Surveying for rare and elusive predators during summer months using altered winter methods in the Absaroka-Beartooth Wilderness, Montana, with an emphasis on wolverine (*Gulo gulo*) survey techniques.

Mountain lion (*Puma concolor*) at camera station 13 in AB Wilderness, MT

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Introduction

Importance of Study

Predators such as the wolverine (*Gulo gulo*) provide top-down control of community structures, making them an important part of mountainous ecosystems. Wolverines are a species sensitive to both climate change and human activity in wilderness areas (Worsely 2011), making them a good indicator species for evaluating the overall ecological integrity of an ecosystem. This paper describes a project that sought to (a) evaluate the distribution of wolverines and other predators throughout 117,731 hectares of the Absaroka-Beartooth Wilderness (ABW) identified as ‘suitable habitat’, (b) determine if non-invasive methods and non-bait scent lures adapted to wilderness use would be effective for a summer wolverine and (c) increase public involvement in wolverine conservation by incorporating citizen science efforts.

Wolverines in the ABW

This study was designed to document the presence of wolverines in Montana’s ABW, which is located in south central Montana, just north of Yellowstone National Park. The ABW is defined by the Beartooth Mountains which rise from about 6,000 feet to more than 11,000 feet above sea level. The ABW features a variety of vegetation types, including vegetation preferred by wolverines during summer months such as whitebark pine (*Pinus albicaulis*) (Absaroka-Beartooth Wilderness Foundation 2014). Only two previous known records exist within the study area, one of them dating back to August 1894 (Figure 1).

Wolverines have a large home range and their presence has been documented throughout a variety of coniferous forest types including whitebark pine, lodgepole pine (*Pinus contorta*), Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*). Wolverines require cold-conditions and limit their distribution to high elevations in northern latitudes (Federal Register 2013). During summer months, wolverines prefer whitebark pine forests and north-facing slopes for the purpose of thermoregulation and hunting (Copeland et al. 2007). Successful reproduction (natal denning), requires persistent snow cover (Copeland et al. 2010, Federal Register 2013), such as that found at high elevations within the ABW.
Figure 1. Historic wolverine records within the current study area in the AB Wilderness, MT.

Susceptibility

Wolverines are a species that is particularly vulnerable to human activity and climate change. Ecological theory suggests that wolverines could be particularly susceptible to climate change due to their generally low density, resource-limited populations and high-alpine habitat dependency (Brodie and Post 2009). Recent studies suggest that as global warming trends increase due to climate change, wolverine habitat in places like the ABW will continue to dissipate and populations will become increasingly isolated and susceptible to decline (McKelvey et al. 2011). Human activity, such as snowmobiling and back country skiing, creates a potential for habitat fragmentation, additive mortality and displacement of wolverine populations (Krebs and Lewis 2000). Similarly, human predation poses a threat to wolverine populations in Montana. Historically, wolverines have been classified as ‘furbearers’ in the state of Montana. Previous trapping regulations allowed the limit of one wolverine per trapper under a long-standing state wide quota of five animals per season (MNHP and MFWP 2014). In 2012, the U.S. Fish and Wildlife Service proposed to list the wolverine as a threatened species under
the Endangered Species Act (ESA). This would prohibit intentional killing, i.e. trapping. Wolverines are not currently protected by the ESA (USFWS 2014). This susceptibility, coupled with a general lack of knowledge, makes wolverine management and conservation difficult for wilderness managers in the ABW.

**Methods**

**Study Area**

The study area encompassed 117,731 hectares of the ABW, Montana in the following drainages: West Rosebud, East Rosebud, West Fork and Lake Fork (Figure 2). In an effort to document wolverine presence in these drainages, three student researchers worked from May through October to set up seven wolverine camera stations in carefully selected locations ranging from 8980 feet to 9912 feet in elevation.

Figure 2. Drainages surveyed in ABW and study area relative to Red Lodge, MT
Site Selection
Past sightings and vegetation type were the primary factors in site selection. United States Forest Service (USFS) Vegetation Mapping was used in conjunction with ArcMap GIS workflows (slope and aspect analyses and geoprocessing) to determine areas of suitable vegetation type for wolverine prior to fieldwork. Suitable habitat criteria included: (a) vegetation type (preferably whitebark pine), (b) elevations of 8,000 feet or greater and (c) north-facing aspects (Hornocker and Hash 1981). On-site selection was based on suitable habitat criteria and available resources for set-up, such as natural feature material. Vegetation mapping included the following vegetation types: whitebark pine, subalpine fir, lodgepole pine and Engelmann spruce. Student researchers also spent one day training under an experienced wolverine camera trap surveyor, Kalon Baughan, determining suitable habitat and setting up efficient camera stations (Baughan 2014).

Camera Details
Seven multi-shot cameras were used as the primary data collection tools for this study. Camera images recorded: time, date, temperature, moon phase and camera number. Moultrie Model # MFH-DGS-D55R cameras were set up at Site 1 (Silver Run Elk Trail) and Site 1(2) (Silver Run Plateau Ridge). Moultrie Model cameras had 5.0 MP image resolution, 50 feet trigger range, one minute delay and multi-shot collection of three images per one trigger. Reconyx HC600 HyperFire H.O. Covert IR cameras were set up at Site 5 (Timberline Lake), Site 6 (Sylvan Lake Ridge), Site 8 (Phantom Lake), Site 12 (Silver Run Plateau Bowl), and Site 13 (First Rock Lake). Reconyx HC600 cameras had 3.1 MP image resolution, 60 feet trigger range, zero second delay and multi-shot collection of five images per one camera trigger. Each camera was encased by a Reconyx HyperFire Security Enclosure to protect cameras from animals and theft. Throughout this paper, camera site coordinates refer to physical camera locations. Camera stations were checked roughly every two week after set up.

Camera Station Elements
At each site, a “natural feature” was constructed in camera view roughly 4-6 meters from the camera location (Figure 3).
Natural features were constructed using available material (i.e. fallen tree), which were further modified using light-weight hatchets (Baughan pers communication 2014, Schlexer 2012).

Hair snares made from carpet squares with ten 1 inch barbed nails passed through the carpet were attached about 17 inches high on either the natural feature or nearest, stable tree in camera view in attempt to collect hair samples for possible DNA analysis for species confirmation (Figure 4) (Gompper et al. 2006).

Figure 4. Hair snare and carpet square setup.
The scent mixture consisted of a 1:6 ratio of *Minnesota Trapline Inc.* glycerine and *Hawbakers Long Distance Call 600*. For each ounce of scent mixture, 10 drops of *Dr. Adorable Inc.* catnip oil was added. The decision to use scent lures over bait was made in an effort to avoid bears, which are more numerous than wolverines in the ABW and readily attracted to bait. Scent lures consisted of five centimeter by five centimeter carpet squares which were soaked in prepared scent solutions and suspended above the natural feature using fishing line. Additional carpet squares were placed above hair snare locations. Owl feathers were used as visual attractants and were hung by fishing line roughly 12-16 meters away from the surrounding camera location (Figure 5). Three visual attractants were used at each site.

**Figure 5. Camera Site setup example**

![Camera Site setup example](image)

**Data Collection and Analysis**

Twenty four GB SD memory cards were used to store data (images) from cameras. An *A1337 iPad* was used to download camera data on site during each camera check. After the download was complete, camera data was deleted from memory cards which were then placed back in the camera for further data collection. Camera data was briefly analyzed on site and the number of species and individual captures were recorded. Regardless of the number of camera triggers and images, a 24-hour period defined one capture per individual animal. Hair snares
were checked for hair samples. Hair samples, when present, were collected using needle nose tweezers and placed in standard size seed packet envelopes. Other notes such as site disturbance, scat, etc. were recorded on site.

**Results**

*Species Detected*

Wolverines were not detected at camera stations during the five months of this study. However, non-bait scent lures proved effective at detecting a wide range of species, including more elusive carnivores. A total of 18 species were documented throughout the course of this study. These species included: American black bear (*Ursus americanus*), American marten (*Martes americana*) (Figure 6), American red squirrel (*Tamiasciurus hudsonicus*), American robin (*Turdus migratorius*), bobcat (*Lynx rufus*) (Figure 7), bushy tailed woodrat (*Neotoma cinerea*), coyote (*Canis latrans*), dusky grouse (*Dendragapus obscurus*), elk (*Cervus canadensis*), grizzly bear (*Ursus arctos horribilis*), house wren (*Troglodytes aedon*), yellow bellied marmot (*Marmota flaviventris*), moose (*Alces alces*), mountain goat (*Oreamnos americanus*), mountain lion (*Puma concolor*), mule deer (*Odocoileus hemionus*), American pika (*Ochotona princeps*), red fox (*Vulpes vulpes*), and snowshoe hare (*Lepus americanus*).

Figure 6. *Reconyx HC600* image of an American marten (*Martes americana*) at Camera Site 5
Species diversity

Species diversity was calculated as the number of species detected at each camera station (Figure 8). Camera Site 5 (Timberline Lake) was the most diverse camera station with seven species, including: American red squirrel, American marten, elk, American robin, coyote, red fox, and American black bear. Camera Site 6 (Sylvan Lake Ridge) was the least diverse camera station.
Capture Success Rate

Cameras were deployed for a total of 11,016 hours. A total of seven carnivore species were captured during this study. Capture success rate was calculated as the number of individual species detected divided by the total hours of all cameras deployed and calculated for each species detected (Figure 9). Species with the highest capture success rate were snowshoe hare, American red squirrel, elk, American black bear, American marten and mule deer.
Figure 9. Capture success rate of species detected

Notably, a total of 37 individual snowshoe hares were captured (detected) throughout the course of this study. Thirty-seven snowshoe hare divided by 11,016 total camera hours is a capture success rate of 0.0034. This was the highest capture success rate of all species detected. The American red squirrel had the second highest capture success rate with a capture success rate of 0.0028. The coyote, grizzly bear, mountain lion, house wren and pike had the lowest capture success rates of all species detected with capture success rates of 0.00009.

Citizen Science Results
An unanticipated result of this study was that due to publicity that appeared on the front page of The Billings Gazette (http://billingsgazette.com/lifestyles/recreation/capturing-photographs-of-lynx-wolverine-proving-tough-for-students/article_68a34ed9-6ea8-5e66-98bd-7c5d96fb7280.html) and outreach generated with our partnerships, five new reliable sightings of wolverine in the ABW were confirmed (Figure 10). Four of these new wolverine sightings were within the current study area. The fifth new wolverine sighting was outside of the study area, near the Boulder River Drainage. A brief anecdote about this observation provides an example of how the citizen scientist reporting worked. After reading about the present study in the newspaper, citizen scientist Kim Latterall submitted an image to the local Montana Fish Wildlife and Parks office an image of a wolverine near West Boulder Lake (near the Boulder River Drainage) that was taken on July 24, 2014 (Figure 11). The image was then submitted to the Yellowstone River Research Center by the other hiker with a full detailed description of the wolverine behavior and exact location. Latterall stated, “the wolverine traveled around the east
and south end of West Boulder Lake and crossed the divide into the Prospect Lake Drainage.” Latterall also captured and submitted an image of the wolverine’s tracks imprinted in the snow (Figure 12). Five new confirmed wolverine sightings resulted in a 150% increase of confirmed wolverine sightings in the ABW.

Figure 10. Five new reliable confirmed sightings of wolverine in the ABW.
Figure 11. Image of a wolverine near West Boulder Lake taken by citizen scientist Kim Latterall on July 24, 2014. Note the distinctive brown color on the back of the animal.

Figure 12. Image of wolverine tracks near West Boulder Lake taken by citizen scientist Kim Latterall on July 24, 2014.
Discussion
Non-invasive Methods, Non-scent Bait Lures and Wilderness Etiquette

In general, carnivore species can be difficult to study because of their cautious nature towards humans. United States Forest Service (USFS) protocol suggests flashers, photographic bait stations and snow tracking as primary methods for carnivore surveys. The USFS encourages the use of road-kill as bait for attracting carnivores. Visual attractants or “flashers” suggested by the USFS include aluminum pie plates, sandwich bags, and compact discs. USFS protocol also suggests the use of single-sensor, double-sensor and line-triggered cameras for detecting carnivores (USFS 1995). Magoun et al. (2011) suggests the construction of a support structure in camera view for specific wolverine identification purposes.

During summer months in the ABW, bait is inefficient and potentially dangerous to hikers in the area due to the potential to habituate bears to food and attract them for long periods of time. The presence of bears and other large predators alone could contribute to the absence of wolverine. There is also evidence that suggests wolverines are less attracted to non-bait scent lures due to natural food availability. To be sensitive to Wilderness Area etiquette and laws no man-made objects were used as visual attractants, instead large owl feathers and only natural objects were used to construct the photographic “site” and attract predators. Due to the limitations of using bait in the summer months and ease of winter tracking surveys in some areas, summer carnivore surveys are not often conducted and thus valuable knowledge about carnivore habitats during summer are lacking. This study found that altering traditional winter techniques (bait and man-made attractants and constructed photo site”) had great success at attracting a variety of carnivore species (seven total).

Unexpected Citizen Science Success

Citizen science involves the collaboration of scientists and volunteers in the collection of scientific data to improve research, and to promote educations and environmental action (Brewer 2002, Toomey et al. 2013). Coop et al. (2014) found that citizen science involvement was particularly useful for documenting large-scale spatial patterns and long-term population trends. Local publicity (French 2014) and partnerships with NGOs increased community awareness about wolverine conservation. All new wolverine records confirmed during this study were submitted by reliable citizen scientists and were often accompanied by detailed accounts and location information. This suggests that in addition to active survey efforts, the documentation of rare and elusive carnivores, in vast areas such as the ABW, with limited winter access, requires the cooperation and active engagement of scientists, and community members.

Capture Success Rate: Rare Carnivores and Incidentals

Capture success rate varied among species. Frederick et al. (1998) describes capture success rate as an indication of frequency that a species is found in an area. Elusive carnivores and incidental species had the lowest capture success rate. Carnivores with relatively low capture success rates included mountain lion, grizzly bear, coyote, bobcat and red fox. Low capture success rates indicate the need for many hours of camera deployment for detection to be achieved for some of these more elusive species. The fact that wolverines were not detected does not mean that they are not in the area. It is clear when looking at species detection rates that it takes many hours of camera deployment to record rather common carnivores like American black bears. Incidental species also had low capture success rates assumedly because they had no motive to return to camera sites and were often not drawn to the camera by scent.
Conclusion

This project pioneered some new techniques for use in Wilderness Areas that are successful at attracting carnivores. The diversity of carnivore species recorded with just a small number of cameras is encouraging. With the guidance from new information on wolverine locations from the recent citizen science observations, continued camera trap survey work can now focus on those areas next summer. Summer records of wolverine are important as they may eventually help identify important denning locations.

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Literature Cited


