai National Forest detected M8's telemetry signal. The bear researchers continued to monitor M8 near American

Creek and the Northwest Peaks Natural Area until he was legally taken by a trapper in December 2004. He had traveled over 200 kilometers as measured by straight-line distance.

7. **Greater Yellowstone Wolverine Study, Cumulative Progress Report December 2003.** Inman, K. H., Inman, R. M., Wigglesworth, R.R., McCue, A.J., Brock, B.L., Rieck, J.D. and Harrower, W. (2003) Wildlife Conservation Society General Technical Report. http://wolverinefoundation.org/wp-content/uploads/2011/02/2003.pdf

Abstract: The status of wolverine populations in the lower 48 remains uncertain and the ecological requirements of the species are not well described. Federal and state resource managers need information in order to make well-informed policy decisions that affect land-use practices and populations of wolverines. This project is designed to provide baseline ecological data and answer specific questions relevant to wolverine management and related land-use policies (i.e., does winter recreation impact wolverine reproduction, where are critical habitat and travel corridors, and are fur trapping practices sustainable). Two areas, the Madison Focal Area of southwestern Montana and eastern Idaho (MFA) and the Teton Focal Area of northwestern Wyoming and eastern Idaho (TFA), have been selected for intensive study. These areas are representative of the land management jurisdictions and human-use impacts common to the Greater Yellowstone Area (GYA).

To date we have constructed 53 log box-traps in Montana, Idaho, and Wyoming. Eighteen different wolverines (9 female, 9 male) have been captured and 10 (6 female, 4 male) are currently radio-instrumented. Seven wolverines were fit with store-on-board GPS collars, and one was fit with a satellite collar. Success and failure of collars is discussed below. We have obtained 921 VHF and GPS locations of wolverines.

We have documented four causes of wolverine mortality: avalanche, trapper-harvest, interspecific competition (black bear), and vehicle collision. Three adult males have died from non-human-related mortality sources, and a subadult female, an adult female, and an adult male from legal harvest. Data suggest that four females have given birth, between Feb.14-24. One natal den was located at approximately 2,200 m elevation (7,200 ft) in an area of mixed conifer stands, the second was at 2,750-3,000 m elevation (9,000-10,000 ft) on a north facing slope.

More specific habitat information will be available at a later date. We have not yet documented the presence of kits with 100% certainty. Doing so, along with documentation of reproductive den habitat, is of highest priority this spring. Although sample sizes for all reproductive analyses are extremely small at this point, pregnancy rates of females more than 2 years old averaged 67% (n=6) and has varied by year (50-100%). We estimated age at first reproduction to begin at 3 years of age; 0% of one-year olds (n=6), 0% of two-year olds (n=3), 50% of three-year olds (n=2), and 100% of 4+ year olds (n=7) showed evidence of reproduction. Percentages of females more than 2 years old giving birth averaged 40% and has varied by year (0-100%, n=5).

Adult female 100% MCP (Minimum Convex Polygon) home range size averaged 754 km² (3 wolverines, 202 locations) while sub-adult females averaged 429 km² (5 wolverines, 213 locations). Adult male home ranges averaged 910 km² (5 wolverines, 231 locations) and a single sub-adult male had a home range of 629 km² (1 wolverine, 24 locations). M304's movements and home range appear to be that of a dispersing male and 251 locations yield a 100% MCP home range estimate of 37,638 km². Fixed Kernel (95%) estimates are also provided for animals with more than 30 locations. Two sub-adults (1 female, 1 male) appear to have shifted home ranges in response to the death of a same-sex adult. Although statistical tests have not yet been performed, it appears that wolverines use higher elevations (greater than 6,890 ft), steep slopes (greater than 16°), NW and N aspects, evergreen forest, bare rock, and perennial ice and snow disproportionately to their availability.

Pilot season data on winter recreation indicated that peak hours of snowmobile and ski activity occurred between 11:00-15:00, and that mean amount of use differed between weekdays and weekends (*P* 0.005). After analysis of parking area data from the pilot season, we classified mean levels of use as low impact (15 trailer spaces), moderate impact (16-40), and high impact (41-80). A recreational flight survey technique was developed and tested on the MFA and then used on the TFA. We conducted one survey of 2,523 km² for distribution of snowmobile and ski use on the MFA and one survey of 3,059 km² for snowmobile and ski use on the TFA during Feb 2003. On the MFA, 18% of the area was impacted by snowmobile use (11% highly impacted), and 4% was impacted by ski use (2% highly impacted). On the TFA, 36% of the area was impacted by snowmobile use (1% highly impacted), and 9% was impacted by ski use (1% highly impacted).

8. **2002 Annual Report** http://wolverinefoundation.org/wp-content/uploads/2011/02/2002.pdf *(Note: substantial new information has been learned about wolverines since these early studies)*

9. **2001 Annual Report** http://wolverinefoundation.org/wp-content/uploads/2011/02/2001.pdf *(Note: substantial new information has been learned about wolverines since these early studies)*

10. **Aerial Surveys for Wolverine Presence and Potential Winter Recreation Impacts to Predicted Wolverine Denning Habitats in the Southwestern Yellowstone Ecosystem.** Heinemeyer, K. & Copeland, J. (2001) Department of Environmental Studies – University of California Santa Cruz, Idaho Department of Fish and Game, and Targhee National Forest.

Introduction: Wolverines (*Gulo gulo*) are rare, medium-sized carnivores that historically inhabited forested regions across the northern tier of North America. Their distribution included much of Canada, southward into United States from Maine to Washington State. Southward, wolverine extended down the Cascade Mountains of Oregon and into the southern Sierras in California, and down the Rocky Mountains into Arizona and New Mexico (Grinnell et al. 1937, Banci 1994, Hash 1987). The wolverine has experienced dramatic reductions in their southern distributional extent. In the United States, their present distribution is restricted to the Rocky Mountains, and only Idaho, Montana and Wyoming are known to support populations. The wolverine is considered extirpated or at extremely low numbers in the Pacific States and the southern Rocky Mountains. Even in northern US Rockies, we know very little about the extent and status of wolverine populations.

We have little understanding of the historical and current impacts to wolverine populations. Some historical threats may continue to threaten wolverine populations, including habitat alteration and population isolation. Additionally, new threats place novel stresses on the remaining populations. One relatively new potential impact is winter recreational use of natal denning habitats. Female wolverines appear to prefer high elevation, north-facing talus slopes for natal denning. Often located within cirque basins, the females occupy extensive snow tunnels that form a complex of dens (Magoun and Copeland 1998). These dens are occupied during the early spring (February – April) birthing and whelping periods. There is a growing body of evidence that females are prone to disturbance at den sites, particularly at the natal dens where birthing occurs. Idaho wolverine selected specific natal and kit rearing habitat and responded negatively to human disturbance near these sites (Copeland 1996). Female wolverine abandoned dens in Finland (Pulliainen 1968) and Norway (Myrberget 1968) when disturbed by human activity.

Both snowmobile use and backcountry ski use has seen rapid increases in popularity over the last several years. Advancements in the power and technology of snowmobiles have resulted in machines and riders that can readily access what was previously viewed as inaccessible areas due to the rugged terrain. Extreme snowmobilers, who use the steep slopes of the cirque basins as playgrounds, favor these remote areas. Unfortunately, it is during the wolverine denning season (February – April) that we may see the highest or most intense recreational use of denning habitats (i.e., cirque basins), by both snowmobilers and skiers. Spring snow pack provides the most favorable conditions to access the remote regions, and it is exactly during this time when these recreationists will most negatively affect reproductive activities of resident wolverines. As snowmobiling and backcountry skiing continues to grow in popularity, there is an increasing concern that reproductive habitats may become limiting to populations due to human disturbance. Protection of reproductive denning habitat may be critical for the persistence of wolverine. An association between wolverine presence and refugia (e.g., Wilderness Areas) may be linked to a lack of available reproductive denning habitat outside protected areas.

Discussion and Recommendations: While the actual percentage of denning habitats with snowmobile activity appears low, particularly in comparison with last year's results, this is due primarily to having a much larger amount of predicted habitats in the study area. The spatial extent of the recreational activity on the TNF appears similar between 1999 and 2000. The areas most impacted by recreational activities are the Targhee Creek, East Centennials and Palisades SUs, with the Teton Range receiving some heavy localized use. These areas warrant careful management consideration if maintenance of potentially critical wolverine reproductive habitat is desired. Below, we discuss each of these areas.

The Targhee Creek SU has the most intensive snowmobile use across the study area. Last year we located a potential wolverine den in the single small basin that was free of snowmobile activity. This year, we saw high levels of wolverine activity in this same general area, which was again without snowmobile activity. We also located wolverine tracks throughout the Targhee Creek SU, but never within areas of high snowmobile activity. Additionally, we did not find any

foraging behaviors (e.g., digs, meandering paths) in areas with snowmobile activity. This may indicate that not only are wolverine sensitive to recreational use near denning sites, but also need secure areas for foraging activities. It is interesting to note that wolverine in this area were found digging for whitebark pine seeds, and we wonder if the limited amount of secure foraging habitat forced animals to seek inferior, alternative food sources in areas free of snowmobile use. We also followed a set of wolverine tracks from this area along the Miles Creek drainage down to open country at its mouth, where there are known elk wintering grounds. We lost the tracks in the low elevation, crusted snow, and do not know if it was seeking or feeding on carrion in this atypical wolverine habitat. Again, it appears that snowmobile activity may be forcing this individual to resort to possibly atypical or risky behaviors to meet winter food requirements.

The East Centennial SU also supports extensive snowmobile activity, but little of this recreational activity occurs in the predicted wolverine denning habitats. Most of the predicted denning habitat occurs along the north face of the range, and is primarily a series of steep avalanche chutes. We found no wolverine tracks along this north face, and the characteristics of these predicted habitats do not appear to form high quality wolverine denning habitat. We did find several wolverine tracks along the broad top of the Centennial Range, and along the south-facing portions of the mountains. This same region of the mountain range was heavily impacted by snowmobiles. Yet, again, most tracks were found in areas with little snowmobile activity, although some tracks did move through areas with high intensity snowmobile activity. Similar to Targhee Creek, tracks in areas with snowmobile activity showed little deviation from a straight path, indicating that the animal was willing only to travel through these used areas. Most of the predicted denning areas not located on the north face were impacted by snowmobile use. If the avalanche chutes on the north-face are not truly denning habitat, then the small amount of denning habitat available in the East Centennial SU is impacted by high intensity snowmobile use.

We found a single set of wolverine tracks on Saddle Mountain in the East Centennial SU. This lone mountain may provide a linkage corridor between Targhee Creek and the East Centennials. Snow conditions did not allow us to follow the tracks to confirm that this animal was moving between the two mountain ranges. In an earlier survey, we did find a single set of tracks traveling through Hell Roaring Canyon, at the base of Sawtell Peak and in an area heavily impacted by snowmobiles. There is the possibility that this drainage forms part of a movement corridor connecting Targhee Creek and the Centennial Mountains via Saddle Mountain.

As was noted in 1999, the heli-ski operation in the Palisades SU impacts a substantial portion of the predicted denning habitats in the area. When combined with the extensive snowmobile use in this area, denning habitats are widely impacted across the Palisades region (approximately 27%), more heavily impacted than even the Targhee Creek SU. We have not found evidence of wolverine presence in the Palisades after 2 years of surveys. We would recommend that at least another year of survey, and preferably multiple surveys be conducted in this area. The region appears to contain high quality wolverine habitat, but these habitats appear to be incurring potentially large impacts due to the widespread winter recreational activities.

Winter recreational use, particularly snowmobile and heli-skiing, may be having potentially severe localized habitat impacts on wolverines. While the impact on populations due to removal of critical denning habitats is more obvious, these recreational uses may be placing additional impacts on wolverine populations by removing foraging habitats as well. Management of snowmobile and heli-skiing is warranted in areas with significant amounts of potential denning habitat, and should include access restrictions during the denning period (February – April).

We recommend future research efforts focus on the winter ecology of wolverines and the impacts of winter recreational activities on individuals and populations. The study area we have examined may provide excellent research opportunities, with the extensive and variable nature of the snowmobile and ski activity across the region. This area has additional advantages in providing naturally and anthropogenically fragmented landscapes and wolverine populations. This provides the unique and critical opportunity to collect data on large-scale animal movements and landscape connectivity. We have documented what we believe is an animal moving between Targhee Creek and the East Centennial via Slide Mountain. Additionally, we documented a single track moving through the north end of the Italian Peaks in 1999, and a single track in the Gravelly Mountains this year. We do not know if the tracks belong to resident animals or to animals using these habitats to move to larger blocks of habitats. Obtaining information on landscape connectivity will be critical for population maintenance of wide-ranging species such as wolverines. The knowledge gained by such research will have application across a diversity of landscapes, including those artificially fragmented by human development and land management practices.

North Cascades Wolverine Study

1. **May 2012 Project Update** http://wolverinefoundation.org/wp-content/uploads/2011/02/ncws_update_may2012.pdf

Introduction: Greetings once again from the North Cascades Wolverine project in British Columbia and Washington. In our last update (March 9, 2012), we had live-captured 5 wolverines since the beginning of the year and attached satellite radio-collars to 4: 3 females (Mallory, Kendyl, and Xena) and 1 male (Rocky). Our live-trapping season continued until the end of March (British Columbia) and the beginning of April (Washington), but we did not capture any additional wolverines. Because of the heavy late-winter snows in March, many of our live traps were closed for extended periods due to high avalanche conditions or access issues. Regardless, we captured more wolverines this year than in any other year since the beginning of the study in 2006. This year also marks another first – we now have evidence that reproduction is occurring in our study population and we have found the first wolverine reproductive dens ever documented for the state of Washington.

2. **Winter 2011-2012 Update** http://wolverinefoundation.org/wp-content/uploads/2011/02/ncws_win2012update.pdf

Excerpts: Successes to-Date – Run-pole Camera Stations: Our first success this winter was in early December when Cliff Nietvelt (biologist with the BC Ministry of Forests, Lands, and Natural Resource Operations) obtained multiple photographs of a new wolverine at the Sumallo Grove run-pole camera station off of Highway 3 in British Columbia (top right). The throat and chest blazes clearly indicate that this is not one of our previously captured study animals.

In Washington, we detected Rocky (a male that we first captured and collared in 2006) at the Slate Creek run-pole camera station in early February (center right). We were able to make a positive identification based on his throat and chest blazes and the fact that he was still wearing the satellite collar that we fitted him with last winter.

Successes to-Date – Wolverine Captures: Thus far, we have captured 5 individual wolverines: 2 new wolverines and 3 previously captured study animals. This is the most wolverines we have captured in any given year, and brings our total number of individuals captured since the beginning of the study in 2006 to 10.

Mallory (an adult female first captured in 2011) was captured on 6 February at the Easy Pass trap in Washington. At the same time, a new wolverine was captured at the Bridge Creek trap (bottom right). We believe this wolverine was a male, but the immobilization drugs we administered were not effective on him. Thus, we collected some hair for genetic analysis and then released him without a satellite collar. We hope to recapture this individual soon, at which time we will use a different combination of immobilization drugs.

On February 18, we captured Xena (an adult female first captured in 2007) at the Twisp River trap in Washington (right). Although we detected Xena at a run-pole camera station in 2010, this is the first time we have recaptured her since 2007. Two days later on February 20, we captured Rocky at the Easy Pass trap. Rocky has now been captured during 5 different years (2006, 2008, 2010, 2011, and 2012) and is at least 8 years old.

Our most recent success was a new young female (Kendyl) captured on Leap Day, February 29, at the Memaloose trap in British Columbia.

All of the wolverines we have captured this year appear to be in excellent health: females were 9.5-9.9 kg (21-22 lb) and Rocky was 14.7 kg (32 lb). We outfitted 4 of the wolverines (all but the 1 captured at Bridge Creek) with satellite collars that will allow us to track their movements for the next 8 months.

3. **Wolverine Distribution and Ecology in the North Cascades Ecosystem – 2011 Annual Report.** Aubry, K., Rohrer, J., Raley, C.M., Lofroth, E.C., & Fitkin, S. (2011) U.S. Forest Service, British Columbia Ministry of Environment, and Washington Department of Fish and Wildlife http://wolverinefoundation.org/wp-content/uploads/2011/02/ncws_2011annual_rept.pdf

Results: *Trapping*—In Washington, we operated 2 traps during the pilot study (winter 2005/06), 4 traps during year 1 (winter 2006/07), 5 traps during year 2 (winter 2007/08), 11 traps during year 3 (winter 2008/09), 10 traps during year 4 (winter 2009/10), and 12 traps during year 5 (winter 2010/11) for a total of 2,694 trap nights. The number of trap nights

for several of the traps was lower in year 5 (winter 2010/11) due to several periods of high to extreme avalanche danger (Table 2). We had to close the Hart's Pass and Rattlesnake traps on 3 occasions due to forecasted avalanche danger, and the Easy Pass trap was only in operation for 4 days due to avalanche activity that made the site inaccessible. To date in Washington, we have captured and radio-collared 8 different wolverines on 14 occasions during 6 winter field seasons (Table 2). Non-target species captured included Canada lynx, marten, and bobcat.

In British Columbia during the winter of 2008/09 (year 3), we operated most of the 10 livetraps for 17-20 nights between 13 January and 26 March. The only exception was the Sunshine Valley trap, which we closed after 4 nights due to high levels of human activity in the vicinity (we moved this trap to a better location in year 4). We did not capture any wolverines in British Columbia during year 3; incidental captures included marten and cougar. During the winter of 2009/10 (year 4), we operated 12 livetraps from 7 January to March 22 for a total of 472 trapnights. We captured 2 adult wolverines: Rocky on February 26 and Melanie, on March 22. Non-target species captured included Canada lynx and marten. During the winter of 2010/11 (year 5), we operated livetraps for varying number of days from 12 January to 5 April, but we did not capture any wolverines. Incidental captures included Canada lynx and marten.

Camera Stations—in year 4 (2009/10) in Washington, we obtained photographs of 3 individual wolverines on 9 occasions (Table 5). We obtained photographs of Rocky at the Bridge Creek station on February 21, 2010 and at the Slate Creek station on March 7 and 8, 2010. We obtained photographs of Xena at the Easy Pass station on February 15, March 18, 23, 24, and 31, and April 10, 2010 (Appendix, Photo 5). We obtained photographs of a wolverine new to this study at the Easy Pass station on March 23, 24, and 31. On March 23 there was a 29-minute separation between the photographs of the new wolverine and the photographs of Xena. On March 24 the separation between the 2 was 53 minutes and on March 31 it was about 185 minutes. It seems likely that these 2 wolverines were travelling together on those days. Subsequently, the new individual was live-captured in 2011 and named "Mallory". During year 5 (winter 2010/11) we obtained photographs of Rocky at the Bridge Creek station on March 31, 2011, at the Easy Pass trap on March 28, April 7, April 27, and May 3, 2011, and at the Hart's Pass trap on May 1, 2011. We obtained photographs of Mallory at the Easy Pass trap on April 27, 2011 (Appendix, Photo 9), and we obtained 1 photograph of Mattie at the Bridge Creek station on April 30, 2011. We obtained photographs of an unmarked wolverine at the Twisp Pass trap on May 8, 2011 (Appendix, Photo 10). Non-target species photographed included marten, lynx, black bear, coyote, mule deer, red squirrel, Stellar's jays, Clark's nutcrackers, and gray jays.

In British Columbia, we operated 9 run-pole camera stations during year 4 (2009/10) and detected Melanie on multiple days in February, March, and April 2010 at both the Memaloose and Cambie camera stations. We also detected Rocky on multiple days in February and April at these same 2 camera stations (Appendix, Photo 3). Camera detections of non-target species included marten, ermine, grizzly bear, black bear, cougar, bobcat, and spotted skunk. We did not detect any wolverines at run-pole camera stations in British Columbia during year 5 (2010/11); non-target species included black bear, Canada lynx, cougar, marten, deer, and moose.

Backcountry Snow-tracking Routes—In year 4 (winter 2009/10), we established 2 backcountry snowtracking routes in Washington to backtrack wolverines to obtain DNA samples (scat or hair; Ulizio et al. 2006) in areas that were too remote for trapping. We made a 3-day scouting trip into the Spanish Camp area of the Pasayten Wilderness from February 10-12. During this trip we followed 1 putative wolverine track and collected 2 scat samples, but the quality of the DNA from these samples was not sufficient to determine species. We completed a second trip into the Spanish Camp area from February 18-22 during which we followed 1 putative wolverine track for a short distance, but collected no samples. Finally, we completed a 4-day trip in the Sawtooth area from March 18-21, but we found no putative wolverine tracks and collected no samples. No back-country snow-tracking routes were attempted in year 5 (winter 2010/11).

4. **Distribution and Ecology of Wolverines in the North Cascades: Pilot Project – Year 2 Year-End Status Report.** Aubry, K., Raley, C., & Roher, J., (2007) U.S. Forest Service, Methow Valley Ranger District, Okanogan-Wenatchee National Forests.

Abstract: During the winter of 2006/07, we operated 4 log cabin-style livetraps for wolverines in the northwestern portion of the Methow Valley Ranger District in the Cascade Range of north-central Washington. We opened traps for varying time periods from January 9 to March 30, for a total of 180 trap-nights. We captured 3 different wolverines on 5 occasions, 2 of them twice and 1 once. We trapped one a third time, but he escaped. We fitted all 3 wolverines with radio-collars containing both satellite (Argos) and VHF transmitters. A young female (Xena) used an area about 760 mi2, based on 120 high-quality satellite locations (Argos location classes 1–3). A young male (Chewbacca) used an area of about 730

mi2, based on 80 high-quality locations. Xena and Chewbacca's activity areas overlapped by about 90%. We recaptured Melanie this year, a young female we originally captured in February 2006. As of last year, she had not bred, but she was pregnant this year. Based on 130 high-quality locations, she used an area of approximately 560 mi2. Due to logistical constraints and problems encountered during aerial telemetry, we were unable to locate her natal den, or even verify that she had successfully reproduced. A preliminary analysis of elevational use by our 3 study animals indicated that elevations <4,400 ft were used less than expected, elevations 5,901–7,000 ft more than expected, and other elevation zones (4,401–5,900 ft and >7,400) at levels comparable to availability, suggesting a preference for relatively high-elevation habitats near treeline. In April 2007, we obtained a remote-camera photograph of Thor, a young male we originally captured in April 2006, near the Hart's Pass trap. We suspect these 4 animals represent 2 mated pairs, because there was almost complete overlap of Chewbacca and Xena's activity areas and, although location data on Thor were limited, Melanie's activity area this winter completely encompassed Thor's activity area from last winter. Future research will involve the continuation of trapping and telemetry efforts, including the construction of 2 additional live-traps along the southern boundary of the Pasayten Wilderness, and field trials using GPS radio-collars in an effort to improve our ability to locate the natal and maternal dens of reproductive females.

Introduction: The wolverine (Gulo gulo) is one of the rarest mammals in North America, and the least known of large carnivores (Banci 1994). It is considered a sensitive species in the Pacific Northwest Region by the U.S. Forest Service, and a candidate species for listing as threatened or endangered by the state of Washington. The northern Cascade Range in Washington represents the southernmost extent of the current range of wolverines along the Pacific coast of North America (Aubry et al. 2007). Wolverines have never been studied in the field in this region, due partly to their low densities and extremely limited access during all periods of the year into the unroaded wilderness areas where they occur. Recent research on wolverines in the Rocky Mountains of British Columbia (Krebs et al. 2007) and the United States (Copeland 1996, Copeland et al. 2007, Squires et al. 2007) indicates that wolverines are wide-ranging, inhabit remote areas near timberline, and are sensitive to human disturbance at natal and maternal den sites. Winter recreation activities are widespread in the North Cascades and often occur in suitable wolverine denning habitat. Such activities may adversely affect wolverine populations or their preferred habitats.

Results: We captured 2 new wolverines, recaptured the juvenile female from last year, and documented the first known reproductive event for wolverines in Washington state. We captured wolverines 6 times in 180 trapnights for a capture rate of 1 wolverine per 30 trapnights, which is higher than the capture rate reported by Copeland (1996) in Idaho (1 wolverine per 47 trapnights). We were unable to re-capture the sub-adult male from last year, but that was probably due to our inability to maintain the Hart's Pass trap throughout the winter. All 3 of our new-design radio-collars remained on our wolverines throughout the winter, and generated 80-130 high-quality locations for each study animal during a 5-6 month period.

With these data, we were able to delineate activity areas for 3 wolverines, which indicate that Chewbacca and Xena, and probably Thor and Melanie, represent reproductive pairs (Figure 5). Although we do not know the fate of Melanie's offspring, we have documented that reproduction is occurring among Washington wolverines. Furthermore, during the past 2 winters, the activity areas for all 4 of our study animals were located primarily in Washington, demonstrating there is a resident population of wolverines in the state. Clearly, recent verifiable wolverine occurrence records in Washington did not simply represent Canadian wolverines that occasionally wander into Washington; rather, our results provide support for the current range of wolverines described by Aubry et al. (2007). However, the extent and location of the activity areas we delineated suggest that a relatively small number of wolverines may be capable of establishing home ranges within the state. The conservation of wolverines in Washington will depend on reliable knowledge of their distribution, population status, and habitat relations. This knowledge can only be gained by long-term field research; thus, it is essential to continue this research and find ways to expand the scope of our activities beyond the boundaries of our current study area.

Wolverine Monitoring for the Juneau Access Improvement Project – Berners Bay, Alaska

1. **Wolverine Monitoring for the Juneau Access Improvements Project – Wildlife Research Annual Progress Report.** Lewis, S.B., Flynn, R.W., and Barten, N.L. (2009) Alaska Department of Fish and Game, Division of Wildlife Conservation http://wolverinefoundation.org/wp-content/uploads/2011/02/BBAKProgress2009.pdf

Results and Discussion: Trap Placement and Construction: We constructed traps during late January and February 2008. We used a helicopter to sling trap material and built them on site (Fig. 3). We constructed these 8 traps in late January and

February. During 2009, we used the same trap sites and reused most of the existing traps. Any traps not used will either be deconstructed and moved or destroyed on site.

Capture and Handling: *2008.*—From January to April 2008, we captured 4 individual wolverines (2 males and 2 females) 9 times during 701 trap nights resulting in a capture rate of 1.28 captures/100 trap-nights (Tables 1, 2). We had a capture rate for individual wolverines of 0.57 individual captures/100 trap-nights. All wolverines were captured in log or modified log box traps; no animals were captured in the portable plastic traps. All captures took place away from the beach edge of Berners Bay (Fig. 3). We anesthetized wolverines each time they were caught in our traps, and we collared each wolverine upon initial capture. Upon recapture, we downloaded GPS data from the collars for wolverines that retained them (M1 twice, F1 once) and deployed a new collar on wolverines that had dropped their original collar (F1 and F2; Table 2). Male wolverines weighted 14 – 15 kg and females weighted 8 – 9 kg.

Wolverines escaped from traps 2 times because of a malfunction in the bait attachment. A modified carbineer was used to connect the trigger wire to the wire surrounding the bait. In both cases, the animal was able to free the bait from this carbineer without triggering the trap and escape with the bait. After this occurred, all carabineers were removed and replaced with a locking connector that could not be unlatched by an animal. Non-target species captured included several martens and a domestic dog (*Canis familiaris*) in 2008 (Table 1). In addition, brown and black bears tripped traps, but did not get caught or were able to escape (identified by tracks at site). Two traps were partially destroyed by bears on the last day of trapping.

2009.—From January to February 2009, we captured 7 individual wolverines (5 males and 2 females) 8 times during 237 trap nights resulting in a capture rate of 2.28 captures/100 trap-nights (Tables 1, 3). We had a capture rate for individual wolverines of 2.95 individual captures/100 trap-nights. All wolverines were captured in log or modified log box traps. All captures took place away from the beach edge of Berners Bay (Fig. 3).

We anesthetized and collared each wolverine upon initial capture. One recaptured wolverine was not anesthetized on its second capture because it was only 1 week after the collar was deployed. This animal was released immediately after identifying it. Male wolverines weighted 13 – 14 kg and females weighted 10 – 11 kg. During 2009, non-target species captured included marten and a red fox (*Vulpes vulpes*; Table 1).

Monitoring: *2008* — Wolverine M1 was collared originally on 3/21/2008. He was recaptured on 3/29/2008 and retained his collar. We downloaded his collar at that time. He was recaptured a third time on 4/22/2008. He still had his collar, and we downloaded it and replaced the battery. M1's collar did not release on 10/7/2008 as scheduled. We were able to subsequently recapture this animal in 2009 to remove this collar.

Wolverine F1 was captured and collared on 4/15/2008. She was captured again on 4/20/2008 and we downloaded her collar. On 4/29/2008, F1 was captured a third time, but had lost her original collar and was given a new collar. On 4/30/2008, F1 dropped her second collar. On 5/3/2008, we attempted to collect both of F1's dropped collars. We found her second collar in a small cave formed by snow drifting over a large rock on a steep slope (Fig. 4). There were signs of porcupine roosting in the cave. The collar was found wedged between the rock and snow (Figure 4). We located F1's first collar in a band of cliffs but determined that it was in a deep cleft in the cliffs and was unreachable. F1's status at this time is unknown.

Wolverine F2 was first captured and collared on 4/18/2008 (Table 2). She was recaptured on 4/28/08 without that collar and was given a new collar at that time. She was last located on 6/25/2008, but has not been heard since that flight. Her first collar was located on 6/25/2008, but was not recovered before winter snows made it inaccessible. Subsequently this collar stopped transmitting a VHF beacon and therefore, we were unable to recover it. Her second collar was retrieved and downloaded on 9/11/2008. F2's status at this time is unknown.

Wolverine M2 was captured and collared on 4/22/2008 (Table 2). He has not been located since his capture despite several attempts to listen for his collar throughout the bay. At this time, we presume that either this animal dispersed from the study area or that the collar failed.

2009 — We recaptured wolverine M1 on 2/22/2009. We had documented him on 2 occasions near one trap using a remotely triggered camera. He still was wearing his collar from 2008 which we removed. We collared him with a new

GPS collar upon recapture. He has been located several times, but his collar did not release. It appears that the collar is no longer transmitting a VHF signal and is lost.
We captured M3 on 1/27/2009 and collared him with a remotely-downloadable collar. We subsequently recaptured him on 2/8/2009, but released him without anesthetizing him. We have remotely downloaded his collar on several occasions and have most of the GPS locations from it. His collar did not release on the scheduled date, and we will need to recapture him to retrieve it.

We captured M4 on 2/11/2009 and collared him with a remotely-downloadable collar. We remotely downloaded his collar twice and have data up to 4/26/2009. Since that time, we have failed to locate his collar causing us to fear he dispersed or that his collar failed.

We captured M5 on 2/18/2009 and collared him with a remotely-downloadable collar. He slipped his collar on 3/22/2009. We recovered it on 9/29/2009 in an avalanche chute in the upper East Fork of Lace River (Fig. 5).

We captured M6 on 2/22/2009 and collared him with a store-on-board GPS collar. He was subsequently located on several occasions from the air, but he has not been located since before his collar was scheduled to release. He has either dispersed from the area or the collar has failed.

We captured wolverine F3 on 2/11/2009 and collared her with a store-on-board GPS collar. She was located from the air on several occasions, but has not been located since before her collar was scheduled to release. She has either dispersed from the area or the collar has failed.

We captured wolverine F4 on 2/14/2009 and collared her with a store-on-board GPS collar. She was located from the air on several occasions, but has not been located since before her collar was scheduled to release. She has either dispersed from the area or the collar has failed.

GPS Location Data: We downloaded collars 3 times from captured animals (M1 and F1; Table 2). We have recovered and downloaded 2 collars that animals dropped prematurely (F1 and F2; Table 2). Four collars remain in the field; 2 still on animals (M1 and M2), 1 yet to be retrieved (F2's first) and 1 that is irretrievable (F1's first).

We experimented with different fix schedules and search times in an attempt to maximize the time over which the collar would collect locations while minimizing the length of time between fixes (i.e., the fix rate). The initial schedule on M1 yielded a 12% fix success (20 fixes over 171 attempts; 70 sec max time) over 8 days (3/21 – 3/29). The second schedule on M1 yielded a 19% fix success (105 fixes over 549 attempts; 120 sec max time) over 24 days (3/29 – 4/22). F1's collar yielded a 36% fix success (39 fixes over 108 attempts; 120 sec max time). F1's collar 2nd fix success was 38% (35 fixes over 93 attempts; 120 sec search time). F2's 2nd collar yielded a 31% fix success (88 fixes over 283 attempts; 120 sec search time). Once we retrieve the remaining collars, we will determine which schedule met our needs and will use that for animals collared this coming field season.

Movements: Based on GPS location data from 1 male and 2 female collars, we calculated a 100% minimum convex polygon for each animal (Fig. 5). During 3/21/2008 – 5/2/2008, M1's home range area was 263 km2. During this time, he made repeated circuits of his home range, regularly covering the approximately 26 km length of this area in a day or two and crossing the approximately 1500 m ridge that runs the length of this area on several occasions (Fig. 5). Many of his locations were in habitat used by wintering mountain goats (White et al. 2007; K. White, pers. comm.). F1's collars were only worn for 8 days, during which she traveled over an area of 42 km2 (Fig. 5). During this time, she stayed in the valley bottoms mostly, never climbing higher than 800 m. During 4/28/2008 – 5/10/2008, F2's home range area was 65 km2. She spent most time on the mountain range between the Berners and Lace Rivers, with 1 foray across the Berners River valley to investigate a mountain goat carcass (collared mountain goat that died over the winter, K. White, pers. comm.). During the 2 weeks she wore her collar, she covered this area 3 times, including crossing the 1100 m ridge on several occasions.

Food Habits: We collected hair and blood sample from 4 wolverine live-captured during this study. In addition, we collected 6 samples from wolverines lethally trapped in the Berners Bay area. We will collect samples from all captured and trapped wolverines from Berners Bay this winter and send those in for stable isotope analysis to examine their diet.

2. **Wolverine Population Ecology in Berners Bay, Alaska – Wildlife Research Annual Progress Report.** Lewis, S.B., Flynn, R.W., and Barten, N.L. (2008) Alaska Department of Fish and Game, Division of Wildlife Conservation http://wolverinefoundation.org/wp-content/uploads/2011/02/BBAKProgress2008.pdf

Results and Discussion: *Trap Placement and Construction:* We began trap construction in January. We built 1 prototype trap near the end of the existing road system. Later in January, parts for 8 traps were slung to preselected sites around Berners Bay (Figure 3). We constructed these 8 traps in late January and February. We slung and built 2 additional traps in April and experimented with 2 portable, plastic traps in late March (Table 1).

Based on last year's trap results, we plan to reuse most of the existing traps. Any traps we do not use will either be deconstructed and moved or destroyed on site.

Capture and Handling: From January to April 2008, we captured 4 individual wolverines (2 males and 2 females) 9 times during 701 trap nights resulting in a capture rate of 1.28 captures/100 trap-nights (Tables 1, 2). We had a capture rate for individual wolverines of 0.57 individual captures/100 trap-nights. All wolverines were captured in log or modified log box traps; no animals were captured in the portable plastic traps. All captures took place away from the beach edge of Berners Bay (Figure 3).

We anesthetized wolverines each time they were caught in our traps. We collared each wolverine upon initial capture. Upon recapture, we downloaded GPS collars for wolverines that retained them (M1 twice, F1 once) and deployed a new collar on wolverines that had dropped their original collar (F1 and F2; Table 2). Male wolverines weighted 14 – 15 kg and females weighted 8 – 9 kg.

Wolverines escaped from traps 2 times because of a malfunction in the bait attachment. A modified carbineer was used to connect the trigger wire to the wire surrounding the bait. In both cases, the animal was able to free the bait from this carbineer without triggering the trap and escape with the bait. After this occurred, all carabineers were removed and replaced with a locking connector that could not be unlatched by an animal.

Non-target species captured included American marten (*Martes americana*) and a domestic dog (*Canis familiaris*; Table 1). In addition, brown and black bears tripped traps but did not get caught or were able to escape (identified by tracks at site). Two traps were partially destroyed by bears on the last day of trapping; the traps will be reconstructed for reuse.

Monitoring: Wolverine M1 was collared originally on 3/21/2008. He was recaptured on 3/29/2008 and retained his collar. We downloaded his collar at that time. He was recaptured a third time on 4/22/08. He still had his collar and we downloaded it and replaced the battery. On 6/25/2008 his collar was located from the air in 'recovery' mode, implying that it had been dropped and that the GPS battery was dead. However, upon attempting to retrieve this collar we learned that he was still wearing it. It is set to come off on 10/7/08 and will be located and retrieved after that.

Wolverine F1 was captured and collared on 4/15/2008. She was captured again on 4/20/2008 and her collar was downloaded. On 4/29/2008, F1 was captured a third time but had lost her original collar and was given a new collar. On 4/30/2008, F1 dropped her second collar. On 5/3/2008, we attempted to collect both of F1's dropped collars. We found her second collar in a small cave formed by snow drifting over a large rock on a steep slope (Figure 4). There were signs of porcupine roosting in the cave. The collar was found wedged between the rock and snow (Figure 4). We located F1's first collar in a band of cliffs but determined that it was in a deep cleft in the cliffs and was unreachable at the time. F1's status at this time is unknown.

Wolverine F2 was first captured and collared on 4/18/2008 (Table 2). She was recaptured on 4/28/08 without that collar and was given a new collar at that time. She was last located on 6/25/2008 but has not been heard since that flight. Her first collar was located on 6/25/2008 but had not been recovered to date because of its remote location and difficult weather. Her second collar was retrieved and downloaded on 9/11/2008. F2's status at this time is unknown.

Wolverine M2 was captured and collared on 4/22/2008 (Table 2). He has not been located since his capture despite several attempts to listen for his collar throughout the bay. We will continue to search for him and will conduct a thorough aerial search once his collar releases on 10/7/2008.

GPS Location Data: We downloaded collars 3 times from captured animals (M1 and F1; Table 2). We have recovered and downloaded 2 collars that animals dropped prematurely (F1 and F2; Table 2). Four collars remain in the field; 2 still on animals (M1 and M2), 1 yet to be retrieved (F2's first) and 1 that is irretrievable (F1's first).

We programmed collars with different fix rates to attempt to optimize the number of points acquired while maximizing battery life. The initial schedule on M1 yielded a 12% fix rate (20 fixes over 171 attempts; 70 sec max time) over 8 days (3/21 – 3/29). The second schedule on M1 yielded a 19% fix rate (105 fixes over 549 attempts; 120 sec max time) over 24 days (3/29 – 4/22). F1's collar yielded a 36% fix rate (39 fixes over 108 attempts; 120 sec max time). F1's collar 2nd fix rate was 38% (35 fixes over 93 attempts; 120 sec search time). F2's 2nd collar yielded a 31% fix rate (88 fixes over 283 attempts; 120 sec search time). Once we retrieve the remaining collars, we will determine which fix rate met our needs and will use that for animals collared his coming field season.

Movement: Based on GPS location data from 1 male and 2 female collars, we calculated a 100% minimum convex polygon for each animal (Figure 5).

During 3/21/2008 – 5/2/2008, M1's home range area was 263 km2. During this time, he made repeated circuits of his home range, regularly covering the approximately 26 km length of this area in a day or two and crossing the approximately 1500 m ridge that runs the length of this area on several occasions (Figure 5). Many of his locations were in habitat used by wintering mountain goats during winter (White et al. 2007; K. White, pers. comm.).

F1's collars were only worn for 8 days, during which she traveled over an area of 42 km2 (Figure 5). During this time, she stayed in the valley bottoms mostly, never climbing higher than 800 m.

During 4/28/2008 – 5/10/2008, F2's home range area was 65 km2. She spent most time on the mountain range between the Berners and Lace Rivers, with 1 foray across the Berners River valley to investigate a mountain goat carcass (collared mountain goat that died over the winter, K. White, pers. comm.). During the 2 weeks she wore her collar, she covered this area 3 times, including crossing the 1100 m ridge on several occasions.

Food Habits: We collected hair and blood sample from 4 wolverine live-captured during this study. In addition, we collected 6 samples from wolverines lethally trapped in the Berners Bay area. We will collect samples from all captured and trapped wolverines from Berners Bay this winter and send those in for stable isotope analysis examine their diet.

3. **Wolverine Population Ecology in Berners Bay, Alaska – Wildlife Research Study Plan.** Lewis, S.B., Flynn, R.W., and Barten, N.L. (2007) Alaska Department of Fish and Game, Division of Wildlife Conservation http://wolverinefoundation.org/wp-content/uploads/2011/02/BBAKStudyPlan.pdf

Introduction: This report provides a summary of planned activities for the field season from December 2007 to June 2008.

Background: The wolverine (*Gulo gulo*) is one of the rarest and least-known carnivores in North America (Banci 1994, Ruggiero et al. 2007). Wolverines occur at low densities and tend to be found in areas removed from human influence (Banci 1994, Aubry et al. 2007). Because of this, relatively little was known about wolverine ecology until recently (Banci 1994, Squires et al. 2007). Research has shown that wolverines are susceptible to human disturbance (Krebs et al. 2007), that suitable denning habitat is a critical habitat component for wolverine population persistence (Magoun and Copeland 1998), and that harvest is an additive mortality that can significantly affect population demographics and cause local extirpation of wolverine populations (Hornocker and Hash 1981, Krebs et al. 2004, Squires et al. 2007).

Wolverines are managed as a commercial furbearer in Alaska for which trapping and hunting is allowed. Based on sealing records from southeast Alaska, 19 wolverines (on average) were harvested in Units 1 – 4 over the last 12 years; 42% of these were taken from Units 1C and 1D in northern southeast Alaska. Over that time, 0-4 wolverines were harvested in the Berners Bay area annually. Although sealing provides managers with some useful information on each animal sealed (e.g., sex and general location of harvest) and general trend of harvest, it provides no information about the wolverine ecology or insight about current or future population levels.

In southeast Alaska, access during the winter trapping season is logistically challenging because of limited road access to wolverine habitats. Near Juneau Alaska, the Alaska Department of Transportation and Public Facilities (DOT) is planning to construct an all-season highway that will extend the existing highway from Juneau approximately 50 miles northwest.

This road will pass through habitats occupied by wolverines and provide significantly increased access to these areas. Increased access to wolverine habitats, provided by this road, will significantly change human access to wolverines, and likely increase exploitation rates. In addition, this road could provide snow machine access to habitats used by female wolverines for denning and kit rearing (Magoun and Copeland 1998), potentially resulting in conflicts between female wolverines at their dens and recreational snow machine riders.

Knowledge of wolverine ecology and population dynamics is limited and field studies are needed to fill critical information gaps (Ruggiero et al. 2007). This is especially true in coastal areas like southeast Alaska (Magoun et al. 2007). Information on basic ecology, including home-range size and habitat use, movements and dispersal characteristics, and diet are needed to determine factors affecting wolverine abundance and ultimately to ensure sustainable populations (Krebs et al. 2004, Lafroth and Ott 2007). By learning the role and relative importance of these factors, we will be able to appropriately manage this species in a responsible manner per the Alaska Department of Fish and Game, Division of Wildlife Conservation's mission to "Conserve and enhance Alaska's wildlife and habitats and provide for a wide range of public uses and benefits".

Objectives: This research is designed to investigate the ecology of wolverines in the Berners Bay area of northern southeast Alaska. The specific objectives are as follows:

1) Determine spatial-use patterns (i.e., home range, movements) and habitat selection of wolverines in the Juneau Access study area;
2) Derive a wolverine population estimate for the Juneau Access study area, and;
3) Investigate wolverine food habits in the Juneau Access study area.

Wolverine Survey: Wallowa-Whitman National Forest, NE Oregon

1. **Wallowa Wolverine Project: 2011-2012 Progress Report** (2012) Wallowa-Whitman National Forest http://wolverinefoundation.org/wp-content/uploads/2012/05/WWWS2012AprilUpdate.pdf

Summary: Field work began on 26 September 2011 and by the end of April 2012, we had established 26 camera stations in and adjacent to the Eagle Cap Wilderness in the Wallowa-Whitman National Forest (Table 1). Access to camera sites was on foot, horse, snowmobile, ATV, skis, and snowshoes. The 6 camera stations that had wolverine visits in late winter 2011 were reestablished this season. Ten of the stations were below 6000' elevation (4784'-5820'). The remaining stations were located between 6014' and 7373' elevation. Additional stations may be added in May or June, depending on travel conditions in the mountains. One station was removed (WCAM1) because of its proximity to where the wolverine Stormy was trapped in December to prevent habituation of the wolverine to this site.

Of the 26 established camera stations, 24 (92%) have been checked at least once (total=57 checks) and at these stations, there were 2,680 active camera days. One wolverine (Stormy; Fig.1-3) has been photographed at 7 stations, including 4 stations where he was photographed in 2011. No other wolverines have been photographed to date. Eighteen other species have been detected at the camera stations (Table 2). Marten have been detected at 21 of the 24 (88%) stations that have been checked so far, and marten hair was collected at many of these stations and submitted for DNA analysis.

We flew tracking flights on 6 days (Fig. 4), most in April, and have located wolverine tracks, or probable wolverine tracks, in 3 areas. Snow conditions and weather made aerial tracking problematic this season. Few calm clear days occurred before April and unseasonably warm weather in April caused rapid melting out of tracks even at high elevations.

Camera stations will be run through May and into June for stations at the higher elevations. If funding is available, we plan to run camera stations at high elevations near snowfields that last into late summer, especially in areas of the Eagle Cap Wilderness that were inaccessible during the winter. Few attempts have been made to use camera "traps" during summer to detect wolverines. We will test the effectiveness of summer camera trapping by deploying cameras within the area used by wolverine detected this winter.

2. **Monitoring Wolverines in Northeast Oregon – 2011 Final Report.** Magoun, A.J., Valkenburg, P., Long, C.D., and Long, J.K. (2011) The Wolverine Foundation http://wolverinefoundation.org/wp-content/uploads/2011/09/wwwp_final_pe.pdf

Conclusion Excerpts: *Camera Detection of Wolverines in the Wallowa Mountains:* Our cameras identified the first verified records in Oregon in nearly 20 years and the first ever in the Wallowa-Whitman National Forest. Even though female wolverines were not detected, the presence of 2 subadult males suggests that there could be a breeding population of wolverines in the study area. The DNA collected from one of the wolverines indicated that this wolverine is more closely related to individuals in Idaho than to wolverines in Washington. It is possible that this wolverine dispersed from Idaho across the Snake River and was not born in the study area. However, it seems unlikely that 3 wolverines would have dispersed from Idaho, all in late winter 2011 and found camera stations all within a relatively small area of the Eagle Cap Wilderness. It is more likely that there are resident wolverines in the Eagle Cap Wilderness. Another year of camera trapping is needed to determine if female wolverines are resident there.

Whether or not wolverines are resident within the study area, the presence of the wolverines we detected indicates that the Wallowa-Whitman National Forest and the Hells Canyon National Recreation Area, between the Eagle Cap Wilderness and the Snake River on the Idaho border, is potential dispersal habitat for wolverines moving from source habitat in Idaho and Montana to areas further west and north of our study area. The male wolverine that was recently detected in northern California could have dispersed from Idaho (Moriarity et al. 2009), possibly through the Wallowa-Whitman National Forest, or may have originated from within the Wallowa-Whitman National Forest. Periodic sightings of wolverines in the study area and in mountains west of the study area in recent years and the occasional verified record of wolverines in Oregon (Hiller 2001) suggest that occurrences of wolverines in Oregon may not represent extreme dispersal events (Aubry et al. 2007; Verts and Carraway 1998). Rather, we suggest that regularly-occurring dispersal events, and possibly even small breeding populations of wolverines, could exist in Oregon but remain undetected or unverified by criteria defined by Aubry et al. (2007). In fact, we suggest that the status of the wolverine in Oregon should receive further attention with additional camera surveys in the Blue Mountains, East Cascades, and West Cascades Ecoregions of Oregon (ODFW 2006) and in some of the more isolated mountainous areas outside these areas where there have been reports of wolverines (Hiller2011).

3. **Wolverine Survey: Wallowa-Whitman National Forest, NE Oregon – Study Plan** Long, C., Magoun, A., and Valkenburg, P. (2010) The Wolverine Foundation http://wolverinefoundation.org/wp-content/uploads/2011/02/wwws.pdf

Summary: A pilot study to survey for wolverines (*Gulo gulo*) in the Wallowa-Whitman National Forest within and adjacent to the Eagle Cap Wilderness using proven non-invasive detection methods for wolverines.
Location of study: The proposed study area is located within and adjacent to the 1,418-km2 Eagle Cap Wilderness (ECW) in the Wallowa-Whitman National Forest (WWNF) of northeastern Oregon, USA (Fig. 1). The ECW is comprised of montane forests at lower elevations and sub-alpine/alpine habitat with glacial cirques, perpetual snow/ice fields, and glaciers at higher elevation. Elevations range from 1,220 m to 3,027 m. No motorized travel is allowed in the ECW and access to the periphery of the ECW is limited to a series of unimproved USFS, county, and state roads.

Background: We believe the ECW and adjacent forest may contain suitable wolverine habitat and comprise an important linkage area between disjunct wolverine habitats in the Pacific Northwest; however, a resident population of wolverines has not been verified in the study area. At higher elevations, temperatures and snow cover are historically consistent with the hypothesized bioclimatic criteria for wolverine presence (Copeland et al. 2010) and, based on discussions with biologists familiar with the area, food resources appear to be adequate to support wolverines. Although 28 wolverine sightings have been reported in the WWNF (USFS Wallowa-Whitman National Forest data base), including 1 in 2008, no sighting or evidence of presence has been verified using criteria outlined by Aubry et al. 2007. Approximately 95 km to the east of the ECW, a resident reproducing wolverine population is present in the Payette National Forest of central Idaho (USFS RMRS 2010; unpublished data). During aerial track surveys in 1998 (Edelmann et al. 1999) and again in 2009 (USFS RMRS; unpublished data), at least 1 set of wolverine tracks was detected in the Seven Devils Mountains of central Idaho, approximately 45 km east of the ECW. Viability of a potential "Seven Devils" wolverine population is unknown. Photographs and/or DNA from wolverines in the WWNF would verify the presence of this species (Aubry et al. 2007) and could provide evidence of a breeding population if lactating females are detected (Magoun, unpublished data), or if specific familial (parent/offspring) relationships from DNA are determined. Even if a resident population of wolverines is not verified during this study, long-term monitoring for wolverines in the WWNF and ECW may be desirable for assessing habitat suitability for wolverines in the WWNF and the role the study area plays in providing dispersal habitat for wolverines in the Northwestern Forested Mountains ecoregion, a Level 1 ecoregion designated by the United States Environmental Protection Agency (http://www.epa.gov/wed/pages/ecoregions.htm). For example; the study area may have served as a dispersal route for a wolverine recently documented in northern California, because mitochondrial DNA

indicated that this wolverine probably originated from along the western edge of the Rocky Mountains and could even have originated from within the Wallowas or Seven Devils Mountains, but DNA samples from wolverines have not been collected from this area (Moriarty et al. 2009). Despite their unknown status in Oregon, the wolverine is listed as "Threatened" by the Oregon Department of Fish and Wildlife (ODFW) and ODFW recognizes the need for monitoring as an essential element of successful implementation of the Oregon Conservation Strategy (ODFW 2006).

Objectives:

A. Use two independent, non-invasive detection methods to investigate the presence of wolverines in the Wallowa-Whitman National Forest within and adjacent to the ECW.
    1) Repeated aerial track surveys (≥3) for the presence of wolverine tracks in treeless portions of the ECW.
    2) Motion detection cameras and associated hair-snag devices to detect wolverines in the forested portions of the study area.
B. Make recommendations regarding future surveys and monitoring for wolverines in the WWNF and ECW.

Other Wolverine Research

1. **Historical Biogeography of the Wolverine in the United States.** McKelvey, K., Aubry, K., & Rivera, P.T. (2002) Proceedings from Defenders of Wildlife Conference on Carnivore Biology and Conservation. p. 64.

Abstract: We compiled current and historical records of wolverine (*Gulo gulo*) occurrence in the contiguous United States from published literature, museums, state wildlife agencies, federal resource management agencies and natural heritage databases. Records obtained were of varying degrees of reliability; they included many museum specimens, photos and first- hand accounts of wolverines being trapped (verified records), but were dominated numerically by visual observations of wolverines or their tracks (unverified records). Resulting biogeographic analyses, including assessments of the current and historical distribution of wolverines in the United States, and correlations between elevation and land-cover types varied substantially in accordance with the reliability of occurrence records included in the analyses. Specifically, the geographic distribution of wolverines based only on verified records is much more disjunct and isolated within high-elevation, boreal habitats than is depicted in published range maps. The distribution of verified records also suggests that wolverines have been absent for many years from California, Colorado and the Great Lakes states. We compare inferences resulting from various data sets and discuss the challenges and conservation implications of determining the current and historical ranges of rare and secretive species that have not been surveyed with reliable methods.