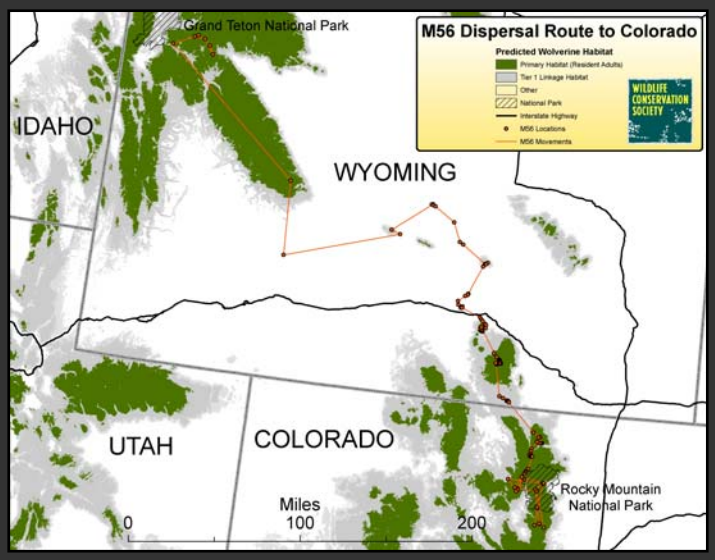
Greater Yellowstone Wolverine Program

Practical, Science-based Solutions for Wolverine Conservation

Progress Report – December 2009



Male Wolverine Travels 900 km and Crosses I-80 on His Way to Colorado, the First Documented Occurrence There Since 1919

Research Summary

Robert Inman, Mark Packila, Kris Inman, Bryan Aber, Rob Spence, Deborah McCauley
Wildlife Conservation Society • North America Program

Wolverine Program Field Office • 222 Main Street • Lone Elk Suite 3B • Ennis, Montana 59729 U.S.A. 406.682.3437

December 2009

Hello,

2009 was an interesting and productive year for the project. The most unique event was the dispersal of a young male wolverine from northwestern Wyoming. We radio-monitored him while he covered over 900 kilometers, crossed a portion of the Great Divide Basin, successfully navigated Interstate-80 on Memorial Day weekend, and eventually made his way to Rocky Mountain National Park in Colorado. This event marked the first verified occurrence of a wolverine in Colorado since 1919, nearly a century ago. This dispersal generated quite a bit of wolverine media coverage and hopefully will help get the public interested in the species and conservation efforts for wolverines.

Thanks,

The Greater Yellowstone Wolverine Program Team

Contact Info:

Wolverine Program

Bob Inman, Director, Greater Yellowstone Wolverine Program
406-682-3437, binman@wcs.org

Mark Packila, Pilot & Field Biologist, Greater Yellowstone Wolverine Program
406-570-3185, mpackila@wcs.org

Kris Inman, Grants Coordinator, Greater Yellowstone Wolverine Program
406-682-3437, kinman@wcs.org

Bryan Aber, Field Coordinator, Greater Yellowstone Wolverine Program
208-558-7301 extension 4215, baber@idfg.idaho.gov

Deborah McCauley, Veterinarian, Greater Yellowstone Wolverine Program
406-581-0571, docmccauley@hotmail.com

WCS North America Program

Jeff Burrell, Coordinator, Yellowstone Rockies Program
406-522-9333 ext 101, jburrell@wcs.org
Rockies Program

Melissa Richey, Senior Development Officer, WCS North America
406-522-9333 ext 111, mrichey@wcs.org

If you find information or ideas contained within this report to be valuable, please consider citing it as follows: Inman, R. M., M. L. Packila, K. H. Inman, B. Aber, R. Spence, and D. McCauley. 2009. Greater Yellowstone Wolverine Program, Progress Report – December 2009. Wildlife Conservation Society, North America Program, General Report, Bozeman, Montana, U.S.A.

Table of Contents

2009 Acknowledgements

We thank the following for providing funding during this reporting period: Beaverhead-Deerlodge National Forest, Caribou-Targhee National Forest, Canyon Creek Foundation, Y. Chouinard, Clara Jeffery Charitable Trust, Elk Meadows Ranch, Grimsö Wildlife Research Station - Swedish University of Agricultural Sciences, Idaho Department of Fish and Game State Wildlife Grants, Laura Moore Cunningham Foundation, Montana Department of Fish, Wildlife and Parks, National Geographic Conservation Trust, New York Community Trust, Tapeats Fund, Weeden Foundation, L. Westbrook, Wilburforce Foundation, WCS Wildlife Action- Opportunities Fund supported by the Doris Duke Charitable Foundation, and Private Individuals.

We would also like to thank: the Bridger-Teton National Forest for providing housing at Blackrock for the December-January trapping session; the Beaverhead-Deerlodge National Forest for providing housing at Wisdom for the January-February trapping session; our veterinarians for their expert work, Doug and Ellie Reedy in the Big Hole and Don Betts and Maura Connelly in the Teton area, and Eric Klaphake for consultation. We thank the Bug Ranch of Natrona County Wyoming for permission to access their land and determine if M56 was still wearing his GPS collar. We also thank the Absaroka-Beartooth wolverine project for their assistance radio-locating wolverines while in the eastern portions of Greater Yellowstone, and we thank Jason Wilmot of the Northern Rockies Conservation Cooperative and Dan Tyers of the Gallatin National Forest for continuing to do so.

We extend a special thanks to Elk Meadows Ranch and all who attended Wolverine Workshop 2009.

Caribou-Targhee National Forest
Beaverhead-Deerlodge National Forest
Bridger-Teton National Forest
Gallatin National Forest

Grand Teton National Park

Laura Moore Cunningham Foundation

Canyon Creek Foundation

Tapeats Fund

Why Do Wolverines Need Metapopulation-level Conservation Action & What Would the Priorities Be?

Conserving wolverines in the lower 48 over the course of the 21st century may prove to be one of the more difficult challenges among the many that wildlife and land managers will face. It is expensive and often dangerous to access the places where wolverines live and give birth in an attempt to understand what is happening with the population and how to manage it. Add to these difficulties the scale over which coordination and conservation must occur (the western states and provinces), and the task becomes even more daunting. Top that with climate change, potential impacts from backcountry recreation, rural sprawl, and the fact that many people don't know and possibly don't even care what a wolverine is, and one might ask – why even try?

However, wolverines can be viewed as a vehicle, an opportunity if you will, to take some of these difficult challenges head-on and advance the legacy of conservation in North America. What will it take to conserve wolverines?

We will have to address the issues of scale and protected areas. When our national parks and public lands were established, we did not understand the true scale over which populations of terrestrial wildlife functioned. The original boundaries of the world's first national park, Yellowstone, were drawn around scenic wonders and geothermal features. Wildlife was a bit of an afterthought, but soon we learned that the park could function as a refugia. Nearly a century later, we learned that conserving grizzly bears in Yellowstone required us to think beyond the park as a refugia and begin managing the park along with its surrounding public lands as a unit (the Greater Yellowstone Area). Now we know that wolverines require us to take the next step and begin developing a network of open space among the National Parks and Public Lands of the western U.S. – Connectivity between Glacier, Grand Teton, and Rocky Mountain National Parks for instance. Perhaps instead of a daunting task for wolverines, this is an opportunity to build western communities in a way that preserves the character and open space so valuable to residents here. With rural sprawl knocking at the door, diverse interests may find common ground in maintaining open space. If these efforts can be informed by wildlife research on dispersal and migrations, then it is possible that we can overcome this major challenge for wildlife conservation.

Conserving wolverines will also require that we make smart moves aimed at coming through climate change. Perhaps most challenging, we will have to implement a wolverine monitoring program so that we can understand what exactly needs to be done and be able to gauge our success. This will include the hard work of determining and adjusting (if necessary) for the increased amount of backcountry recreation.

So there are significant challenges. But was it less challenging at the start of the 20th century with decimated wildlife populations, commercial hunting, a lack of public lands, no state agencies focused on wildlife management, and the Great Depression? Our degree of success will improve if we identify, prioritize, and act upon the things that need to be done. Here is our current thinking on why and how to go about conserving wolverines here during the 21st century. We invite your help in refining this suggested course of action and moving the right things forward.

Research Summary 2009

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).

Photo 3. A camera bait site and the resulting picture that was used to identify a known age subadult female whose VHF transmitter had failed prematurely. This subadult was then target trapped during January 2009 to continue monitoring her for dispersal and age at first reproduction (for information about identifying individual wolverines from photographs see Magoun et al. 2008).

Winter 08-09 Field Season: A Targeted Effort in the CLE

As outlined in the last WCS Wolverine Progress Report (Nov. '08), we conducted aerial den surveys in the Central Linkage Ecosystem (CLE) during spring 2008. Two confirmed dens of unmarked wolverines were aerially located in the CLE that year. The recognized presence of a reproductive wolverine population, including dispersal aged subadults, spurred a winter field trapping session in the CLE. Dispersing-aged subadults were targeted for capture and fitting with GPS collars prior to dispersal, which could provide valuable inter-mountain range connectivity data. Resident females of this area were also targeted to acquire reproductive data.

Last winter field season, we experimented with a portable trap design (Lofroth et al. 2008) constructed of commercial 4"x4" untreated lumber that can be pre-assembled and transported in the field as needed with snowmobiles (Photo 6). We also drilled numerous small holes in the top and sides to prevent condensation and potential hypothermia. This trap differed from the log box trap design we had used previously which was constructed in the field of dead and down wood found on site and not capable of being transported. Three of these portable traps were used this winter.

Four new wolverines were captured in the CLE area. M558, was captured in January, implanted with VHF and collared with a GPS collar. A previously reproductive adult female, F551, was captured in the same trap a couple of days later and was also fit with a VHF implant and GPS collar. Both animals are currently in the mountain range of original capture . F551 is notable in that she is an adult female that appears to have a home range overlapping two states and a US highway. She also used portions of 3 National Forests. The third wolverine captured was F541, a juvenile female captured and presumably one of the cubs observed on May 16, 2008 at a rendezvous site (one of the dens aerially located). Also captured was F540, a previously reproductive adult female.

F540's capture event was noteworthy because when she was anesthetized she had an irregular heartbeat. In spring 2008, the WCS Wolverine Program revamped its capture gear to include a veterinary pulse oximeter, bottled oxygen setup, and more warming equipment to battle hypothermia. The importance of the new equipment was validated during this capture, as the pulse oximeter aided in diagnosing the irregular heartbeat, and adequate oxygen perfusion to tissues was able to be maintained using bottled oxygen despite the circulatory system anomaly. We chose not to implant F540 with VHF due to her heart condition, but she was fit with a GPS collar. Based on the GPS data, F540 returned to normal movements after the capture.

Photo 4. Portable wolverine trap being hauled to a capture site in southwest Montana, 2009.

Photos 5-8. Remote cameras were used as part of an efficient capture effort. With limited personnel and time to trap a large area we relied on remote cameras to learn when a wolverine was using a bait prior to setting up a portable trap and beginning the daily trap checking routine. This method saved time and resources compared to running all traps all winter – with the majority of the time the traps not having wolverine activity.

Aerial Locations 2008-2009

During 2008 and 2009, we radio-located 20 wolverines (12 F, 8 M) a total of 1,026 times. These wolverines were spread over a large geographic area including 4 different states (Montana, Idaho, Wyoming, and Colorado).

Determining Den Detection Rate for Fixed-wing Surveys

During spring 2008, we began developing a fixed-wing aerial wolverine distribution/den survey method. The method focuses on confirmation of a breeding population rather than only the presence of wolverine tracks. Locating a den leaves no doubt as to the presence of a population, and tracks are documented while searching for a den anyway. Using this method to locate dens could also prove to be useful as an index of wolverine reproduction and can produce other important info, e.g., den habitat, DNA, known-age cubs for demographic data, etc… Before this technique can be deemed useful for indexing wolverine reproduction, it needs to be tested for it's capability to "blind-locate" dens that are known (via telemetry) to be present. We began this test during spring 2009. The test consisted of a comparison between the number of dens found on the study area via telemetry locations vs. the number found by an observer using the blind search den survey method. The observer was of course unaware of the telemetry locations of the marked females or whether we suspected that any of them had reproduced.

Survey Areas We determined the area to be searched for tracks/dens by calculating the minimum habitat score (based on Brock et al. 2007) of all 28 natal den and rendezvous sites that we have documented during the study (Inman et al. 2007b). We considered all areas scoring as high as these den sites to be "maternal habitat," and searched all survey grid cells overlapping maternal habitat. We did not search areas consisting of <100km^2 of primary wolverine habitat (Brock et al. 2007) because this is the minimum female home range size (Hornocker and Hash

Photo 9. A wolverine den located during a fixed-wing search for dens and tracks during 2008.

1981, Copeland 1996, Squires et al. 2006, Copeland and Yates 2006, Inman et al. 2007*a*).

Survey Timing Three factors influenced our decision on timing of conducting surveys, i.e., the length of time after a track-clearing snowfall to wait and let tracks accumulate before searching: 1) maximizing the number of 'flyable days' considering the commonly inclement weather during the spring survey period, 2) minimizing the flight/personnel time and cost spent investigating extraneous tracks (non-target species), and 3) minimizing the flight/personnel time and cost required to follow a wolverine track to a den site. Thus we wanted to fly as soon as possible after a track clearing snowfall. Conversely, we are cautious about flying after long periods with no covering snowfall because tracks can melt during spring or a lot of tracks can accumulate, both wolverine and non-target species, potentially making it more difficult and time consuming to follow a myriad of tracks to determine if they are wolverine and/or follow wolverine tracks back to a den. These factors guided our determination of an appropriate grid-cell size.

Survey Grid Cell Size Using GPS collar movement data from a female rearing cubs, we calculated movement areas and determined that hexagonal survey cells of 12.5km^2 would be the right size to allow track detection of a reproductive female in as little as 24 hours after a track clearing snowfall. This relatively small grid cell size would result in 8 cells within the minimum female home range size. This density of cells ensures adequate coverage of all areas within the home range. Survey cells were arranged to completely overlap the maternal habitat outlined above.

Results of the Spring 2009 Den Detection Rate Test Six radio implanted adult females being monitored for reproduction using VHF telemetry flights were used to test our aerial den detection survey method (Fig. 5). In early April, after almost a month of weather delays, an observer without knowledge of the telemetry location results conducted the blind den detection survey within the home ranges of the marked females. The observer identified tracks as wolverine within each of the female's home ranges and identified concentrated tracks/activity in 4 of 6 female home ranges. This initial flight was followed up with ground visits (weather too poor to fly) at 2 of the 4 concentrated activity sites. At one site there was no new activity and at the other site there was a mtn. goat carcass, but no new activity. The other 2 of 4 sites with concentrated activity were aerially inspected one week after the initial flight. One site showed no activity in the drainage. The other site had one set of wolverine tracks moving through the drainage, but no concentrated activity. This track prompted a second flight 5 days later that showed no activity in the area.

Without continued use at any of the 4 sites of concentrated activity, the test den detection survey concluded that none of the 6 females had reproduced. This matches the results of the VHF telemetry flights during the denning period plus the subsequent observations and camera work through the summer (details of efforts used to determine reproduction via telemetry and follow-up efforts are below in the Demographics section). Unfortunately, the lack of reproduction prevented us from obtaining a den detection rate at this time (0/0) (Table 2). However, we were able to gain insight into our ability to find tracks with this relatively inexpensive method.

Tracks recorded as wolverine were found in each of the six female home ranges searched. This information can be useful for suggesting current distribution and could be valuable in occupancy modeling.

The test flight occupied a pilot and observer for about two days (11.25 total flight hrs, 6 survey hrs & 5.25 ferry hrs). The flight crew searched 163 cells (2037 km^2) for an averaged of 2.2 min/12.5 km^2 cell. Follow up to check areas with concentrated activity consisted of 1.5 days for 2 technicians to check areas of activity on the ground and <1 hour (3.7 hours including ferry) of flight time to check areas of activity from the air. Total cost was similar to that outlined in our 2008 report – approximately $3,000 per 1,000km^2 of habitat and 7 person-days. This includes ferry time and purchase of a remote camera. If the effort was limited to simply surveying for tracks, the cost would be about $750 per 1,000 km^2 without ferry time to the site.

Table 2. Track and den detection rate results.

	Year (Spring)	
	2009	2010
Adult female home ranges surveyed	6	6
Home ranges with tracks detected during survey	6	?
Track dection rate	1.0	?
Adult females radio-monitored for reproduction	6	6
Actual dens (telemetry & follow-ups)	0	?
Survey method dens located	0	?
Den detection rate	.	?

Dispersal

Monitoring a Long-Distance Dispersal, Northwest WY to Northeast CO

On December 20, 2008 WCS captured a young male wolverine, M56, near Togwotee Pass, Wyoming. He was implanted, fit with a GPS collar, and released.

Over the next several months (Jan-Mar) M56 was located in the Leidy Highland area between Togwotee Pass and the Gros Ventre River. We thank the Absaroka Beartooth Wolverine Project for providing several additional telemetry flights during this period. However, there were two flights when M56 was missing, and we began wondering if this young male had begun to make exploratory movements. The last location in the Leidy Highlands was in mid-March and by the end of March it was apparent M56 was no longer in the area. WCS conducted extensive search flights and on April 6th we found M56 in the southern Wind River Range near Lander with the GPS collar still on. The collar was scheduled to fall off by this date, thus the collar release mechanism had failed to function. Three days later an oil-field worker reported to WY G&F that he saw a wolverine running on a dirt road near Freighter Gap, Wyoming (between the southern Winds and Rock Springs, WY). The man stated that "if the wolverine was wearing a collar, it was white", a description that matches M56's collar. Wyoming Game and Fish visited the site and verified wolverine tracks (M. Grenier, Wyoming Game and Fish, pers. comm.).

Poor weather prevented search flights until later in April when we found M56 in the Green

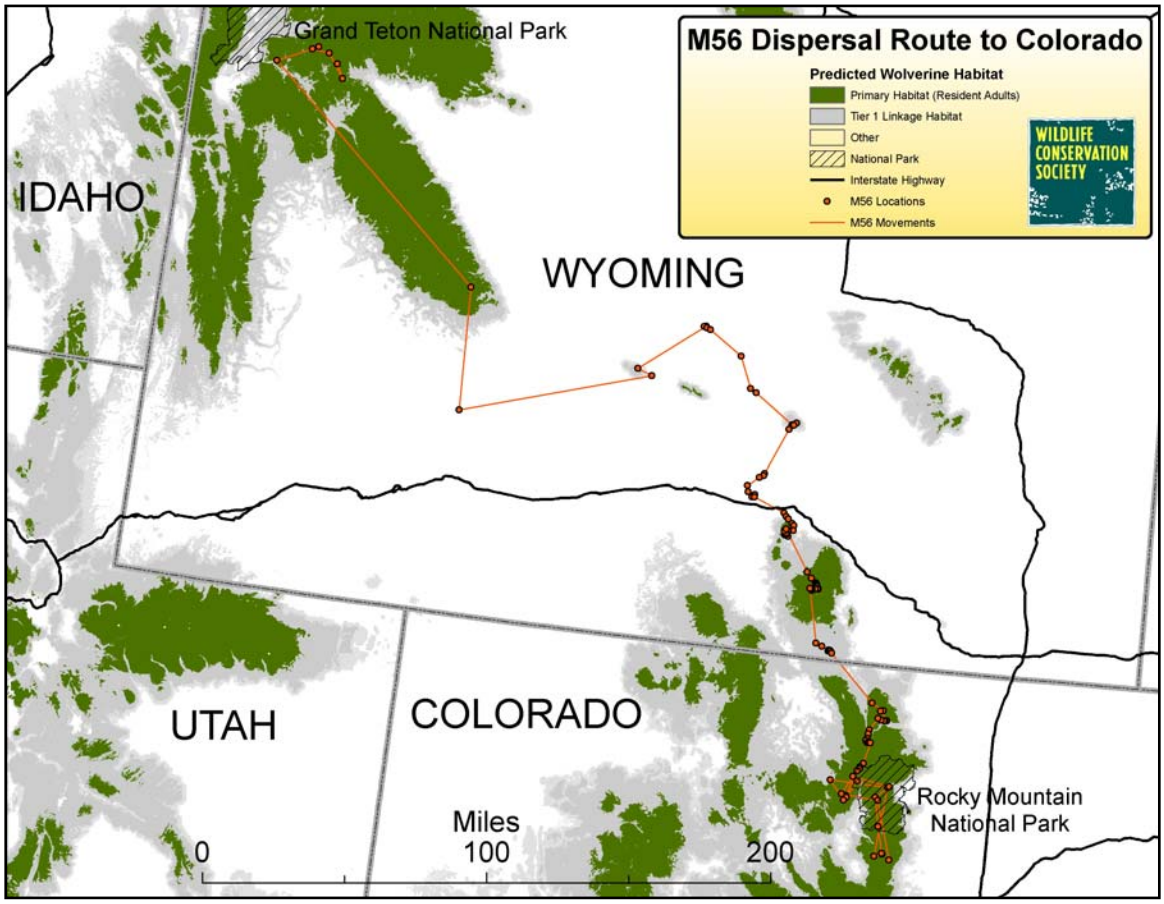


Figure 1. M56 dispersal route to Colorado. This event marked the first verified record of a wolverine in the state of Colorado since 1919. M56 crossed I-80 on Memorial Day weekend. He also landed on at least 2 out of the 3 islands of habitat predicted by our telemetry-based habitat modeling efforts while he moved between the Greater Yellowstone and Colorado Rockies Ecosystems. This movement of at least 942 km (541 straight line distance) may be the longest movement ever recorded for a wolverine.

Mountains, east of the Wind River Range, leaving us wondering where all he had been on his excursion through the Great Divide Basin and hoping that his GPS collar might tell us. M56 next moved north to the Granite Mountains, but at this point the GPS collar's VHF could no longer be heard. In the Granite Mountains M56 was found scavenging a dead cow near the Bug Ranch and Bug Ranch and WCS personnel were able to get a visual on M56 and verify that he was still wearing the GPS collar. So now the collar VHF had failed in addition to the release mechanism failing. This is the last time M56's collar has been seen. It is no longer on M56, so the collar is somewhere between central Wyoming and northeast CO.

Through the middle of May, M56 moved east, crossing the North Platte River to the Shirley Mountains. After a break in the Shirley Mountains, M56 started moving south towards Interstate 80. Aerial and ground telemetry leads us to believe that M56 crossed I-80 near where Dana Ridge meets the interstate sometime between midnight and 4 AM on Memorial Day. He was first located south of I-80 at 5:30 AM on May 23rd (Photo 10) and he continued to move that morning until about 10 AM when he moved into tree cover on the east side of Elk Mountain.

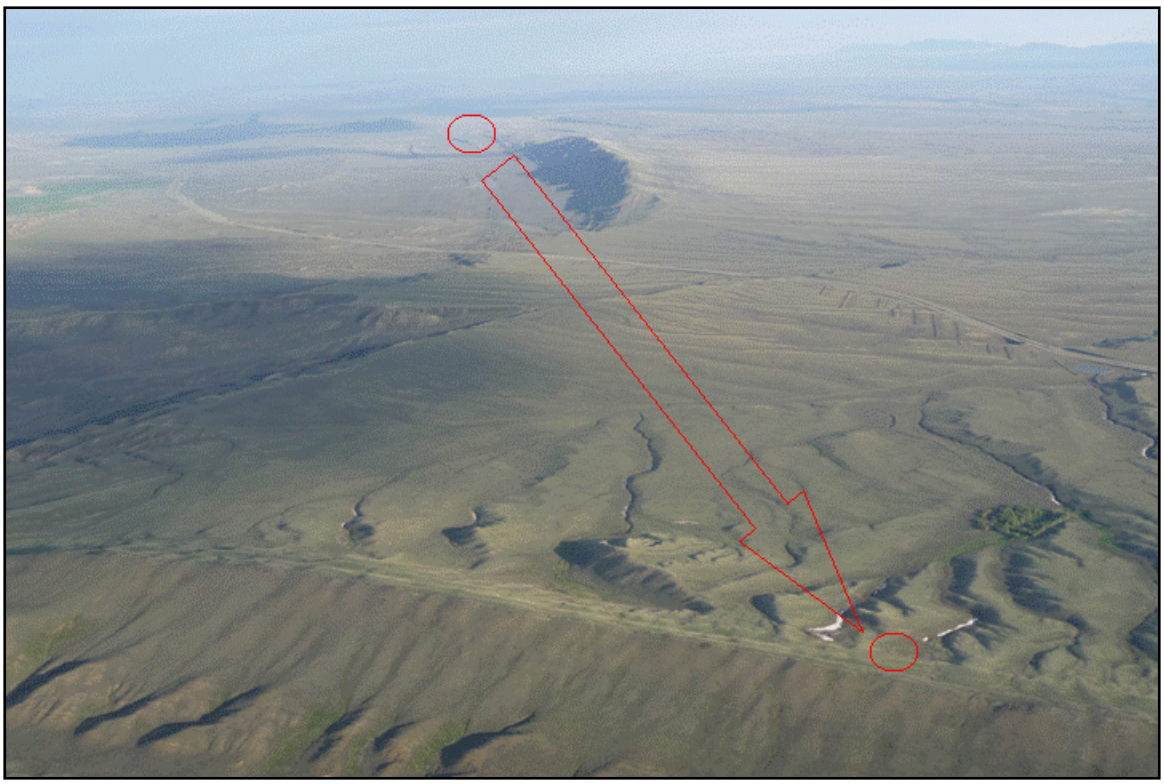


Photo 10. This is the area where M56 crossed Interstate 80. Red circles represent VHF locations before and after crossing.

After spending a week on Elk Mountain, M56 continued south to the Snowy Range. While near the crest of the Snowies, we were able to watch an aborted attempt to cross WY Hwy 130 at 8:31 AM (Photo 11). M56 approached WY Hwy 130 and, just as he got on top of a small rise above the road, two cars heading east came past. This made him stop. Just after the two cars passed, a motorcycle heading west came by and this made him run into a small patch of trees away from the road and off the rise. M56 continued west along the north side of the road and didn't cross the road before weather forced us to stop flying.

Photo 11. M56's path (red) as he moved from the lower right side of the picture, encountered traffic on Hwy 130 (yellow), and took an alternate route that included a steep climb.

The failed road crossing attempt didn't stop M56 from continuing south. The next morning he was over 10 miles south, moving a minimum of 31 miles in 24 hours. Near Mountain Home, WY aerial locations indicated he bumped into a housing development. He went straight north away from the development about a half mile before continuing east and crossing WY Hwy 230 between 9:00 and 9:06 AM (Photo 12). At this point he was within three miles of the CO border. Poor weather prohibited flying the next morning (6/2/09), but a window in the afternoon allowed a flight. M56 was over 20 miles southeast into CO on the Roosevelt National Forest at that time. After a brief slow down in the Roosevelt NF, M56 crossed CO Hwy 14 (between 12:30 and 12:45 PM) and was in Rocky Mountain National Park. He has continued to use the area around Rocky Mountain NP and the surrounding Routt, Roosevelt, and Arapaho National Forests during the summer. The Colorado Division of Wildlife has been aerially monitoring him during the summer and fall.

This movement was exciting to watch, and it also generated significant interest in wolverines, not only in Colorado, but around the nation. Over 150 media outlets covered the story of the first wolverine documented in Colorado since 1919, including a front page article in the Denver Post, a feature article in the New York Times, and several outlets outside of North America. This movement confirmed that long distance dispersal through large areas of arid, treeless habitat is possible for certain wolverines and genetic exchange is possible between areas like Colorado/California and the northern Rockies/Cascades. This movement between two major habitat blocks (Greater Yellowstone and Colorado) is an excellent example of why wolverines need to be managed as a metapopulation within the western states.

Photo 12. M56 bumps into a small subdivision and skirts around it and across WY Hwy 230.

M56 – The Numbers as of July 1, 2009

-Straight line distance from point of capture to furthest location was 541 km (336 miles).
-Minimum distance traveled since capture was 942 km (585 miles).
-Located on 6 National Forests, 3 BLM Districts, 1 National Park, WY and CO State Lands, and Private Lands
-Average rate of movement during dispersal (April 6 – June 9) was 9.8 Km/day. To approximate minimum distance travelled within 24 hours, we grouped VHF locations into separate 21-27 hour periods and the general pattern of movement was either travelling, 17.8 – 57.6 Km (average 36.1 Km, n=6, time 22.0-27.0 hours) or not travelling, 0.3 – 5.9 Km (average 2.2 Km, n=11, time 22.0 – 25.8 hours).
-9 significant roads crossed:
1 interstate: I80; 3 US highways: 287 (twice), 34 (within RMNP); 5 state highways: WY 28, WY 220, WY 130, WY 230, CO 14

M56 Remote camera photo, Wyoming.

Menan Buttes Capture

On January 22, 2009 a bobcat trapper caught a wolverine on Menan Buttes west of Rigby, ID and contacted Idaho Fish and Game regarding how to handle or release the animal. IDFG employees, including Bryan Aber, met the trapper at Menan Buttes later that day and sedated the animal. The wolverine had been caught in a #3 coil-spring trap. Its foot and body condition were evaluated and the wolverine was determined to be in good condition. The wolverine was transported in a large (cougar/wolf) aluminum transport box to the Driggs Vet Clinic where he was held overnight and a full examination was planned for the next morning. On January 23, the wolverine (M57) was examined and a foot x-ray showed the only damage to be one dislocated joint in the center toe. Overall, M57 appeared to be in good condition and was fit with an implant and GPS collar. M57 was transported and released in Greater Yellowstone. Currently, WCS along with Jason Wilmot of the Northern Rockies Conservation Cooperative and Dan Tyers of the Gallatin National Forest are cooperating in monitoring this wolverine.

F544's dispersal

We also documented dispersal within the CLE. F544, the sibling of M545 (see mortality below), was captured in SW Montana in May 2008 . She was found consistently in the initial area captured until November 2008, but was often missing during telemetry flights at the end of December and January. However, poor winter weather prevented us from making extensive searches when she was missing. By early winter 2009 she began exploratory movement two mountain ranges north of her original capture and since and was located there until June 2009. Her implanted radio-transmitter had malfunctioned and was transmitting at twice the normal rate, which uses twice the battery power. We have not been able to locate her since June; this could be due to implant battery failure, but we will continue to scan for her during telemetry flights.

Photo 14. Camera trap photo of F544

Demographics

Reproduction

None of the six adult females we monitored during spring 2009 showed evidence of successful reproduction. From February 1 through April 8, the number of VHF locations ranged from 16 – 19 for 5 adult females and 10 VHF plus 65 GPS locations for one adult female. This included periods of intensive locations when two locations per day allowed a better understanding of their movements. One female (F121) raised some suspicion during the VHF telemetry relocations because she appeared to be restricting movement during early spring to a smaller than expected area of her normal home range. F121 was investigated further during late spring and summer to determine if she had cubs. Three sites that she used on more than one occasion during the VHF telemetry flights were investigated and five instances of snow tracking, remote camera photographs, and on the ground visuals failed to reveal any indication that F121 had cubs (Photo 15).

So far we have radio-monitored almost 40 adult female (>3yrs) reproductive-years. Total reproductive rate is 0.24 cubs per female per year, or approximately 1 cub every 4 years per adult female. Average litter size is 1.4 (n=10 litters) and the sex ratio of litters so far is 3F:1M (n=5 litters).

Photo 15. F121 leaving a rock hole alone. Observations suggest that she slept here overnight and did not return to this spot during the next 24 hours. Considering our observations of F121 with cubs in the past, this type of behavior was additional evidence leading us to believe she did not rear cubs during 2009.

Mortality

One mortality was documented during calendar years 2008 and 2009. M545 was the male cub implanted in the SW Montana during May 2008. On October 6, 2008 the telemetry flight indicated mortality. His body was retrieved on October 7, 2008 (Photo 16). The carcass was necropsied at the Montana Fish, Wildlife & Parks lab in Bozeman. M545 had several puncture wounds, fractured ribs, and his back was broken in two places. He had been bitten and muscle bruising around the bite marks indicated that at least some bites happened before death. Thus, the cause of death was due to another animal, species unknown.

Photo 16. The mortality site of M545 in the Beaverhead Range, MT.

M56 in the Granite Mountains of central Wyoming. Location is in the far left portion of the upper photo.

Literature Cited

Anderson, N.J. and K. E. Aune. 2008. Fecundity of female wolverine in Montana. Intermountain Journal of Sciences 14:17-30.

Aubry, K. B., K. S. McKelvey, and J. P. Copeland. 2007. Distribution and broadscale habitat relations of the wolverine in the contiguous United States. Journal of Wildlife Management 71:2147-2158.

Balkenhol, N., L.P. Waits, M.K. Schwartz, J.P. Copeland, R.M. Inman, M.L. Packila, and N.J. Anderson. In Review. A multivariate, multi-scale approach for assessing the relative influence of landscape variables on wolverine (*Gulo gulo*) gene flow.

Brock, B. L., R. M. Inman, K. H. Inman, A. J. McCue, M. L. Packila, and B. Giddings. 2007. Broad-scale wolverine habitat in the conterminous Rocky Mountain states. Chapter 2 *in* Greater Yellowstone Wolverine Study, Cumulative Progress Report, May 2007. Wildlife Conservation Society, North America Program, General Technical Report, Bozeman, Montana, USA.

Cegelski, C. C., L. P. Waits, N. J. Anderson, O. Flagstad, C. Strobeck, and C. J. Kyle. 2006. Genetic diversity and populations structure of wolverine (*Gulo gulo*) populations at the southern edge of their current distribution in North America with implications for genetic viability. Conservation Genetics 7:197-211.

Copeland, J. 1996. Biology of the wolverine in central Idaho. Thesis, University of Idaho, Moscow, USA.

Copeland, J. P., and R. E. Yates. 2006. Wolverine population assessment in Glacier National Park, Spring 2006 Progress Report. US Forest Srvc., Rocky Mountain Research Station, Missoula, Montana, USA.

Copeland, J. P., and R. E. Yates. 2008. Wolverine population assessment in Glacier National Park, Comprehensive Summary Update. January 2008. USDA Forest Service, Rocky Mountain Research Station, Missoula, Montana, USA.

Copeland, J. P., K.S. McKelvey, K.B. Aubry, A. Landa, J. Persson, R.M. Inman, J. Krebs, E. Lofroth, H. Golden, J.R. Squires, A. Magoun, M.K. Schwartz, J. Wilmot, C.L. Copeland, R.E. Yates, I. Kojola, R. May. In Review. The bioclimatic envelope of the wolverine (*Gulo gulo spp.*): do climatic constraints limit its geographic distribution?

Fahlman, A., J. Arnemo, J. Persson, P. Segerstrom, and G. Nyman. 2008. Capture and medetomidine-ketamine anesthesia of free ranging wolverines. Journal of Wildlife Diseases. 44(1): 133-142.

Garcelon, D.K., R. Rall, B. Hudgens, J.K. Young, R. Brown, and S. Kohlmann. 2009. Feasibility assessment and implementation plan for population augmentation of wolverines in California. Institute for Wildlife Studies Report, Arcata, CA, USA.

Greater Yellowstone Coordinating Committee. 1999. Winter visitor use management: a multi-agency assessment. Final report of information for coordinating winter recreation in the greater Yellowstone area. March 1999.

Grinnell, J., J.S. Dixon, and J.M. Linsdale. 1937. Fur-bearning mammals of California. University of California Press, Berkeley, CA, USA.

Gude, P. H., A. J. Hansen, and D. A. Jones. 2007. Biodiversity consequences of alternative future land use scenarios in Greater Yellowstone. Ecological Applications 17:1004–1018.

Hornocker, M. G., and H. S. Hash. 1981. Ecology of the wolverine in Northwestern Montana. Canadian Journal of Zoology 59:1286–1301.

Inman, R. M., K. H. Inman, A. J. McCue, and M. L. Packila. 2007a. Wolverine space use in Greater Yellowstone. Chapter 1 *in* Greater Yellowstone Wolverine Study, Cumulative Progress Report, April 2007. Wildlife Conservation Society, North America Program, General Technical Report GYW-07, Bozeman, Montana, USA.

Inman, R. M., K. H. Inman, A. J. McCue, and M. L. Packila. 2007b. Wolverine reproduction in Greater Yellowstone. Chapter 4 *in* Greater Yellowstone Wolverine Study, Cumulative Progress Report, May 2007. Wildlife Conservation Society, North America Program, General Technical Report, Bozeman, Montana, USA.

Inman, R. M., A. J. Magoun, D. Pedersen, J. Persson, and J. Mattison. 2007c. Wolverine reproductive chronology. Chapter 3 *in* Greater Yellowstone Wolverine Study, Cumulative Progress Report, May 2007. Wildlife Conservation Society, North America Program, General Technical Report, Bozeman, Montana, USA.

Inman, R. M., M. L. Packila, K. H. Inman, R. Spence, and D. McCauley. 2008. Greater Yellowstone Wolverine Program, Progress Report – November 2008. Wildlife Conservation Society, North America Program, General Report, Bozeman, Montana, U.S.A.

Iversen, J. A. 1972. Basal metabolic rate of wolverines during growth. Norwegian Journal of Zoology 20:317–322.

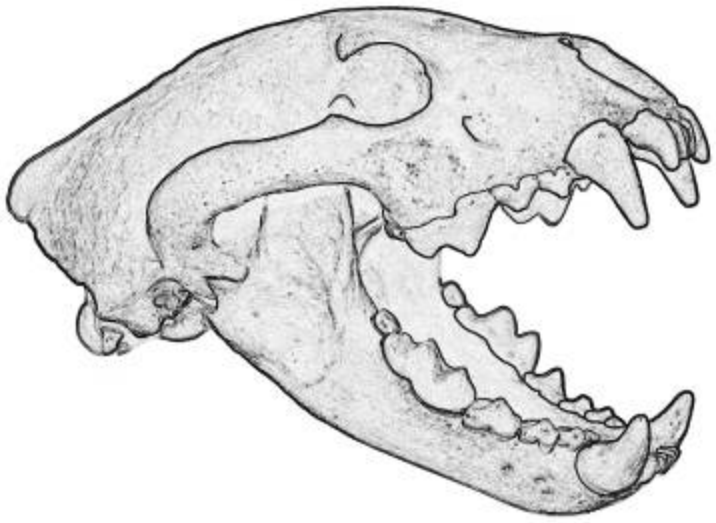
Krebs, J., E. C. Lofroth, and I. Parfitt. 2007. Multiscale habitat use by wolverines in British Columbia, Canada. Journal of Wildlife Management 71:2180–2192.

Kucera, T.E. and R.H. Barrett. 1993. The California cooperative wolverine survey: a progress report. Transactions of the Western Section of the Wildlife Society 29:49-53.

Lofroth, E.C., Klafki, R., Krebs, J.A., Lewis, D. 2008. Evaluation of live-capture techniques for free-ranging wolverines. Journal of Wildlife Management. 72(5):1253-1261.

MacKenzie, D.I., J.D. Nichols, J. A. Royle, K.H. Pollock, L.L. Bailey, and J.E. Hines. 2006. Occupancy Estimation and Modeling. Elsevier, Inc. Burlington, MA.

Magoun, A. J. 1985. Population characteristics, ecology and management of wolverines in northwestern Alaska. Dissertation, University of Alaska, Fairbanks, USA.
Magoun, A. J. 1987. Summer and winter diets of wolverines, *Gulo gulo*, in arctic Alaska. Canadian Field Naturalist 101:392–397.
Magoun, A.J., P. Valkenburg, and R.E. Lowell. 2008. Habitat Associations and Movement Patterns of Female Wolverines (*Gulo gulo luscus*) On the Southeast Alaska Mainland. Wildlife Research Annual Progress Report. Alaska Department of Fish and Game. Petersburg, Alaska. 29pp.
May, R. 2007. Spatial ecology of wolverines in Scandinavia. Dissertation. Norwgian University of Science and Technology, Trondheim, Norway.
Miller, G.C. and J.C. Halfpenny. 1981. Lynx and wolverine verification. CO Division of Wildlife, Wildlife Research Report.
Moriarty, K.M., W.J. Zielinski, A.G. Gonzales, T.E. Dawson, K.M. Boatner, C.A. Wilson, F.V. Schlexer, K.L. Pilgrim, J.P. Copeland, and M.K. Schwartz. 2009. Wolverine conformation in California after nearly a century: native or long-distance immigrant? Northwest Science 83:154-162.
Nead, D.M., J.C. Halfpenny, and S. Bissell. 1985. The status of wolverines in Colorado. Northwest Science 8:286-289.
Newby, F. E., and J. J. McDougal. 1964. Range extension of the wolverine in Montana. Journal of Mammalogy 45:485-486.
Newby, F. E., and P. L. Wright. 1955. Distribution and status of the wolverine in Montana. Journal of Mammalogy 36:248-253.
Paquet, P. C., and L. N. Carbyn. 2003. Gray Wolf. Pages 482–510 *in* G. A. Feldhamer, B. C. Thompson, and J. A. Chapman, editors. Wild mammals of North America, biology, management, and conservation. Second edition. The Johns Hopkins University Press, Baltimore, Maryland, USA.
Persson, J. 2003. Population ecology of Scandinavian wolverines. Dissertation, Swedish University of Agricultural Sciences, Umeå, Sweden.
Persson, J. 2005. Female wolverine (Gulo gulo) reproduction: reproductive costs and winter food availability. Canadian Journal of Zoology 83:1453-1459.
Rohrer, J., K. Aubry, and C. Raley. 2008. Distribution and ecology of wolverines in the north Cascades. FY 2008 Status Report for the Interagency Special Status/Sensitive Species Program. USFS.
Rowland, M.M., M.J. Wisdom, D.H. Johnson, B.C. Wales, J.P. Copeland, and F.B. Edelmann. 2003. Evaluation of landscape models for wolverines in interior northwest, United States of America. Journal of Mammology 84:92-105.
Schwartz, C. C., S. D. Miller, and M. A. Haroldson. 2003. Grizzly Bear. Pages 556–586 *in* G. A. Feldhamer, B. C. Thompson, and J. A. Chapman, editors. Wild mammals of North America, biology, management, and conservation. Second edition. The Johns Hopkins University Press, Baltimore, Maryland, USA.
Schwartz, M.K., J.P. Copeland, N.J. Anderson, J.R. Squires, R.M. Inman, K. S. McKelvey, K.L. Pilgrim, L.P. Waits, and S.A. Cushman. 2009. Wolverine gene flow across a narrow climatic niche. Ecology 90:3222-3232.
Squires, J. R., D. H. Pletscher, T. J. Ulizio, and L. F. Ruggiero. 2006. The association between landscape features and transportation corridors on movements and habitat-use patterns of wolverines, Final Report, June 2006, Montana Department of Transportation Project No. 8171.
United States Fish and Wildlife Service. 2008. Endangered and Threatened Wildlife and Plants; 12-Month Finding on a Petition To List the North American Wolverine as Endangered or Threatened. Federal Register March 11, 2008. Available at http://edocket.access.gpo.gov/2008/pdf/E8-4197.pdf
Vangen, K. M., J. Persson, A. Landa, R. Andersen, and P. Segerström. 2001. Characteristics of dispersal in wolverines. Canadian Journal Zoology 79:1641–1649.
Wilson G.M., R.A. Van Den Bussche, P.K. Kennedy, A Gunn, and K. Poole. 2000. Genetic variability of wolverines (*Gulo gulo*) from the northwest territories, Canada: conservation implications. Journal of Mammology 81:186-196.
Zielinski, W.J., R.L. Truex, F.V. Schlexer, L.A. Campbell, and C. Carroll. 2005. Historical and contemporary distributions of carnivores in forests of the Sierra Nevada, California. Journal of Biogeography 32:1385-1407.



WOLVERINE (*Gulo gulo*)

Greater Yellowstone Wolverine Program

M56's tracks near Freighter Gap, Wyoming on his way to Colorado

The Wildlife Conservation Society, founded in 1895 as the New York Zoological Society, is a private, non-profit organization involved in conserving wildlife and wild lands in North America, Africa, Asia, Latin America, and the Marine Environment. www.wcs.org

WILDLIFE CONSERVATION SOCIETY