

Science

FINDINGS

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"Science affects the way we think together."

Lewis Thomas

ON THE TRACK OF THE ELUSIVE WOLVERINE



John Rohrer

Snow cover that lingers into May is a defining habitat feature for wolverines in the contiguous United States.

"Picture a weasel—and most of us can do that, for we have met that little demon of destruction, that small atom of insensate courage, that symbol of slaughter, sleeplessness, and tireless, incredible activity—picture that scrap of demoniac fury, multiply that mite some fifty times, and you have the likeness of a Wolverine."

—Ernest Thompson Seton

The wolverine has a near-mythical reputation. Stories abound of wolverines chasing down or leaping on the backs of animals as large as moose, harassing bears and wolves over prey, ravaging hunters' cabins, and even

attacking humans. However, most of these stories are either misunderstandings of wolverine behavior or tall tales. Although there have undoubtedly been altercations between wolverines and bears or wolves over potential food sources, wolverines do not try to compete directly with these much larger predators—in fact, wolverines are primarily scavengers. Their long canine teeth and claws, a sense of smell so acute they can sniff out animals buried under 6 feet of snow, and muscular jaws capable of breaking bone and tearing apart even frozen flesh—likely earned wolverines their scientific name: *Gulo gulo*, meaning "gluttonous glutton." Related to weasels and otters, wolverines resemble small bears with bushy tails, and the musky odor they exude has elicited such nicknames as "skunk-bear."

IN SUMMARY

The wolverine is one of the rarest and least-known mammals in North America. A lack of understanding regarding its historical distribution in the contiguous United States and its broad-scale habitat needs has hampered conservation efforts. Using a suite of research methods, including the assemblage of historical data on wolverine occurrence, analyses of habitat factors, GIS mapping, radio-telemetry tracking, and genetic studies, researchers were able to address these information gaps.

Their findings show that historically, wolverines occurred primarily in high-elevation areas of the major western mountain ranges and in the Great Lakes region, where spring snow cover persisted throughout the animals' reproductive denning period. By the mid-1900s, the wolverine's range was dramatically diminished, owing probably to high levels of human-caused mortality and low or nonexistent immigration rates.

Today, wolverines survive in high-elevation pockets of northern Washington, northwestern Montana, south-central Idaho, and northwestern Wyoming. Throughout the year, wolverines stay within areas characterized by persistent spring snow cover, even when dispersing to new locales, and avoid areas with warmer temperatures to prevent thermal stress. This narrowly defined "bioclimatic envelope" suggests the wolverine's range will retreat northward in the face of climate change, but it also offers an empirical basis for initiating new conservation efforts.

The wolverine has long played its ecological role as scavenger, predator, and nutrient recycler in boreal regions from Mongolia and Siberia to Scandinavia and North America. But the wolverine's unwarranted reputation as a particularly fierce and dangerous carnivore, and their propensity to raid traplines set for marten and other valuable furbearers, steal food from cabins, and spray musk and urine on the remaining contents made human-wolverine conflicts inevitable. As a result, wolverines were persecuted during the settlement of the West, and by 1930, they had been eliminated from most of their former range in the contiguous United States.

The wolverine is one of the rarest and least-known mammals in North America. Its sparse populations and secretive habits make finding and observing the animal tricky at best. Past efforts to map their historical range in the contiguous United States produced sketchy and often contradictory results. Similarly, the habitat conditions that affect wolverine distribution and abundance were poorly understood. This lack of information became critical when petitioners sought in 1994, and again in 2000, to list *Gulo gulo* under the Endangered Species Act. In rejecting both petitions, federal officials concluded that there simply wasn't enough known about the wolverine to determine whether it was endangered or not. In 2004, a program of research on the wolverine was begun by

research wildlife biologist Keith Aubry at the Pacific Northwest Research Station in Olympia, Washington, in collaboration with Kevin McKelvey, Jeff Copeland, and Mike Schwartz at the Rocky Mountain Research Station in Missoula, Montana, and others to increase our understanding of wolverine

ecology in the contiguous United States. Among other findings, these studies provided the first reliable and comprehensive maps of the wolverine's past and present distribution in the "lower 48," and revealed specific environmental factors that support the species' survival.

KEY FINDINGS

- Contrary to previous beliefs, the historical range of the wolverine in the West was limited to discontinuous, high-elevation areas of the Rocky Mountains, Cascade Range, and Sierra Nevada, primarily in areas of alpine habitat and snow cover that persists until mid-May.
- The historical wolverine population in California was genetically unique and highly isolated for millennia.
- Wolverines were extirpated from their historical range in California, Colorado, and Utah by 1930.
- In the contiguous United States, wolverines currently occur only in northern Washington, northwestern Montana, south-central Idaho, and northwestern Wyoming. An ongoing field study in the North Cascades has confirmed the existence of a resident population in Washington.
- Correlations between reproductive denning sites and telemetry data from throughout the wolverine's circumboreal range indicate that the distribution of spring snow cover defines *Gulo gulo*'s bioclimatic envelope. In addition, genetic analyses indicate that these areas also serve as the species' primary pathways for dispersal.

MAPPING CHANGES IN WOLVERINE DISTRIBUTION

“Many previous range maps for the wolverine basically ‘connected the dots’ among geographic locations associated with museum specimens or encounters with wolverines,” Aubry says, “but for a wide-ranging carnivore that may make long-distance movements to places where they don’t actually reside, such range maps can be very misleading.” To identify the areas that were occupied by wolverines historically, Aubry’s team tracked down specimen records, photos, and written accounts of wolverines being killed or captured. They searched in 114 museums and combed through the published and unpublished literature, the archives of state and federal resource management agencies, and the archives of the U.S. Biological Survey (USBS) at the Smithsonian Institution in Washington, DC.

Fewer than 100 museum specimens exist from the lower 48, but numerous reports

were available from trappers and other early pioneers who had killed or captured wolverines, and from the USBS biologists who charted furbearer populations during the late 1800s and early 1900s. In all, the researchers compiled 729 reliable records of wolverine occurrence dating from 1827 to 2005.

The next step was to organize the records in space and time. The records were grouped into three major periods: historical (1827 to 1960), recent (1961 to 1994), and current (1995 to 2005). Mapping the geographic locations associated with the records showed that wolverines once traversed terrain in 24 states, spanning parts of the western mountains, northern Great Plains, and Great Lakes region, as well as the upper Midwest and Northeast. However, as previous researchers had suspected, the new data showed that, by the mid-1900s, *Gulo gulo*'s range in the contiguous United States had shrunk dramatically.

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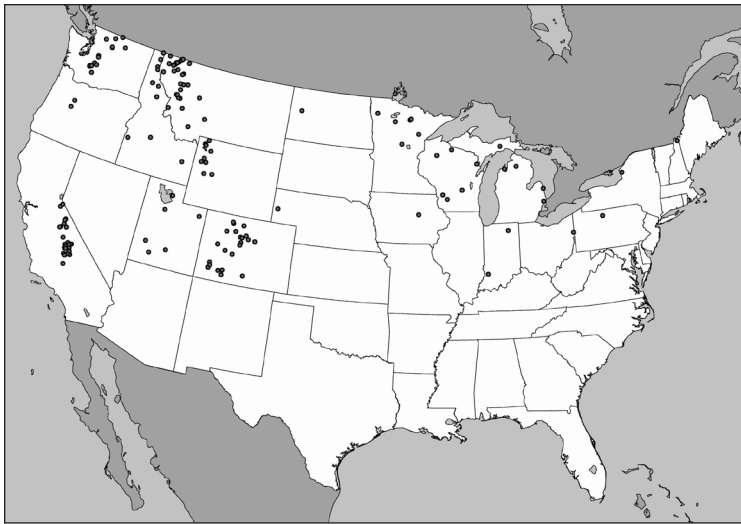
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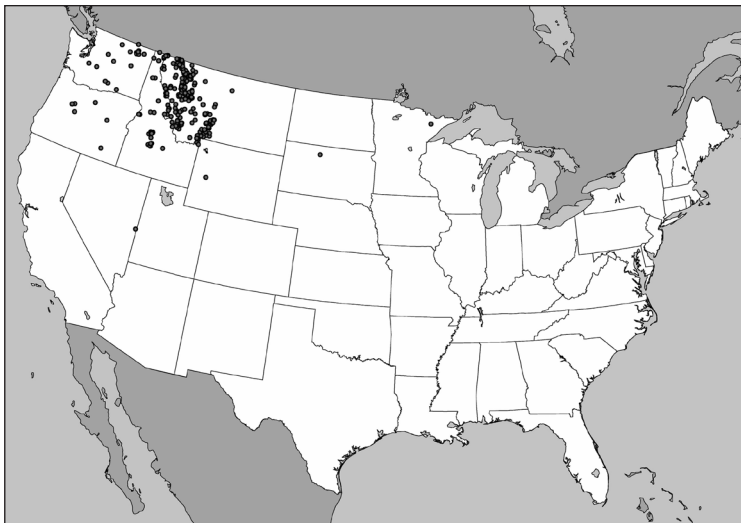
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Historical wolverine locations, 1827 to 1960.



Recent wolverine locations, 1961 to 1994.



Current wolverine locations, 1995 to 2005.

SLEUTHING FOR HABITAT CLUES

To home in on the environmental features that determine the wolverine's distribution, the team employed three broad-scale habitat maps: one that depicts potential natural vegetation types in the contiguous United States (i.e., those that would occur in the absence of major human or natural disturbances), another that maps the climatic conditions associated with ecosystem function (i.e., "climatic life zones"), and a third that shows the geographic extent of spring snow cover based on satellite imagery. When the team overlaid their historical wolverine records on these maps, a fresh interpretation of wolverine ecology began to emerge.

It had often been assumed that wolverines were habitat generalists that occupied many different types of terrain. "However, our findings revealed that in the West—where the bulk of historical records originated—they frequented an archipelago of habitat 'islands' at high elevations in the northern Cascade Range, the southern Sierra Nevada, and throughout the Rocky Mountains," Aubry explains. "Virtually all those records were within or near areas with alpine vegetation and climatic conditions." A smattering of historical records cropped up in nonalpine locales such as the Northeast and the northern Great Plains. These, the researchers surmised, probably represented wolverines wandering into those areas from populations in Canada and the Great Lakes region. But significantly, the common denominator for the vast majority of the records was a high probability of persistent snow cover during the wolverine's spring denning period, which typically ends in mid-May. "Spring snow cover was the only habitat feature that fully accounted for the historical distribution of wolverines," Aubry concludes.

With its compact body, thick fur, and feet optimized for moving across wintry landscapes, the wolverine is well-adapted for life in snowy environments. Females excavate long, complex snow tunnels for reproductive dens, where they give birth to kits and shelter them from predators and harsh weather until weaning time. The close match of wolverine occurrence records with areas covered by snow in the spring offers a convincing explanation for the island-like patterns of habitation in the West, and the accounts of wolverines around the Great Lakes during the 1800s, when a colder climate brought more snow, Aubry says. Conversely, it provides a plausible explanation for the wolverine's historical absence in regions such as the central Great Plains, where food supplies would have been plentiful but enduring spring snow was lacking.

However, Aubry points out, "It's difficult to prove whether an absence of occurrence records represents a real gap in wolverine distribution, or simply an area where the historical record was poorly documented." Although previous distribution maps had showed wolverines occurring throughout the Cascade Range and Sierra Nevada in all three Pacific States, Aubry's team found compelling evidence of their historical presence only in Washington's northern Cascades and the southern Sierras in California.

To investigate this apparent gap in wolverine distribution in the Pacific States, the researchers compared DNA samples from California wolverines to samples from outside the golden state. "The genetic results showed that the gap was real. Wolverines that once occupied the southern Sierra Nevada were genetically distinct from all other North American populations, and had been isolated for 2,000 to 10,000 years. Apparently, the geographic extent of suitable wolverine habitat in the intervening area is inadequate to support resident wolverine populations," Aubry says. "Populations that once occurred in California, Colorado, and Utah were probably extirpated by 1930 owing to low or nonexistent immigration from other populations, combined with high levels of human-caused

mortality from trappers, hunters, and predator-control programs using poisoned baits,” he concludes.

In the contiguous United States, wolverines currently occur only in northern Washington, northwestern Montana, south-central Idaho, and northwestern Wyoming. About 15 years ago, wolverines reappeared in the north Cascades, where they hadn’t been documented in decades, suggesting that the area had been colonized from another population. In response, Aubry initiated the first radio-telemetry study of wolverines conducted in the Pacific States. Since 2005, Aubry’s field crew has captured and tracked five wolverines, including a pregnant female. The telemetry data show that the animals are residents, not Canadian wanderers—a promising sign. “With human-caused mortality no longer a major threat, there are good reasons to hope that wolverines are taking their place again in Washington’s wilderness areas,” Aubry says.



John Rohrer

Researchers put a radio collar on a temporarily sedated wolverine in northern Washington to learn about the species’ current range in the contiguous United States.

THE IMPORTANCE OF SPRING SNOW COVER

The researchers found further proof of the critical importance of spring snow cover to wolverines in studies that considered an even wider swath of the species’ habitat. A team led by Jeff Copeland developed a finer-scale map of snow cover from mid-April through mid-May (the latter portion of the wolverine’s denning period) covering their entire circumboreal range, and compiled precise location data for 553 wolverine reproductive dens in North America and Scandinavia. When the two maps were overlaid, more than 98 percent of the dens corresponded with areas of spring snow cover.

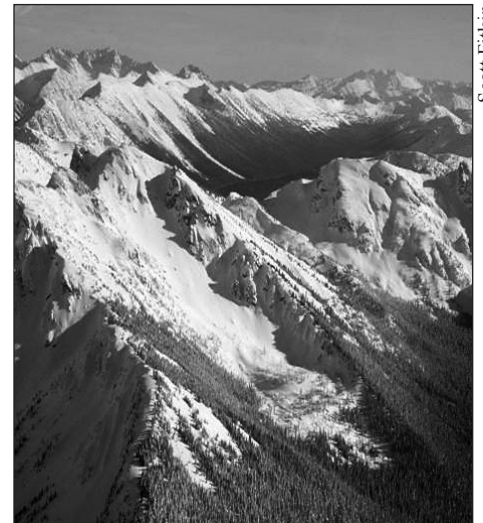
These findings reaffirmed that female wolverines are tied to snow-covered terrain for reproduction, but it was not yet clear whether other members of the population were also restricted to that terrain during winter, or whether wolverines frequented other habitat types during the snow-free months. To investigate these questions, the team scrutinized radio-telemetry data for about 120 wolverines in the northern Rockies, British Columbia, and the north Cascades. “To our surprise we found that wolverines stayed in or near the areas defined by spring snow cover 95 percent of the time, regardless of season. This included males, nonreproductive females,

and juveniles, as well as denning females,” Aubry says. In addition, a team led by Mike Schwartz conducted genetic analyses of Rocky Mountain wolverines to identify areas where gene flow occurs; their results showed that wolverines also use areas with spring snow cover as dispersal pathways. “Thus, if a wolverine needs to get from point A to point B, but there’s a warm, dry valley in between, it will remain in cooler conditions at high elevations and go around the valley, rather than through it,” Aubry explains.



John Rohrer

Female wolverines excavate long snow tunnels where they give birth and raise their kits. This denning period generally occurs between February and May.



Scott Fitkin

Radio-telemetry data showed that wolverines will go around a valley rather than through it, presumably preferring the cooler, high-elevation conditions.

Given that *Gulo gulo* evolved in the Arctic, the researchers speculated that wolverines may remain in high-elevation areas during the snow-free summer months to avoid overheating at lower elevations. To examine this hypothesis, the researchers overlaid the telemetry points on a map depicting the areas where maximum summer temperatures were typically less than 72 °F. “Although prey availability and other habitat factors may also play a role,” Aubry notes, “our analyses indicate that even after the snowpack has melted, wolverines continue to use the same areas they used during the winter due to an upper limit of thermal tolerance.” Thus, the researchers concluded that persistent spring snow cover provides a reliable and spatially explicit model of the wolverine’s “bioclimatic envelope” throughout its circumboreal range.



LAND MANAGEMENT IMPLICATIONS



- The wolverine’s specialized habitat requirements, combined with rising temperatures owing to global climate change, make it highly likely that wolverine populations in the contiguous United States will become even more fragmented than previously recognized.
- The reestablishment of wolverine populations in California, Colorado, and Utah is unlikely to occur without human intervention. Because human activities such as trapping and poison-baiting no longer pose significant threats, reintroduction may be an appropriate management strategy.
- The strong body of scientific evidence demonstrating that wolverines are closely associated with areas that contain persistent spring snow cover offers a sound empirical basis for managing the habitat conditions that are most important to wolverines.

IMPLICATIONS OF GLOBAL CLIMATE CHANGE

These studies have yielded important new insights into the nature of the wolverine’s ecological niche in North America. Unfortunately, recent findings don’t bode well for the species’ future as the planet—and particularly the Arctic—continues to warm. “The wolverine may be second only to the polar bear in its sensitivity to global warming,” Aubry contends. “If current warming trends continue, the spring snow cover layer will shift upwards in elevation and shrink in geographic extent, increasing the fragmentation and isolation of wolverine habitat,” he explains. “We believe our research provides an empirical basis for identifying the most likely areas of wolverine persistence in the face of global climate change, and the most significant habitat corridors for maintaining connectivity among their populations,” he adds.

The findings have already been used in a policy analysis related to the species. The U.S. Fish and Wildlife Service (FWS) relied extensively on the researchers’ distributional analysis in its 2008 review for potential listing of *Gulo gulo* under the Endangered Species Act. However, the FWS ruled that listing was not warranted because the wolverine population in the contiguous United States is connected to populations occurring in Canada, and does not represent a significant portion of wolverine range in North America.

Although *Gulo gulo* faces an uncertain future, the species can only benefit from this growing knowledge of its ecology. “The wolverine is an iconic symbol of the American wilderness,



Wolverine tracks.

and if we can produce new scientific knowledge that contributes to understanding its habitat requirements in the lower 48, then we’ll be helping to preserve a part of our heritage that has significant value to a great many people, whether or not they ever see a wolverine in the wild.” Aubry declares.

“Man masters nature not by force but by understanding.”

—Jacob Brownowski

Dan Russell

FOR FURTHER READING:

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