

# Wolverine Survey Summary Report: 2016–2017 and 2021–2022

June 2023



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## Background

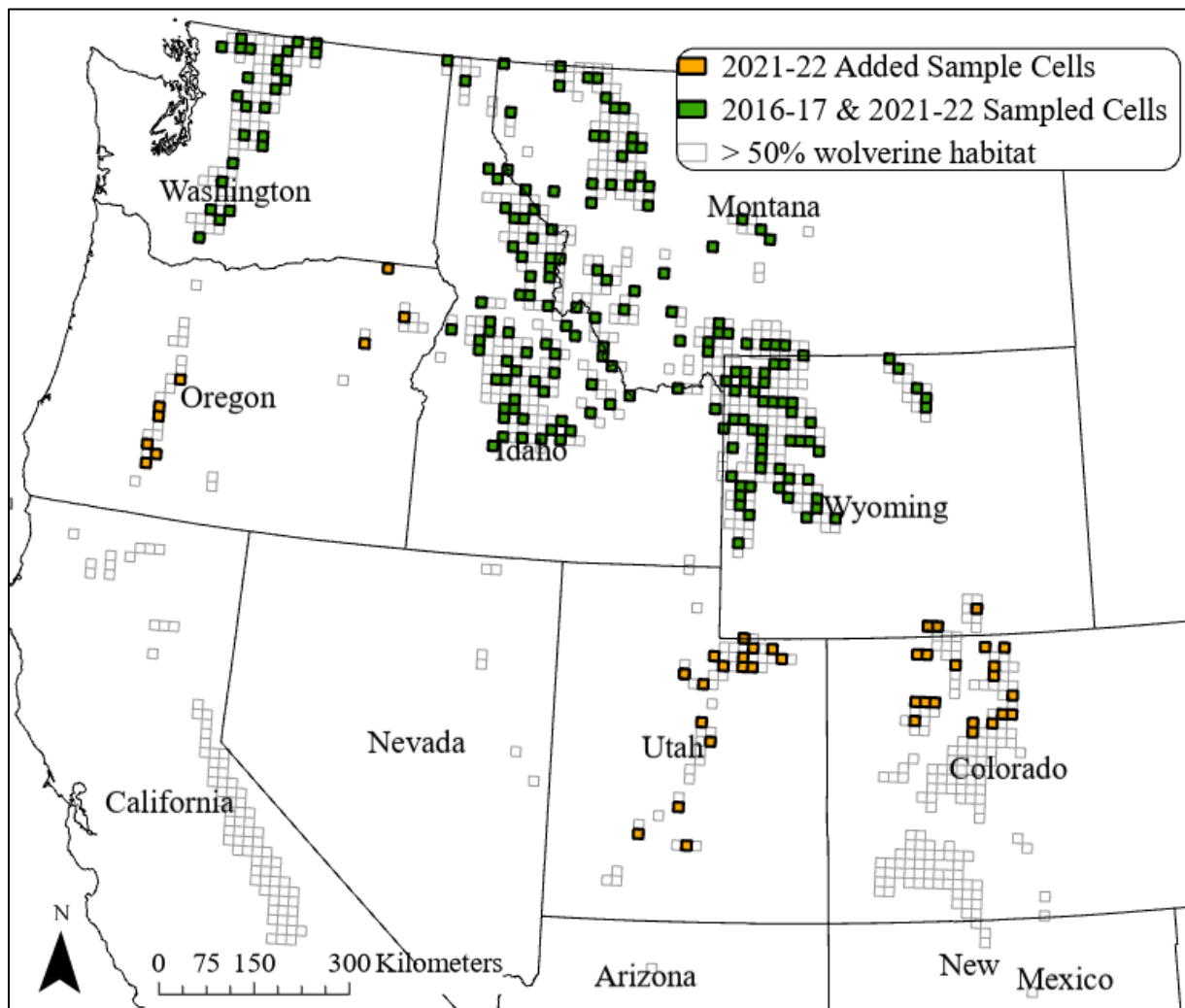
Wolverines (*Gulo gulo*) are a wide-ranging species that had historical distribution extending from northern Alaska, southward into the mountainous areas of Colorado and California. By 1920, wolverines had been extirpated from much of the contiguous United States due to impacts from increasing levels of human-cause mortality, backcountry recreation, and human infrastructure (Krebs et al. 2004, Aubry et al. 2007, Gude et al. 2007, Inman et al. 2012). Since then, wolverines have been expanding southwards from Canada to reoccupy some portions of their historical range in the West (Newby and McDougal 1964, Moriarty et al. 2009). Due to the vast, remote areas where wolverine populations occur and the lack of information that was known about wolverines, the Western Association of Fish and Wildlife Agencies (WAFWA) wildlife chiefs committee organized the Western State Wolverine Working Group (WSWWG). The WSWWG is composed of about 20 members from state and federal wildlife agencies, university faculty, and several other research organizations from across the West. This group of biologists and researchers identified the need to collaboratively gather more information regarding the distribution and population status of wolverines and developed the Western States Wolverine Conservation Project (WSWCP). The goal of this project was to define the limits to the current distribution of wolverines, identify any potential gaps in distribution, and provide a baseline dataset for future monitoring and analysis of factors contributing to changes in the distribution of wolverines across the West (Lukacs et al. 2020).

Over the winter of 2016–2017, Montana Fish, Wildlife & Parks (FWP) participated in the first western United States wolverine occupancy survey which spanned across Idaho, Montana, Washington, and Wyoming. The full scientific findings from the 2016–2017 wolverine survey can be found within Lukacs et al. (2020). This survey was then followed-up over the winter of 2021–2022 in order to detect any changes in overall distribution and occupancy compared to the results from the previous study. The findings from the 2021–2022 survey are currently (June 2023) in the final analysis phase with hopes for publication in 2024. The wolverine survey then has prolonged plans to occur every 5 years.

The primary focus of this report is on the effort and participation from Montana FWP staff. This report also discusses the field methods used during these surveys, the amount of effort it took across the study area, and will provide a deep dive into the field findings from the cameras placed in Montana. This report will break down the rough statistics of camera effort in Montana, the total number of photos taken over both surveys, the different species that were detected, and some other findings that extend past the breadth of both wolverine manuscripts. Additionally, this report was created to help highlight the great work that the staff at FWP do and the other useful information we benefit from passively gathering during efforts that are designed to target an individual focal species.

## Methods

A grid of 15-km x 15-km cells was overlaid a composite model of wolverine habitat that was comprised of persistent spring snow (Copeland et al. 2010) and suitable habitat (Inman et al. 2013). Each one of these 225-km<sup>2</sup> grid cells represents the size of a female wolverine home range from those in the Greater Yellowstone Ecosystem (Inman et al. 2012). The cells that were included in the sampling frame for these surveys were comprise >50% wolverine habitat. During the 2016–2017 survey there were 633 cells across the 4-state area of Idaho, Montana, Washington, and Wyoming. From a power analysis, 185 cells (59 ID, 48 MT, 26 WA, 52 WY; Figure 1) were selected to be sampled using remotely triggered cameras at bait and lure stations. During the 2021–2022 survey, additional states across the West were invited to participate in the survey to provide a wider scope of inference and to gather information about wolverines from across most of their historical range in the continental United States. The 2021–2022 survey sampling frame included a total of 941 cells, 239 of which were selected to be sampled.



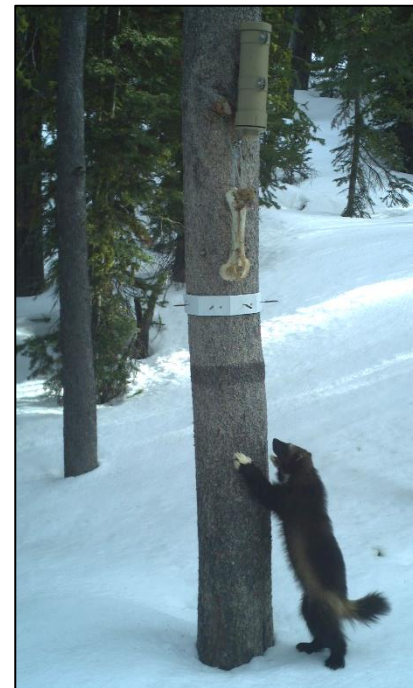
**Figure 1.** Sampling frame and selected cells for the wolverine survey across Washington, Idaho, Montana, and Wyoming, USA, 2016–2017 (green) and selected cells added in Colorado, Utah, and Oregon, USA, for the survey in 2021–2022 (green & orange).

**Camera Stations** – One camera was deployed within each 15-km x 15-km cell from 1 December through 31 March of each survey year (2016–2017; 2021–2022). Over the 2 surveys, some camera stations were baited with meat bait (roadkill game or beaver [*Castor canadensis*] carcasses) wired to a bait tree 1–3.5 meters above the winter snow height with a long call scent lure for wolverine. Other stations, in place of bait, used a scent dispenser (Figure 2; R. A. Long, Woodland Park Zoo, Seattle, WA, USA) that would drip a liquid wolverine lure onto a cow femur bone once per day throughout the winter survey period. Stations that included meat bait were revisited once per month to refresh the bait while stations with the scent dispenser were not revisited until after the survey period.

Gun brush collars were also placed around each bait tree below the femur bone or meat bait to snag hair from wolverines climbing the tree (Kendall and McKelvey 2008). During each site visit, these gun brushes were also collected and replaced with new ones in attempt to collect as much DNA as possible. DNA samples were first identified to species. Those that were positive were then identified down to the individual level (Lukacs et al. 2020).

Additionally, for the 2016–2017 survey, supplemental cameras were deployed in areas not originally selected to be sampled, where biologist felt there was a high change of wolverine detections. Overall, there were 56 supplemental camera stations deployed during that survey period but were not replicated during the 2021–2022 survey.

All photos that were captured by the cameras deployed over these two surveys were classified to species. We also estimated the number of individual wolverine detections that occurred by separating detection occasions by a 24-hour period. Estimates of overall detection probably are listed in the manuscripts that correspond with each survey but are not included in this report (Lukacs et al. 2020, Lukacs et al. in progress).



**Figure 2.** Bait station including scent dispenser on bait tree with cow femur bone and gun brush collar.



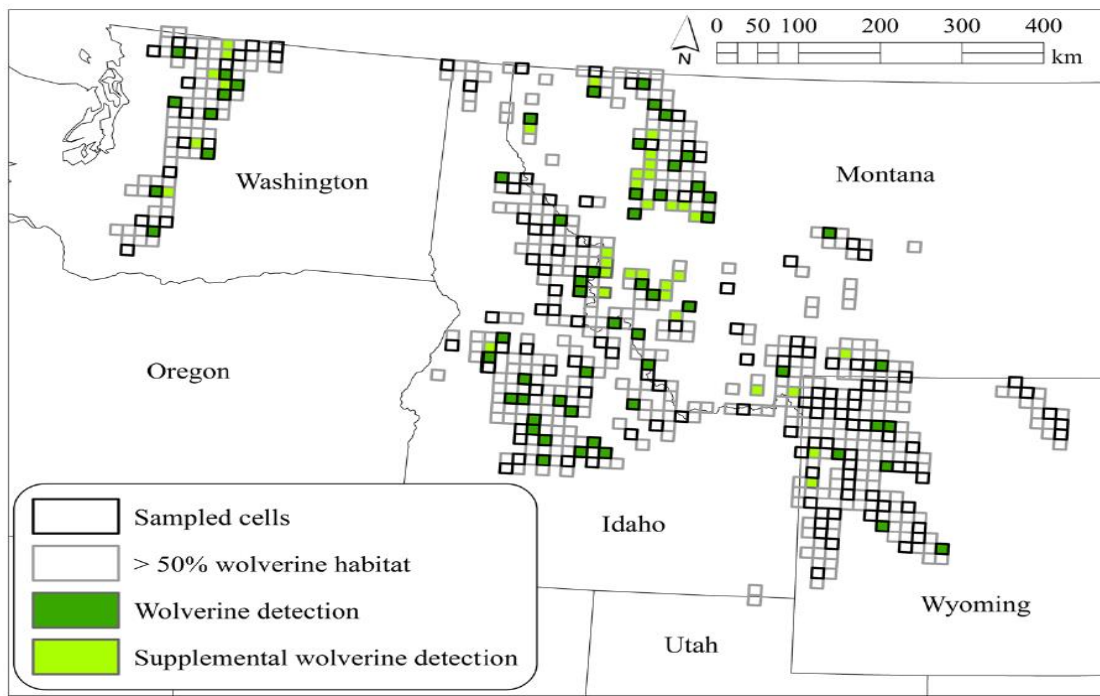


## 2016–2017 Wolverine Survey Results

Across the 4-state area, there were a total of 439,834 photos taken from 183 of the 185 official survey cameras deployed. One of the cameras in Idaho was stolen and 1 camera in Montana was burned in a wildfire. There were a total of 22,641 photos of wolverines in 59 of the 183 cells (Figure 3) including 7,114 taken in 23 of the 48 cells in Montana (Table 1). There were also wolverine detections in 24 additional supplemental cells in Montana and a total of 32 cells that gathered DNA used to identify the sex of the wolverines at the sight. Although wolverines were the primary focal species of these survey efforts, there were also photos of 23 other known species in Montana, with the most frequently detected species being the marten (*Martes* spp.; Appendix A). There were a total of 80,665 photos taken by the 49 cameras in Montana including 14,807 photos of marten (~18% of the total photos). The most recorded photo classification (24%) were photos with nothing in them ( $n = 19,024$ ). There was an average of 1,876 photos taken per camera with the greatest being 7,989 photos on one camera for the duration that it was in the field. Cameras were deployed for an average of 143 days in the field with the longest deployment being 164 days. The earliest a camera was deployed was on 1 November 2016 and the latest pull date was on 28 April 2017.

**Table 1.** Wolverine detections during 1 December to 31 March during 2016–2017 wolverine survey across a 4-state area, USA.

State	Cells	Detections	Cells with detections
Idaho	59	10,165	21
Montana	48	7,114	23
Washington	26	3,622	9
Wyoming	52	1,740	6
Total	185	22,641	59



**Figure 3.** Wolverine detections across a 4-state area, USA, in winter of 2016–2017.

These survey efforts demonstrated that all the large areas of predicted wolverine habitat contain wolverines. The Northern Continental Divide Ecosystem in Montana showed the highest predicted occupancy in the 4-state area, with nearly complete use of the 15-km x 15-km cells in Glacier National Park and the Bob Marshall Wilderness complex. There was no difference in wolverine detection between the baited stations and the scent dispenser locations, ensuring that the camera station protocol used was very effective for detecting wolverines, given they were present. Because of the large-scale nature of this survey effort and the partnerships built to implement it, FWP continues to have an unprecedented opportunity to work on wolverine conservation across their range in the contiguous United States (and perhaps beyond), with coordination among all the government agencies with jurisdictional responsibilities (Lukacs et al. 2020).

## 2021–2022 Wolverine Survey Results

During the second iteration of this study, Colorado, Utah, and Oregon were also able to participate which resulted in one additional wolverine detection. Across the 7-state area there were a total of 472,136 photos taken including 24,688 wolverine photos at 60 sites (Table 2; Figure 5). This does not account for the photos taken on several cameras in Washington that have not yet be retrieved and processed (June 2023). To compare to the 2016–2017 results, the 4-state level had a total of 296,564 total (-33%) photos taken including 24,355 wolverine photos (-1%) at 59 sites. This is the same number of sites to detect wolverines within the 4-state areas as the previous study, although not all the same cells detected wolverines. There was a shift of wolverine detections during this study resulting in the most detections in Idaho compared to Montana being the slight leader of wolverine detections during the 2016–2017 study. This iteration of the study did not include wolverine detections from any additional supplemental cells since most stations used scent dispensers rather than bait stations and there was very little, to no, human activity in these areas during the survey period to supplement detections.

The greatest amount a time that an individual wolverine spent in front of the camera at one time during this study was 4 hours and 49 minutes, all during daylight hours. During that time, this particularly determined wolverine proceeded to swing from and chew on the cow femur bone that was attached over 8 feet off the ground (Figure 3). It was only to the prevail of this wolverine detaching the bone from the tree by chewing

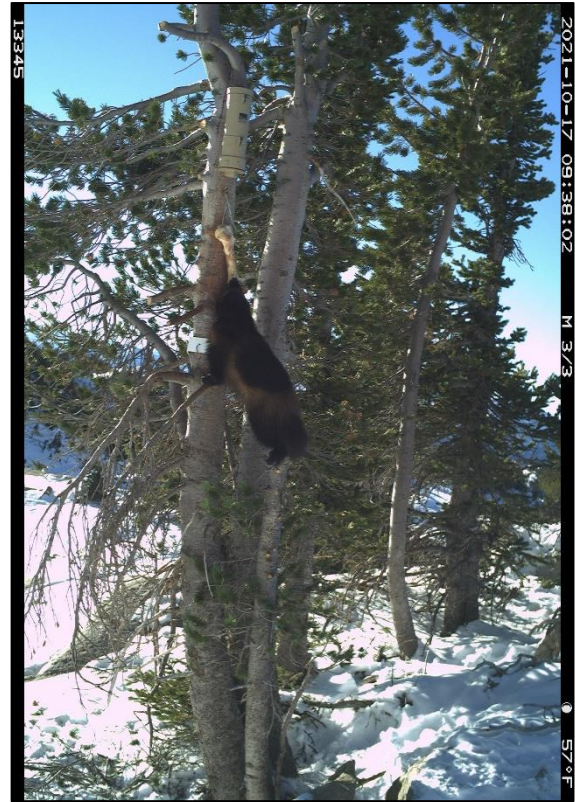
**Table 2.** Wolverine detections during 1 December to 31 March during 2021–2022 wolverine survey across the 4-state area and all participating states, USA.

State	Sites	Wolverine photos	Sites with wolverine detections	Total photos (all species)
Colorado	16	0	0	118,566
Idaho	58	12,752	25	108,679
Montana	48	6,291	16	60,331
Oregon	19	333	1	30,955
Utah	16	0	0	26,051
Washington	25	286	3	9,665*
Wyoming	55	5,026	15	127,554
Total	239	24,688	60	472,136
Total 4-state area	185	24,355	59	296,564

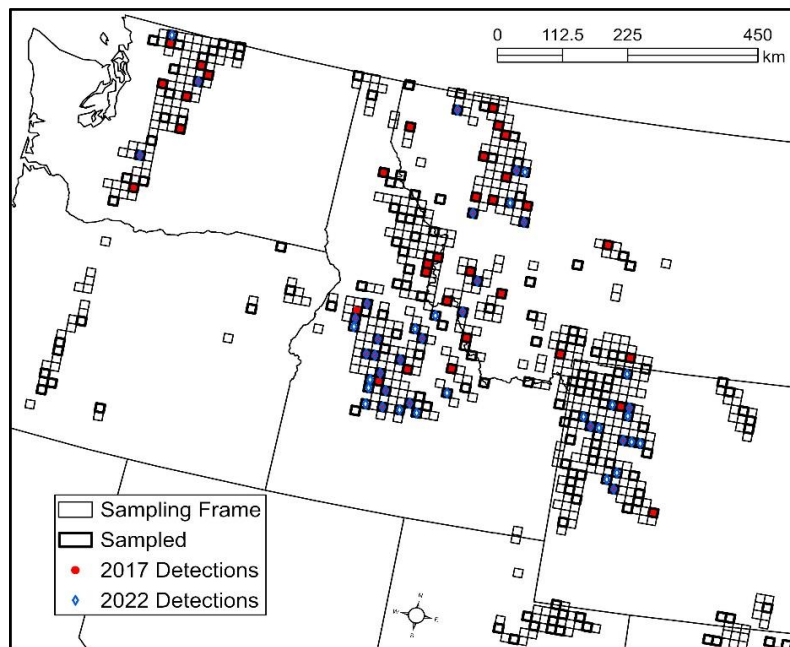
\* = not all photos processed at the time of this report

through the 1/8-inch insulated aircraft cable, that the wolverine left the site, only to return the next evening.

Although wolverines continued to be the focal species during the 2021–2022 study, there were also photos of 22 other known species in Montana, with the focal species, wolverines, holding the greatest number of photos by species. Red squirrels (*Tamiasciurus hubsonicus*) and black bears (*Ursus americanus*), respectively, were the most frequently detected non-focal species (Appendix A). There were a total of 60,331 photos taken by the 48 cameras, although 3 of the camera cards were encrypted and unreadable. The most recorded photo classification (56%) were photos with nothing in them ( $n = 33,539$ ) which is over twice as many blank photos as the previous study even though the 2021–2022 study had a 33% decrease in overall photos. There were an average of 1,257 photos taken per camera with the greatest being 4,245 photos on one camera over the duration it was in the field. Cameras were deployed for an average of 234 days in the field with the longest deployment being 293 days. The earliest a camera was deployed was on 5 November 2021 and the latest pull date was on 8 August 2022.



**Figure 4.** Wolverine swinging from femur bone for almost 5 hours.



**Figure 5.** Wolverine detections across a 7-state area, USA, in winters of 2016–2017 and 2021–2022.

## Summary

Over the two study years of the multi-state wolverine occupancy survey (2016–2017; 2021–2022), there have been 424 camera stations deployed across Colorado, Idaho, Montana, Oregon, Utah, Washington, and Wyoming. This monumental, collaborative effort wouldn't have been possible without the dedication from countless state and federal agency staff, volunteers, tribal members, and various other partners that participated. These cameras captured just under 1 million photos (911,970) including 47,329 (5.2%) wolverine photos. Over these two study years, 96 monitoring stations were deployed in Montana that captured a total of 140,996 photos including 13,405 (9.5%) wolverine photos. These stations also captured photos of 15 different wild mammal species and 9 avian species with marten (16,258 photos) and wolverines (13,405) being the most detected species. These results reflect the efficacy of the methods used to detect wolverines and other forest mustelids and were proven effective at also detecting a great number of other species. These additional species detections can be used to inform species distribution maps, confirm the use of these methods as an effective means of detecting other species such as marten and fisher (*Pekania pennanti*), and estimate various species activity patterns throughout the winter, specifically bears leading to den emergence. These efforts also provide insight into winter snowpack levels, the timing of snow melt, and species behavior at lured sites.

Wolverines were detected in the same number of cells during each study, although there was a slight shift in detections from Montana to Idaho. The significance of these spatial differences in detections will be discussed in the manuscript that is currently being drafted by Lukacs et al. Wolverines continue to be detected throughout the extent of their known range and have also been recently detected in areas previously thought to be outside of their normal distribution. The continued collaboration among these states will provide valuable, long-term information regarding any spatial and temporal changes in wolverine occupancy and distribution in the western United States. Through these efforts, managers can ensure the perpetuation of wolverine populations throughout the extent of their range. Surveys occur every 5 years with the next survey scheduled over the winter of 2026–2027. There are plans to expand these collaborative efforts into Alberta and British Columbia, Canada so that this next survey can continue to provide advancing information about wolverines throughout much of their range in North America.



**Figure 6.** Wolverine track in snow.



## Acknowledgements

Montana Fish, Wildlife and Parks would like to thank all the dedicated staff that participated in this study. From the initial development of this study with other states, to the analysis and writing phase, FWP staff have been an integral part of this ongoing study for the last 8 years. We would like to thank all the people in Montana and at FWP for their efforts in this study, only a fraction of who's names are to follow in no particular order: B. Inman, J. Gude, B. Wakeling, K. McDonald, M. Parks, T. Parks, N. Kluge, P. Lukacs, C. Gower, P. Kelly, J. Coltrane, N. Lance, M. Evans, W. Cole, B. Lonner, R. Rauscher, E. Lula, M. Ebinger, N. Anderson, L. Bradley, R. Mowry, V. Boccadori, W. Hansen, J. Newby, M. Yarnell, J. Kolbe, B. Chappelow, T. Chilton-Radandt, C. Peterson, K. Smucker, J. Cunningham, S. Eggeman, T. Smucker, E. Graham, E. Schwalm, J. Lindstrom, J. DeVoe, K. Davis, A. Wallingford, D. Schott, L. Breidinger, L. Schroerer, Turner, D. Heffington (Volunteer), J. Waller (GNP), M. Monroe (MSU), J. Roose (USFS), R. Scarlett (USFS), J. Trivette (USFS), J. Gatlin (USFS), R. Bullington (USFS), A. Roberts (USFS), P. Shanley (USFS), and K. Benzel (BLM).



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**Appendix A:** The number of photos captured of each species in Montana during the 2016–2017 and 2021–2022 wolverine survey.

Species	2016–2017 Survey Photos	2021–2022 Survey Photos
Marten	14,807	1,451
Black bear	3,145	3,145
Bobcat	29	16
Canada lynx	7,413	129
Chickadee	42	5
Clark's nutcracker	1,374	595
Common Raven	3,742	260
Coyote	178	111
Elk	0	1,514
Ermine	26	0
Fisher	0	55
Flying squirrel	0	133
Golden Eagle	10	0
Gray Jay	301	306
Grizzly bear	506	312
Grouse	3	0
Human	13,718	6,163
Magpie	125	0
Moose	36	153
Mountain lion	175	202
Mule deer	91	266
None	19,024	33,539
Red fox	6,756	449
Red squirrel	952	3,218
Snowshoe hare	746	777
Stellars jay	145	212
Unknown Bird	34	13
Unknown Mammal	26	6
Unknown	71	0
White-tailed deer	58	713
Wolf	5	300
Wolverine	7,114	6,291
Woodpecker	13	0
<b>Total</b>	<b>80,665</b>	<b>60,334</b>



Appendix B: Top species photos from the 2021–2022 wolverine survey.



Wolverine



Gray Wolf



Mountain Lion



Moose



Marten



Canada Lynx



Grizzly Bear



Black Bear

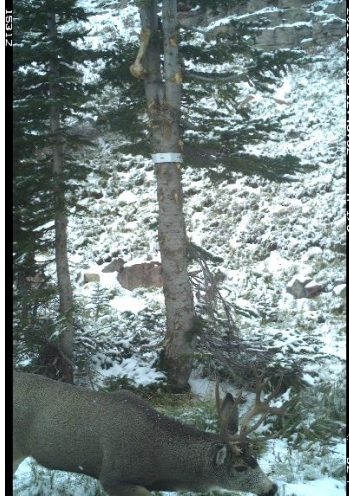


Elk





Coyote



Mule Deer



Bobcat



White-tailed Deer



Fisher



Red Fox



Red Squirrel



Flying Squirrel



Snowshoe Hare