



SOLVING MONTANA'S MOOSE MYSTERIES

FWP researchers search for answers to help conserve these popular big game animals in the face of rising temperatures, shrinking habitat, and more predators. **BY TOM DICKSON**



In winter, the Big Hole valley looks like a vast white lake lapping against the Pioneer Mountains to the east and the Beaverhead Mountains to the west. The 15-mile-wide expanse of snow sits atop a mix of sagebrush prairie, pasture, hayfields, and willow swamp. Within this broad valley and surrounding forests resides one of the state's largest moose populations.

On a frigid February morning, the temperature hovering around -20 F., Montana Fish, Wildlife & Parks wildlife research biologist Nick DeCesare and I are driving across the valley near Wisdom searching for a cow moose he has radio-collared. Two miles out of town, he parks his pickup along a frozen county road. After picking up a strong signal with his radio receiver, we wade through knee-deep snow in pursuit.

"There," DeCesare says a few minutes later, pointing to two distant dark shapes. A cow moose sporting a bright white collar and her calf pause against a stand of willows. Then they amble off, long legs carrying them easily through the deep drifts. Trudging after the pair, DeCesare gathers a handful of the cow's fresh thumb-sized droppings to be tested for progesterone, indicating pregnancy.

DeCesare, who earned his doctorate in wildlife biology at the University of Montana, makes his way back to his truck. He mentions that he's been following this particular moose for six years, watching her raise calves to young adulthood as part of a study he's doing with other research scientists. "It's great getting all this broad population-wide data that will eventually be used to manage moose," he says. "But it's also pretty neat that we get to intimately know these individual moose year after year. They're such cool animals."

WELL-LOVED

Few would disagree. Nearly as large as a horse, graceful and stately in movement,

and possessing a noble snout, moose are one of western Montana's most popular wildlife species. Tourist shops sell sweat-shirts, mugs, and postcards adorned with images of this largest member of the deer family. "Landowners, hunters, residents, nonresidents—you name it—I've found that almost everyone loves moose," says Jesse Newby, an FWP wildlife research technician working with DeCesare.

Despite the popularity of *Alces alces*, Montana wildlife managers lack information about the species' diet, movements, pregnancy rates, and other basic "vital rates." FWP lacked funds to study a species that generates relatively little hunting license revenue. Only about 300 moose are harvested in Montana

each year, compared to 25,000 elk and 95,000 mule deer and white-tailed deer.

Moose managers have long been frustrated by the scant information, especially regarding population sizes and trends, which help them determine hunting harvest quotas. "It's a major dilemma," says Ryan Rauscher, FWP wildlife biologist in Conrad, whose work area includes moose range along the Rocky Mountain Front. "If a moose population is trending down and we overharvest by issuing too many licenses, we could set recovery back for years."

At the same time, if managers don't know that a population is growing and could sustain additional harvest, they must be cautious and issue fewer licenses than if they had more accurate data. "That means denying some hunters a hunt of a lifetime," says Rauscher.

The need for information grew in the mid-1990s, as hunters and others started reporting fewer moose in parts of western Montana. Hunter success rates began declining too, as did annual harvest. The hot, dry years of the early 2000s raised concerns further. Moose require cool, wet climates and can overheat in summer temperatures above 60 degrees. Large mammals that need Alaskan weather were enduring Arizona-like conditions.

British Columbia, Maine, Vermont, Wyoming, and other provinces and states



OUTDOOR OFFICE FWP wildlife research biologist Nick DeCesare, who runs the 10-year moose study, logs data after gathering droppings from a cow moose in the Big Hole valley. Chemical analysis will determine if she's pregnant. Later surveys will monitor whether the cow gives birth, and how well the calf (or calves, if twins) survives (right).



LEFT TO RIGHT: TOM DICKSON/MONTANA OUTDOORS; DONALD M. JONES

also were reporting moose declines (though in some parts of North America, including northeastern Montana, numbers were increasing). A population in Minnesota, one of the largest in the lower 48 states, crashed from roughly 4,000 in the mid-1980s to almost zero in the mid-2000s. “We started to wonder: Is there a continent-wide trend that Montana is a part of?” says Justin Gude, head of FWP’s wildlife research program.

Meanwhile, wolf and other large carnivore numbers were increasing. And logging, which opens forests to sunlight that generates more willows and other shrubs that moose prefer, had declined for decades. Were these factors driving moose numbers down? What about parasites—winter ticks, brain worms, arterial worms, and liver flukes—to which moose are particularly vulnerable? “With so many possible factors, it was impossible to figure out the right course of action for managing moose,” says Gude. “We needed answers.”

10 YEARS, 3 AREAS

Since 2013, FWP research scientists have worked to answer these and other moose management questions with an unprecedented 10-year study. Its two primary goals are (1) understand the relative importance of adult cow survival, cow pregnancy, calf survival, and other factors driving moose population ups and downs; and (2) find a cost-effective way to monitor moose numbers in the future.

The study focuses on moose in three widely different areas: the upper Big Hole valley and surrounding mountains, the east Cabinet and Salish Mountains near Libby, and the Rocky Mountain Front in western Teton and northern Lewis and Clark Counties.

During the first six years of the project, 162 moose have been captured with nets or tranquilizer darts. Scientists check each animal’s fat content, age (by examining teeth), other vitals, and tick numbers before fitting it with a large white collar carrying a radio transmitter, which emits a unique frequency. In winter, they determine pregnancy rates by analyzing fecal pellets. In spring, they fly in planes or helicopters to see if pregnant cows have given birth and,

Tom Dickson is editor of Montana Outdoors.

if so, whether to single calves or twins. The researchers check a few months later to monitor calf survival, then fly again the following March to see if the young are still alive and thus have been “recruited” into the population. “The first year is critical,” Newby says. “That’s when calves are most vulnerable to predators, disease, and malnutrition. If they make it through their first



MOOSE MONITORING Nick DeCesare with a cow moose tranquilized from a dart fired from a helicopter. After drawing blood samples and taking body measurements, he attaches a collar fitted with a radio transmitter. Transmitters on 162 moose tracked in the three study areas (below) allow scientists to locate individual animals and see which habitats they use and how well they survive from year to year.

Moose Population Ecology Study Areas



winter, they stand a good chance of living a long time.”

Researchers also monitor adult cow survival, analyzing fecal pellets to learn which plants the moose eat. By using ultrasound equipment to measure body fat in captured cows and monitoring the percentage that give birth to twins, they can determine the nutritional quality of habitat.

FWP isn’t pulling off the moose population ecology study on its own. Partners in-

clude Safari Club International, The Nature Conservancy, and dozens of local landowners, as well as other wildlife agencies in the United States and Canada studying moose and sharing results. Successful moose hunters also assist by sending in blood samples and measuring rump fat to provide additional data.

MAJOR FINDINGS

Now on year seven of the study, researchers have already learned much about Montana’s moose. Perhaps most significantly, none of the three studied populations appears in dire straits. “We didn’t know what we’d find, so that’s definitely good news,” DeCesare says.

The main discovery in the Big Hole is that many adult moose are being killed by three-inch-long parasites transmitted from horseflies. These arterial worms congregate in the arteries at the base of the animal’s head and apparently restrict blood flow to the brain.

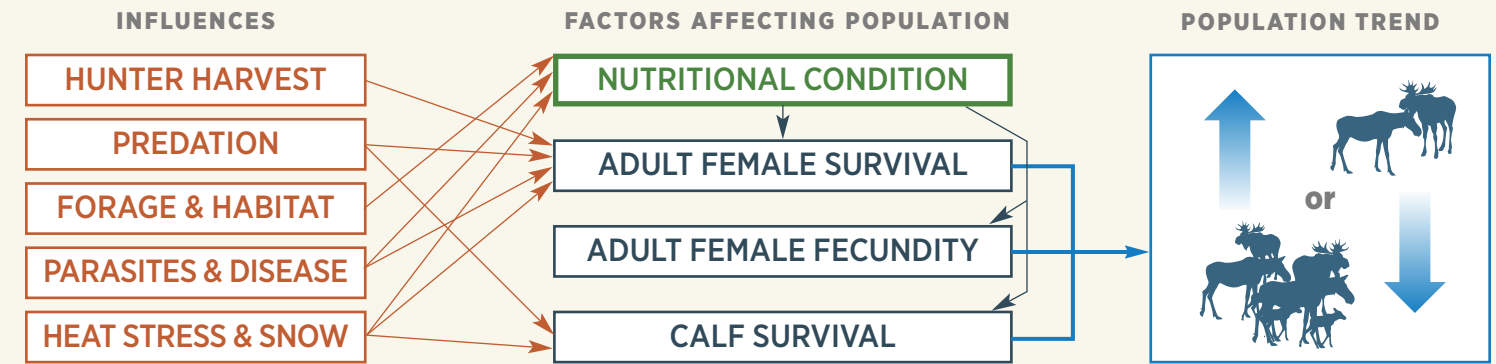
Researchers found Big Hole pregnancy rates and calf survival comparable to the other areas, but that hasn’t fully offset the decline in adult cow numbers. The result has been a slight annual population decline of 3 percent over the past six years. “The two drivers of moose populations are adult female mortality and calf survival,” Newby explains. “And of the two, cow mortality is the biggest factor. That’s why the Big Hole population is struggling a bit.”

Researchers’ most important finding in the Cabinet-Salish study area is the population’s poor moose calf survival—the lowest by far of the three areas. “It’s what you’d expect from a region with a lot of large carnivores,” DeCesare says. Researchers set up trail cameras confirming that the moose study area is rich in predators, including mountain lions, black bears, and wolves.

Fortunately, the Cabinet-Salish has high adult cow survival, which more than offsets the calf loss to predators and has accounted for a modest annual population growth of 3 percent.

The story along the Front is a strong 11 percent annual population increase. The main driver, Newby says, is the relatively high number of calves that cows churn out each year. Though pregnancy rates in all three study areas are similar, moose on the Front are fatter, become pregnant at an earlier age,

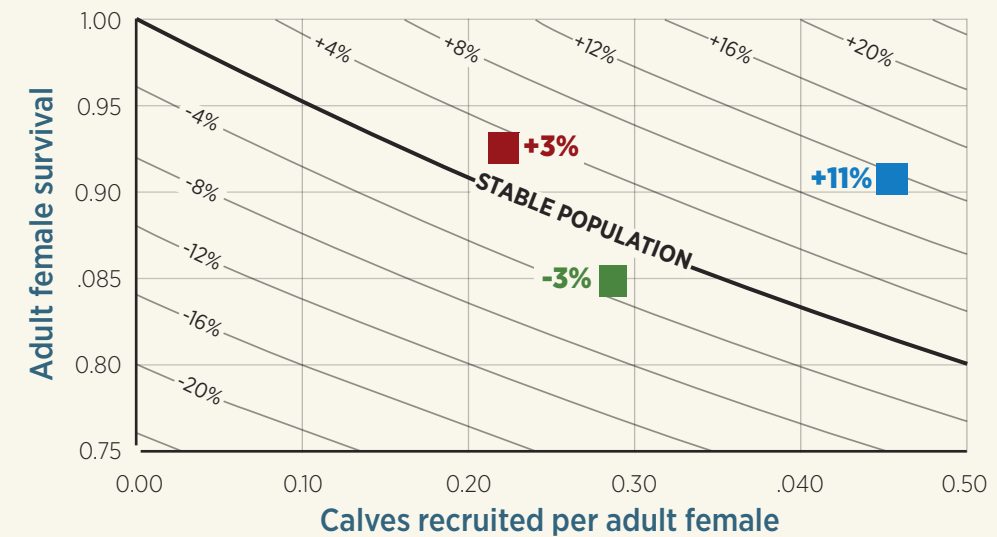
VARIABLES: FACTORS AFFECTING MOOSE POPULATIONS



The main factors that determine whether a moose population increases or decreases: survival of adult females (which produce young and thus drive a population), cow moose pregnancy rates (fecundity), and calf survival. Driving fecundity and calf survival is the animals’ health (nutritional condition), which is influenced by habitat, disease, and stress; other influences are hunter harvest and predation. FWP researchers are monitoring and measuring all these influences and factors.

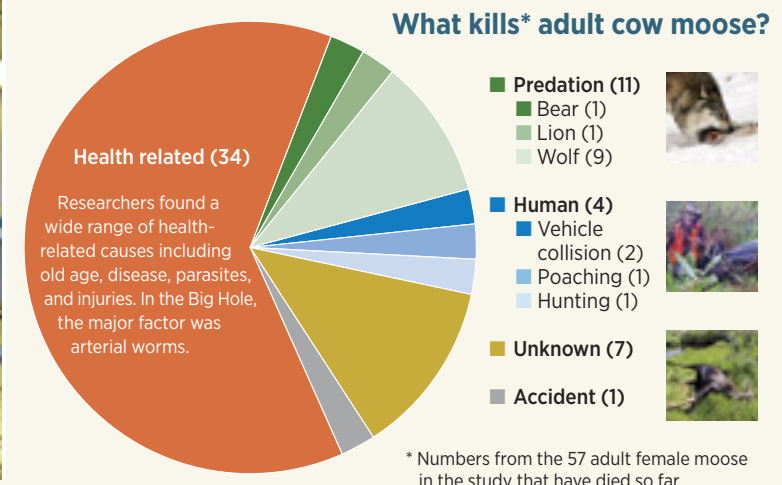
Population growth rates: 2013–2018

This chart shows the two main factors affecting moose populations: cow survival rates and rates of calf recruitment (survival to age one). The dark line in the middle indicates a stable population. Populations above the line are growing, and the one below the line is shrinking slightly. Note that even though calf survival in the Cabinet-Salish is relatively low, the population is still increasing at 3% per year due to the high cow survival. On the Front, both rates are high, leading to an 11% annual population growth.



Causes of female moose mortality: 2013–2018*

Despite widespread speculation that adult moose are being killed by wolves and other carnivores, the study shows that the main culprits are health related. FWP researchers had suspected winter ticks, which have devastated populations in northeastern states. But it turns out that the major cause of mortality, especially in the Big Hole study area, is arterial worms, which congregate in a moose’s neck and restrict blood flow to the brain.



produce more twins, and see higher calf survival. “It all seems to be related to nutrition, that the habitat is super conducive to moose growth,” says Newby.

MONITORING POPULATIONS

When they aren’t outside tracking moose, DeCesare and Newby sit at computers trying to find a way to monitor moose populations statewide.

For decades, FWP moose managers flew aerial surveys in some hunting districts, but they wondered about accuracy. Like wolves, moose are difficult to spot in the dense forests where they often live. Unlike deer and elk, which congregate in visible herds, moose are mostly solitary, making them especially tough to spot, even from the air. Unstable and rapidly changing weather in moose range also meant surveys were inconsistent during widely varying times of the year, rendering results only somewhat useful.

In most moose areas, FWP relied on hunter harvest data, which, when not backed up by other survey methods, can be even less helpful in monitoring population trends. “Let’s say you had a hunter success rate of 90 percent one year and 60 percent the next,” says Vanna Boccadori, an FWP wildlife biologist in Butte whose work area covers the Big Hole. “Did that reflect a decrease in the moose population, or did it just mean that hunting conditions were particularly bad that second year?”

Looking back, the moose researchers compared the aerial survey results to hunter harvest data. Did hunter harvest increase in years when biologists spotted more moose from the air the previous winter? That would indicate a strong correlation, and show that the two monitoring methods might be valid ways to count moose. Too often, however, the two didn’t line up. “The lack of a strong correlation means we don’t know which one to trust, and based on our previous concerns, we don’t trust either one,” says Gude, the research bureau chief. That’s valuable knowl-



EYEBALL BREAK Wildlife technician Jesse Newby takes a breather after a morning of monitoring moose along the Front in July.

edge in more ways than one. FWP is already saving money by no longer conducting expensive helicopter flights in many areas.

But with most aerial surveys no longer a smart option, how could managers monitor moose populations. The researchers had an idea: What about asking hunters if they saw moose during the season? Not just the 350 or so moose hunters, but also the 160,000 deer and elk hunters who put in a combined 2 million days afield each year. “That’s a lot of eyeballs,” says DeCesare. “If the sightings start corroborating each other, after a while you have a real high confidence level of moose distribution and population trend.”

Each winter for several years, FWP phone surveyors have asked hunters if, where, and when they saw moose. Scientists are now using statistical analysis and computer modeling to translate the information into moose populations and population trends. “Because it’s so cost-effective, we hope this is the answer,” says Gude. “But we still need to finish the modeling and vet it with local wildlife managers to see if they find the information valuable for setting moose seasons.”

ANSWERS DOWN THE ROAD

Over the next few years, researchers will keep monitoring the collared moose and their young. They’ll also continue studying the genetics of Montana’s Shiras moose to see if it is indeed a distinct subspecies, as bi-



HOW RESEARCH PAYS OFF Biologists hope the 10-year moose population ecology study will provide information to help them offer as many hunt-of-a-lifetime opportunities as possible while ensuring that populations are not overharvested and remain healthy.

ologists have long believed. Hunters in particular want to know, because it affects how record-keeping organizations like the Boone & Crockett Club score moose antlers.

This past summer, researchers and biologists have been meeting to decide which other aspects of moose population ecology the study should consider. “Should we focus on learning more about what’s killing calves in northwestern Montana?” says DeCesare. “Should we spend more time studying how arterial worms are transmitted via horseflies to Big Hole moose—whether from mule deer, elk, or some other host? Should we put our resources into understanding nutritional and habitat differences separating the Front moose from

those in the other study areas?”

Rauscher, the Conrad-area biologist, hopes the researchers can help him and other managers track cow and calf survival rates after the study ends. “This study is too expensive and intensive to continue perpetually,” he says. “Is there some other way we can gather the data we need to manage moose in the future?”

“THERE SHE IS”

Like DeCesare, Newby wants to supply wildlife managers with key information they can use for decades down the road. On this late June morning, however, he’s simply hoping to locate one elusive cow moose.

You’d think a large, dark animal that

weighs 750 pounds and stands five feet at the shoulder would be easy to see, especially from a helicopter. But along Dupuyer Creek, a shrub-shrouded stream that spills out between towering granite reefs along the Rocky Mountain Front, Newby and FWP pilot Rob Cherot struggle to spot a moose they know is directly below.

For years Newby has been tracking this and other cows, watching them grow fat and fertile in the lush shrub forest habitat. Today he’s checking to see how well their calves are faring. Though aerial surveys aren’t effective for determining moose population estimates, a helicopter is still the best way to locate individual radio-collared animals.

As the radio receiver beeps louder, indicating the moose is even closer, Cherot banks the chopper and makes another pass over a dense aspen stand. Nothing. Then, as he circles once again, a large near-black animal emerges from the pale green foliage followed by two smaller red-brown shapes. “There she is, with her twins,” Newby says.

It’s an encouraging sign during what has been a puzzling summer. After years of high calf survival along the Front, fewer young moose have been surviving in 2019. “We don’t really know what’s changed,” Newby says.

Along with everything else about this beloved species that he and other researchers are working to better understand, he’ll have three more years to find out. 🐻

CLOCKWISE FROM BELOW: LEFT, JESSE LEE VARNADO; TOM DICKSON/MONTANA OUTDOORS; DENVER BRYAN

Other moose study findings

AFTER STUDYING COW AND CALF MOOSE in three areas for more than 6 years of a 10-year study, here’s some of what researchers have learned:

► **Moose age and size:** Cows ranged from 1 to 16 years old, averaging 6 years, weighed 650 to 800 pounds, and ranged in length from 8 to 9 feet long.

► **Movement:** Most moose stayed within areas of 10 square miles or less, but some ranged widely. One cow from the Front traveled as far east as Havre. Another roamed well into Alberta, Canada. “Young males are known to range, but we were surprised to see several females making such long journeys,” says FWP research technician Jesse Newby.



During one winter in the Cabinet-Salish study area, two cows crossed the Cabinet Mountain Continental Divide. “Those two are great examples of how we’re seeing many moose living at much higher elevations than we’d thought, and how they are traveling through snow to get there,” says Tonya Chilton-Radandt, FWP wildlife biologist in Libby.

► **Adult mortality:** Of the 57 collared cow moose that have died so far, 34 perished from arterial worms and other health-related causes, 11 from predators (wolves, grizzly bears, mountain lions), 4 from humans (poaching, vehicle accident, hunting), 1 from a natural accident, and 7 from unknown causes. “People assume that large carnivores kill a lot of adult moose, but we

found that 60 percent of mortality is from disease and parasites, especially in the Big Hole,” says FWP research biologist Nick DeCesare. “Predators account for less than 20 percent.”

► **Nutrition:** In the Cabinet-Salish study area, moose mainly ate shrubs, with some conifers in the winter. In the Big Hole, their winter diet consisted of roughly half shrubs and half grass and sedges (from haystacks), and shrubs entirely in the summer. On the Front, moose ate only shrubs in the winter and mostly shrubs in the summer.

► **Pregnancy:** All three populations had roughly the same pregnancy rates. The more rump fat that cows had—a reflection of nutrition—the more likely they were to get pregnant.

► **Recruitment:** By far, the highest “recruitment”—the rate of calves that are born and survive one year—was on the Front, likely due to more nutritional habitat and less predation. Next was the Big Hole population, and in last place were the Cabinet-Salish calves, likely because of high numbers of large carnivores in the area.

► **Parasites:** In addition to the arterial worms found mainly in Big Hole moose, researchers looked at winter ticks. Winter ticks are common on moose and, in small numbers, cause no problems. But heavy infestations of 50,000 or more on one animal result in considerable blood loss. During winter, the loss leads to depleted fat and eventually muscle reserves. In other northeastern states, winter ticks are responsible for major moose population declines.

On moose in the three Montana study areas, researchers found winter tick numbers ranging from just a few hundred to 8,000 per animal. The highest tick loads were along the Front. Yet that’s also where moose had the highest pregnancy rates, the highest rates of twins, and the greatest population increase. “So it doesn’t look like ticks are limiting Montana moose fecundity or survival,” says DeCesare.

Researchers also found that brainworms (carried by white-tailed deer) are not killing Montana moose as they are in states to the east, especially Minnesota. ■