

# BIG CATS, BIG TERRITORIES

How new DNA technology, spatial science, and computer modeling are helping FWP adjust mountain lion numbers to where Montanans want them.

By Jessianne Castle

**B**right beams of light pierce the darkness of the pre-dawn February morning as my husband Ryan and I slowly drive up a logging road through fresh snow. As qualified hound handlers, we've been hired by Montana Fish, Wildlife & Parks to search for mountain lions in the Lolo National Forest near St. Regis.

At daybreak, I spot a trail of round, hand-size indentations crossing the road. We quickly strap tracking collars onto our two scent hounds, Rooster and Bay, and turn them loose. Noses down and tails wagging wildly, the dogs follow the tracks up a

mountainside while Ryan and I wait and listen. Soon we hear Rooster's throaty bawl carry through the still air, announcing he's found fresh scent.

Ryan and I race after the dogs, scrambling up steep slopes through the barely lit forest in knee-deep snow. Chasing dogs that are chasing lions is not for the easily winded. Listening to Rooster in the distance, we watch the hounds on the digital map of our GPS unit as they cut straight up a ravine, moving ever more quickly. Finally, five miles after they were let loose, they come to an abrupt stop. The lion is treed.

When we arrive and leash our dogs, the cat is about 30 feet up a tall Douglas fir. Ryan loads a dart gun and fires. The biopsy dart flies into the lion's hip then pops out, dropping to the snow-covered ground below. I retrieve the dart and check the tip to confirm that it contains a tiny pinch of flesh and hair with the lion's DNA. I hold the dart up to let Ryan know that our work here is done.

Except for a temporarily sore rump, the lion is unharmed.

The DNA sample we've secured, along with dozens of others taken by FWP staff and contract workers across this study area

in northwestern Montana, will allow biologists to estimate how many mountain lions live in this region. DNA analysis, along with sophisticated computer habitat mapping tools and population modeling, is changing how Montana manages these large and elusive forest carnivores. The new science is providing wildlife biologists with much more accurate estimates of mountain lion abundance and population trends—information they will use to raise or lower lion numbers through hunting harvest to healthy and sustainable levels that will be decided by Montana residents.

COURTNEY RUGGERO

## NUMBERS UP AND DOWN

In 1989, a mountain lion killed a five-year-old boy 20 miles north of Missoula. A year later, another child was mauled by a cougar in Glacier National Park. Montana homeowners were increasingly reporting lions in their yards.

Were lion numbers rising? It seemed so, based on homeowner reports. And it made sense. For much of the 20th century, Montana had declared war on lions, going so far as to pay a bounty for each one killed. Numbers dwindled to the point that lion sightings, even by hunters pursuing the big cats, were rare.

**RETURN TO THE KILL** A trail camera captures a mountain lion at an elk carcass cached in the snow. New information on lion movement, range, and habitat use allows wildlife biologists to better manage the large carnivores.

Then in 1971 Montana classified the species as a game animal, giving them protection with regulated hunting seasons and, later, harvest "quotas"—the number of lions that hunters could kill in various hunting districts.

As expected, lion numbers increased. But by the late 1980s, the population appeared to exceed anyone's expectations. Angry and frightened residents demanded that something be done to keep their families safe.

FWP responded by steadily increasing



harvest quotas. The statewide harvest skyrocketed from 159 lions in 1988 to 776 lions in 1998. But then it appeared that FWP had overshot its goal. Toward the end of the 1990s, hound handlers—the men and women who pursue mountain lions with trained scenting dogs—demanded that FWP reduce the annual harvest to increase the population. Wildlife managers tapped the brakes on harvest, eventually dropping the statewide quota to 282 by 2006.

By this time FWP wildlife biologists realized they had to find a better way to manage mountain lions. Using reports from scared people on one hand and angry hound handlers on the other was no way to estimate population trends and establish quotas.

Biologists had some idea of lion numbers. They counted tracks in the snow, collected anecdotal information from deer and elk hunters, responded to livestock depredation reports, and tallied lion harvest data. But that wasn't enough to accurately estimate numbers and trends, which resulted in quotas that were often either too high or too low.

#### GETTING A HANDLE ON LIONS

Two major mountain lion research projects over the past quarter century have vastly improved FWP's ability to count and thus manage lions. The first was a lion ecology study by since-retired FWP biologist Rich

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DeSimone that began in 1997. Over nine years, DeSimone's team captured and radio-collared 121 lions in the Garnet Range east of Missoula and recorded more than 46,000 locations of the large forest carnivores. The researchers collected vital information used to manage lions, such as the age when young lions leave their mother. They also found that high hunting harvest can lower lion densities but that these changes are temporary because lions move in from other areas.

Then, in the 2010s, FWP research biologist Kelly Proffitt led a team that developed a way to estimate lion populations and abundance in the Bitterroot Valley using DNA samples. “It was a big change,” says Proffitt. “We went from needing multiple years of animal capture and monitoring information to estimate population size to being able to do that with just three or four months of sampling.”

Estimating the abundance of elusive car-

nivores such as mountain lions has always been a challenge. But with DNA analysis and statistical tools like Spatial Capture-Recapture modeling (see sidebar, page 42), “we can now quickly and efficiently estimate populations,” Proffitt says.

These new methods can be used to identify mountain lions, based on their DNA signatures, that biologists and hound handlers may recapture later. Proffitt explains that often the same individuals are sampled multiple times in different places as the lions move around their home ranges throughout the winter. The distances between multiple DNA sampling locations for the same animals is used to estimate the sizes of home ranges for male and female lions. Recapture information is also used to estimate the number of lions in a study area (see sidebar, page 42). And information on recaptures, estimates of population abundance, and correlations with habitat quality in a study area allow biologists to develop estimates of the total number of lions in a broader landscape.

With this new information, wildlife managers can now also quickly understand whether lion populations are growing, declining, or staying stable, and adjust harvest quota recommendations accordingly.

#### THE BIG PICTURE

Jay Kolbe, FWP wildlife biologist in White Sulphur Springs, was the lead author of FWP's comprehensive mountain lion management strategy document, adopted by the Fish and Wildlife Commission in 2019. He says another benefit of DNA technology is that, with lions, “we no longer need to tranquilize and handle the animals, which is a lot easier on them. We can now even identify individual animals just by analyzing the DNA in hair we find in tracks.”

Equally important, he adds, is new research conducted by states across the West on the vast distances lions cover and how that affects conservation and management. “One huge lesson we've learned is that we have to be thinking on a much larger spatial scale than we have in the past,” Kolbe says. Biologists now know that lions occupy home

**A TINY PIECE OF PUMA** Innovations in DNA technology allow wildlife agencies to identify lions without having to tranquilize and handle the animals. Top right: Mountain lions will commonly climb a tree in response to pressure from hounds. Near right: FWP wildlife technician Ben Jimenez waits for a clear shot with a dart gun at a treed lion while a dog keeps the cat from jumping down and running further. Clockwise from far right: A biopsy dart and a CO<sub>2</sub> cartridge used to fire it from a gun; when the dart strikes a lion in the flank, it pops out carrying a small chunk of tissue that is extracted while the cat is allowed to continue on its way, unharmed but for a sore hip; the tissue specimen is marked and then sent to a laboratory, where DNA is extracted and analyzed to identify the lion; scent hounds bay at a treed lion overhead.

ALL PHOTOS: JESSIANNE CASTLE, EXCEPT FOR CENTER IMAGE, OPPOSITE PAGE: MONTANA FWP

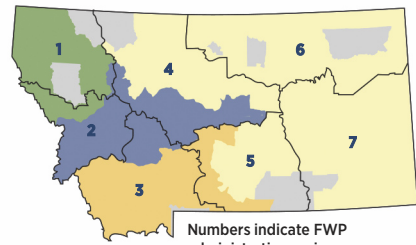
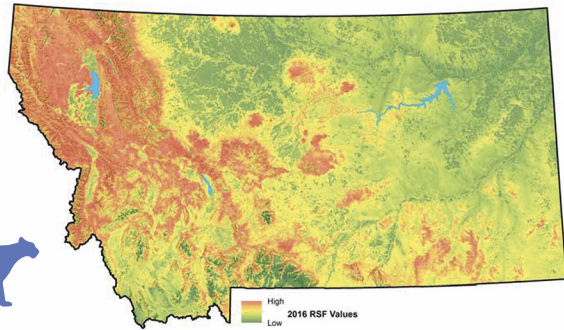
**CAT SIGN** A hound handler and his dog check lion tracks crossing a logging road before following the prints into the Lolo National Forest near St. Regis. FWP hires handlers for their expertise in finding lions and tracking them with dogs. Right: Hand-size tracks indicate where a lion crossed a log.





## MONTANA'S BEST MOUNTAIN LION HABITAT

The lion habitat model at right, showing the range of high-quality to low-quality habitat, is based on where the big cats were found in 10 different research projects. The model determined the four new ecoregions (below) now used for lion management.



- 1 Northwest Ecoregion
- 2 West-Central Ecoregion
- 3 Southwest Ecoregion
- 4 Eastern Ecoregion
- 5 Areas not managed by FWP
- 6
- 7

Numbers indicate FWP administrative regions.

SOURCE: MONTANA FWP

ranges that often exceed 100 square miles and cover great distances to disperse and find those ranges. When lion numbers decrease in areas of good habitat, such as when FWP increases harvest quotas, that creates a habitat “sink” into which wide-ranging cats from “source” areas settle into.

The upshot of these “source-sink dynamics,” Kolbe says, is that efforts to raise or lower lion density in one area (such as a mountain range or a hunting district) will likely be only short term unless similar management actions are applied to the much larger surrounding landscape. “Research has clearly shown us that because mountain lions disperse so readily, to effectively influence lion population trends, management units need to be many thousands of square miles in size.”

This is a major change in how FWP manages mountain lions, and it will take time for the public to adapt, Kolbe adds. “Many lion hunters are used to recommending changes to harvest quotas for only their local area. Now, people interested in lion management—hunters, wildlife enthusiasts, biologists, and members of the Fish and Wildlife Commission—will need to think about population objectives that affect one of the four statewide lion ‘ecoregions,’” he says.

The ecoregions, on which much of

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FWP’s new mountain lion management strategy is based, were drawn to include large areas of similar-quality habitat. Montana’s best lion habitat is in the northwest, where dense conifer forests support abundant white-tailed deer; the lowest-quality habitat is in eastern Montana’s open grasslands and sagebrush. Based on habitat differences, managers divided the state into distinct ecoregions—Northwest, West-Central, Southwest, and Eastern—that have unique environmental factors contributing to habitat quality and ultimately support different densities of cats.

“We let lions themselves tell us where the ecoregion boundaries should be,” Kolbe says. He explains that FWP staff and Hugh Robinson, director of applied science for the international wild cat conservation organization Panthera, worked together to build a statewide computer habitat model using thousands of lion location points collected as part of 10 different research projects in Montana and Yellowstone National Park. “When we compared the habitat model to where lions were actually harvested, it performed very well” in predicting where lions will and won’t be, Kolbe adds.

FWP is now managing lions on a landscape scale based on the animals’ biology rather than on the smaller hunting districts used for other big game species. “The department is managing lions using more complex science than we are for any other big game



**COMEBACK CAT** In Montana and throughout the West, mountain lions were subject to indiscriminate killing during much of the 20th century. After they were declared a game species in Montana in 1971 and harvest was regulated, lion numbers steadily increased.

species,” says FWP northwestern region supervisor Jim Williams, who has studied lion conservation in Montana, Chile, and Argentina over the past three decades and is the author of *The Path of the Puma*.

### PARTNERS IN RESEARCH

Using its newly adopted management strategy, FWP set out in December 2019 to collect field data to help build an estimate of the number of mountain lions in the Northwest Ecoregion. That winter, a team of hound handlers collected DNA samples from a monitoring area south of Libby. The following winter, they collected samples from another monitoring area around St. Regis.

“This project is one of those unique opportunities to involve the public in mountain lion research,” Williams says. “There’s no

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way we could do any of this research or management without the help of hounds specially trained to pursue and tree a mountain lion so that we can obtain DNA samples.”

Molly Parks, FWP mountain lion monitoring technician, coordinates the sample

collecting. Throughout the winter, she assigns hound handlers to randomly selected “cells” within the survey area. At winter’s end, Parks sends the DNA samples to a lab in Idaho, where geneticists identify how many individual lions were detected and how many were treed more than once. These results, along with capture locations and the habitat model, are later used to develop a population density estimate using the Spatial Capture-Recapture (SCR) sampling method (see sidebar, page 42).

“The estimates we produce using the SCR method are far more accurate than what’s been reported in the past,” Kolbe says. Previously, when managers wanted to estimate the number of lions in an area, they tried to radio-collar every lion living there. But because so many members of any lion

population are wide-ranging teenagers, that approach usually missed many of the cats available for harvest. “We’ve almost certainly underestimated densities using that older method,” Kolbe says.

After conducting field surveys during two winter seasons, FWP estimates that roughly 1,400 adult mountain lions inhabit the Northwest Ecoregion. Over the next two winters, the department will survey the West-Central Ecoregion, followed by two years in the Southwest. Given its lesser-quality habitat and lower overall harvest, the state is not managing the Eastern Ecoregion with the same monitoring strategy. Field crews will return to the Northwest Ecoregion in December 2025, to resume monitoring, and will do similar six-year rotations for the other two surveyed ecoregions.



## MONTANANS DECIDE

After FWP estimates the lion population and density estimate for an ecoregion—data it plans to release every two years—the information is added to what’s called an Integrated Population Model, or IPM (see sidebar, below). Scientists can then input various possible harvest numbers to project how a lion population would respond.

“IPM is a new tool that allows us to take all the pieces of information we have on any big game species, make a prediction regarding harvest, weather, breeding probability, litter size, and other factors, and then see what will happen to a population,” says Brian Wakeling, chief of the FWP Wildlife Game Management Bureau. “We can then adapt our population models and resulting management recommendations as new information comes in.”

While all this science is essential to managing lions, it can’t answer the question of how many lions *should* live in each eco-

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region. That’s for Montanans to decide.

FWP recently formed the Northwest Lion Ecoregional Population Committee to grapple with this challenge. Composed of hound handlers, hunting outfitters, elk and deer hunters, livestock producers, and regional residents, the citizen advisory panel will meet this winter to discuss lion numbers and how the big cats affect the region’s people, businesses, ungulate populations, and other communities. Committee members will also discuss how harvest might be distributed over the entire region to address as many concerns as possible. With input from

the committee, FWP will make recommendations to the Fish and Wildlife Commission on northwestern Montana hunting seasons and quotas in the spring of 2022. The commission makes the final decision.

When field crews return to the Northwest Ecoregion in 2025 to gather new population and density information, FWP wildlife managers will be able to see if harvest strategies adopted by the commission affected the lion population as models predicted. At that time, the citizen lion committee can recommend new management direction and the cycle will begin again. The department plans to use this same approach in the other ecoregions.

Montana is a state with enough wild habitat and abundant prey to support healthy and widespread mountain lion populations. But at what size? FWP now has the tools to accurately raise or lower lion populations. But it’s up to Montanans themselves to reach agreement on how big or small those populations should be. 🐾

## Three tools for mountain lion management

Wildlife managers use these tools to estimate mountain lion populations and recommend harvest quotas to the Fish and Wildlife Commission:

### 1. RESOURCE SELECTION FUNCTION

The Resource Selection Function (RSF) model predicts lion presence based on habitat features. It can be represented as habitat maps or used as a statistical model. FWP used this tool to divide the state into four mountain lion ecoregions. Each has different levels of lion habitat quality and prey types able to support specific densities of mountain lions.

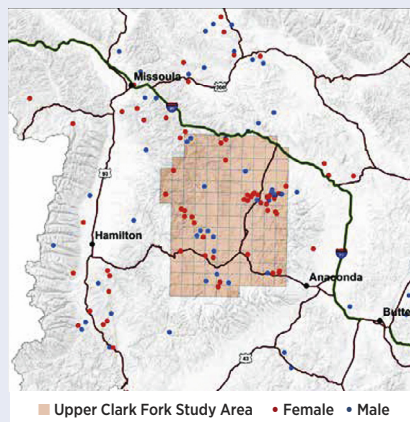
### 2. SPATIAL CAPTURE-RECAPTURE

The Spatial Capture-Recapture (SCR) model is a modern refinement of the classic way of estimating wildlife populations. For decades, biologists have captured animals, tagged them, then noted the percent of tagged animals that are later recaptured.

Think of it this way: You’re given a bag of beans and need to estimate how many are in the bag. You pull out a handful of beans, mark each one with an X, and

return them to the bag. After giving the bag a shake, you pull out another handful of beans. Comparing the number of beans marked with Xs with the total number of beans in your second handful allows you to, based on the number you originally marked with Xs, figure out the total number of beans in the bag.

When contracted hound handlers collect DNA samples from mountain lions in a specific search area, it is the same principle as marking beans with an X.



A SCR sampling area and the locations of 132 mountain lion tissue samples from which DNA was extracted and analyzed to determine individual identification.

The spatial component of this tool involves combining each DNA sample with a GPS location to factor in where on the landscape initial and subsequent captures occur. Based on the probability that a lion would be captured in various habitats—high probability in prime habitats and low in marginal areas—scientists can even more accurately estimate the total number of lions in a search area.

### 3. INTEGRATED POPULATION MODEL

The Integrated Population Model (IPM) combines density estimates using the SCR method with mountain lion vital rates (such as survival and reproduction rates) derived from research and monitoring projects in Montana and across the West. When biologists recommend harvest quotas to the Fish and Wildlife Commission, they can input those proposed numbers into the IPM and see how the harvest would affect mountain lion densities in each ecoregion over time. This will help the commission factor in whether the public wants more or fewer mountain lions in a particular area when it makes its decisions.

With the addition of new density estimates after each field season, the IPM will also show if an ecoregion’s population is trending up or down and could give biologists a sense of the overall status of a region’s mountain lion population. ■