IDAHO WOLVERINE – WINTER RECREATION RESEARCH PROJECT:
INVESTIGATING THE INTERACTIONS BETWEEN WOLVERINES AND WINTER RECREATION

2011-2012 Progress Report

DECEMBER 12, 2012

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WITH THE SUPPORT OF PROJECT PARTNERS AND COLLABORATORS:
Payette National Forest
Boise National Forest
Sawtooth National Forest
Idaho Department of Fish and Game
University of Montana
Idaho State Snowmobile Association
Southwest Idaho Resource Advisory Committee
Southeast Idaho Resource Advisory Committee
Valley County of Idaho
U.S. Fish and Wildlife Service
The Wolverine Foundation
The Wolverine Network
The Sawtooth Society
Central Idaho Recreation Coalition
Brundage Mountain Resort
And the winter recreation community of Idaho

To receive a copy of this report or other project information, contact *idahowolverine@gmail.com* or visit *www.forestcarnivores.org*

ACKNOWLEDGEMENTS

Over the last couple years, the wolverine-winter recreation project has significantly advanced towards meeting its goals and objectives. We are grateful to our multiple partners and collaborators who have assisted the project in numerous ways and provided the opportunities for these successes. We thank both those partners who have been with us from the beginning of the project and those who have joined the project as they learn of it.

We are grateful for the funding and equipment for the project, which has been contributed by the US Forest Service, Southwest Idaho Resource Advisory Committee, Southeast Idaho Resource Advisory Committee, Round River Conservation Studies, U.S. Fish and Wildlife Service, Idaho Department of Fish and Game, Idaho State Snowmobile Association, The Wolverine Foundation, Wolverine Network, Sawtooth Society, Central Idaho Recreation Coalition, Brundage Mountain Resort and the Nez Perce Tribe.

The project would not have been possible without the commitments of the Payette (PNF), Boise (BNF), and Sawtooth (SNF) National Forests, Region 4 of the USFS and the Idaho Department of Fish and Game (IDFG). In particular, we thank Ana Egnew (PNF), Lisa Nutt (BNF), Robin Garwood (SNF) and Diane Evans Mack (IDFG) for tirelessly ensuring the success of the project. We also want to thank Mark Drew, IDFG Veterinarian for all his assistance and time in helping us safely anesthetize wolverines. So many Forest Service and IDFG staff have helped us in so many ways – we thank you all for your assistance and support.

We thank Jeff Copeland (The Wolverine Foundation) for the many ways he assists and advises us. We also thank Mark Hebblewhite (University of Montana) for providing scientific advice and oversight as a member of our science team.

A very large amount of time is completed behind the scenes in the processing, management and organization of numerous large and complex data sets generated or needed by the project. Rick Tingey, Round River Conservation Studies is primarily responsible for much of this effort, and we are exceptionally grateful for his time, skill and diligence and for his assistance in data analyses and interpretation.

The backbone of the research is high quality data collection under sometimes challenging conditions, and we are indebted to our hard-working field crew over the last 2 winters: Blakeley Adkins, Kristina Boyd, Drew Chambers, Llona Ney Clausen, Katie Coyle, Tony Folsom, Gary Gadwa, Jessica Haas, Dylan Hopkins, Brooklyn Hudson, Rollie Jones, Tyler Kaebisch, Chris Klingler, Tulley Mackey, Scott Martin, Madison Mcconnell, Celina Moreno, Katy Nelson, Ben Rooney, Toni Ruth, Kristen Sellmer and Will Tyson. Their commitment, professionalism and good humor have made the project not only successful, but also good fun.

We thank the hundreds of recreationists who agreed to carry funny little orange data loggers while out having fun and who took the time to return them to us. Your contribution provides a critical foundation to the project.

Finally, we thank the wolverines, some who also carried funny, little data loggers for us, and who have taught us so much.

TABLE OF CONTENTS

TABLE OF FIGURES

Table of Tables

PROJECT BACKGROUND

The growing popularity of winter backcountry recreation combined with improved snowmobile technology has resulted in winter recreation expanding across previously undisturbed public lands. Some winter recreationists seek steep, open areas, typically on north-facing slopes and in cirque basins for ideal snow conditions. Public lands provide good opportunities for winter recreationists because of existing roads, some of which are groomed to accommodate winter recreation access. Advances in snowmobile technology provide skilled riders access to nearly any topography and the opportunity and challenge of accessing rugged and remote terrain. Increasingly, backcountry skiers are also using snowmobiles to reach remote areas. In addition, guided access to remote areas for skiing using helicopters (heli-skiing) or tracked vehicle (cat-skiing) is growing in popularity.

Winter recreation is increasing in habitats used by wolverines during winter and reproductive denning and kit rearing seasons. The potential effects of winter recreation on wolverine reproduction, behavior, habitat use and populations are unknown and current management of winter recreation for wolverine persistence has little scientific foundation. Current management is based primarily on anecdotal and conflicting accounts of wolverine response to human-related disturbance. Given the uncertain status of wolverine within the United States and elsewhere, there is concern regarding the effects of winter recreation on wolverine, particularly in areas favored by female wolverine for reproductive denning (Carroll et al. 2001, Rowland et al. 2003, May et al. 2006, Copeland et al. 2007, Krebs et al. 2007).

PROJECT DESCRIPTION

This ongoing research aims to increase our understanding of wolverine responses to winter recreation, particularly relative to habitat use and denning behavior and den site selection. The project was initiated in 2009 with winter aerial surveys over 3 National Forests in central Idaho to identify and map the presence of wolverine as well as motorized and non-motorized winter recreation (Copeland 2009). These surveys identified areas of extensive recreation use within potential wolverine denning habitat, and that wolverine are present in some of these areas of overlap. The field-based research effort began in the winter of 2010, focusing in areas where overlap between wolverines and winter recreation was documented.

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. The specific objectives of the research include:

1) Determine wolverine winter and denning habitat selection;
2) Understand the spatial and temporal patterns of recreation use, including the distribution and intensity of use;
3) Assess the spatial overlap between winter recreation and wolverine potential habitats and habitat use at multiple spatial scales;
4) Assess the spatial and temporal patterns of wolverine movements and activities relative to the distribution and relative intensity of recreation; and
5) Document denning behaviors and locations, particularly in relation to recreation patterns.

Objectives 1 and 2 provide the basic analyses that allow us to address and investigate the primary objectives 3 – 5.

The research effort is led by the Rocky Mountain Research Station and Round River Conservation Studies, in partnership with the Payette, Boise and Sawtooth National Forests; Idaho Department of Fish and Game and the University of Montana. The project has several collaborating organizations including the Idaho State Snowmobile

Association, The Wolverine Foundation, Valley County of Idaho and several others that assist and support the project in numerous ways. Because of the extensive involvement of multiple organizations, the project has established a 'Science Team' (Kim Heinemeyer, Round River Conservation Studies, John Squires, Rocky Mountain Research Station and Mark Hebblewhite, University of Montana) to ensure that the scientific process remain insulated from a diversity of potential organizational biases.

STUDY AREA

The study is located in the Rocky Mountains of Idaho. Within this area, we selected study areas for implementation of the research based on wolverine presence and level of recreation use (Figure 1) and focused efforts within the Payette, Sawtooth and Boise National Forests. The first study area was north and east of McCall, Idaho and was identified as an area particularly popular for snowmobile recreation within areas of known wolverine presence. Additional study areas were established on the Boise National Forest east of Cascade and on the Sawtooth National Forest in the Sawtooth, Smoky, Boulder and White Cloud Mountains. Each study area has been studied for 1-3 years, with work continuing in most study areas through at least the winter of 2013. We will be conducting reconnaissance data collection in other regions to identify additional study areas with high levels of winter recreation overlapping areas of known wolverine presence, including on the Caribou-Targhee National Forest in eastern Idaho.

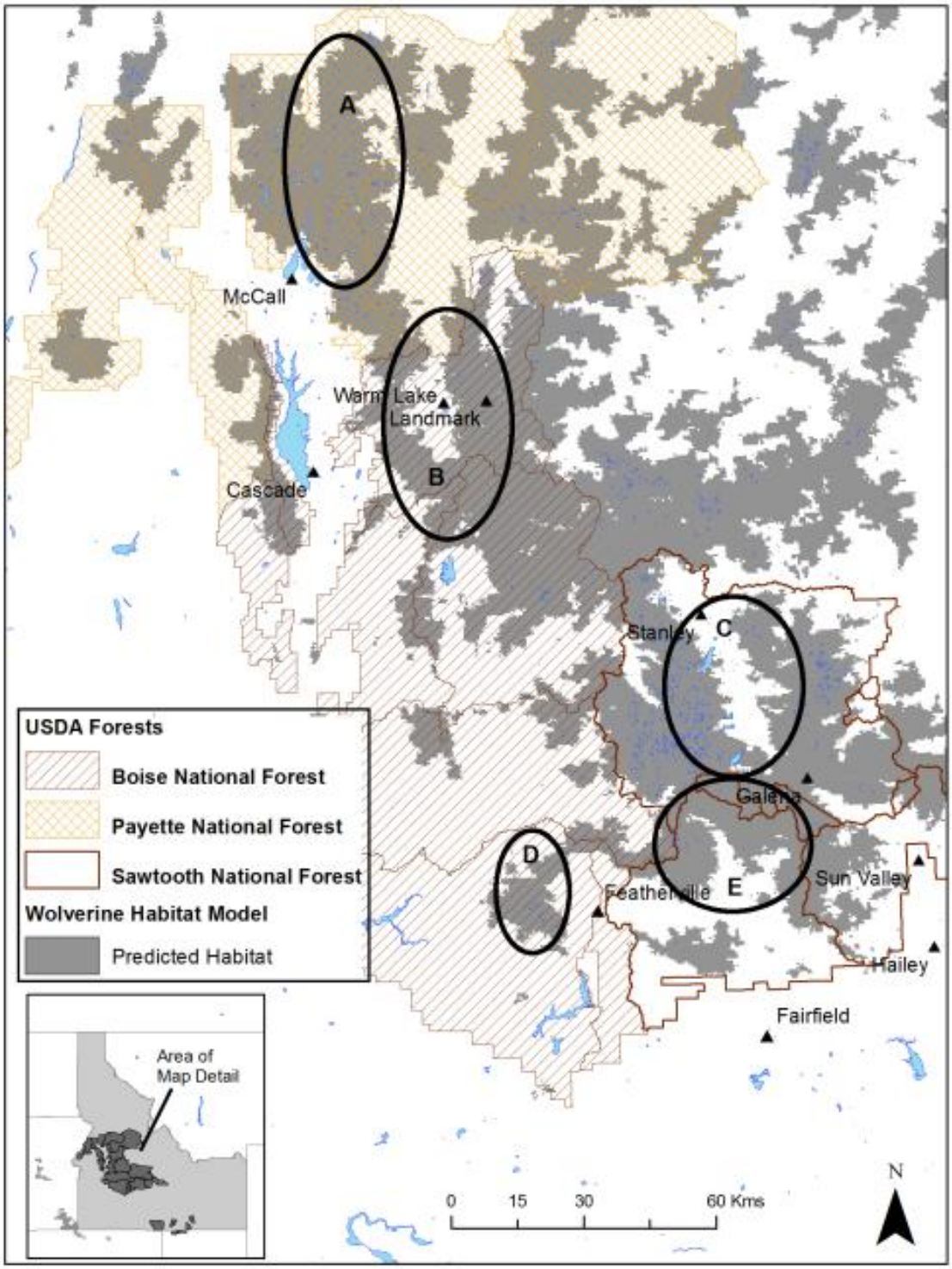

FIGURE 1. IDAHO WOLVERINE-WINTER RECREATION STUDY REGION AND STUDY AREAS: A) PAYETTE NATIONAL FOREST NEAR MCCALL, B) BOISE NATIONAL FOREST NEAR CASCADE (NORTH BNF), C) SAWTOOTH NATIONAL FOREST NEAR STANLEY (NORTH SNF), D) BOISE NATIONAL FOREST NEAR FEATHERVILLE (SOUTH BNF) AND E) SAWTOOTH NATIONAL FOREST NEAR FAIRFIELD (SOUTH SNF).

METHODS AND RESULTS TO DATE

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. This report focuses on presenting information collected during the last 2 winters (2011-2012), and includes 2010 data when helpful; a full reporting of 2010 project information as well as a detailed description of our field methods is available in the 2010 annual report prepared for the project (Heinemeyer et al. 2010).

We have completed 3 winter field seasons, from January 2010 through April 2012. Over the first 2 winters (2010-2011), we implemented both wolverine and recreation monitoring in the Salmon Mountains north and east of McCall, Idaho, referred to as the Payette National Forest (PNF) study area (Figure 1). In 2011, we established a second study area in the southern portion of the Salmon mountains on the Boise National Forest (BNF) near Warm Lake and east of Cascade, Idaho (northern BNF study area). During that second winter, we also completed exploratory field work on the Sawtooth National Forest (SNF) near Stanley, Idaho, which was subsequently selected as the third study area (north SNF study area). During the third winter (2012), we implemented the full wolverine and winter recreation monitoring methods in the northern SNF study area and we continued GPS collar monitoring of key resident animals in the PNF and northern BNF study areas supported by trail use counts and aerial surveys for recreation use. In this third winter, we also implemented exploratory work in the Smoky Mountains north of Fairfield (south SNF study area) and in the Trinity Mountains near Featherville (south BNF study area) as potential new areas for full implementation of the project. This exploratory work included baited camera stations and recreation monitoring.

WOLVERINE MONITORING

The project objectives span multiple spatial and temporal scales and require information on wolverine movements, habitat use and behaviors be collected at fine scales with the ability to generalize this information to also address broader spatial scale questions. At the finest scales, we need to understand wolverine responses to varying intensities of winter recreation activities, including potential changes in wolverine movement characteristics (velocity, tortuousity), space use, foraging and resting patterns and den site selection relative to winter recreation activities.

Trapping and Handling. We used log box-traps (Copeland et al. 1995) that were built on site using dead lodgepole pine to capture wolverines. We operated these live-traps from mid-January to late April or early May of each year, with the number of traps varying through each winter with 7, 16 and 19 traps in 2010, 2011 and 2012 respectively. These traps were distributed across up to 3 different study areas (Table 1). Total trapping effort, number of animals and overall wolverine capture success were variable from year to year, with a high capture success of 11.2 trapnights/wolverine capture in the PNF study area in 2010 to a lower capture success of 29.2 trapnights per wolverine capture in the SNF study area in 2012.

We began using satellite-based trap transmitters (Vectronics Aerospace, TT2 Globalstar Trap Transmitter) in 2011, with VHF trap transmitters serving as a secondary or backup system. All traps were physically visited and maintained every 3 days. The TT2 transmitters sent email and text messages immediately and then every 20 minutes after a trap was triggered. This allowed us to know precisely when an animal was captured and to efficiently deploy teams to check traps that had been triggered. Due to safety considerations, we avoided checking triggered traps after sunset or before sunrise, though we made exceptions to this rule during spring trapping in

areas where there have been lactating females. The amount of time animals typically remained in traps that were monitored more traditionally through physical checks or 1-2 time daily VHF monitoring is unknown, but we believe that the satellite-based trap monitoring almost certainly reduced the amount of time an animal remained in a trap. Using the TT2 trap transmitters, the average time a wolverine has remained within a trap is 11.7 hours (range 0.7 – 25.1 hours). This included animals that were anesthetized for processing as well as those released without processing. Animals that were anesthetized for processing (n= 32) had longer trap times averaging 12.3 hours while those released without processing (n=26) averaged 10.9 hours; occasionally anesthetized animals were held overnight to recover. Much of time was due to travel time to traps, with traps further from our field station or further by snowmobile generally having longer holding times.

Captured wolverines were chemically immobilized and fitted with a GPS collar and colored ear tag. Animal trapping and handling protocols were reviewed and approved under the University of Montana IACUC (University of Montana AUP 061-09) and the Idaho Department of Fish and Game.

The GPS collars (Quantum 4000 Enhanced, Telemetry Solutions, Concord, CA) allowed for advanced programming of data collection schedules and remote download of location data, but were limited in battery life given the small collar size required for wolverine. Thus, our study design provided a balance between obtaining fine-scale location data while maximizing the life of the collar through the winter and denning seasons. Collars were programmed to record GPS locations every 20 minutes for 24-hour periods for 4 days each week. Days were stratified to represent higher use recreation use (Saturday, Sunday) and lower use recreation use (Tuesday, Wednesday) days. During the other days of the week, the collars collected locations every 8 hours.

Wolverine Camera Stations. We operated remote-triggered cameras at bait stations during the winter of 2011 in the northern SNF study area near Stanley, and during the winter of 2012 in the BNF study area near Featherville and the southern SNF study area near Fairfield. Six camera stations were monitored in the northern SNF study area in 2011 from early January through March for an average of 118 days each of monitoring. During this time, we documented 10 wolverine visits on cameras from potentially 3-4 individual wolverines and collected 33 samples of hair. In addition, we had numerous instances of American marten and red fox visiting the sites. Hair samples were sent to the USFS Rocky Mountain Research Station for genetic analyses; no wolverine DNA was successfully extracted from the hair samples. Over the winter of 2012, we established 4 camera stations in the southern BNF study area near Featherville and 3 camera stations in the southern SNF study area near Fairfield. These were established in mid-January and monitored through late March for approximately 80 days of operation. No wolverines were documented within either study area using this method. Numerous instances of American marten and red fox visitations were documented.

Collared Wolverine Monitoring. Over the 3 winter field seasons, we collared 16 wolverines and successfully collected GPS location and activity data on 13 (7 females, 6 males); 2 animals were never recaptured to retrieve data and 1 animal slipped her collar soon after release. We have 2-3 years of data on 7 of these animals, including 4 adult females (Table 2). We have also identified an additional 2 animals: 1 male offspring from F3 from hair collected at her 2010 densite and 1 adult female captured in both 2010 and 2011 too late in the season for collaring. Of the 18 animals we have identified, 14 are classified as adult animals, 3 as subadults and 1 kit.

For animals with sufficient data (>4 weeks of monitoring and >300 locations), minimum convex polygons (MCP) were calculated to estimate winter home range size and extent (Figure 2, Figure 3, Table 2). Typical of

wolverines, the calculated MCPs showed a strong intrasexually exclusive pattern of territoriality but extensive intersexual overlap. Home range sizes tended to be similar to other reported home range size estimates for wolverine.

The intensive GPS monitoring of female wolverines allowed us to document reproductive effort with a high level of certainty. Over the 3 winters, we monitored the equivalent of 10 reproductive seasons across 6 adult females. We documented 6 denning events for 5 females including 2 failed denning efforts (Table 3). We confirmed den locations through summer site visits and DNA collections. Multiple dens (natal and maternal dens) were used by 3 females for a total of 9 dens, adding significantly to the 12 dens previously documented in the continental US. Each den site was visited during the following summer and data were collected on den structure and its associated habitat and hair and scat samples were collected. To date, denning habitat has been associated with complex vertical and horizontal structure provided either by large rock talus slopes or old forests with large diameter woody debris complexes.

TABLE 1. SUMMARY OF TRAPPING EFFORT AND TRAPPING SUCCESS (TRAPNIGHTS/WOLVERINE CAPTURE) FOR 3 WINTERS, 2010-2012 ACROSS 3 STUDY AREAS OF THE IDAHO WOLVERINE-WINTER RECREATION STUDY.

Study Area-Year	No. of Traps	Total Trap Nights	Total Wolverine Captures	Trapping Success	Marten and Fox Captures
Payette NF - 2010	7	416	37	11.2	39
Payette NF - 2011	11	672	38	17.7	80
Payette NF - 2012	7	187	7	26.7	27
Boise NF - 2011	5	229	8	28.6	27
Boise NF - 2012	2	23	1	23.0	4
Sawtooth NF - 2012	10	409	14	29.2	48

TABLE 2. SUMMARY OF WOLVERINES CAPTURED AND MONITORED OVER 3 YEARS (JANUARY 2010-APRIL 2012) ON THE PAYETTE NATIONAL FOREST (PNF), BOISE NATIONAL FOREST (BNF) AND SAWTOOTH NATIONAL FOREST (PNF) AS PART OF THE IDAHO WOLVERINE-WINTER RECREATION STUDY.

Year	Animal	Dates	N	MCP Area (Km^2)	Study Area; Notes
2010	*F1*	Jan 29 - Mar 31	965	380.9	PNF
2010	*F2*	Jan 30 - Mar 21	1050	243.0	PNF
2010	*F3*	Feb 20 - Apr 3	819	278.5	PNF
2010	*M1*	Jan 31 - Mar 10	1023	439.9	PNF
2010	*M2*	Feb 5 - Apr 20	2079	1040.8	PNF
2010	*M3*	Feb 11 - Apr 14	2356	993.5	PNF/BNF
2011	*F1*	-	-	-	PNF; Collar failure
2011	*F2*	Jan 25 - Apr 10	2106	266.4	PNF
2011	*F3*	-	-	-	PNF/BNF; Collar failure
2011	*F4*	Jan 22 - Mar 16	1146	236.2	PNF
2011	*F5*	Jan 30 - Apr 2	1026	481.3	BNF
2011	*M1*	Jan 18 - Mar 17	1505	859.5	PNF
2011	*M2*	Feb 10 - Apr 3	1978	1426.2	PNF
2011	*M3*	Mar 29 - Apr 8	416	785.3	PNF/BNF
2011	*M4*	-	-	-	BNF; Collar not recovered
2011	*M5*	-	-	-	PNF; Collar not recovered
2012	*F1*	Jan 15 - Mar 10	1718	441.6	PNF
2012	*F3*	Feb 2 – Mar 3	1183		PNF
2012	*F5*	Feb 7 – Feb 25	625		BNF
2012	*F7*	Feb 5 - Mar 22	2002	415.5	SNF
2012	*F8*	Feb 8 - Feb 8	3	-	SNF
2012	*F9*	Feb 10 - Apr 26	1828	162.0	SNF
2012	*M1*	Jan 14 - Jan 24	305	246.4	SNF
2012	*M6*	Jan 16 - Mar 11	2859	1119.3	SNF
2012	*M7*	Jan 17 - Feb 7	1084	47.5	SNF
2012	*M8*	Jan 17 - Mar 24	2312	2127.7	SNF

TABLE 3. SUMMARY OF DENNING EFFORT AND SUCCESS DOCUMENTED FOR FEMALE WOLVERINES MONITORED AS PART OF THE IDAHO WOLVERINE-WINTER RECREATION STUDY; ALSO SHOWN IS THE PERCENT OF THE MINIMUM CONVEX POLYGON WINTER HOME RANGE AREA THAT IS OVERLAPPED WITH WINTER RECREATION.

Animal	Year	Reproductive Effort	Recreation Overlap
F1	2010	*Failed Denning Attempt*	46%
F1	2011, 2012	No evidence of denning	Similar to above
F2	2010	**'Successful' Denning**	21%
F2	2011	No evidence of denning	30%
F3	2010	**'Successful' Denning**	4%
F3	2011	No evidence of denning	Similar to above
F5	2011	**'Successful' Denning**	8%
F5	2012	**Probable Denning**	Similar to above
F7	2012	No evidence of denning	6%
F9	2012	*Failed Denning Attempt*	6%

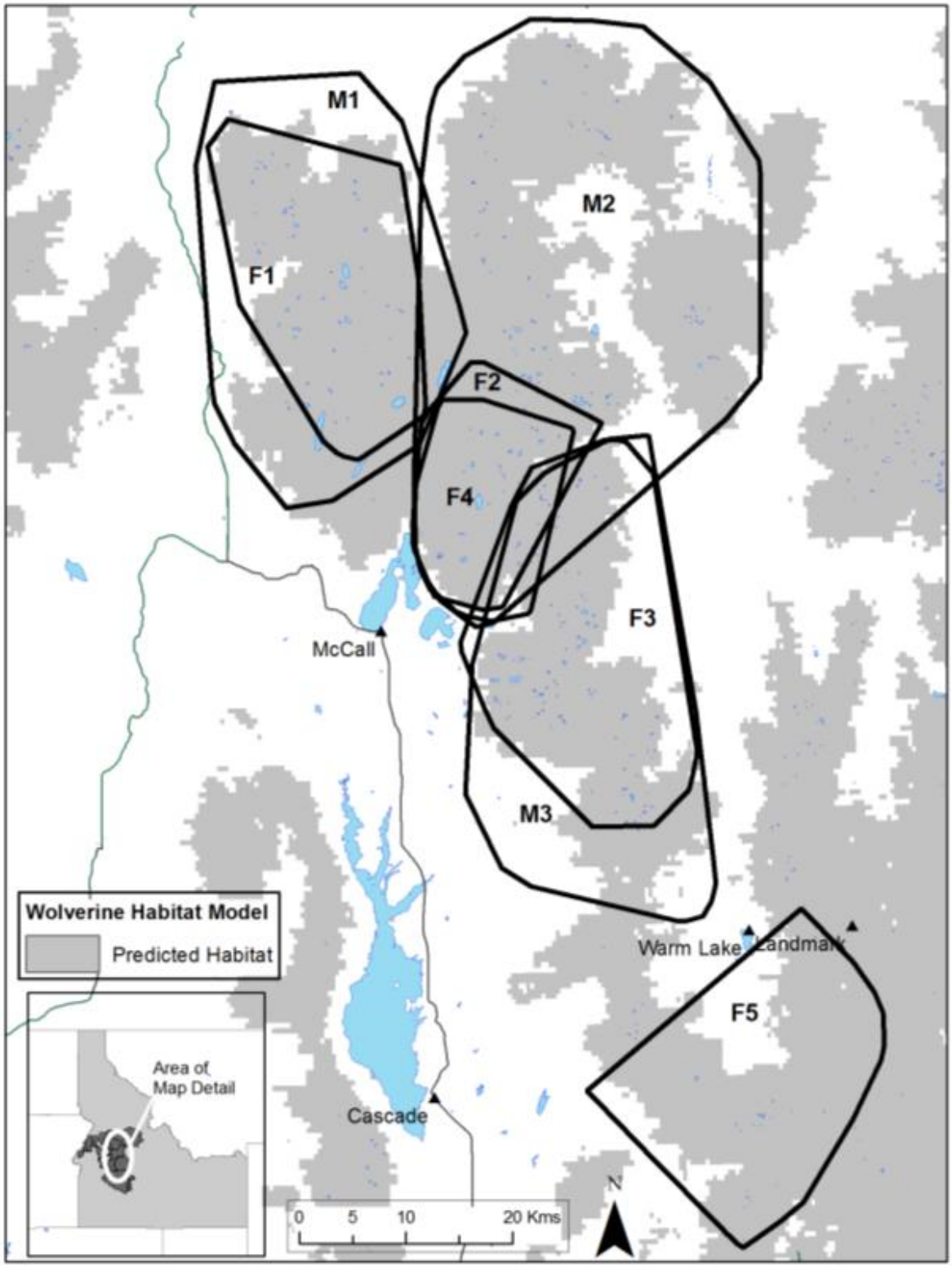

FIGURE 2. MINIMUM CONVEX POLYGON WINTER HOME RANGES FOR WOLVERINES MONITORED IN THE PNF AND NORTHERN BNF STUDY AREAS IN 2011 AND 2012.

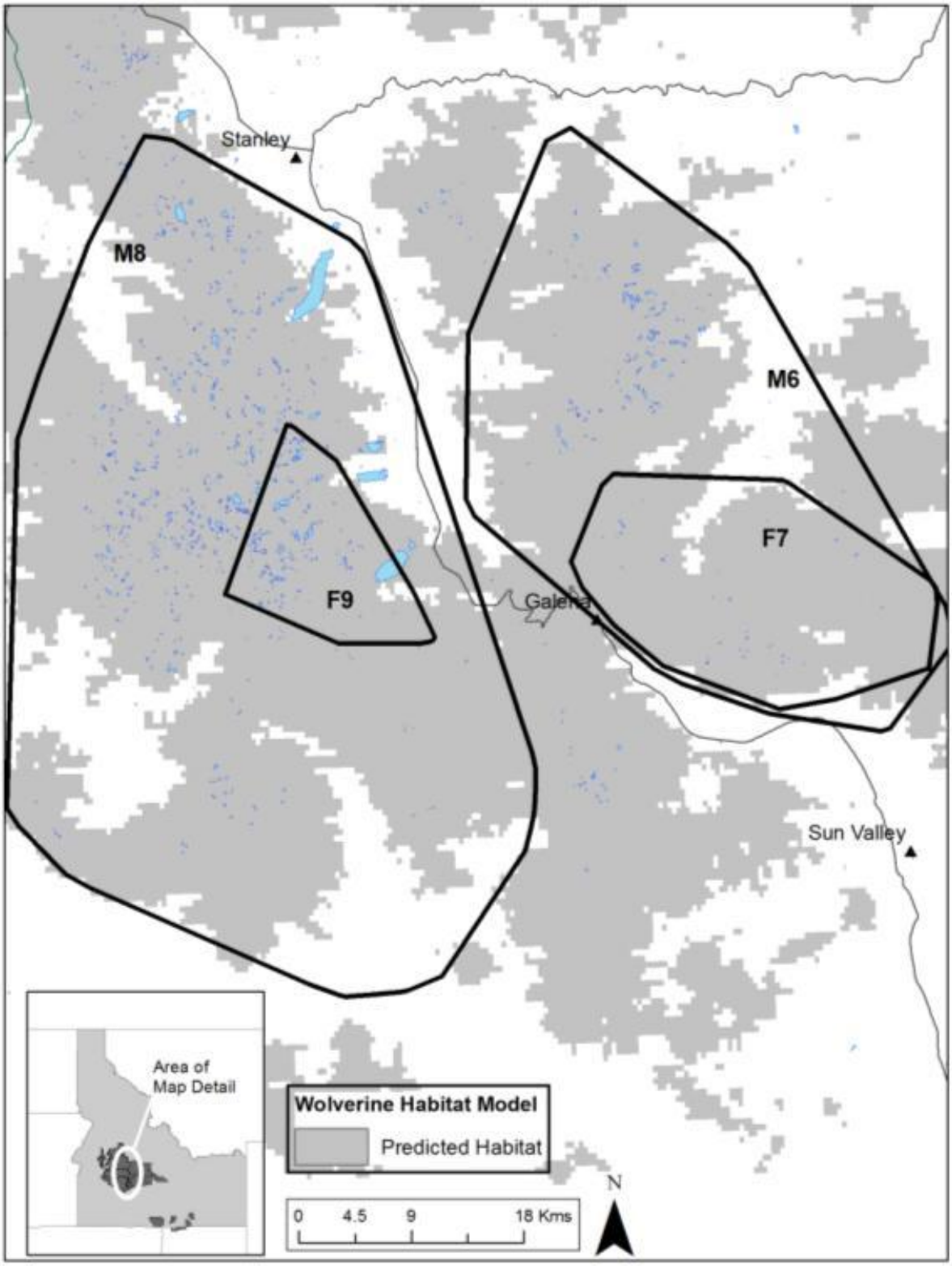

FIGURE 3. MINIMUM CONVEX POLYGON WINTER HOME RANGES FOR WOLVERINES MONITORED IN THE SNF STUDY AREA IN 2012.

RECREATION MONITORING

A critical component of the study is to gather information on the spatial and temporal patterns and intensity of recreational use across the study area. We need to collect fine-scale high quality data on winter recreation to match the high quality of data we are able to collect on wolverines. We have implemented 3 independent methods to collect complementary data on recreation use: GPS monitoring of individual recreationists, aerial recreation surveys and trail use counts.

Recreation GPS Tracking. The highest resolution recreation data were collected by asking recreationists to carry a small GPS unit (Qstarz BT-Q1300s) that provides the date/time-stamped path of their travels in the study area. At primary access areas (e.g., trailheads), we stationed 1-2 technicians to conduct project outreach and seek voluntary participation from recreationists to carry and return a GPS unit. The recreation sampling occurred on the same days as the wolverine GPS collars were programmed to collect wolverine location data (i.e., Saturday, Sunday, Tuesday and Wednesday).

The GPS monitoring of recreationists provided high resolution data and the volunteer approach to the study allowed us to interact with hundreds of winter recreationists each winter. We attempted to collect information from all forms of winter recreation within the wolverine habitats of our study areas. Recreationists included in the monitoring were those using snowmobiles, skis and snowshoes. We also monitored recreationists using guided services for helicopter skiing, cat-skiing and yurt rentals through agreements with the private companies to cooperate with the study. Over the past 3 years, nearly 90% of the recreationists asked to carry a GPS data logger were willing to do so and the return rate of the units was over 80% (Table 4). Each year we collected over 700 recreation tracks from volunteer recreationists. The majority of the recreation within our study region was snowmobile-based and the majority of our tracks were also of snowmobile recreation. Still, we collected recreation tracks from backcountry skiers, including skiers that do not use motorized access and skiers using a diversity of motorized access including snowmobile and guided services (cat-skiers, heli-skiers).

Each year, the data were compiled into a spatial database that provided the analytical framework allowing multiple temporal and spatial scales to be examined. Raw data were a series of points along each track collected attributed with track ID, date, time, recreation type and recreation group size. The point data were subsampled by temporal or spatial definitions (e.g., monthly, by study area, etc.) and transformed into grid-based data of 30 m^2 resolution for analyses. Each grid cell value was the number of recreation track points that fell in the grid cell during a defined temporal period. The grid cell value formed the basic unit for additional analyses.

To provide a spatial representation of relative recreation intensity across our 3 study areas, we combined the 3 years of recreation monitoring data. There were important differences in sampling intensities between years and across study areas and we developed a correction factor based on estimates of total recreation use provided by our trail use counter data (see below). Correction factors were applied to naturally distinct regions across our study areas (e.g., area accessed by a single trailhead) for each year of data and a smoothed recreation value calculated by averaging the cell values of adjacent cells (e.g., average from a 270m^2 area) using a moving window analysis. For areas with multiple years of data (i.e., PNF study area has 2 years of recreation monitoring completed), we took the maximum value for each cell to create a single spatial dataset representing relative recreation intensity across our study areas. For preliminary display and analyses, the resulting data were grouped into 3 classes: "high recreation" areas with median or higher recreation values, "low recreation" areas with recreation values less than the median value and "no recreation" areas where recreation has not been documented through our GPS

monitoring (Figure 4, Figure 5). Over the areas encompassed by our wolverine home ranges, an estimated 14% of the area has been documented to have winter recreation use based on our GPS sampling. The level of recreation use varies dramatically across different wolverine MCP home ranges, ranging from 1-46%.

Aerial Recreation Surveys. Aerial monitoring provided a snapshot picture of recreation use and extent. Aerial monitoring of recreation use was not influenced by the willingness of recreationists to carry GPS units or limitations in our sampling effort– two important considerations of the GPS monitoring of recreationists. Aerial surveys were influenced by a number of different factors including sightability, snow tracking conditions and time since last snowfall. Because the potential biases between the two monitoring approaches were distinct and unrelated, we used aerial surveys as an independent data source to validate the patterns of recreation use estimated by GPS monitoring of recreationists.

While using aerial approaches to map recreation is not new, most methods use a visual evaluation of relative recreation intensity or estimated amount of area disturbed. Standardizing these visual estimates across observers and landscapes is extremely difficult and using visual evaluations reduces the utility of the monitoring. We developed a repeated presence-absence approach to score the relative intensity of recreation use across the study area. Observers recorded whether recreation tracks were present and what types of recreation tracks were present at established sampling intervals. This approach requires no interpretation by the observers of areal extent or intensity and allows more robust comparisons between surveys, observers and landscapes (see detailed description in Heinemeyer et al. 2010).

In 2010, we completed 3 aerial recreation surveys across the PNF study area to develop the methods and test their reliability and utility. In 2011, we completed 1 aerial survey across our PNF and our BNF study areas. In 2012, we repeated 1 aerial survey across the PNF and BNF study areas and completed 2 aerial surveys across our SNF study area. The surveys have shown that the recreation sampling using volunteers to carry GPS units provides a robust approximation of the recreation footprint and relative recreation intensity within our study areas.

Trail Use Counters. Infra-red trail use counters (Trafx Infrared Trail Counters, Trafx, Canmore, Alberta) were placed along established recreation access routes to provide an estimate of the total numbers of recreationists using different access points. We also strategically placed trail use counters along the trail systems (e.g., above trail intersections) to capture coarse-scale data on the spatial distribution and relative intensity of recreation use across different regions of each study area.

The trail use counters not only assisted in validating the GPS tracking but also provided timing and estimated total numbers of recreationists within our study areas and within different portions of the study area. We have collected 3 years of trail use counts within our PNF study area, 2 years of counts for our northern BNF study area near Cascade and our northern SNF study area near Stanley, and 1 year of counts for our southern BNF study area near Featherville and our southern SNF study area near Fairfield (Appendix I). With multiple years of data, we plotted annual recreation count totals by study area to display variation from year to year and across study areas (**Error! Reference source not found.**). Across the study areas, the PNF study area near McCall consistently has the highest recreation counts, with the highest counts in 2010 and the lowest counts in 2012. Two years of data in the northern BNF and SNF study areas showed that trail use counts were higher in 2012 than in 2011 in both study areas while the use on the PNF may have declined. This is consistent with local discussions on the generally poor snow conditions and low recreation use in the Stanley/Ketchum area of SNF in 2011, and suggestions that recreationists tend to rely more upon the McCall area in years of poorer snow. Thus, it is possible that some of the

variation in recreation use across years is driven by snow conditions found within study areas and, more generally, across the northern Rockies.

TABLE 4. SUMMARY OF GPS RECREATION MONITORING EFFORTS AND DATA COLLECTED 2010-2012 ON THE IDAHO WOLVERINE-WINTER RECREATION STUDY.

Study Area - Year	No. Snowmobile Tracks	No. Ski Tracks	No. Guided Ski Tracks	No. Snowshoe Tracks	Total No. Tracks	Total Recreationists Represented	Lost Units	Refusals
Payette NF – 2010	644	46[a]	24[b]	-	714	2398	79 (10%)[c]	88 (10%)[c]
Payette NF – 2011	876	37[a]	29[d]	6	948	3251	314 (25%)	149 (11%)
N. Boise NF - 2011	71	-	-	1	72	228	18 (7%)	16 (6%)
S. Boise NF - 2012	148	1	-	2	151	683	8 (5%)	53 (25%)
Sawtooth NF - 2012	332	350[e]	52[f]	-	734	2549	135 (16%)	83 (9%)
Total	**2071**	**434**	**105**	**9**	**2619**	**9109**	**554 (17%)**	**389 (11%)**

[a]All are skiers using snowmobiles to access ski terrain

bGuided cat-skiing tracks

[c]Documentation incomplete; represents best estimate based on existing information

[d]This represents 25 guided cat-skiing tracks and 14 guided ski tracks using snowmobiles to access ski terrain

[e]Of the 350 skiers, 48 were skiers using snowmobiles to access ski terrain

[f]Guided heli-ski tracks

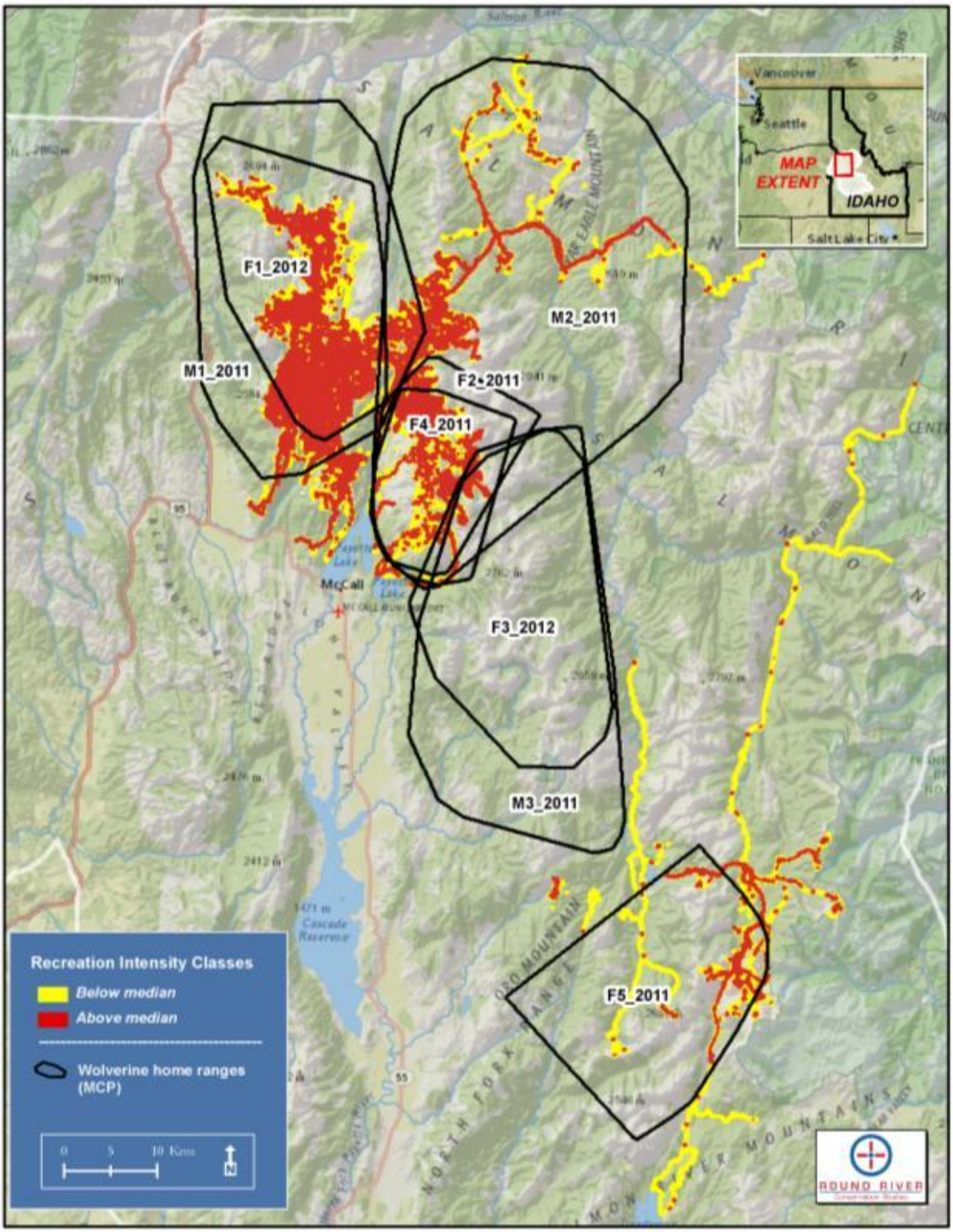

FIGURE 4. RELATIVE RECREATION USE INTENSITY IN THE PNF AND NORTHERN BNF STUDY AREAS BASED ON GPS TRACK MONITORING DATA COLLECTED OVER 3 WINTERS, 2010-2012; ALSO SHOWN ARE WINTER HOME RANGE AREAS OF MONITORED ANIMALS FROM 2011 OR 2012.

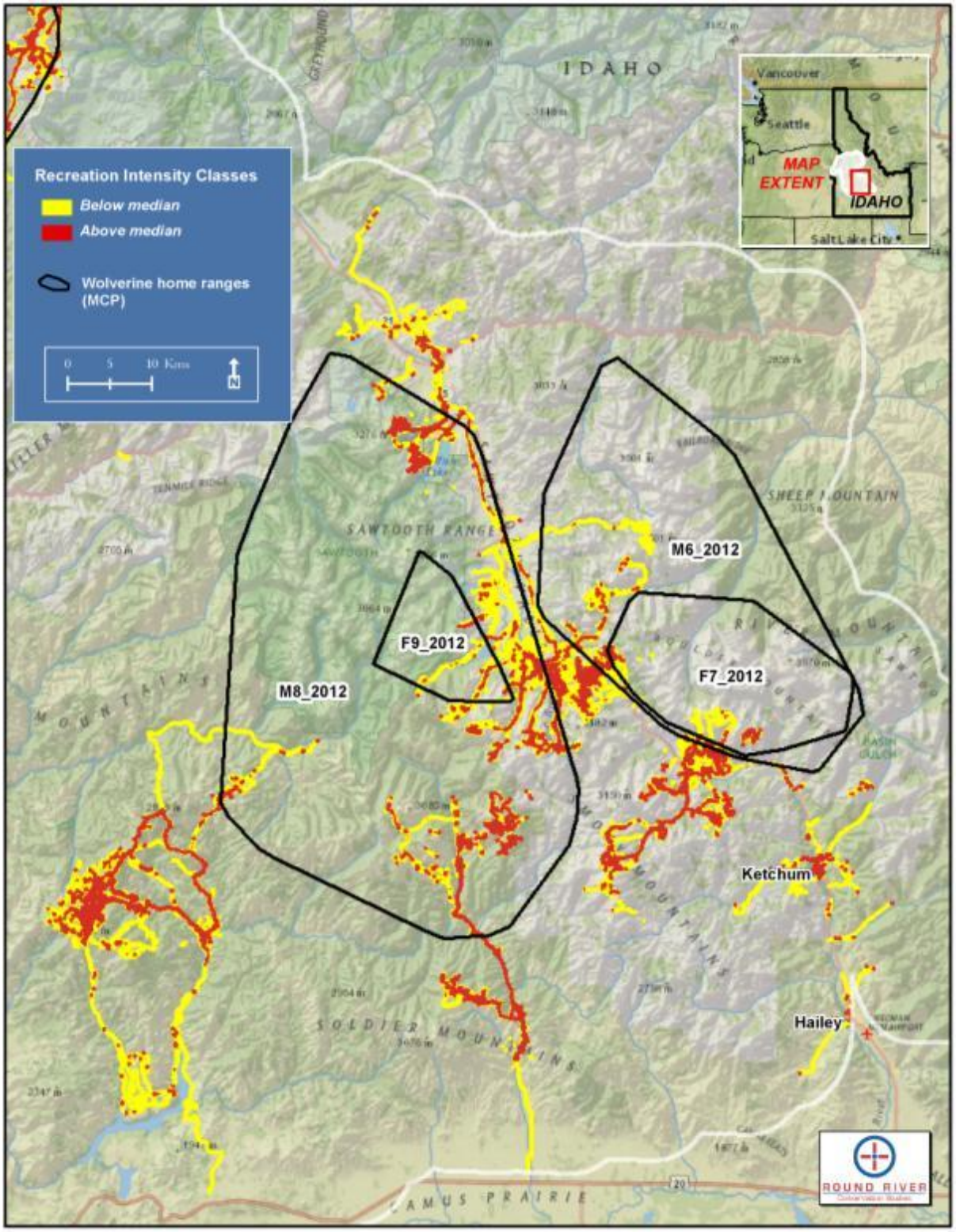

FIGURE 5. RELATIVE RECREATION USE INTENSITY IN THE SOUTH BNF AND SNF STUDY AREAS BASED ON GPS TRACK MONITORING DATA COLLECTED DURING THE WINTER 2012; ALSO SHOWN ARE WINTER HOME RANGE AREAS OF MONITORED WOLVERINES IN 2012.

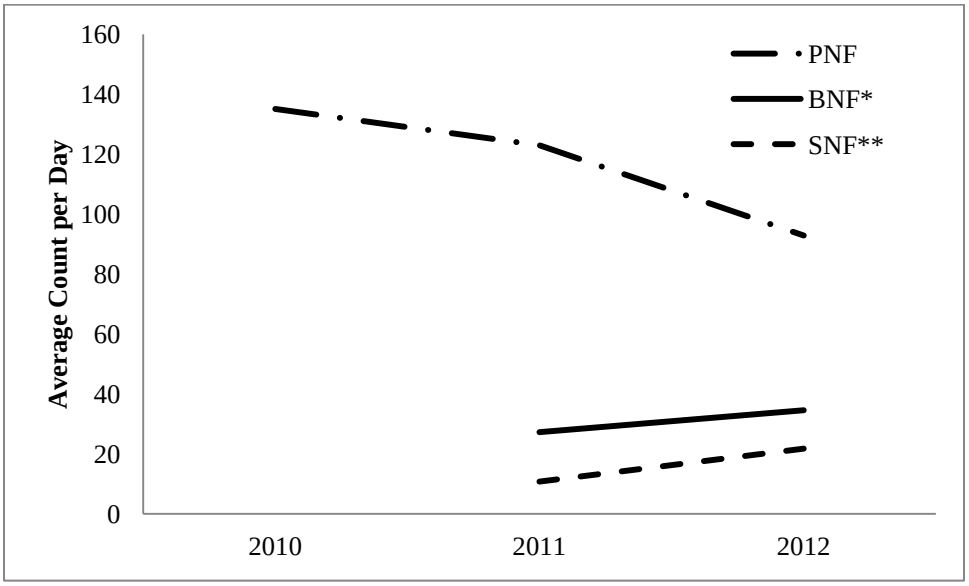

FIGURE 6. DAILY AVERAGE ESTIMATES OF THE NUMBER OF RECREATIONISTS ACCESSING THESE AREAS BASED ON INFRA-RED TRAIL USE COUNTERS ESTABLISHED ALONG ACCESS ROUTES WITHIN EACH OF OUR STUDY AREAS.
*North BNF study area only, where 2 years of monitoring have been completed
**North SNF study area only, where 2 years of monitoring have been completed

NEXT STEPS

The 2009 aerial surveys for wolverine presence and winter recreation activity indicated that at a regional scale wolverines and winter recreation may occur in the same landscapes (Copeland 2009). The GPS monitoring of wolverines and winter recreation completed over the last 3 winters indicates an overlap between areas occupied by wolverines and areas used for winter recreation at the home range scale, with the same animals residing over 3 years of monitoring in some of our most highly recreated landscapes. Even while data are still being collected, we are pursuing preliminary analyses to assess how animals in these landscapes are responding to potential disturbance including examining temporal activity patterns, movement patterns and habitat use relative to winter recreation intensity and use.

Across our study areas, we have animals exposed to relatively high levels of winter recreation as well as animals exposed to very little winter recreation. Because wolverines have such large home ranges, we are challenged by a small sample size of animals and particularly of animals exposed to higher levels of winter recreation across a notable portion of their home range (Figure 4 and Figure 5). These few animals are critical to the project, as is identifying and monitoring additional animals in other highly recreated landscapes. For example, one female we have monitored for 3 years in a highly recreated landscape attempted to den but failed in the first year and has not denned in the subsequent 2 years of monitoring. In order to significantly advance our understanding of the potential effects of winter recreation on wolverines, we need to both continue to monitor our known wolverines, particularly females, in highly recreated landscapes and find and monitor additional wolverines in other highly recreated landscapes. We are currently working to identify additional study areas with wolverines and relatively high levels of winter recreation.

Our fourth winter field season commences January 2013. We are conducting a second year of research in the northern Sawtooth Mountains with a refinement of effort to include the southern Sawtooth Mountains where significant snowmobile and heli-ski recreation occurs. This expansion requires establishing two field crews of 6-8 technicians each. We will continue a limited and non-invasive effort to monitor wolverines for a 4th year in the Payette National Forest study area near McCall, Idaho and a 3rd year in the northern Boise National Forest study area, using remote cameras and aerial denning surveys.

Additionally, we will be identifying possible new study areas beyond central Idaho and hope to complete preliminary data collection to inform project implementation. We are pleased with our ability to monitor wolverines and winter recreation across broad landscapes. The field methods that we employed to date are effective in providing data that addresses study objectives. However, our sample size is still small given the inherent individual variation we expect among wolverines. We especially lack sufficient data (recreation and wolverine) in areas with intense, high levels of recreation. Thus, we propose to complete 2-3 years of additional research in 1-2 new study areas that support both wolverines and high levels of winter recreation, while continuing to monitor key individual wolverines across our study areas.

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APPENDIX A

Infra-red trail use counter monitoring information summarized by study area.

TABLE 5. TRAIL USE COUNTS COLLECTED FROM INFRA-RED TRAIL USE COUNTERS SET UP ALONG PRIMARY ACCESS ROUTES ON THE PAYETTE NATIONAL FOREST STUDY AREA NEAR MCCALL, IDAHO, 2010-2012 WINTERS.

Year	Site	Start	End	Count[1]	Days with data	Average Daily Use
2010	**Lick Cr Trailhead**	1/19/2010	4/30/2010	753	100	7.5
	Upper Elevation Trailhead	1/19/2010	4/30/2010	7,014	96	73.1
	Warren Wagon Trailhead	1/18/2010	4/28/2010	4,794	88	54.5
2011	**Lick Cr Trailhead**	1/15/2011	4/29/2011	1,057	100	10.6
	Upper Elevation Trailhead	1/15/2011	4/27/2011	5,961	102	58.4
	Warren Wagon Trailhead	1/11/2011	4/29/2011	6,050	112	54.0
2012	**Lick Cr Trailhead**	1/1/2012	4/30/2012	703	100	7.0
	Upper Elevation Trailhead	1/1/2012	4/13/2012	4,824	102	47.3
	Warren Wagon Trailhead	1/1/2012	4/13/2012	3,943	102	38.6

TABLE 6. TRAIL USE COUNTS COLLECTED FROM INFRA-RED TRAIL USE COUNTERS SET UP ALONG PRIMARY ACCESS ROUTES IN THE NORTH BNF STUDY AREA NEAR CASCADE, IDAHO OVER 2 WINTERS 2011-2012.

Year	Site	Start	End	Count[1]	Days with data	Average Daily Use
2011	**Big Cr Summit**	1/15/2011	3/29/2011	123	57	2.2
	Clear Cr	1/15/2011	4/29/2011	1,232	107	11.5
	Curtis Cr	1/15/2011	4/29/2011	277	108	2.6
	Gold Fk	1/15/2011	4/29/2011	493	101	4.9
	Stolle Meadows	1/15/2011	4/29/2011	502	106	4.7
	Warm Lake Summit	1/15/2011	4/29/2011	915	107	8.5
2012	**Clear Cr**	1/1/2012	4/13/2012	2,360	103	22.9
	Curtis Cr	1/1/2012	4/13/2012	329	102	3.2
	Stolle Meadows	1/1/2012	3/17/2012	277	75	3.7
	Warm Lake Summit	1/1/2012	4/30/2012	574	119	4.8

[1] Count is the number of passes by the counters divided 2 to provide an estimate of number of recreationists. The count is divided by 2 based on the assumption that recreationists entering the study area also leave the study area by passing by a trail use counter.

TABLE 7. TRAIL USE COUNTS COLLECTED FROM INFRA-RED TRAIL USE COUNTERS SET UP ALONG PRIMARY ACCESS ROUTES IN THE NORTH SNF STUDY AREA NEAR STANLEY AND KETCHUM, IDAHO OVER 2 WINTERS 2011-2012.

Year	Site	Start	End	Count[1]	Days with data	Average Daily Use
2011	**4th of July**	2/22/2011	4/30/2011	48	67	0.7
	Alturas	2/12/2011	4/30/2011	102	77	1.3
	Main Baker	2/6/2011	4/30/2011	128	81	1.6
	Beaver Cr	1/31/2011	4/30/2011	100	87	1.2
	Headwaters	1/21/2011	4/30/2011	106	84	1.3
	Titus Ridge	2/6/2011	4/30/2011	258	81	3.2
	Twin Cr	2/8/2011	4/30/2011	122	81	1.5
2012	**Pole Cr**	1/29/2012	4/17/2012	38	78	0.5
	4th of July	1/26/2012	4/17/2012	153	81	1.9
	Alturas	1/31/2012	4/17/2012	93	76	1.2
	Main Baker	1/30/2012	4/16/2012	862	76	11.3
	Beaver Cr	1/29/2012	4/16/2012	66	77	0.9
	Cross Parking	2/1/2012	4/15/2012	481	73	6.6
	Headwaters	1/31/2012	4/16/2012	210	75	2.8
	Mayes Cr	1/26/2012	4/14/2012	236	79	3.0
	Titus Ridge	2/1/2012	4/15/2012	189	73	2.6
	Twin Cr	2/1/2012	4/15/2012	81	73	1.1

TABLE 8. TRAIL USE COUNTS COLLECTED FROM INFRA-RED TRAIL USE COUNTERS SET UP ALONG PRIMARY ACCESS ROUTES IN THE SOUTH SNF STUDY AREA NEAR FAIRFIELD, IDAHO DURING THE WINTER 2012.

Site	Start Date	End Date	Total Count[1]	Days with Data	Average Daily Use
Fairview	1/14/12	4/2/12	145	58	2.5
Fall Cr	1/14/12	3/31/12	213	57	3.7
Feather River	1/16/12	4/1/12	200	51	3.9
Trinity Cr	1/15/12	4/2/12	2017	56	36.0

TABLE 9. TRAIL USE COUNTS COLLECTED FROM INFRA-RED TRAIL USE COUNTERS SET UP ALONG PRIMARY ACCESS ROUTES IN THE SOUTH BNF STUDY AREA NEAR FEATHERVILLE, IDAHO DURING THE WINTER 2012.

Site	Start Date	End Date	Count[1]	Days with Data	Average Daily Use
Couch	1/17/12	4/2/12	1168	74	15.8
Salt Bounds	1/17/12	4/2/12	357	75	4.8
Skunk	1/17/12	4/2/12	83	75	1.1
Upper So. Fk	1/17/12	4/2/12	152	75	2.0

We would like to again acknowledge our partners and collaborators: