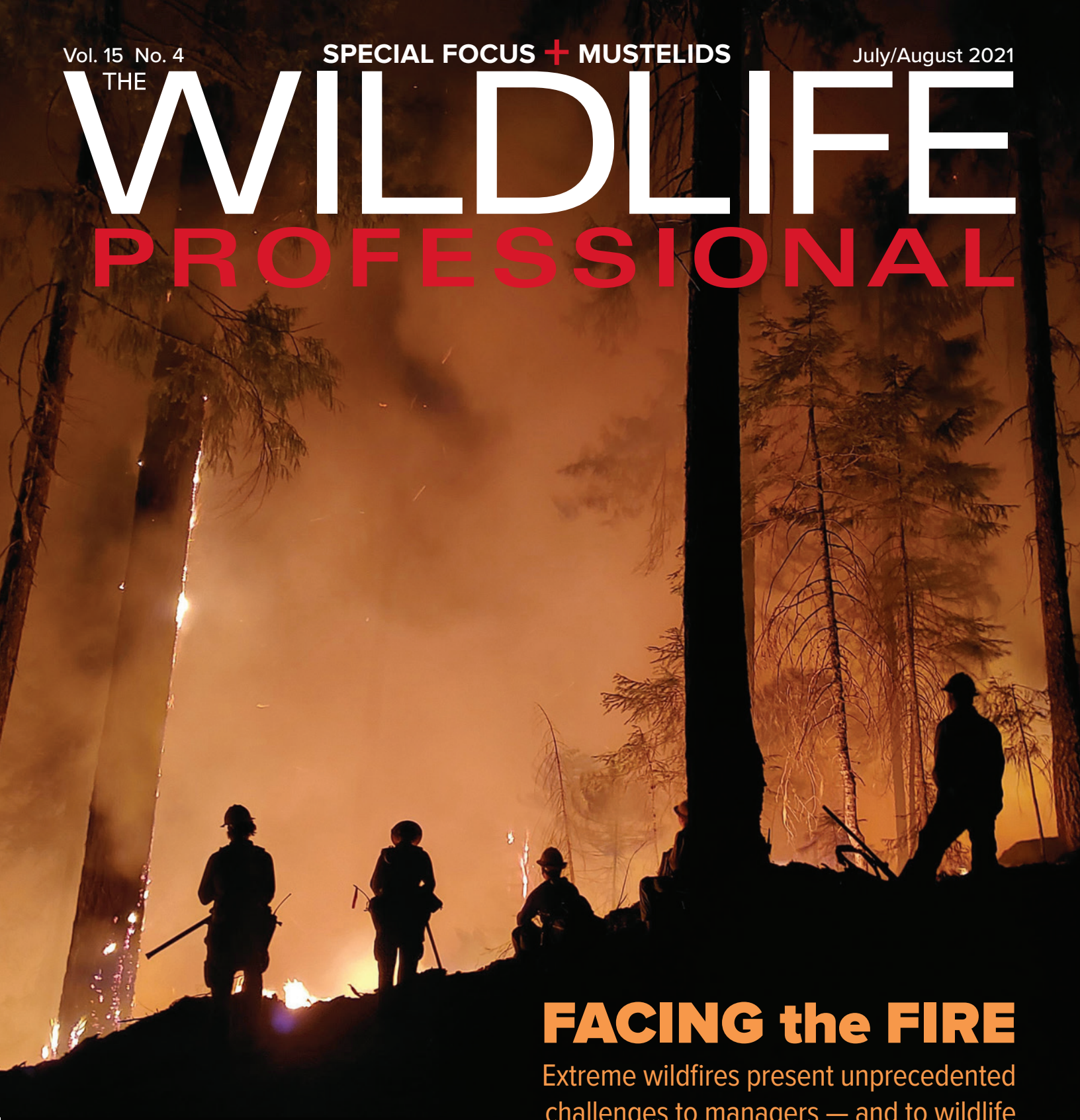
Vol. 15 No. 4 SPECIAL FOCUS + MUSTELIDS July/August 2021

THE WILDLIFE PROFESSIONAL



FACING the FIRE

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THE WILDLIFE SOCIETY

Learning from Wolverines

AS THE CRYPTIC SPECIES RETURNS TO THE CASCADES, CLIMATE CHANGE IS ALTERING ITS SNOWY HABITAT

By Paula MacKay and Robert Long

Credit: Woodland Park Zoo

In his book *Lessons from the Wolverine*, author Barry Lopez writes of a man searching for answers in the Alaskan wilderness. After falling asleep by a creek, he dreams of being visited by two wolverines. "You have to pay attention," one of the wolverines instructs the wanderer as they lay looking at the sky. "We're going to show you something." Next, the wolverines bestow powerful visions upon their visitor to help him understand his place in the natural world.

Wolverines (*Gulo gulo*) are important messengers in our waking hours, too, especially as we try to better comprehend how climate change and other anthropogenic factors affect the northern landscapes they inhabit. These tenacious mustelids exhibit a circumboreal distribution across Eurasia and North America — in part reflecting their apparent requirement for persistent spring snow cover to site natal and maternal dens (Copeland et al. 2010) and to possibly "refrigerate" their food caches (Inman et al. 2012). Surviving populations in the contiguous U.S. are mostly limited to the mountains of Washington, Montana, Idaho and Wyoming, with a few scattered individuals in eastern Oregon, Colorado, Utah and the Sierra Nevada of California. All told, an estimated 300 wolverines keep the species in existence in the Lower 48.

Recent history shows that we shouldn't take the presence of these animals for granted. Decimated by widespread predator control and trapping, wolverines were largely extirpated from the contiguous U.S. a century ago (McKelvey et al. 2014). Here in Washington state, where we conduct our research with Woodland Park Zoo, wolverines didn't show promise of recovery until the mid-1990s. At that time, research wildlife biologist Keith Aubry — today an emeritus scientist with the U.S. Forest Service's Pacific Northwest Research Station — noticed a growing trend in wolverine reports from the North Cascades.

◀ A wolverine visits a camera station set up with a scent dispenser and hair-snag devices in the North Cascades.

Reliable observations prompted Aubry and Cathy Raley, a fellow Forest Service wildlife biologist, to launch the North Cascades Wolverine Study in 2005. During the decade-long study, field crews collared 14 individuals and documented two natal dens, suggesting that wolverines were on their way to reoccupying the North Cascades — presumably responding to decreased trapping pressure. But where had the animals come from, and would a population take hold? While Aubry, Raley and others began to investigate the first question with genetic analyses, we set out to design a framework for monitoring the wolverines that now inhabit the vast, rugged terrain of the Washington Cascades.

Making scents for wolverines

Biologists in Alaska and elsewhere have successfully surveyed wolverines in winter with noninvasive run poles integrating hair snags and motion-triggered cameras. This system entices the wolverine to climb the run pole and reach for overhanging bait, ideally depositing hairs for genetic analyses while revealing its diagnostic ventral pattern (and possibly its sex) to a nearby camera (Magoun et al. 2011).

In summer 2013, our teams deployed 16 run poles in the Okanogan-Wenatchee National Forest, targeting suitable habitat as identified by existing models and telemetry data from the collaring study. We knew wolverines were out there, but we wanted to determine if they would visit our stations in the snow-free months, when we could safely access the backcountry by foot to rebait our stations. We also wondered if run poles could withstand the curiosity of black bears (*Ursus americanus*), which would be highly active during this period.

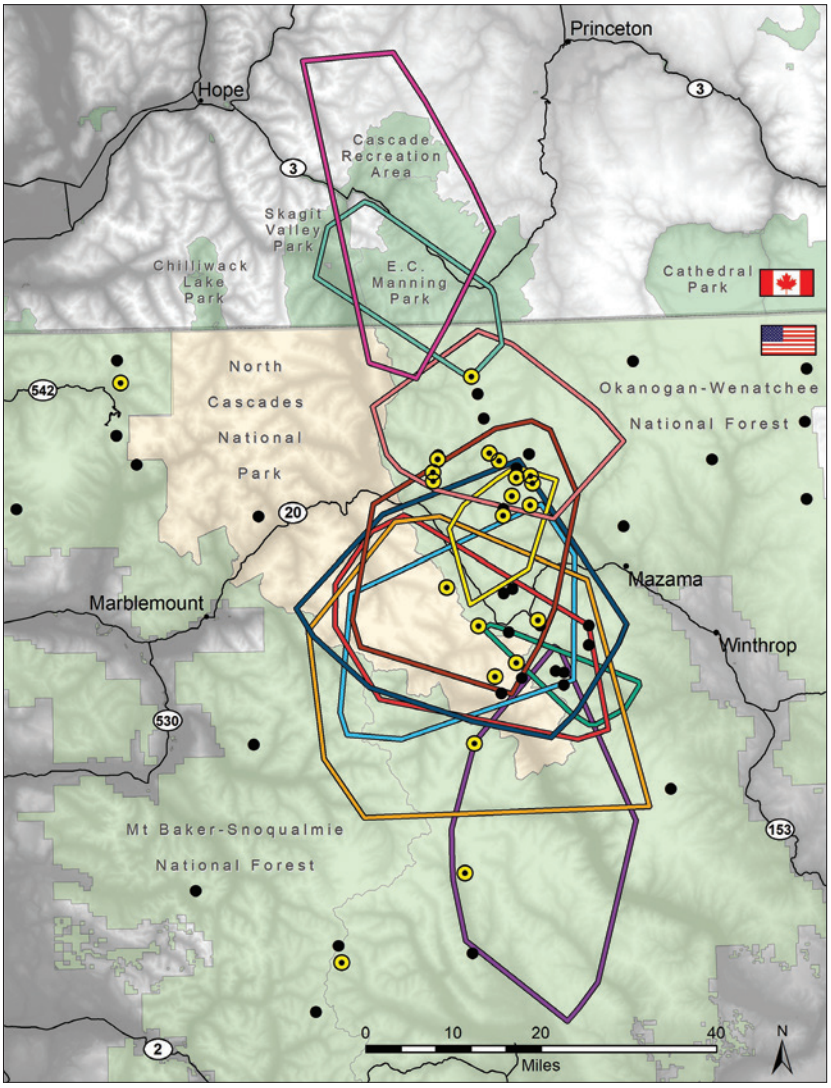
We detected only a single wolverine during our pilot field season, along with several bears trying to retrieve the dangling cow bone we'd used as a visual lure. The bears were entertaining (and surprisingly polite), but they weren't the dinner guests we'd hoped would stop by. Despite deploying almost double the number of run poles the following year, which required 10 people to hike hundreds of mountain miles, we obtained only one additional wolverine detection. Clearly, summer monitoring was not our solution.

Along the trail, we found ourselves brainstorming about how we could attract wolverines to cameras through the winter without having to revisit remote sites every few weeks to refresh bait and replenish scent lure. Winter access to wolverine habitat in the North Cascades is severely limited by deep snow, avalanche risk, lack of roads and the sheer scale of the wilderness. We needed a device that could store and perpetually release scent lure, much like a mischievous air freshener or an IV drip bag. It turned out Joel Sauder, a biologist with the Idaho Department of Fish and Game, had similar ideas, and we put our heads together to create a realistic design. By the fall of 2015, thanks to pivotal contributions from Microsoft engineer Mike Sinclair, we were ready to field test our automated scent dispensers (Mongabay 2016).

A game changer

To build the dispensers, we packed a bear-proof metal box with an ultra-low-power control processor, a filtration bag filled with liquid lure and food-grade antifreeze, and a small peristaltic pump, enabling us to program the release of 3 milliliters of skunky

▼ On this map, activity areas (polygons) for wolverines collared by the North Cascades Wolverine Study from 2005 to 2015 are overlaid with locations of scent dispenser/camera stations between 2015 and 2020. Yellow dots denote locations with at least one wolverine detection.



Credit: Cathy Raley/U.S. Forest Service

lure from the tree-mounted box every day for close to a year. During deployment, we installed a remote camera on a facing tree and secured a bone immediately beneath the drip device to further beef up our attractant. We placed both the dispenser and the camera about four meters from the ground to ensure that our equipment wouldn't be buried by snow.

The dispensers were a game changer for detecting wolverines. In summer 2016, when we returned to the 24 cameras we'd set out with scent dispensers the previous autumn, we found that wolverines had visited 13 of them. The following winter, we tested the dispensers again as part of a multi-agency wolverine survey conducted in Washington, Montana, Idaho and Wyoming, where their effectiveness at drawing wolverines to camera traps was comparable to that of baiting with meat (Lukacs et al. 2020). As we'd hoped, the dispensers yielded the added benefit of providing a consistent attractant at sites lacking winter access.

We've since continued to modify the scent dispenser as we and others have used it to survey wolverines in the Cascades and the Rockies. We've also employed this tool in partnership with agency biologists to detect Pacific martens (*Martes caurina*) on the Olympic Peninsula — where their status is uncertain (Moriarty et al. 2019). Researchers in Montana and Idaho also deployed scent dispensers at seasonally inaccessible camera locations to strengthen surveys for fishers (*Pekania pennanti*; Krohner 2020). (In the next article, "In Search of a Ghost," Krohner and her colleagues describe this effort.)

▼ **Robert Long deploys a scent dispenser in a tree to prepare for winter operation. Note the facing remote camera with a protective roof.**

Credit: Paula MacKay

One friendly pro tip: be sure to turn the dispenser off before you load it with your gear! We learned this lesson the stinky way on a multi-day wolverine survey along the Pacific Crest Trail. Let's just say one of our backpacks will never be the same.

Team Gulo

As we prepare to make the scent dispenser more widely available through Woodland Park Zoo, we're moving toward building a long-term monitoring program for Washington's wolverines. In 2019, we assembled a small group of regional biologists and conservationists dedicated to benefitting wolverine conservation with rigorous science. This group, spanning agencies, academia and nongovernmental organizations, continues to share ideas, data and other resources.

We hope to soon initiate collaborative, large-scale surveys for wolverines and other rare carnivores in the Washington Cascades with the goal of repeating surveys at statistically determined intervals into the future. We are currently finalizing our monitoring framework by integrating an occupancy model and design simulations developed by PhD candidate Robbie Emmet (whom Long co-advises at the University of Washington) with data from the wolverine surveys we've carried out to date. At the same time, we're working with TerrAdapt (cascadiapartnerforum.org/terradapt) — a new Google-affiliated, dynamic land-use change tool for conservation planning in Cascadia — to help develop a wolverine application as its first test case.

Innovative research methods and collaborations are key as wolverines continue to expand their range in the Cascades, demonstrating the innate capacity of these animals to cover a lot of ground. In 2018, biologists with the Cascades Carnivore Project documented two kits at a den near Mt. Rainier, in the southern portion of the Washington Cascades (Seattle Times 2018). That same year, an adult male was killed by a vehicle while crossing I-90 where it bisects the Cascades east of Seattle. And last May, in the midst of the pandemic, a wolverine was photographed feasting on the carcass of an elephant seal (*Mirounga angustirostris*) on the Washington coast, a long way from the mountains and our camera traps (Chinook Observer 2020). Wolverines are definitely on the move — but we can't yet be sure how the population will fare.

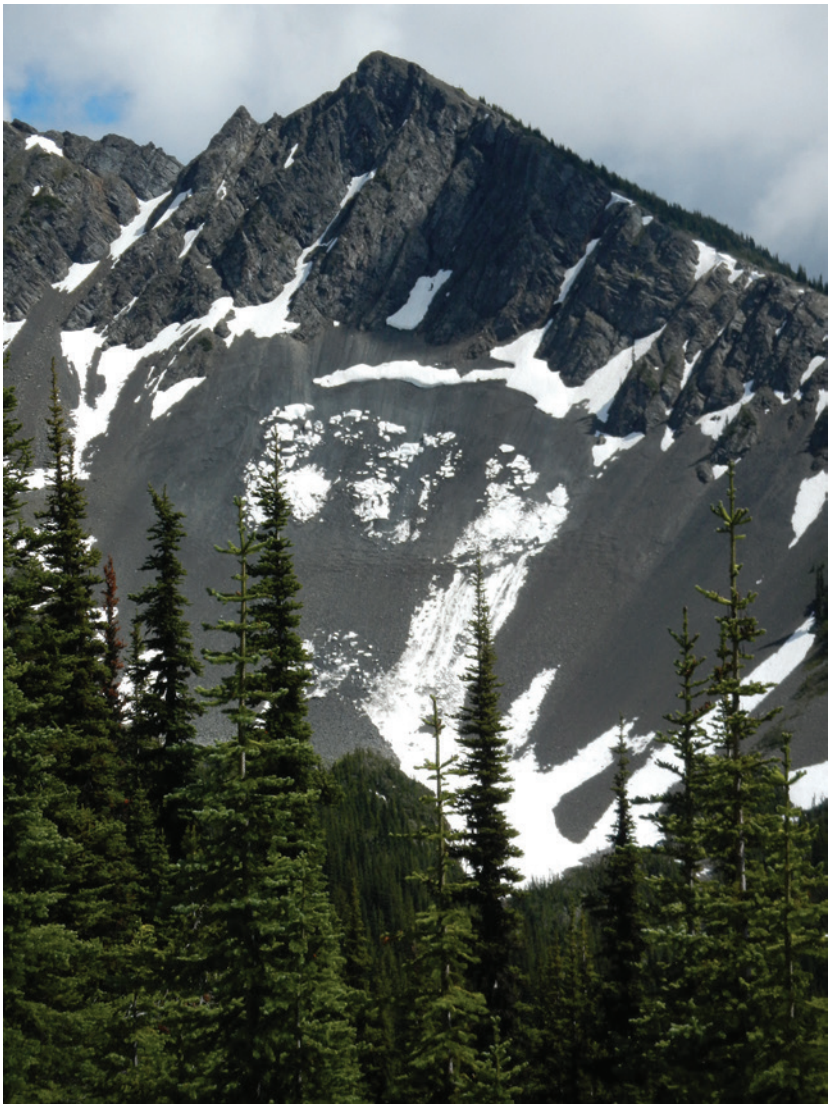
The promising evidence that wolverines are recolonizing alpine and subalpine habitat in the Cascades

is countered by climate change models predicting reduced snowpack and earlier spring snowmelt in the Pacific Northwest (Littell et al. 2010). Given the wolverine's reliance on deep snow to safely raise kits and potentially preserve carcasses, we — and many of our colleagues — are concerned that climate change will have negative effects on wolverine reproduction, distribution, competition and foraging ecology. Indeed, in 2013, the U.S. Fish and Wildlife Service proposed listing wolverines in the Lower 48 as threatened under the Endangered Species Act due to climate change-driven concerns. Although the Service denied protections to wolverines last year, a coalition of conservation organizations filed a lawsuit to contest this decision. In our darker moments, we can't help but imagine the plight of wolverines paralleling that of polar bears (*Ursus maritimus*) chasing ice flows in a warming sea.

Climate change isn't the only worry for wolverines. Research in the Rockies showed that human recreation — both motorized activities and quieter endeavors like backcountry skiing — caused wolverines to avoid using areas of otherwise high-quality habitat (Heinemeyer et al. 2019). The effect was more pronounced for female wolverines than for males. These findings are especially troublesome because they could compound potential climate change threats to wolverine dispersal processes and metapopulation dynamics. Colleagues have observed that winter recreation is increasingly popular in the North Cascades and often occurs in wolverine habitat. In response, the grassroots Cascades Wolverine Project is using community science to engage skiers and snowmobilers in reporting wolverine field observations and educating other outdoor enthusiasts. Meanwhile, all Forest Service activities, including new recreation developments and timber sales, must be evaluated for potential impacts to wolverines. The Washington Department of Fish and Wildlife classifies wolverines as a candidate for listing as state endangered, threatened or sensitive.

The link to lynx

Another montane carnivore, the Canada lynx (*Lynx canadensis*), is also potentially vulnerable to climate change. Lynx reach their southern range limits in the North Cascades and, like wolverines, probably number only a few dozen animals in the region (USFWS 2017). Catastrophic wildfires have destroyed hundreds of thousands of acres of lynx habitat in eastern Washington over the past two decades, further threatening this tenuous population.

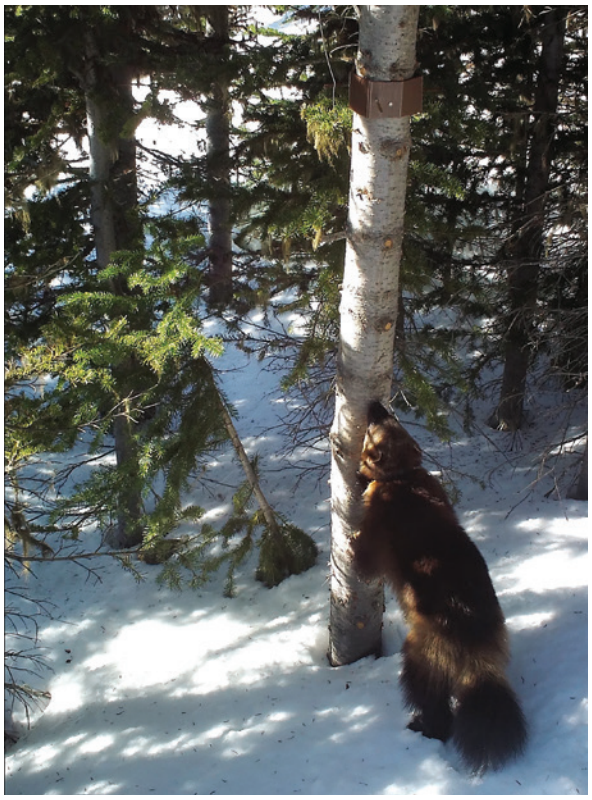


Credit: Paula MacKay

▲ **Wolverines appear to be recolonizing alpine and subalpine habitat in the Cascades, but that could be countered by climate change, which is predicted to lead to reduced snowpack and earlier snowmelt in the Pacific Northwest.**

The co-occurrence of wolverines and lynx in eastern portions of the North Cascades inspired us to partner with Washington State University's Daniel Thornton to explore a dual approach to monitoring these two species. Thornton, an assistant professor in the School of the Environment, has established a summer methodology for surveying lynx with unbaited, on-trail remote cameras. Jointly, we seek to determine if our respective on-trail summer and off-trail overwintered cameras differentially detect wolverines and lynx and whether our methods can be combined to provide year-round occupancy information for these and other species.

We're encouraged by the results so far, which demonstrate that we can monitor lynx and wolverines concurrently throughout the year and also collect important detection data on gray wolves (*Canis lupus*), reintroduced fishers and most other native



Credit: Woodland Park Zoo

A collared wolverine is detected at one of our camera/scent dispenser stations in the North Cascades.

carnivores. Interestingly, we've preliminarily observed that certain carnivores, including lynx, cougars (*Puma concolor*) and coyotes (*Canis latrans*), can be readily detected along hiking trails. Others, such as wolverines and fishers, seem to be best surveyed at off-trail camera stations treated with attractants.

New approaches

Ongoing genetic research brings broader perspective to the recolonization of wolverines. Regional scientists are probing wolverine genetic data to resolve which wolverine population — or populations — provided the source animals for repopulating the North Cascades. Previous findings indicate that wolverines were indeed extirpated from Washington and that dispersers reoccupying the state likely ventured south from Canada (McKelvey et al. 2014). We anticipate that further analyses of tissue and hair samples collected from the Cascades and bordering areas will provide more information about the source population, how many founders were involved and potential present-day mixing between wolverines in the Cascades and nearby populations.

Another genetic analysis of wolverine populations across western North America will yield an even bigger picture. Researchers representing more than a dozen U.S. and Canadian institutions, led by Mike Sawaya, of Sinopah Wildlife Research Associates, and Erin Landguth, of the University of Montana, are assessing genetic relationships among wolverines from Washington, Idaho, Montana, Wyoming, British Columbia and Alberta. With population genetic and landscape genetic methods, this project hopes to inform wolverine conservation by identifying barriers to movement, the extent of isolation among subpopulations and existing habitat linkages.

And in a fitting nod to Seattle's high-tech culture, we're collaborating with Microsoft to merge wolverine research with artificial intelligence. Because our scent dispensers operate year-round, we accumulate hundreds of thousands of camera-trap images each year. Although this is, overall, a good problem to have, we've found that summiting a rising mountain of photos is no easy feat. Like numerous wildlife projects worldwide, we've begun to explore machine learning as a means of reducing the effort necessary to analyze photographic data. More specifically, we are collaborating with Microsoft's AI for Earth program to develop machine learning-based image "classifiers," which we ultimately plan to integrate into our survey programs. The AI project is still under development, but the possibilities are exciting.

Wolverines continue to catalyze new ways of looking at the natural world. Our work with this fascinating, snow-dependent species over the past decade has inspired ingenuity, creative collaborations and, frankly, hope. Their return to the North Cascades speaks volumes about the region's wildness and connectivity. Repeated estimates of wolverine occupancy and distribution, paired with information about genetics, reproduction and movement, will help us better understand what wolverines and other montane species are up against as our climate changes. Wolverines are telling us we need to pay attention. ■

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