WHERE ARE THE WOLVERINES?

In an unprecedented multistate survey, biologists found the forest carnivores everywhere they thought they should be—along with a few surprises. BY TOM KUGLIN

PASSING BY A professional photographer's trail camera captures a wolverine in the Helena–Lewis and Clark National Forest near Lincoln, Montana. A new study documented wolverines there and in other prime habitats across the northwestern United States.
PHOTO BY KALON BAUGHAN

To most people, it's a wonder that biologists found *any* wolverines.

Only the size of a border collie, the elusive carnivores have home ranges of up to 500 square miles and live in the most remote reaches of North America. Few people, even backcountry outfitters, have ever seen one in the wild. So when scientists set out two years ago to find where wolverines occur in Montana, Idaho, Wyoming, and Washington, the task was daunting.

To do it, they used old-school wildlife monitoring gear like scent lures and snowshoes, as well as snowmobiles and the latest computer-aided scientific analysis.

The four states, along with federal, tribal, and university partners, recently finished their first report on what's called the Western States Wolverine Conservation Project. The document details the unprecedented multistate survey of this largest land-dwelling member of the weasel family. "This whole effort started with putting people who know wolverines in a room and asking the question, 'What can we do to make sure this species is here decades from now?'" says Bob Inman, Montana Fish, Wildlife & Parks Carnivore-Furbearer Program coordinator.

Researchers traditionally study wolverines anecdotally or with small-scale projects in known hotbeds in a few mountain ranges and national parks. The new survey looked for the mountain carnivores in an area of nearly 55,000 square miles. Researchers and wildlife managers now have baseline information to determine whether distribution of this iconic high-country species grows or shrinks in the future. The new data will also help them identify and conserve core breeding populations and decide where to protect connections between critical habitats.

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LIVING ON THE EDGE

For thousands of years, wolverines have lived at naturally low densities in some of the most inaccessible terrain in the Northern Rockies and Cascades, Canada, and Alaska. Biologists estimate that, historically, several hundred lived in today's lower 48 states. By 1900, poisoning by federal agencies and unregulated commercial trapping eliminated the species south of the Canadian border. Then, in the 1930s, wolverines started to recolonize their former territory.

Wolverines have a well-deserved reputation for ferocity and tenacity. Though weighing less than 40 pounds, *Gulo gulo* (from the Latin word for "glutton," referring to their seemingly insatiable appetites) have been known to chase a grizzly bear off a kill and, in deep snow, use their snowshoe-like paws and crushing jaws to take down elk. "They're always living on the edge—that's the constant for them," says Diane Evans Mack, a biologist with Idaho Fish and Game and a member of the wolverine conservation team. "They have huge territories, and they're still active in the winter when a lot of prey is either hibernating or gone."

Inman recalls the day when he realized just how strong and smart wolverines can be. He and colleagues were tracking a radio-collared female in the Spanish Peaks southwest of Bozeman to see if she had produced a litter. As they hiked across snowpack on a 9,000-foot mountain, the biologists came across an elk calf the wolverine had killed and left. While they examined the carcass, the radio receiver began beeping louder and louder. The wolverine was returning.

Inman and the others hid, then watched the 20-pound female try to drag the 30-pound carcass uphill. Every time she stopped to rest, the calf slid back down the hill. After repeated attempts, the wolverine decided instead to drag the elk down and across a boulder field and tuck it deep into a hole under a rock, before going on her way. "It all clicked for me about how this animal makes a living," Inman says. "Here we are in mid-June, and she basically took that carcass and stuck it in a 'refrigerator' that nothing bigger than a wolverine could get to later when there's not a lot of food around."

WOLVERINES ARE WHERE?

Scientists have long known that wolverines are one of North America's hardiest creatures. But they didn't know exactly where the animals lived, or how habitat fragmentation and declining snowpack from climate change affect the species. Unlike elk and other game species that generate hunting license dollars used for monitoring and management, wolverines create no income for research. The resulting lack of information, especially regarding the possible effects of reduced snowpack, led the U.S. Fish & Wildlife Service in 2013 to consider listing wolverines under the Endangered Species Act.

> "Whether they're listed as threatened or not, we needed more information to make good management decisions."

Though the agency eventually concluded that listing was "not warranted," the four states decided to marshal forces and come up with a collective strategy to conserve wolverine populations in much the same way as if the species had been federally protected. "The states have wanted to do more for wolverines for years," says Inman, who previously directed wolverine conservation for the Wildlife Conservation Society. "Whether they're listed as federally threat-

TOP PHOTO: TONY BYNUM; ALL OTHERS: WESTERN STATES WOLVERINE CONSERVATION PROJECT. WOLVERINE ILLUSTRATION BY ED JENNE

PHOTO OPS Clockwise from left: Idaho crew members Peter Ott and Luke Ferguson hang a deer haunch at a remote bait station; in Montana, wildlife technician Wendy Cole checks a trail camera in midwinter; three of the 22,641 wolverine images captured by cameras at 183 stations in four states.

ened or not, we need more information to make good management decisions. That was the impetus for taking on a really difficult project like this one."

In 2015, wolverine experts met to figure out what the state, tribal, and university partners could accomplish by working together. "Every state has its own interest in management and recovery, and those don't always align," says Robert Long, conservation scientist with Woodland Park Zoo in Seattle. Long, part of the zoo's research team, works with the U.S. Forest Service to monitor wolverines in the northern Cascades and partnered with the Washington Department of Fish & Wildlife on the multistate survey. "But this is a rare, recovering species that's impossible to study in isolation," he says. "No one group or isolated mountain range study can give us a picture of what's going on. This was an opportunity to study a species over the extent of its range with scientific rigor that wouldn't have been possible if we hadn't collaborated."

The first step was to conduct a baseline survey against which future monitoring could be compared. The aim wasn't to determine an exact population number—that would be astronomically expensive over such a vast landscape—but rather to measure whether wolverine distribution is shrinking, expanding, or holding steady. "First we map where wolverines occur, then we monitor those sites over time to see if the range is changing, and then we figure out why those changes are occurring," Inman says.

The survey would encompass thousands of square miles of rugged and remote habitat that wolverines historically occupied. "The word that comes to mind is 'ambitious,'" says Bob Lanka, a recently retired senior wildlife official with the Wyoming Game and Fish Department who was instrumental in starting the project. "There's definitely a reason it was never tried before."

SNOWSHOES AND STATISTICS

Researchers started by identifying the best wolverine habitat in the four states that either held or could hold wolverines. (In recent years, wolverines have also shown up in California and Colorado, but those states don't have breeding populations and weren't included in the survey.) Then biologists divided that vast mountainous landscape into

633 cells, each measuring 87 square miles. Using traditional bait stations aimed at capturing wolverine hair, scientists randomly sampled 183 of the cells to see which ones held wolverines.

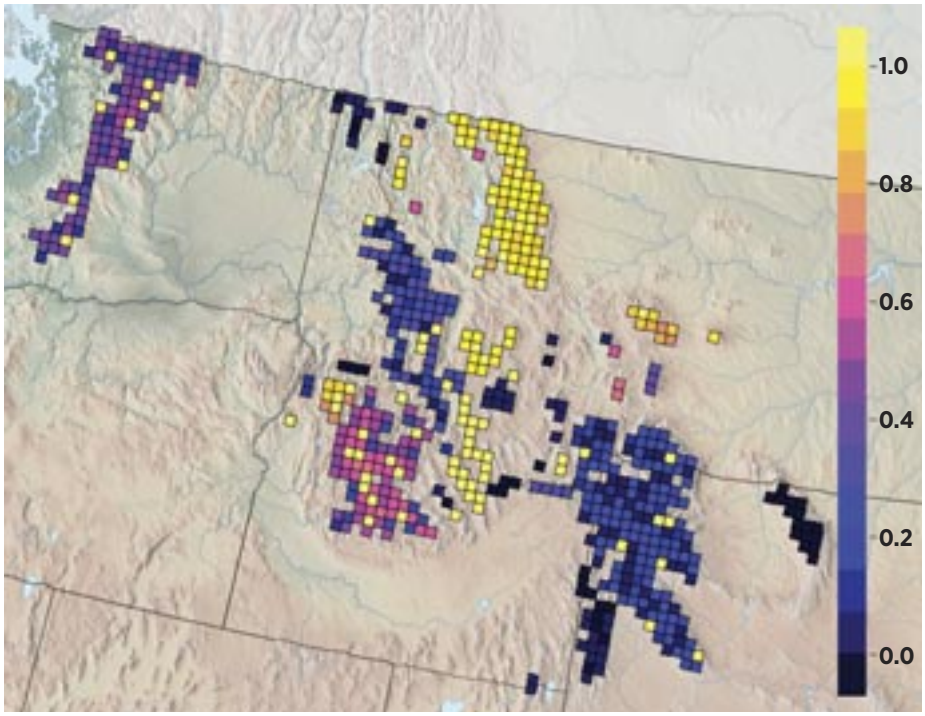
The states partnered with the U.S. Forest Service; U.S. Fish & Wildlife Service; National Park Service; the Northern Arapaho, Eastern Shoshone, and Confederated Salish and Kootenai Tribes; University of Montana; and Montana State University. The partners raised nearly $1 million for the labor-intensive work.

Survey crews hiked, skied, snowshoed, and snowmobiled deep into mountain ranges in the 183 grid cells and placed bait or scent stations with cameras along with genetics-gathering hair traps. They hung deer, beaver, or other meat on trees into which wire brushes were inserted to catch the hair of wolverines climbing to the bait. Trail cams installed nearby captured images of animals that investigated the sites. The cameras and brushes were checked once a month over four months at stations that could be accessed; stations in extremely remote sites were not visited until the following spring. Snagged hairs were sent to the U.S. Forest Service's National Genomics Center for Wildlife and Fish Conservation in Missoula for analysis to determine if they came from a wolverine or another carnivore such as a marten or fisher.

Setting up the backcountry stations was difficult enough. Even harder was returning in midwinter to check brushes and cameras, which often required traveling through deep snow in below-zero temperatures. To ensure scientific accuracy of the findings, scientists established strict field protocols, including everything from the placement of cameras within each cell to the size of the brushes used to snag wolverine hair. "The point was to make sure the data from each cell was collected in the exact same way, so that analysis of all the information was as accurate and repeatable as possible," says Evans Mack, the Idaho biologist.

> "I've never seen such extensive collaborations among agencies and NGOs in my entire career."

The survey detected wolverines in 59 of the 183 cells that were sampled. But just because a camera or brush didn't detect a wolverine didn't mean the animals weren't living in that cell. To account for what's known as "imperfect detectability," the study hired Paul Lukacs of the Quantitative Wildlife Ecology Lab at the University of Montana. Lukacs analyzed forest cover and other characteristics of cells with high and low levels of detection (ranging from one to four detections per month over four months). That allowed him to estimate the probability that cells where wolverines weren't identified by hair traps did in fact contain the animals. He estimated that if a wolverine lived in a sampled cell, there was a 92 percent chance of detecting it there at least once over the entire four-month survey. "That's a really high detection probability for a rare animal," Lukacs says. "It shows that the biologists knew how to attract wolverines to the bait stations." After accounting for imperfect detectability, the team adjusted the estimate of occupancy at cells where wolverines were not detected and concluded that wolverines were likely present in roughly half the 633 cells.



Where the wolverines (most likely) are

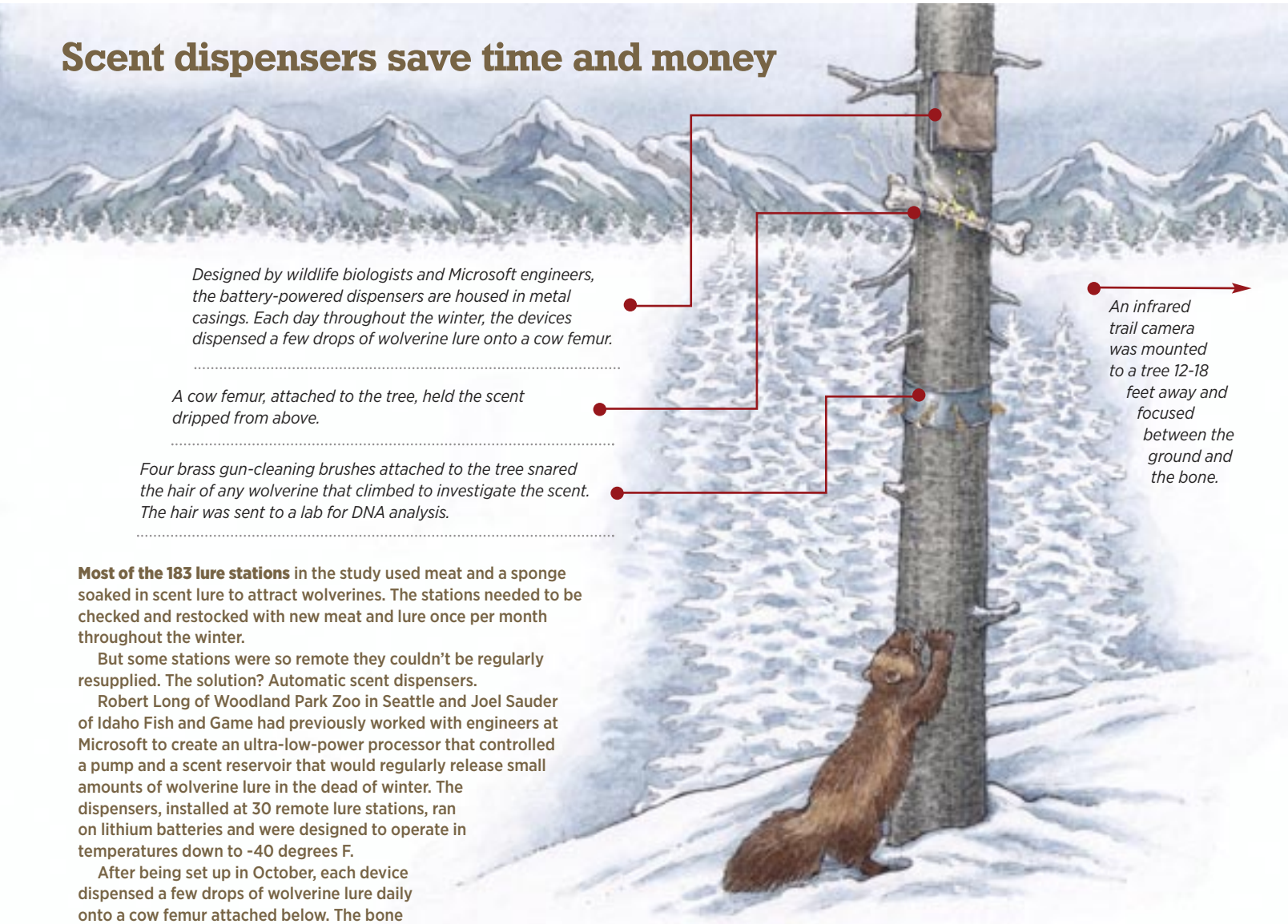
Researchers didn't look for wolverines in all of the 633 cells they identified as possible habitat. That would have been astronomically expensive in these remote mountains. But they sampled 183 cells and found wolverines in 59. After analyzing the findings, and accounting for "imperfect detectability," scientists concluded that wolverines were likely present in roughly half of the 633 cells. The colors on this map represent the probability that wolverines live in an individual cell, ranging from yellow for high probability (1.0) to dark purple and black for low probability (0.0)

MAP: WESTERN STATES WOLVERINE CONSERVATION PROJECT

EXCITING DISCOVERIES

Though occupancy varied across the study area, with lower rates at the southern periphery, wolverines were found across much of their historic range. "This confirms the broad distribution of wolverines across the region, and it also shows that recolonization has progressed substantially since historical lows," Lanka says. Unsurprisingly, known wolverine hotbeds such as the Bob Marshall Wilderness and central Idaho's Sawtooth Mountains produced plenty of detections. But so did many other areas previously considered unoccupied, such as the first detec-

Scent dispensers save time and money



Most of the 183 lure stations in the study used meat and a sponge soaked in scent lure to attract wolverines. The stations needed to be checked and restocked with new meat and lure once per month throughout the winter.

But some stations were so remote they couldn't be regularly resupplied. The solution? Automatic scent dispensers.

Robert Long of Woodland Park Zoo in Seattle and Joel Sauder of Idaho Fish and Game had previously worked with engineers at Microsoft to create an ultra-low-power processor that controlled a pump and a scent reservoir that would regularly release small amounts of wolverine lure in the dead of winter. The dispensers, installed at 30 remote lure stations, ran on lithium batteries and were designed to operate in temperatures down to -40 degrees F.

After being set up in October, each device dispensed a few drops of wolverine lure daily onto a cow femur attached below. The bone held the scent and gave the wolverine something to chew on. Crews returned to the sites in late winter or spring, as soon as snow conditions allowed, to retrieve hair samples and trail camera files.

The scent-disperser stations attracted wolverines just as effectively as did the labor-intensive meat-and-sponge stations. That means "agencies could cut future survey costs substantially if we use the dispensers at all the sites," says Justin Gude, head of wildlife research for Montana FWP.

Woodland Park Zoo is currently developing an updated dispenser and intends to produce the devices for researchers, says Long. ■

ILLUSTRATION: ED JENNE

tion in years in central Montana's Little Belt Mountains between Helena and Lewistown.

One of the most exciting discoveries was in Wyoming, the southern reach of known wolverine populations in the Northern Rockies. The mountains surrounding Yellowstone National Park have long been known as core habitat. But the survey detected wolverines for the first time in the Gros Ventre Mountains and the first male-female pairing in the southern reaches of the Wind River Range, up to 100 miles south of the park. The Wind River detections suggest that wolverines could be breeding in the area. "It was pretty exciting to find them that far south," says Zack Walker, Nongame Wildlife Program supervisor for the Wyoming Game and Fish Department.

In Washington, the survey verified two wolverines south of I-90, a region where recolonizing wolverines have only recently been documented. "We've got a good amount of public land, and wolverines are starting to show up in places where they haven't been, and that's all positive," says Long, the Seattle-based scientist. "Knowing that the species is here and recovering gives us additional incentive to learn more about what factors affect where wolverines can and can't occur."

Key to the massive survey effort has been nearly unprecedented cooperation and collaboration among the four states, says Lanka, the retired Wyoming wildlife official. "We tend to work within our own state boundaries, but in this case we had experts from across the region come together and create a remarkably effective team that was able to pull off a nearly impossible task," he says. "I've never seen such extensive collaboration among agencies and NGOs [nongovernmental organizations] in my entire career."

Justin Gude, head of wildlife research for FWP, says that collaboration and commitment have led the four states to agree to repeat the survey every five years to see if wolverine distribution grows or shrinks. "That will help us see the effects on distribu-

FEW AND FAR BETWEEN Forest carnivores with home ranges of up to 500 square miles, wolverines have always lived in low densities. Biologists estimate that, historically, only several hundred occupied today's lower 48 states, mostly in the high-mountain habitats where scientists found them in a recent survey.

ERIC ROCK

tion from things like climate change, human development, and translocations," he says.

In the meantime, biologists want to identify key connectivity corridors between core habitats and figure out how to protect them. They hope to combine information from a Montana State University study on wolverine habitat use in the Greater Yellowstone Ecosystem with research from Glacier National Park, central Idaho, and the northern Cascades. "That would give us comprehensive data on which to model connectivity among the core alpine habitat patches that wolverines use," says Gude.

Wolverine habitat in designated wilderness areas is protected from roads and oil, gas, and other development that could hamper the animals' movement. Key habitat on private land is another matter. The project's partners want to safeguard corridors so the animals can move through private property, using conservation easements with landowner partners. Connectivity is essential to link populations and allow wolverines to move the vast distances necessary for finding mates, essential for the species' long-term survival.

Team members have also begun talking to wolverine experts in other Western states about translocating wolverines to new areas of suitable habitat (see sidebar, below). "From the very beginning of this project, our mantra has been 'connect, restore, and monitor,'" says Inman. "We've made a great start on monitoring, and now we're moving into the connection and restoration work."

Other western states could be potential wolverine recipients

While the Western States Wolverine Conservation Project survey found solid wolverine distribution across Wyoming, Montana, Idaho, and Washington, scientists wonder what a wider survey would have uncovered. "Wolverines are well distributed throughout the range we surveyed, so there are very few places left in the four states for translocation," says Justin Gude, head of wildlife research for Montana Fish, Wildlife & Parks. "If we could have extended the survey into likely habitat in Oregon, California, Utah, and Colorado, I think we would have found places with much less use by wolverines where they could be reintroduced."

Those states have already shown interest in the next wolverine survey. Colorado and California, both with mountain ranges reaching 14,000 feet, may even consider accepting wolverines from other states or Canada. During the last decade in both Colorado and California, young males traveled from neighboring states to become the first documented wolverines in a century, sparking interest among the public.

After successfully reestablishing the Canada lynx to its historic range, Colorado is considering doing the same for wolverines. But Colorado Parks and Wildlife officials say that some ski resorts, other businesses, and landowners are concerned about what might happen if the species were listed under the Endangered Species Act (ESA) after reintroduction into Colorado. Western states have begun working with the U.S. Fish & Wildlife Service to find ways to reintroduce wolverines to new areas while addressing the concern.

"We hope to get past the ESA-listing concerns and start working on active conservation," says Eric Odell, Terrestrial Species Conservation Program manager for Colorado Parks and Wildlife. "If wolverines could reoccupy suitable habitat in Colorado and California, we could increase the population by 50 percent across the Lower 48."

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