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2017-2018 Winter Mammal Survey

Konnex Resources, Inc. - Empire Mine

Konnex Resources, Inc.
Mackay, Idaho
December 2018

444 Hospital Way, Suite 520
Pocatello, Idaho 83201
Ph. (208) 233-6565
Fax (208) 233-6566
cascade-earth.com

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Empire Mine Project
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Prepared For:	Mr. Ryan McDermott Konnex Resources, Inc. PO Box 329 Mackay, ID 83251
Prepared By:	Cascade Earth Sciences 444 Hospital Way, Suite 520 Pocatello, ID 83201 (208) 233-6565
Author(s):	Leanna Ballard, Staff Biologist
Reviewed By:	Daniel J. Bruner, PG, Managing Geologist
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Daniel J. Bruner

Daniel J. Bruner, PG, Managing Geologist

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EXECUTIVE SUMMARY

Cascade Earth Sciences (CES) conducted a mammal study at the historic Empire Mine near Mackay, Idaho, for Konnex Resources, Inc. during the winter of 2017 to 2018. The purpose of the study is to document mammals that are active at the Site during winter months, with particular emphasis on the fisher, North American wolverine, and gray wolf.

The Empire Mine is a contiguous block of nearly three square miles of patented and unpatented mineral claims on the east slope of the White Knob Mountains. The study included identification of tracks in fresh snow and photographing animals at six camera traps distributed over the Empire Mine.

Animal track surveys were conducted following two snowstorms in March. Tracks identified on March 7, 2018 included coyote, red fox, mountain lion, bobcat, elk, snowshoe hare, chipmunk, and red squirrel. Wolverine tracks were observed on March 20, 2018, in addition to coyote, marten, mountain cottontail, snowshoe hare, long-tailed weasel (ermine), packrat, and red squirrel.

Six camera trap stations distributed across the Empire Mine were operated from January through mid May 2018. The camera traps consisted of a game camera mounted on a tree that was pointed at another tree approximately 30 feet away where a cow or deer leg was mounted. A scented lure product was also applied onto the tree. The species that were photographed included wolverine, wolves, bobcats, coyotes, red foxes, moose, mule deer, snowshoe hares, and red squirrels.

The most significant finding of the study was that two young wolverines were photographed individually and together. Three maternal wolverine dens were also found close to one of the stations. It is apparent that the observed wolverines were kits because they were socializing together, still had some white fur from birth, were too small to be adults, and they engaged with the bait bones in a playful manner. Wolverines are solitary, so it would not be expected to find two adults hunting together. Female wolverines give birth, typically to three kits in deep winter. The kits stay with their mother until the fall of the year they were born, then they disperse. The kits are born white, which provides camouflage protection to them in their snowy birthplace. One of the kits can clearly be viewed with a lot of white still on his underside as he is still transitioning to his adult pelage coloring. None of the photos captured the mother.

Within the context of wolverine genetic studies being undertaken in Central Idaho and the Bitterroot Range, further surveys and genetic testing of hair samples should be considered in future studies to build upon the findings of this study. Genetic testing would help determine relationships of any wolverines observed at the Empire Mine with other populations in the region and provide context for evaluating the significance of wolverine occurrence and habitat at the Empire Mine.

1.0 INTRODUCTION

Konnex Resources, Inc. (Konnex) is conducting a mineral resource evaluation (mapping, drilling, surface sampling, resource modeling), engineering feasibility studies and environmental baseline studies for developing an open pit copper mine on 1,837 acres of mineral claims that it holds near the historic Empire Mine (Site) within the Salmon-Challis National Forest. The Site is located four miles west of Mackay, Idaho, in the White Knob Mountains (Figure 1).

Baseline wildlife surveys are being conducted to characterize wildlife within the vicinity of mineral claims (patented and unpatented) held by Konnex near the (Site). The surveys will help define existing biological resources and act as "measuring sticks" for planning. The purpose and need also assist with identifying how future mining activities may interface with federal agency protections of certain sensitive plant and wildlife resources that would need to be addressed during the permitting process.

This report is provided as an addendum to the 2017 baseline biological survey completed by Cascade Earth Sciences (CES) at the Empire Mine Project for Konnex Resources, Inc. (Konnex; Oct. 10, 2017). Starting in May 2017, CES gathered baseline biological resource information within the Empire Mine patented claim block; 407 acres, plus a 500 foot (ft) buffer surrounding the claim block for a total survey area of approximately 700 acres. CES collected wildlife data and performed surveys for federally and state listed threatened, endangered, or candidate wildlife species, as well as US Bureau of Land Management (BLM) special status wildlife species.

This report summarizes the methods and findings of additional wildlife surveys conducted between January and May 2018. The survey objectives were to detect and document the presence or absence of mammals, especially forest carnivore species, which are active and can be tracked in snow during the winter months. The primary target species of this study was the North American wolverine (*Gulo gulo luscus*), which has been proposed for listing under the Federal Endangered Species Act as a threatened species since 2010. Other target mustelid family species included fisher (*Pekania pennanti*) and American marten (*Martes americana*). The study also targeted felid family species, including mountain lion (*Felix concolor*) and bobcat (*Lynx rufus*). Canada lynx (*Lynx canadensis*) were not targeted, based upon consultation with wildlife biologists in the Salmon-Challis United States Forest Service (USFS) field office, who indicated Canada lynx had not been detected in numerous previous field surveys of the Site area. Canid family species targeted in the study included red fox (*Vulpes Vulpes*), and gray wolf (*Canis lupus*). During the surveys, CES also recorded several big game species, such as deer (*Odocoileus hemionus*), Rocky Mountain elk (*Cervus elaphus nelsoni*), and moose (*Alces shirasi*). The fisher and North American wolverine are also listed as sensitive species in Region 4 of the USFS, which includes the Salmon-Challis Forest.

The scope of the winter wildlife survey included desktop research to identify species of interest and potential habitat, a track survey along routes that could be safely navigated in a reasonable timeframe (one to two days), and establishing and monitoring camera traps. Protocols for both winter tracking and camera trap surveys were based upon a USFS survey methods manual (Zielinski, William J., et al. 1995). These surveys were performed in a manner by which a set of qualitative and/or quantitative observations are made, by means of a standardized procedure and within a restricted period of time and over a restricted area" (Hellawell 1991). Although no wolverine had been documented within the Site before, with the large home range of this species, and with known sightings in Copper Basin, it is important to understand the distribution of this sensitive species. The study commenced in January 2018 when there was sufficient snow cover and continued until mid May 2018.

2.0 DESKTOP RESEARCH

Preliminary research into the habitat requirements, specific traits of the gait, qualifying features and appearance of the tracks of forest Mustelids (weasel family), Canids (dog family), Felids (cat family), Cervids (deer), Sciurids (squirrels) and Leporids (rabbits and hares) were studied before field surveys of these forest carnivores were conducted.

2.1 Wolverine (*Gulo gulo luscus*)

The wolverine is a large, wide ranging mustelid that occurs throughout arctic, alpine, and boreal forest habitats of North America and Eurasia. The southernmost extant population of wolverines in North America occupy the Rocky Mountains of Idaho, Montana, and Wyoming, and the north Cascade Range of Washington. Wolverines have specialized habitat needs, including enormous space requirements and affinity to areas characterized by persistent snow cover and cool temperatures.

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). Idaho wolverine distribution is related to snow, cold temperatures, and rugged terrain and occurs in high elevation montane habitats centered near alpine tree line (Copeland 1996, Copeland et al. 2010).

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 Sawtooth-Challis National Forest.

2.1.1 Habitat Use

Wolverine habitat in the western U.S. is broadly associated with high elevation montane areas with alpine climatic conditions and isolation from human activity (Aubry et al. 2007). These features likely reflect wolverine life history needs including availability of seasonal food resources, predator avoidance, and apparent avoidance of human activity (Lofroth and Krebs 2007). Wolverine habitat selection is strongly influenced by seasonal food supply, suggesting that wolverine populations are food limited in the cold, low productivity environments they occupy (Persson 2005). In summer, both sexes shift to slightly higher elevation subalpine and alpine habitats where small mammals and birds comprise a majority of the diet (Hornocker and Hash 1981, Krebs et al. 2007).

Wolverines exhibit consistent use of avalanche chute habitats in all seasons given the prevalence of large mammals killed by avalanches in winter and the availability of marmots (*Marmota spp.*) and ground squirrels (*Urocitellus spp.*) in summer (Krebs et al. 2007). Wolverine researchers generally agree that wolverines' association with a particular vegetation type is likely attributed to some other ecological component of that habitat, such as greater abundance of food, thermoregulatory benefit, or avoidance.

Predation risk may influence female wolverine selection of reproductive sites (Magoun and Copeland 1998). Natal dens are located in high elevation, rugged, and complex terrain where security from predators is presumably greater. These areas are typically snow covered alpine and subalpine habitats associated with large wood or rock structures. These include avalanche debris, large talus rubble and rock fields, and large downed woody debris that appear to provide large subnivean spaces or may be temporary structures within the snow layer itself (Magoun and Copeland 1998). Persistent, stable snow cover appears to be an important feature of denning habitat and may aid in kit survival by providing reduced predation risk, thermal benefits, or proximity to quality rearing habitat (Magoun and Copeland 1998). In central Idaho, wolverines do not spatially associate with elk winter range, perhaps to reduce the probability of encounters with gray wolf, mountain lion, and coyote (*Canis latrans*) (Copeland et al. 2007). Wolverines scavenge carrion in winter in mid elevation forests often associated with hunter camps and wounding mortality (Copeland 1996).

Occupied wolverine habitat is generally spatially separated from human habitation, including roads, infrastructure, and backcountry recreation (May et al. 2006, Copeland et al. 2007, Inman et al. 2013). This relationship likely suggests wolverines' preference for alpine and subalpine habitats, which are typically inhospitable to human development, rather than avoidance of human activity per se (Copeland et al. 2007).

If wolverine distribution in southern regions can be delineated reliably by persistent spring snow cover, climate driven reductions in the size and connectivity of these areas may signal associated range losses for the wolverine. Significant reductions in spring snow cover associated with climatic warming have already occurred in some portions of the wolverine's range in the contiguous US (Mote et al. 2005). If these trends continue, habitat conditions for the wolverine along the southern extent of its circumboreal range will likely be diminished through reductions in the size of habitat patches and an associated loss of connectivity, leading to a reduction of occupied habitat in a significant portion of the species' range.

Wolverines use modestly higher elevations in summer versus winter, and they shift use of cover types from whitebark pine (*Pinus albicaulis*) in summer to lower elevation Douglas fir (*Pseudotsuga menziezii*) and lodgepole pine (*Pinus contorta*) communities in winter. Elevation explains use of habitat better than any other variable in both summer and winter. Grass and shrub habitats and slope also have explanatory power. Wolverines prefer northerly aspects, have no attraction to or avoidance of trails during summer, and avoid roads and ungulate winter range (Copeland et al. 2007).

Wolverines have been reported in 34 of 44 (77%) counties in Idaho. Distribution records documented during the past decade suggest wolverines presently occurring in most, if not all, historically occupied suitable habitat in Idaho. Most historical (1891–1960) records in Idaho are from high elevation montane habitats in the northern and central parts of the state (Aubry et al. 2007). Current range in the contiguous U.S. includes northern and central Idaho, western Montana, western Wyoming, northcentral Washington, and northeast Oregon. Populations appear to have declined during the late 1800s and early 1900s contemporary with declines documented elsewhere in North America (Groves 1988).

2.1.2 Food Habits

Wolverines are opportunistic omnivores in summer and primarily scavengers in winter (Hornocker and Hash 1981). Food habit studies from North America have demonstrated the importance of large mammal carrion in the wolverine diet (Banci 1994). Elk (*Cervus elaphus canadensis*), mule deer (*Odocoileus hemionus*), and domestic cattle carrion were the most common food sources in central Idaho during both summer and winter in one study (Copeland 1996). Wolverines scavenge carrion in winter in mid elevation forests often associated with hunter camps and wounding mortality (Copeland 1996). Small mammal prey, including rodents and lagomorphs, are used to a lesser extent, but these may be key during important periods of reproduction (Inman et al. 2012).

2.1.3 Spatial Use

Wolverines are highly mobile and have large spatial requirements. Adult home ranges vary in size depending on sex and age of the animal (Sandell 1993, Banci 1994). Range wide, the average home range size varies from 422–1,522 kilometers squared (km^2) for males and 73–384 km^2 for females (Magoun 1985, Whitman et al. 1986, Copeland 1996, Persson et al. 2010). Males and females in central Idaho have the largest home ranges reported for the species (Copeland 1996). Food resource availability and dispersion, habitat and topography, and spatial arrangements of conspecifics have all been suggested to influence home range size for the wolverine (Copeland 1996).

2.1.4 Wolverine Status

Regions 1, 4, and 6 of the USFS, with 9 National Forests in Idaho, and the Idaho Office of BLM classify the wolverine as both Proposed and Sensitive Species. These classifications direct each agency to consider consequences of management actions on wolverine habitat and populations. The wolverine is recognized as an Idaho Species of Greatest Conservation Need (SGCN) and has been proposed for listing under the Endangered Species Act (ESA) since 2010. In February 2013, the U.S. Fish and Wildlife Service (USFWS) published proposed rules to list wolverines in the contiguous U.S. as a threatened species, citing the primary threat of habitat and range loss as climate change. The North American wolverine, (*Gulo gulo luscus)*, is considered a distinct subspecies from the wolverines that inhabit boreal parts of Asia and Europe. USFWS proposed listing the North American wolverine as a Threatened Species in February 2013, but delayed its final decision, originally due in February 2014, in order to obtain more comments from the public. Wolverines are currently under consideration by the U.S. Fish and Wildlife Service for federal listing. That agency identified winter recreation as a potentially important listing consideration for wolverines. The research findings incorporate the conservation requirements of wolverine, as well as the desires of winter recreationists. At this time, the State of Idaho maintains that a threatened determination is not warranted due to the high level of uncertainty related to climate change effects on wolverines and their habitat.

Wolverine populations occur over vast geographic areas influenced by multiple political jurisdictions. Because wolverine populations in Idaho are part of the western U.S. metapopulation, IDFG sought an integrated, collaborative approach to wolverine conservation among western states and Canadian provinces in developing the *Management Plan for the Conservation of Wolverines in Idaho*.

As the state agency with legal responsibility to preserve, protect, perpetuate, and manage Idaho's wildlife resources, the Idaho Department of Fish and Game (IDFG) developed the *Management Plan for the Conservation of Wolverines in Idaho* (Plan) to proactively lead state efforts to ensure the long term persistence of wolverine populations in Idaho. The Plan provides an initial framework for identifying and prioritizing research and management actions over the five year period of 2014–2019. The Plan provides a statewide synthesis of wolverine status and distribution, factors that affect populations and habitat, priority areas for conservation, and supporting actions to benefit wolverine populations at state and local scales.

The Plan has been developed in accordance with Idaho Code and policy, which define IDFG's mission to "preserve, protect, perpetuate, and manage" the state's wildlife resources and provide continuing supplies for hunting, fishing, and trapping. The Idaho Fish and Game Commission is charged with administering state wildlife policy through supervision and management of IDFG.

Idaho Code 67-1903 requires state agencies to develop strategic plans expressing how they will meet core mission requirements that identify outcome based goals and performance measures. The current IDFG strategic plan, The Compass, calls for the development of "action plans" that describe programs, projects, and activities necessary to meet strategic plan goals (IDFG 2005a). This Plan tiers to The Compass, functioning as the action plan for wolverine management in the state.

Although IDFG is the State's lead fish and wildlife manager, federal agencies including the USFS and BLM have stewardship responsibility for public lands, i.e., habitat. In deference to state authority for wildlife management, federal agencies are not required to restore native wildlife populations, but they must ensure that the required habitat is maintained to support those populations whether the species actually occurs or not.

The Idaho State Wildlife Action Plan (SWAP) provides an integrated framework for conserving Idaho's 229 Species of Greatest Conservation Need (SGCN) and the habitats they depend on. It is the State's guiding document for managing and conserving at risk species before they become too rare and costly to protect. Proactive guidance in the SWAP promotes recovery efforts and appropriate land use measures.

2.2 Gray Wolf (*Canis lupus*)

Wolves are highly social animals, and the family structure is focused around the pack. Packs typically consist of a breeding pair, the "alpha male and alpha female", and their young from previous years. Pack size doesn't vary much between years because the wolves that either leave or die each year are replaced by newborn pups. Wolves breed in late winter and give birth to an average of four to five pups in spring. The pups are born in a den dug by the breeding female, around which the pack congregates. Wolf pups spend their first six to eight weeks at the den and are weaned at around six weeks of age. Once they begin eating meat, the pups are fed by adult members of the pack.

As the pups become older the pack typically moves them from the den to “rendezvous sites”, which are usually wet meadow areas within a pack’s territory where the adults can leave the pups while they go off to hunt. Wolves may use several rendezvous sites during the summer months until the pups are big and strong enough to travel full time with the pack, generally by late September or October. An adult male wolf stands about 30 inches (in) at the shoulder and can be over six feet (ft) long from the tip of nose to point of tail. It will weigh 70 to 110 pounds. Females are slightly smaller, usually 60 to 80 pounds.

Wolves range in Idaho from the Canadian border south to the Snake River Plain and from the Washington and Oregon borders east to the Montana and Wyoming borders. Biologists documented 108 wolf packs in Idaho at the end of 2015. In addition, there were 20 documented packs counted by Montana, Wyoming, and Washington that had established territories overlapping the Idaho state boundary. Not all packs are presumed documented.

During 1979, wolves were found to be colonizing northwestern Montana from Canada, and a den was located in 1986 (Pletscher et al. 1997). By 1994, the wolf population in northwestern Montana consisted of at least 23 wolves (pre denning), and abundance was increasing at an average of 20% annually (Pletscher et al. 1997). Dispersers from Montana were documented moving through northern Idaho, northeastern Washington, and British Columbia by the early 1990s (Pletscher et al. 1997). Through natural processes, Idaho’s wolf population was expected to reach recovery levels by about 2015 (U.S. Fish and Wildlife Service 2017).

The USFWS completed an Environmental Impact Statement for the reintroduction of wolves into central Idaho and Yellowstone National Park in 1995. During 1995 and 1996, the USFWS, working under authority of the Endangered Species Act (ESA), captured 66 wolves in Alberta and British Columbia, Canada, and released 35 wolves in central Idaho and 31 in Yellowstone National Park. By 2002 Idaho’s wolf population had met all metrics for delisting, and the State of Idaho adopted a state delisting plan (2002 Plan; Idaho Legislative Wolf Oversight Committee 2002) for gray wolf conservation and management pursuant to Idaho Code Title 36, Chapter 24. Wolves were removed from the ESA endangered species list Montana and Idaho in 2011.

The gray wolf, being a keystone predator, is an integral component of the ecosystems to which it typically belongs. The wide range of habitats in which wolves can thrive reflects their adaptability as a species, and includes temperate forests, mountains, tundra, taiga, and grasslands. Gray wolves were originally listed as subspecies or as regional populations of subspecies in the contiguous United States and Mexico. In 1978, USFWS reclassified the gray wolf as an endangered population at the species level (*C. lupus*) throughout the contiguous United States and Mexico, except for the Minnesota gray wolf population, which was classified as threatened. Gray wolf populations in Idaho and Montana were delisted due to recovery in 2011 (USFWS_ECOS_2017).

Wolves in Idaho are currently managed under the 2002 Idaho Wolf Conservation and Management Plan and are classified as a big game animal with harvest authorized for both hunting (2009) and trapping (2011). The plan objective is to retain state management authority by maintaining a well distributed, self sustaining wolf population. Strategies in the plan include:

- use public hunting and trapping as a preferred means of managing wolves,
- annually monitor whether at least 15 wolf packs are extant in Idaho,

- annually monitor changes in trend of Idaho's wolf population and in its distribution, and
- prioritize management to respond quickly, decisively, and effectively should monitoring indicate the need.

Idaho Fish and Game applies the following strategies to address areas of recurring depredation on livestock and other domestic animals:

1. cooperates with livestock interests, the Idaho State Animal Damage Control Board, the Idaho Wolf Depredation Control Board, and USDA APHIS Wildlife Services to reduce and document wolf depredations on livestock, and
2. takes additional, aggressive action to reduce depredations in areas with frequent and abundant livestock depredations:
   - a: provide liberal opportunities for sport harvest of wolves,
   - b: authorize and encourage full pack removal in response to confirmed wolf depredations in chronic depredation areas and,
   - c: provide liberal private kill authorizations near chronic depredation areas (Oversight Committee 2002).

Wolf distribution and pack numbers were monitored across Idaho through multiple detection state and method occupancy models through 2009–2014 using noninvasive genetic sampling in predicted rendezvous site habitat, locations of radio collared wolves, a survey of wolf observations by hunters, and up to nine covariates such as slope, elevation, and forest cover (Ausband et al. 2015). Following Ausband et al. 2015, an estimated 81 wolf packs (95% CI 78 to 85 packs) were extant in Idaho during summer 2016. Population Size: After peaking in 2008 at 849 wolves, Idaho's estimated number of wolves in documented packs, other documented groups, and lone wolves at year end stabilized between 684 and 786 wolves during 2010–2015.

2.3 Other Canids

In addition to the gray wolf, two other canid species that are more common in the region are the red fox and coyote. Coyote and red fox tracks are similar since they are both members of the canid family, but coyote tracks are larger. Tracks are oval, usually show triangular foot pads, and can show claw marks. Coyotes and red fox walk or trot in an alternating pattern with prints nearly inline, but may trot with a two print track pattern or lope or gallop in a four print pattern. Track patterns are usually straight but may meander. Coyote tracks can reach up to 3 in in length compared to 2.5 in for red fox (Fisher, et al. 2000). Fox tracks often show foot drag marks.

2.3.1 Red Fox (*Vulpes vulpes*)

Red foxes are the most common wild canid species in the world, as they are able to adapt quickly to new environments. They are long associated with human occupation, and thrive in many suburban and urban areas.

2.3.2 Coyote (*Canis latrans*)

In pioneer days, coyotes (*Canis latrans*) were restricted primarily to the sagebrush lands, brushy mountains, and open prairies of the American West. Wolves occupied the forests. Coyotes have since taken advantage of human activities (including the reduction of gray wolf populations) to expand their range throughout North and Central America. In many parts of the United States, these intelligent and adaptable animals now manage to occupy almost every conceivable habitat type, from open ranch country to densely forested areas to downtown waterfront. Despite ever increasing human encroachment and past efforts to eliminate coyotes, the species maintains its numbers and is increasing in some areas. The coyote's tenacity tries some people's patience and inspires others' admiration. At first glance, the coyote resembles a small German shepherd dog, yet its color can vary from animal to animal. Shades include black, brown, gray, yellow, rust, and tan. Coyotes also have shorter, bushier tails that are carried low, almost dragging the ground, and longer, narrower muzzles than their dog cousins.

2.4 Other Mustelids

Mustelids are members of the weasel family, which is the largest group of carnivores. Members include ferrets, weasels, mink, fishers, martens, wolverines, badgers, and otters. In addition to the wolverine, target species for the mountainous mature conifer habitat of the Site include weasels (short-tailed and long-tailed), fisher, and pine marten.

Mustelid feet have five toes with an inverted v shaped central pad. The smaller fifth toe print may be obscured. They move with a bounding gait where the front feet land side by side and the hind feet direct register with the front feet. Their gait produces pairs of tracks that are aligned in the direction of travel. The foot placement of larger mustelids tends to be offset, rather than a perfect alignment.

2.4.1 Short-tailed Weasel (*Mustela erminea*)

The short-tailed weasel (ermine) diet consists almost entirely of animals, including mice, voles, shrews, chipmunks, pocket gophers, rabbits, bird eggs, and nestlings. It is most abundant in coniferous forests and streamside woodlands. Short-tailed weasel tracks are less than 0.5 in square.

2.4.2 Long-tailed Weasel (*Mustela frenata)*

Long-tailed weasels have similar diets and habitats as short-tailed weasels. Long-tailed weasel tracks are between 0.5 and 1 in square.

2.4.3 American Pine Marten (*Martes americana*)

The American pine marten occupies late successional forest with dense canopy closure and often associated with riparian areas, similar habitat as the fisher. American pine marten tracks are 3 to 4 in long, less than 2.5 in wide with five toes, straddling less than 4.5 in, and may show claw marks; foot pads are chevron shaped.

2.4.4 Fisher (*Pekania pennanti*)

Fishers are similar in size to a domestic cat, smaller than wolverines and larger than martens. The size of fisher tracks can overlap those of its close relative, the marten. Distinguishing marten tracks and trails from those of fishers has proven difficult (Halfpenny, 1995). Fishers are a Region 4 sensitive species and are much rarer than martens. Fishers are described as arboreal, but they may cover considerable distances on the ground.

2.5 Deer Family (Cervidae)

Three species of the deer family occur at the Site, as they do throughout the region. Deer species are herbivores that forage throughout the year, switching from grass and forbs in warm weather to shrubs and trees during winter.

Deer species have cloven hooves that form an upside down heart shaped track with a rounded bottom. The sides of a deer track are convex with the tips of the hooves pointed towards the inside of the track. Deer typically walk with a direct register where the hind foot lands directly where the front foot imprinted.

2.5.1 Mule deer (*Odocoileus hemionus*)

Mule deer are the most common deer species, and the smallest of the three species. Mule deer tracks are 2 to 3.3 in long by 1.6 to 2.5 in wide, straddling 5 to 10 in, with a walking stride of 10 to 24 in and a stotting (bounding) stride of 9 to 19 ft.

2.5.2 Elk (*Cervus canadensis*)

Elk have a diverse habitat range, where they tend to winter ranges at lower elevations in open forests and floodplain marshes and migrate higher into subalpine forests and alpine basins in the summer. Elk tracks are 3.2 to 5 in long by 2.4 to 4.5 in wide, straddling 7 to 12 in, with a walking stride of 2 to 3 ft and a galloping stride of up to 8 ft. Elk tend to drag their feet through the snow as they walk. The hind foot will sometimes double register slightly ahead of the front foot.

2.5.3 Moose (*Alces alces*)

Moose are the largest deer species and tend to be solitary. Moose are well adapted to cold weather and select habitat on the basis of tradeoffs between risk of predation, food availability, and snow depth. They tend to prefer sub alpine shrublands in winter, river valleys with deciduous cover or alpine terrain above tree line. Moose tracks are 4 to 7 in long, 3.5 to 6 in wide, straddling 8.5 to 20 in, with a walking stride of 1.5 to 3 ft and a trotting stride of up to 4 ft. Moose do not drag their feet as elk do. Since moose are very heavy, the dew claws tend to register behind the hoof prints.

2.6 Cat Family (Felids)

Felids are members of the cat family. Compared to coyotes and other canids, the prints tended to be wider than longer, and the retractable claws never register. In addition, felid tracks have an asymmetrical shape with a leading toe within a more round outline. Felids have larger pads on their feet than canids, which leaves a flatter, more even track than the characteristic bump or high spot in the middle of canid tracks between the pads and the toes. Mountain lion tracks are greater than 3.3 in wide whereas bobcat tracks are 2 to 2.5 in wide.

2.6.1 Mountain Lion (*Puma concolor*)

Mountain lions are found most frequently in remote, wooded, rocky places, usually near an abundant supply of deer. In the Rocky Mountains they inhabit mainly the montane regions, which is where the tracks for this largest of the felids were viewed.

2.6.2 Bobcat (*Lynx rufus*)

The bobcat looks like a larger version of a housecat with a bobbed tail, but it is a wildcat in every way. It depends on its light footedness, agility, and stealth. Bobcats occupy open coniferous and deciduous forests and brushy areas. Their preferred food is rabbit, but they will also eat squirrels, mice, voles, and beavers. When necessary, bobcats feed on the kills of other animals.

2.7 Rabbit and Hare Family (Leporids)

Leporid species are members of the hare and rabbit family. Target Leporidae species for this study are the mountain cottontail and the snowshoe hare.

2.7.1 Snowshoe Hare (*Lepus americanus*)

The snowshoe hare has very large hind feet that enable it to travel on top of soft snow, which helps it escape predators. Another protective characteristic of the snowshoe hare is that its coat turns completely white in the winter, which provides camouflage. They are found almost everywhere in forest and dense shrub habitat of the Rocky Mountains.

2.7.2 Mountain Cottontail (*Sylvilagus nuttallii*)

The mountain cottontail does not hibernate. A major habitat requirement is cover, whether it is brush, fractured rock outcrops or buildings, or where the forest edge meets meadows.

2.8 Squirrels (Sciurids)

Sciurid species are squirrels, which are rodents. The target sciuridae species for this study is the red squirrel (*Tamiascuirus hudsonicus*).

The red squirrel occurs frequently in wooded areas of the Site as it is active year round. It occupies coniferous forest in the Rocky Mountains. Several pinecone middens (piles of cone scales and cores indicating a squirrel's favorite feeding site left at the bottom of trees) were discovered. The tracks' fore prints tend to be side by side, with fore prints having each four toes, with five on the hind. The heels often do not register as these squirrels run. In deeper snow, the tracks merge to form pairs of diamond shaped prints.

Chipmunks are members of the Sciuridae family also present at the Site, including the least chipmunk (*Neotamias minimus*) and yellow pine chipmunk (*Neotamias amoenus*). However, chipmunks would not be observed actively foraging during the winter. Instead, they stay in their burrows and eat food they have cached during warmer months.

3.0 SURVEY METHODS

Track surveys and camera traps were operated in a standardized fashion using methods that were tailored to the local environment.

3.1 Camera Traps

Camera trap stations were setup during the week of January 8–13th and decommissioned on May 11, 2018. The camera trap stations were used to document whether wolverines would occupy the Site at any time during the winter months. Wolverines, fishers, and martens are opportunistic hunters. In addition to taking live prey, they frequently scavenge in winter and can be attracted to the carcasses of ungulates.

3.1.1 Camera Trap Locations

CES researched the most likely landscape locations where wolverine could occur within the Site. Copeland (2010) studied the habitats where wolverine choose natal and maternal den locations. These include snow covered rocky scree or boulder talus (Haglund 1966, Myrberget 1968, Pulliainen 1968, Copeland 1996, Lee and Niptanatiak 1996) and snow covered fallen trees usually near timberline, including trees downed by avalanches (Pulliainen 1968, Zyryanov 1989, Copeland 1996, Inman et al. 2007).

Google Earth imagery was utilized to determine the best general locations for the cameras. The major considerations for establishing stations in the field were for maximizing the probability that they would attract the target animal species and minimizing the likelihood that the station would be found by people. Field reconnaissance for station selection included traversing roadways, looking for tracks and assessing accessibility to higher elevations, ridgelines, open avalanche chutes, and scoping with binoculars for mammals.

Camera trap stations were established at six locations dispersed across the Site in key areas where wolverine, if present within the Site would be likely to visit. Stations were placed as shown in Figure 2 in the following locations (approximate elevations (+/- 10 ft) above mean sea level (ft amsl)) with camera identifications:

- Station 1 – base of north facing slope on edge of Douglas fir forest in Rio Grande Canyon above the Horseshoe Mine at 8,120 ft amsl, Camera “US91MP14E CRAMERUDWR” (same designation as Station 4),
- Station 2 – open ridge with sage brush and sparse conifers on north side of Rio Grande Canyon at 7,610 ft amsl, Camera “BELL E CRAMER MDT”,
- Station 3 – bottom of Horseshoe Canyon along perennial stream in conifer forest approximately 60 yards above road at 7780 ft amsl, Camera “BIG SW CRAMER MDT”,
- Station 4 – near north edge of Douglas fir forest on north facing slope approximately 100 yards southwest of Empire Mill at 7,600 ft amsl, Camera “US91MP14E CRAMERUDWR” (same designation as Station 1),
- Station 5 – avalanche shoot approximately 160 yards above road at 8050 ft amsl, Camera “PC800 PROFESSIONAL” replaced by “MP378U N CRAMER UDOT”, and
- Station 6 – broad ridge near wall area of granite boulders approximately 300 yards west of AP Pit at 9,100 ft amsl, Camera “BELL W CRAMER MDT”

The camera station locations were selected to provide a clear line of site between two trees approximately 30 ft apart, where the camera was mounted on one tree and the bait was mounted on the other. Photographs of the stations during establishment are included in Appendix A.

3.1.2 Camera Trap Bait

Signs were mounted on the bait trees to indicate the station numbers in photos. Signs were created by printing the number on 8.5 by 11 in white paper that was laminated. The signs were attached to the bait trees facing the cameras using wood screws.

A local meat processing facility in Mackay supplied cow legs, and occasionally deer legs. The legs included femurs, tibias and attached muscles. The legs had partial pieces of meat attached to the bones. The bait was transported either on a sled with snowshoes or with an ATV. The bait was suspended approximately 10 ft off the ground so that the carnivores would be captured on camera as they reach and/or climb the tree to reach it. The bait was mounted to the trunk of each tree using braided wire rope. Holes were drilled into the bones for threading the rope through the bones. The wire rope was slung over a tree branch to raise the bait to the desired height, and the technician climbed a ladder to wrap the rope around the trunk and secure it tightly with wire nuts. The bait was replaced whenever the flesh had been removed by feeding. Unexpectedly, the flesh was rapidly removed at several stations by Clark’s Nuthatches. To mitigate the bird feeding, the bait was wrapped with inexpensive wire window screen. A scale for measuring animal dimensions was fashioned from polyethylene rope that was fastened to the tree with reflective tape markers placed at one ft increments.

A commercially available lure product was applied to the bait called “Caven's Gusto - Long Distance Call Lure - Predator Trapping.” The product description includes: “…certainly smell skunk but underneath you will detect a sweet odor consisting of a generous dose of castor and muskrat musk. To top it off, I’ve added a couple more ‘special agents’ and put it up in a thick base so it hangs in there a long time. Use ‘GUSTO’ above your set during warm weather and directly at your set when it starts to cool down. Made for red fox, grey fox, coyotes, bobcats and for you marten and fisher trappers, it doesn’t get any better than this.” It was very pungent for a long distance.

3.1.3 Camera Specifications

The game cameras were motion sensitive Reconyx Model PC800, which have a practical range of 100 ft by day and 70 ft by night. They are also equipped with infrared heat detectors and trigger upon animals walking within the cone of influence, especially when the cold night temperatures vary greatly from the wildlife species’ bodies as they pass near the bait stations. The cameras took 3.1 megapixel images at a frame rate up to two frames per second for ten photos at a time. The cameras had 32-gigabyte memory cards that can store approximately 80,000 images. The photos are color by day or lo-glow infrared monochrome images at night. The cameras were mounted to the trees with bungee cords and steel braided, plastic coated locking cables that ran through the protective steel camera security enclosures. Each camera had a laminated, detailed explanation of why the cameras were at each location in case of discovery by recreationists or trappers, for added security.

3.1.4 Camera Trap Station Monitoring and Maintenance

The camera traps were maintained and monitored by Konnex staff every one to two and a half weeks (average 12 day frequency). Monitoring duties included exchanging or downloading the camera memory cards and investigating tracks surrounding the bait stations. Maintenance duties included inspecting and replacing the bait if the flesh had been removed, checking the functioning of the cameras by reviewing photos taken during each monitoring event, and replacing batteries as necessary.

3.2 Track Surveys

The track surveys involved locating tracks, photographing them and identifying the species that made them. A trained biologist collected georeferenced photographs of animal tracks while traveling. In addition, individuals, and/or signs, e.g., scat, hair, feathers, scratch marks, were recorded. Tracks were photographed and later determined to species level.

The track survey protocols required mobilizing to the Site within four days of a snow erasing event i.e., snowfall that fills in old tracks. Measurements of both length and width of individual tracks as well as a measurement between tracks to measure the mammal's gait were taken. Melting and evaporation, sublimation, erosion, and settling of the snowpack can alter tracks to varying degrees. Tracks undergoing metamorphism may become enlarged and distorted in one dimension or both. Enlargement can be dramatic, with prints increasing up to four times in an area.

The surveys were completed along Upper Empire Mine Road, Forest Road 40207-C, from the junction with Windy Devil Road to the AP Pit (700 level) (Figure 2). The road was plowed, which enabled travel with a 4 wheel drive passenger vehicle. Travel routes were surveyed for 5 meters (m) from the side of the plowed road.

Track surveys were also periodically conducted in 10 m wide swaths along unplowed travel routes to six camera trap stations dispersed across the Site (Figure 2). Camera trap stations were located an average of 350 yards from the plowed road (50 to 800 yards, median of 285 yards). These travel routes were surveyed by snowshoe.

4.0 RESULTS

Study results include identification of tracks photographed during two winter tracking surveys and species photographed in the five month camera trap survey.

4.1 Winter Tracking Surveys

Two winter tracking surveys were conducted following snow erasing events in March 2018. The winter tracking surveys yielded diverse populations of wildlife species, which are exemplified by photos included in Appendices B and C. Wolverines and other forest carnivores were the focus of the winter tracking effort, but prey species were also recorded when their prints were observed.

4.1.1 Track Survey March 7-8, 2018

Track surveys were conducted on March 7–8, 2018, following the first snow erasing event on March 1-3, 2018, where 11 in of snowfall was recorded at the Mackay Lost River Ranger Station. However, high winds during March 3-5 obliterated fresh tracks in open areas.

On March 7, 2018, CES traveled to the AP Pit to begin searching for tracks, and then traveled back down the road to complete the tracking survey. A second day of tracking was undertaken on the morning of March 8, 2018, but no new tracks were detected anywhere along the roadway, and the ones photographed on March 7th had deteriorated further, preventing identification of additional mammal tracks. Still, it was surprising that no new tracks were detected on March 8th when so many tracks had been created by animals between the snow fall event that ended on March 3rd and the track survey on March 7th.

Tracks identified on March 7th photos included coyote, red fox, mountain lion, bobcat, elk, snowshoe hare, chipmunk, and red squirrel (Appendix B). All of these species were found near the AP Pit. Coyote tracks were also photographed the previous day when technicians checked Station 6, which was west of the AP Pit. Tracks of coyote, red fox, bobcat, snowshoe hare, elk, and deer were also observed at lower elevations.

4.1.2 Track Survey March 19-20, 2018

The second winter track survey was conducted on March 19–20, 2018 following a snowstorm on March 17th that dropped 4.0 in of snowfall at the Mackay Lost River Station. The snow conditions were somewhat better for observing tracks than the prior event, but some melting, sublimation and deformation had occurred.

Wolverine tracks were observed on March 20th while snowshoeing into Station 3 (Appendix C). The wolverine tracks, which are of the highest interest in this study, are distinguished from canid or felid tracks by having five long toes with larger claws.

Other tracks identified included coyote, marten, mountain cottontail, snowshoe hare, long-tailed weasel (ermine), packrat, and red squirrel (Appendix C). Coyote tracks were documented at Station 2. An ermine was observed at the Cossack Tunnel (1600 ft level of Empire Mine) compressor building along with a packrat). Numerous red squirrel tracks were viewed going in and out around conifers. Several red squirrels were viewed and heard during the March 20th visit to Station 3 in the Horseshoe Canyon area. A few cottontail tracks were observed. However, tracks of snowshoe hare were much more common and viewed in many areas. The most numerous tracks viewed during the track survey belonged to snowshoe hare. Their tracks were viewed abundantly near Stations 3, 4, and 5. Snowshoe hares were also observed on cameras.

4.2 Camera Trap Results

Numerous mammals were documented at the camera traps from January through mid May 2018. Since the wolverine is the primary species of concern for this study, several photographs of wolverines are included in Appendix D. Photos of other mammals are exhibited in Appendix E. All of the wildlife observations at the camera traps are listed in Table 1.

The species observations are summarized as follows:

- Wolverine at Stations 1, 3 and 5 between April 4 and 9th
- Two wolves observed together and separately at Station 3 on April 27th.
- Bobcat (once) at Stations 2 and 3
- Coyote (twice) only at Station 2.
- Moose at Stations 2 and 6.
- Mule deer at Stations 2, 4 and 5.
- Red foxes commonly observed at all stations except Station 4.
- Snowshoe hares at Stations 2, 3 and 5.
- Red squirrels commonly observed at Stations 1, 3, 4, and 5.

Although not exhibited in Appendix E, bird species observed at Station 6 during maintenance visits included common raven (*Corvus corax*) and Clark's nutcracker (*Nucifraga columbiana*). The Clark's nutcrackers were observed picking off large sections of meat from the cow bones. By the end of February, the bones were bare due to scavenging by the birds. Although the high elevation Limber pine and White-barked pine seeds are their preferred food, Clark's nutcrackers are omnivores that readily utilized the energy rich remaining meat on the cow bones. Red-breasted nuthatch (*Sitta canadensis*) and Mountain chickadees (*Poecile gambeli*) were especially numerous at the lower elevation camera/bait stations, particularly at Station 3, where they aggressively defended the bait from the investigating technicians.

4.2.1 Wolverines

Two young wolverines were photographed individually at Stations 1 and 3, and together at Station 5 (Appendix D). Three maternal wolverine dens were also found and photographed near Station 3 (Appendix D). It is apparent that the observed wolverines were kits because they were interacting with each other, still had some white fur from birth, were too small to be adults, and they engaged with the bait bones in a playful manner. Wolverines are solitary, so it would not be expected to find two adults hunting together. Female wolverines give birth in deep winter, typically to three kits. The kits stay with their mother until the fall of the year they were born, when they disperse. The kits are born white, which provides camouflage protection to them in their snowy birthplace. One of the kits can clearly be viewed with a lot of white still on his underside as he is still transitioning to his adult pelage coloring. None of the photos captured the mother.

Station 1

At Station 1 (Camera "US91MP 14E CRAMERRUDWR") one wolverine was captured on April 4th from 8:33 am to 9:16 am, photos 547 to 552. One wolverine was captured again on April 6th from 4:22 pm to 5:22 pm in photos 559 to 570. The wolverine took down the cow legs.

Station 3

At Station 3 (Camera "Big SW Cramer MDT") one wolverine was captured on April 4th from 9:53 am to 8:08 pm in photos 253 to 432 and again on April 7th from 8:39 am to 2:19 pm in photos 433 to 501.

When the station was visited on April 9th, wolverine tracks were observed crossing multiple routes through the camera view and behind the bait tree. The station was heavily disheveled. The braided wire holding the bait to the tree had been gnawed through. The legs were scattered down the creek. The "meat purse" had been brought to the ground and entirely emptied. The sign labeling this station 3 was entirely shredded into pieces no larger than 3" long and scattered through the frozen creek bed.

Two maternal wolverine dens were found in the snow on April 9th near Station 3. The first den had clear tracks leading into it. The sides were compacted, and the tunnel was well made and maintained. The second den was located under the bows of a pine tree with a clear tunnel leading under the snow. A cow leg bone was left outside the hole, which would have been too heavy for a fox or any smaller carnivore other than a wolverine to move. Gray undercoat fur was left on a pine bow, which was collected for genetic testing.

Additionally, at Station 3, wolverine tracks were located that led away from the creek. While following these tracks, another cow leg bone from the project study was observed at the base of a tall snag. Next to the bone, a wolverine had begun digging a hole. A camera facing that tree and the bone was set up at the base of the tall snag. However, no additional photographic results of wolverines from that new camera set up occurred, likely because the human disturbance caused the wolverines to abandon this potential den site (Magoun and Copeland 1998). There were, however, several photos of wolves taken on April 21st at this new camera site. This could provide a second reason why this potential wolverine maternal den was abandoned, as wolves are primary predators of wolverines. By May 11th, the dens at Station 3 were completely gone.

Station 5

At Station 5 (Camera "MP376BU N Cramer UDOT") two wolverines were observed on April 9th from 8:08 am (2nd arrives at 8:46 am) until 11:19 pm in photos 241-710.

Both kits are approximately the same size – roughly 30 in long and 35 to 40 pounds. The kits are distinguished by their fur coloring; one has more light colored fur (pelage) than the other. Both individuals climbed the tree and grappled with the bones extensively.

4.2.2 Gray Wolves

At Station 3, a pair of wolves was photographed on April 21st. Wolf tracks were detected at Station 3 on April 27th. The tracks are much larger than other canid species, red fox, or coyote. Wolf prints are 4 in 10 centimeters or more from front to back.

5.0 DISCUSSION

The presence of wolverines and three maternal dens within the project area are the most significant findings of this study.

5.1 Wolverine Dens

Female wolverines give birth in deep winter in dens that provide security and a buffer to cold winter temperatures. (Magoun and Copeland 1998) described two types of reproductive dens, natal dens where young are born and maternal dens where the mother may move the kits if conditions are no longer suitable at the natal den. Wolverines den in the snow, which helps keep kits (young wolverines) insulated and also protects them from predators. These dens are generally tunneled through snow and are associated with uprooted trees, avalanche debris, and boulders, often in remote alpine cirques at or above tree line. A wolverine den would be relatively inconspicuous, just a hole in the snow, but should have multiple sets of tracks leading to and from it. After a few weeks, a mother wolverine moves her kits from the natal den to a series of maternal dens. She may do this because the dens become unhealthy, with too many parasites.

Copeland (1992) conducted extensive investigations into wolverine seasonal habitats and denning habitats. Sites where wolverine dens have been found include ravines or drainages where snow accumulates (Pulliainen 1968, Bjärvall 1982, Serebryakov 1984, Magoun 1985). This matches well with the maternal dens discovered in the Horseshoe Canyon drainage where Stations 3 was located. Other areas preferred for natal and maternal dens include snow covered rocky scree or boulder talus (Haglund 1966, Myrberget 1968, Pulliainen 1968, Copeland 1996, Lee and Niptanatiak 1996), snow covered fallen trees usually near timberline, including trees downed by avalanches (Pulliainen 1968, Zyryanov 1989, Copeland 1996, Inman etal. 2007), taiga peat bogs or conifer forest with rocky areas and fallen trees (Pulliainen 1968, Dawson et al. in press).

Magoun and Copeland (1998) suggested that a critical feature of wolverine denning habitat is the dependability of deep snow throughout the denning season (February–May). Snow greater than 1 m deep, distributed uniformly or accumulated in drifts, provides protection from cold temperatures.

Long, complex snow tunnels in hardened snowdrifts characterize den sites in tundra and alpine areas. In some cases, the tunnels lead down to entrances under boulders that provide additional protection for kits. If boulders or rocky cliffs are present at the den site, the snow tunnels will often run along the edge of the boulders or cliffs where snow has accumulated in deep drifts and the boulders and rocky shelves of the cliffs may be used to shelter the kits. If rocky areas are extensive enough, the kits may be located well within the rocks where they are inaccessible to larger predators. In forested habitats, natal dens are often located under fallen trees, either under a single large tree that has fallen or a group of trees that have blown down or been sheared off by an avalanche. The trees are covered with deep snow and dens are formed in snow tunnels that incorporate spaces under the tree trunks. This is the preferred denning environment of many hibernal animals, as it provides insulation and protection from predators.

In forested areas where snow is deep and soft, dens are located under fallen trees or boulders that provide added structure to the den, preventing snow tunnels from slumping. Many natal dens are located on north-facing slopes where snowmelt is delayed in the spring months. Reported aspect and slope of wolverine natal dens are quite variable, especially for dens in tundra and alpine habitats. The aspect for the two wolverine dens occurring in the Horseshoe Drainage are also north. Sites used for maternal dens are often close to the natal den and have similar structure, although the distance between the natal den and maternal den can be three to four kilometers away (Magoun and Copeland 1998) and as much as six kilometers (Myrberget 1968). The length of the tunnel systems in maternal dens can be considerably shorter than at the natal den site, especially if the female moved her kits to the maternal den as a result of disturbance at the natal den (Myrberget 1968).

In tundra and alpine areas where wind hardened snowdrifts are used as natal dens, the dens have a complex structure involving branching snow tunnels about 30 to 40 centimeters in width that are up to 60 m in total length and contain a number of enlarged beds 40 to 90 centimeters wide that are used as lairs for the kits, food storage, and latrine depots (Myrberget 1968, Serebryakov 1984, Magoun 1985). The floor of the tunnel system where the kits are kept can be as much as 3 to 5 m under the surface of the snowdrift or a little as 1 m. Kits often rest directly on the snow surface or on bare ground if the tunnels go all the way to the ground. Sometimes there is vegetation on the floor of the bed where kits are kept, although it is not clear if the female purposefully places vegetation in the bed or if the vegetation on the floor of the bed results from the female chewing off shrubby vegetation contained within the snow layer while constructing the bed.

Wolverine kits are kept at reproductive (natal) dens until they are able to follow the mother, at least for short distances, usually around the time they are weaned at nine to ten weeks of age. In some cases, kits are kept at the natal den until weaning (Magoun 1985), but females may use multiple maternal dens prior to weaning. This seems to be the case in the three potential maternal wolverine dens located near Station 3. All of these appear to be temporary, or maternal dens. Soon after the photos of them were taken, higher temperatures created rapid snowmelt and these were abandoned by the time the camera stations were decommissioned on May 11, 2018.

Why natal dens become unsuitable and the mother wolverine moves her kits to maternal dens is not well understood. Magoun (1985) suggested that den abandonment in the arctic was probably forced by spring snow melt. In Idaho, abandonment of natal dens coincided with a period when maximum daily temperatures rose above freezing for the first time since denning commenced (Magoun and Copeland 1998), suggesting that den abandonment may be a response to increased moisture in the dens or collapsing snow tunnels. Den abandonment could also be caused by disturbance at the den site. Myrberget (1968) mentions four instances of den abandonment due to human disturbance and suggested that secondary dens may be less suitable than the natal den. Den abandonment by females in Idaho and Alaska appeared to be caused by human presence at maternal den sites whereas repeated human presence at a natal den site in Alaska did not cause den abandonment (Magoun and Copeland 1998).

Magoun and Copeland (1998) suggested that maternal dens may not be as secure as natal dens and use of maternal dens may be easily disrupted by the presence of humans nearby. Whatever the cause of den abandonment, the repeated use of some sites for natal dens (Lee and Niptanatiak 1996, Copeland 1996) suggests that there are critical denning requirements that are only met at specific sites. Copeland et al. (2010) suggested that areas where snow lasts well into May across the worldwide range of the wolverine define the habitat niche of the wolverine, citing the distribution of documented den sites.

These findings by Magoun and Copeland suggest that the dens located in the Horseshoe Canyon area were maternal (more temporary) in nature and that the mother and kits moved to the maternal dens sometime after the kits were old enough to move around. It is unlikely that the natal den was near Station 3 in Horseshoe Canyon, as there were no photos recording wolverine movement of the female mother wolverine before April 9, 2018, when she was accompanied by two juveniles. It is likely that the natal den for these two wolverine kits was located at a higher elevation where snow cover would be more secure.

Reproductive females may also be influenced in their selection of denning habitat by its suitability as rearing habitat for kits after weaning (Magoun and Copeland 1998). Factors contributing to successful rearing of kits have not been well studied. Magoun and Copeland (1998) suggested that wolverines may select denning areas that have low populations of predators and provide adequate food for kits in summer. See more detailed information at: http://wolverinefoundation.org/denning

Researchers have documented shifts in wolverine activity from lower elevations to higher elevations in summer (Hornocker and Hash 1981, Whitman et al. 1986, Banci 1987, Copeland 1996) or reported selection by reproductive females for high elevation habitats with marmots and ground squirrels (Krebs et al. 2007, Lofroth et al. 2007). However, (Bevanger 1992) stated that opportunities for hunting are severely reduced for wolverines in summer and that wolverines rely on food previously cached in swamps, rocky screes, and snowdrifts. High elevation and high latitude habitats probably provide more options for food storage in summer than do low elevation habitats (Magoun and Copeland 1998). Long lasting snow beds and other cool areas where wolverines are known to cache food may be important features of wolverine kit rearing areas, especially in spring when they may also serve as rendezvous sites for the mother and kits (Magoun 1985). Once winter food caches are exhausted in early summer and the kits are more mobile, wolverines may rely more heavily on predation of small mammals and birds than on scavenging (Magoun 1987, Myrberget and Sørumgård 1979, Copeland 1996, Landa et al. 1997). The relevance of summer food availability to the selection of denning areas by reproductive female wolverines needs further research.

5.2 Genetic Studies to Connect Wolverine Individuals with Other Populations in Central Idaho

Wolverines are rare carnivores that live at low densities and have large spatial requirements; characteristics that leave them vulnerable to both direct and indirect effects of highways. Maintaining connectivity between sub populations is necessary to allow dispersal for gene flow and recolonization of vacant habitats.

Wolverines are particularly vulnerable to habitat fragmentation because of the large spatial requirements of individuals and populations, small population sizes, and low reproductive rates. Of all the carnivores in North America, the wolverine (*Gulo gulo*) remains the least understood. Wolverines not only have the traits listed above, but they also occur at extremely low densities and typically inhabit rugged, remote habitats (Banci 1987), therefore, it is no coincidence that scientific data on wolverines is lacking. The wolverines' status as a rare and poorly understood carnivore has resulted in conservation concerns leading to two petitions to list the wolverine for protection under the Endangered Species Act (Federal Register [9], [10]). The combination of small population size, large spatial requirements, and conservation concern for this rare species makes the wolverine a high priority for mitigation efforts.

Cegelski et al. (2006) found wolverines in Idaho to have the lowest genetic diversity levels among eight populations evaluated across the Rocky Mountains and high levels of genetic structure. They concluded that despite some evidence of immigration of wolverines from Canada to the U.S., Idaho populations were genetically isolated, even from populations in Montana.

Overall, wolverines in the northern Rockies exist as small and semi isolated subpopulations within a larger metapopulation that requires regular dispersal of individuals between habitat patches for maintenance (Aubry et al. 2007, Inman et al. 2013). Given that subpopulations are small (essentially family groups) and movement between subpopulations is limited, inbreeding is likely over the long term (Kyle and Strobeck 2001, Cegelski et al. 2006, Schwartz et al. 2009).

6.0 RECOMMENDATIONS

While we have basic understandings of wolverine ecology and spatial requirements in the coterminous United States (Hornocker and Hash 1981, Copeland 1996), minimal data is available regarding how wolverines move across the landscape and their spatial arrangement relative to related populations. Learning more about how wolverines travel and how gene flow connects sub populations will be an important area of study in the years to come.

Wildlife conservation and research has benefited from the field of molecular genetics (DeYoung and Brennan 2010). Our ability to delineate populations, understand dispersal patterns, detect hybridization, and count and monitor wildlife has improved through the synergy of traditional wildlife biology with molecular ecology (Schwartz et al. 2009). It would be beneficial to investigate whether the wolverines that occurred at the Site for a few weeks are related to surrounding populations that have previously been documented by other researchers, or whether the individuals at the Site represent a separate population. Within the context of the wolverine genetic studies being undertaken in neighboring Bitterroot Range and the findings of Copeland and others regarding the central Idaho populations of wolverines, further surveys and genetic sampling and analysis techniques employed by other researchers should be considered in future studies to build upon the findings of this study.

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TABLE

Table 1. List of Mammal Photos

Table 1. List of Mammal Photos

Photo Numbers	Station Number	Date	Time
Bobcat- ***Lynx rufus***			
0046-0048	3	2/17/2018	03:44-03:45
0118-0120	2	4/6/2018	23:21
Coyote-***Canis letrans***			
0247-0261	6	1/19/2018	18:35-18:40
0116-0165	5	1/29/2018	18:10-18:16
0166-0188	5	1/29/2018	18:51
0106-0153	2	2/16/2018	02:31- 02:40
0049-0053	6	4/5/2018	02:22
Mule Deer-***Odocoileus hemionus***			
0100-0102, 0103-0105	4	1/24/2018	16:17-16:19
0106-0108	4	1/24/2018	16:20
0109-0110	4	1/24/2018	16:29
0037-0039	2	1/27/2018	03:51
Red Fox-***Vulpes vulpes***			
0325-0327	2	1/14/2018	19:24
0328-0330	2	1/14/2018	23:32
0331-0333	2	1/15/2018	20:21
0334-0336	2	1/17/2018	22:49
0064-0090	2	2/11/2018	07:19-07:26
0067-0168	6	2/13/2018	08:00-09:24
0094-0095	2	2/13/2018	20:58
0037-0039	3	2/16/2018	02:16
0040-0045	3	2/16/2018	19:29-20:56
0049-0054	3	2/18/2018	19:42
0154-0171	2	2/18-19/2018	22:26-03:53
0058-0060	3	2/19/2018	23:22
0172-0174	2	2/19/2018	23:44
0061-0072	3	2/20/2018	0:26
0175-0180	2	2/20/2018	21:03
0081-0095	5	2/25/2018	04:43-04:52
0181-0183	2	2/25/2018	0:18
0124-0171	3	3/1/2018	05:45-06:00
0172-0175	3	3/1/2018	06:57-07:03
0055-0056	2	3/8/2018	04:00
0016-0018	3	3/11/2018	22:06
0064-0066	2	3/13/2018	22:39
0178-0182	3	3/13/2018	02:52
0184-0195	3	3/15/2018	20:55-21:09

Table 1. List of Mammal Photos

Photo Numbers	Station Number	Date	Time
Red Fox-*Vulpes vulpes (continued)*			
0196-0198	3	3/16/2018	05:48
0013-0024	3	3/20/2018	16:35-16:37
0025-0042	3	3/20/2018	17:02-18:15
0106-0108	2	3/20/2018	23:08
0081-0085	5	3/24/2018	23:19
0109-0111	2	3/24/2018	04:43
0058-0051	3	3/25/2018	03:49-06:08
0070-0159	1	3/26/2018	20:08-22:41
0052-0054	3	3/27/2018	02:57
0096-0110	5	3/27/2018	05:58-06:05
0160-0255	1	3/27/2018	21:47-22:26
0055-0057	3	3/28/2018	21:27
0058-0060	3	3/28/2018	21:29
0256-0297	1	3/28/2018	04:28-04:58
0297-0306	1	3/28/2018	21:25
0307-0312	1	3/28/2018	21:28
0313-0336	1	3/28/2018	21:30-21:49
0061-0087	3	3/29/2018	17:07-17:13
0111-0116	5	3/29/2018	23:07
0340-0438	1	3/29/2018	05:32-07:11
0439-0444	1	3/29/2018	19:11-19:12
0445-0462	1	3/29/2018	20:31-20:47
0088-0117	3	3/30/2018	02:45-03:40
0118-0156	3	3/30/2018	04:29-04:45
0463-0468	1	3/30/2018	00:13-00:14
0469-0471	1	3/30/2018	01:18
0472-0489	1	3/30/2018	21:59-22:13
0163-0171	3	3/31/2018	05:51-06:13
0490-0540	1	3/31/2018	03:24-04:03
0541-0543	1	3/31/2018	05:01
0175-0234	3	4/2/2018	00:16-00:51
0166-0194	5	4/3/2018	21:45-23:08
0235-0243	3	4/3/2018	00:33-00:34
0244-0246	3	4/3/2018	0:58
0247-0252	3	4/3/2018	20:09-20:10
0544-0546	1	4/3/2018	00:49-00:50
0073-0078	4	4/5/2018	04:44-04:47
0055-0060	6	4/9/2018	02:45
0057-0059	6	4/9/2018	02:45

Table 1. List of Mammal Photos

Photo Numbers	Station Number	Date	Time
Snowshoe Hare-*Lepus americanus*			
0097-0100	2	2/14/2018	03:48
0172-0174	3	4/1/2018	23:04
Tree Squirrel-*Sciurus carolinensis*			
0072-0075	5	2/13/2018	13:42
0077-0080	5	2/19/2018	14:41
0091	5	3/26/2018	14:22
0136-0146	5	4/3/2018	13:12-13:55
0236-0240	5	4/8/2018	14:05
0346-0347	5	4/9/2018	11:50
Wolverine-*Gulo gulo*			
0253-0326	3	4/4/2018	09:53-10:05
0331-0381	3	4/4/2018	14:13-14:54
0382-0402	3	4/4/2018	15:21-15:28
0406-0432	3	4/4/2018	19:12-20:09
0547-0552	1	4/4/2018	08:33-09:16
0553-0554	1	4/5/2018	12:40
0496-0501	3	4/8/2018	14:19
0241-0345	5	4/9/2018	08:08-09:14
0352-0555	5	4/9/2018	12:34-12:51
0556-0700	5	4/9/2018	16:26-17:13
0701-0710	5	4/9/2018	23:07-23:18

NOTES:

The following photos from Station 5 on 4/9 in the sequence 0352 to 0555 show two wolverines: 0261-0265, 0301-0305, 0491-0500, 0512-0515 and 0521-0534.

FIGURES

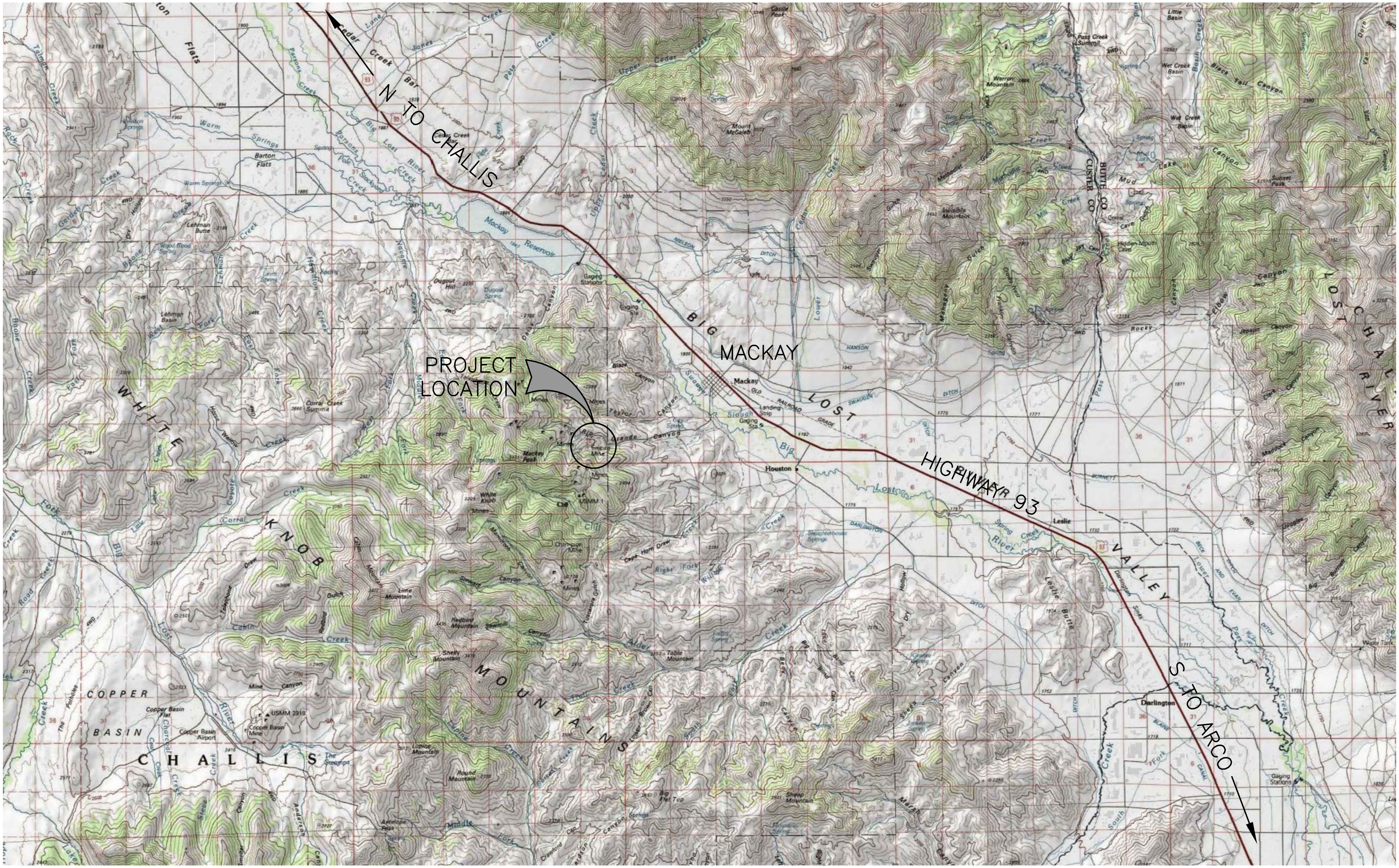


Figure 1. Site Location Map

0 3 mi

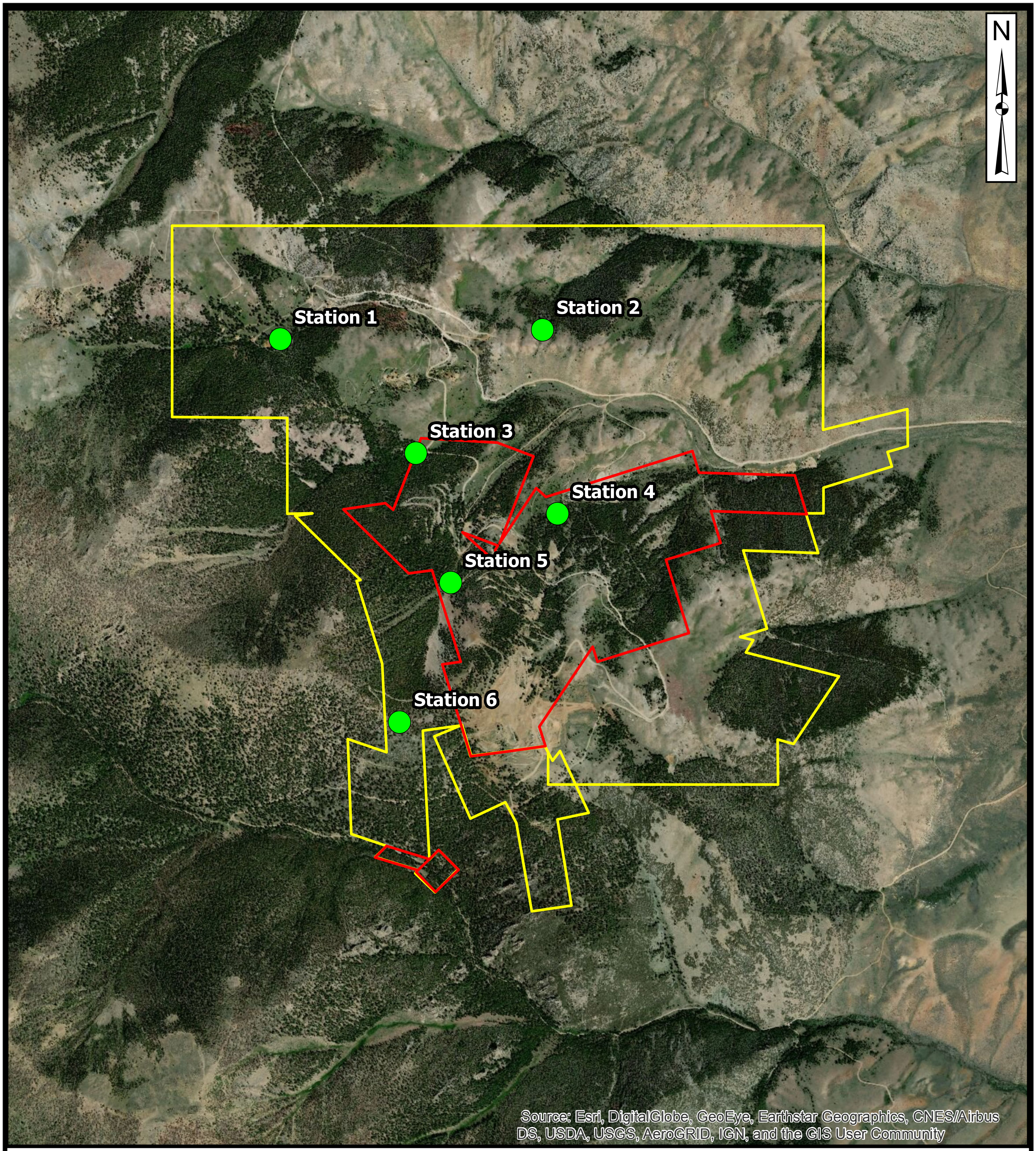
1"=3 mi

(LOCATIONS AND SCALE ARE APPROXIMATE)

N

PROJECT NUMBER: 2017220015	2017–2018 Winter Mammal Survey Report
DATE: 8/8/2017	
DWG NO: 2017220015 FIGURE 1.DWG	Konnex Resources Inc. Mackay, Idaho
DWG BY: 6DJR / PROJECT MANAGER: 5DJB	
REVISED:	CES CASCADE EARTH SCIENCES

(SOURCE: ©2013 National Geographic Society, i-cubed)



Explanation

- Station
- Patented Claims
- Unpatented Claims

0 2,000 Feet

1" = 2000 ft
(LACATIONS AND SCALE ARE APPROXIMATE)

Map projected in NAD1983 (2011) StatePlane Idaho Central FIPS1102 (US FEET)

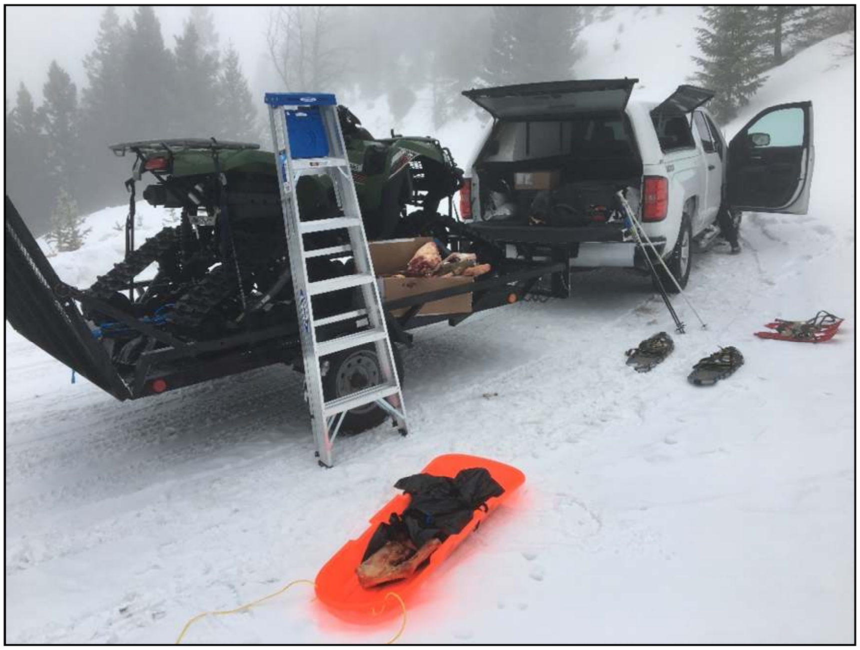
Figure 2. Map of Camera Trap Stations

PROJECT NUMBER: 2017220015		2017-2018 Winter Mammal Survey Report
DATE: 11/03/2018		
DWG NO: 2017220015 FIGURE 2.pdf		Konnex Resources Inc. 313 E. Custer St, P.O. Box 329 Mackay, Idaho 83251
DWG BY: MC	PROJECT MANAGER: DB	
REVISED:		CES CASCADE EARTH SCIENCES

APPENDICES

Appendix A.

Photos of Camera Trap Stations



Photograph 1.

Camera trap deployment
(CES 1/9/2018)

Photograph 2.

Station 1 Bait tree

Photograph 3.

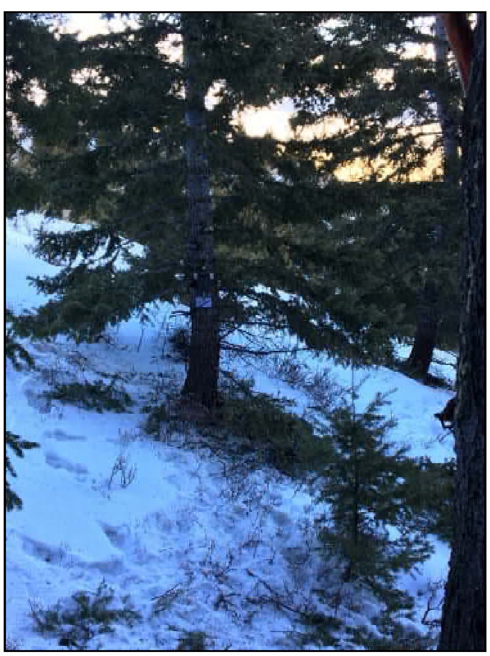
Station 2 camera setup

Photograph 4.

Station 2 Bait tree

Photograph 5.

Station 3 Bait tree



Photograph 6.

Station 4

Photograph 7.

Station 4 bait tree

Photograph 8.

Station 5

Photograph 9.

Avalanche shoot above Station 5

Photograph 10.

Station 6 bait tree

Photograph 11.

Station 6

Appendix B.

Mammal Track Photos from March 7-8, 2018

Photograph 1.

Bobcat tracks

Photograph 2.

Bobcat tracks

Photograph 3.

Chipmunk small front paw

Photograph 4.

Coyote paw over 3 in wide

Photograph 5.

Elk tracks

Photograph 6.

Mountain lion tracks over 3 in wide

Photograph 7.

Red fox track 2.3-3.1 in long

Photograph 8.

Squirrel tracks

Appendix C.

Mammal Track Photos from March 19-20, 2018

Photograph 1.

Bushy-tailed packrat tracks

Photograph 2.

Small chipmunk tracks

Photograph 3.

Juvenile wolverine tracks

Photograph 4.

Juvenile wolverine tracks

Photograph 5.

Long-tailed weasel tracks

Photograph 6.

Marten tracks

Photograph 7.

Mountain cottontail

Photograph 8.

Mountain cottontail

Photograph 9.

Red fox tracks

Photograph 10.

Red squirrel

Photograph 11.

Red squirrel

Photograph 12.

Snowshoe hare

Photograph 13.

Wolverine paw print

Photograph 14.

Wolverine tracks

Photograph 15.

Wolverine tracks

Photograph 16.

Wolverine

Photograph 17.

Wolverine

Photograph 18.

Wolverine print over 4 in

Appendix D.

Photos of Wolverines

Photograph 1.

Two wolverine sibling kits were photographed playing at Station 5, which was in Bullion Gulch above the Alberta Tunnel/700 Level of the Empire Mine (4/9/2018).

Photograph 2.

The kits were distinguished by the color of their pelage. The lead kit had more white in its pelage than the other kit (4/9/2018).

Photograph 3.

Kits scavenging on the bait bones (4/9/2018).

Photograph 4.

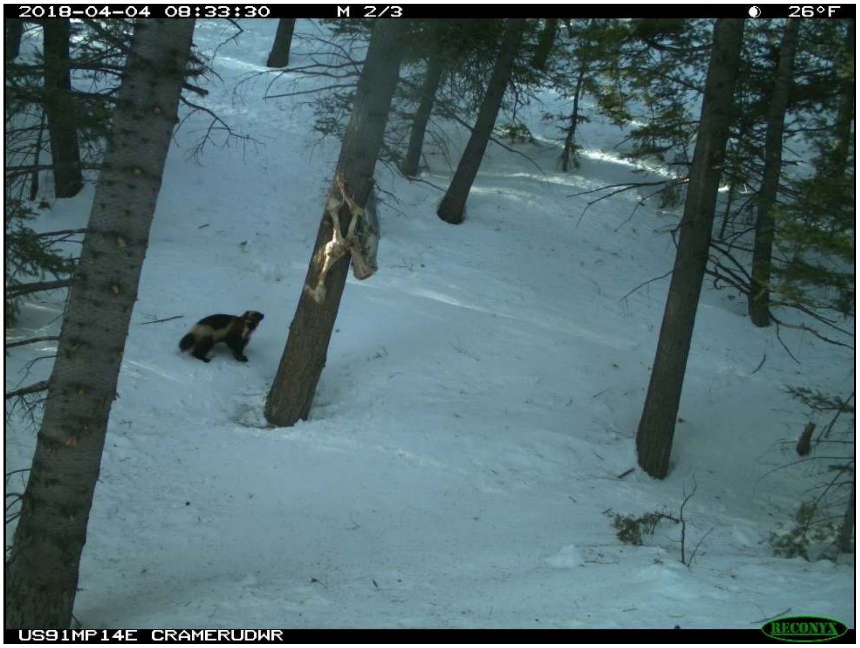
Darker kit vocalizing at Station 3, which was located in Horseshoe Canyon (4/4/2018).

Photograph 5.

Darker kit investigating bone at Station 3 (4/4/2018).

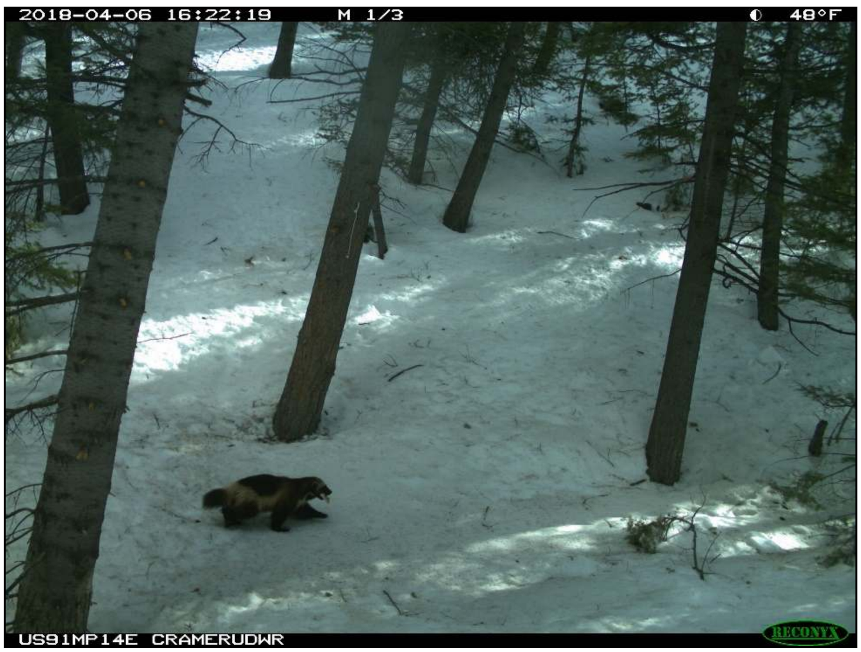
Photograph 6.

Darker kit walking around bait tree at Station 3 (4/4/2018).



Photograph 7.

Lighter kit approaching bait tree at Station 1, which was in the northwest part of the Site near the Horseshoe Mine (4/4/2018).



Photograph 8.

Lighter kit carrying bone fragment at Station 1 (4/4/2018).

Photograph 9.

Den 1 near Station 3 (4/10/2018).

Photograph 10.

Den 2 near Station 3 (4/10/2018).

Photograph 11.

Den 3 near Station 3 with wolverine track in right photo (4/10/2018).

Appendix E.

Photos of Other Mammals

Photograph 1.

Bobcat at Station 1 (4/6/2018).

Photograph 2.

Bobcat at Station 3 (2/17/2018).

Photograph 3.

Coyotes at Station 2 (2/16/2018).

Photograph 4.

Gray Wolves at Station 3 (4/21/2018).

Photograph 5.

Moose at Station 5 (1/29/2018).

Photograph 6.

Mule deer at Station 2 (1/27/2018).

Photograph 7.

Mule deer at Station 4 (1/24/2018).

Photograph 8.

Red fox at Station 1 (3/29/2018).

Photograph 9.

Red fox at Station 3 (3/20/2018).

Photograph 10.

Red fox at Station 5 (4/7/2018).

Photograph 11.

Red fox at Station 6 (2/13/2018).

Photograph 12.

Snowshoe hare at Station 2 (2/14/2018).

Photograph 13.

Snowshoe hare at Station 3 (4/18/2018).

Photograph 14.

Squirrel at Station 5 (4/8/2018).