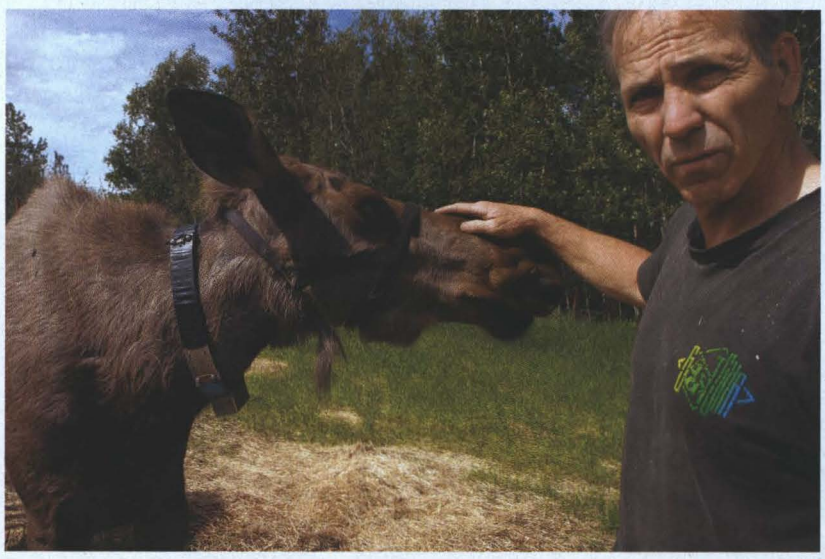
Captive moose can teach researchers a lot about wild animals. Bill Collins (INSET), a researcher with the Alaska Department of Fish and Game, and University of Alaska professor Don Spalinger are using tame moose and caribou to study the feeding habits of these animals in the wild.

the moose men

two innovative scientists take an offbeat path to understanding moose in the Nelchina Basin



JOHN SCHNEIDER / ACCENTALASKA.COM; INSET: ELIZABETH MANNING / ADF&G

BY ELIZABETH MANNING

We had been flying for nearly an hour in a Piper Super Cub, occasionally spotting moose and swans, but seeing no sign of man except for the tracks left by all-terrain vehicles. Then, as we approached a lake in the Nelchina basin, the pen appeared. A long fence fashioned from black, tarp-like fabric stretched up, down and across an entire hillside. I had been told to look for it, but the odd sight still made me wonder: What sort of biologists would go to the trouble to build a 20-acre moose pen in the middle of nowhere?

Bill Collins, a moose and habitat researcher with the Alaska Department of Fish and Game, and Don Spalinger, a University of Alaska Anchorage biology professor, have gone to great lengths to learn what moose eat and how much nutrition the animals obtain from their food. They have hand-picked plants to feed captive moose, pulverized moose poop into a fine dust for experiments and even put fistulas, or holes, in moose stomachs to study how the animals digest food. But to learn about the nutritional choices that moose make in the wild, Collins and Spalinger needed to take captive moose into the field, so Collins set about building a pen to contain the tame moose he had raised from birth. The enclosure had to be large enough that the moose could forage for food just as they would in the wild.

PHOTOS BY ELIZABETH MANNING / ADF&G

While other biologists might have been daunted by the logistics of building such a large, remote pen, Collins relished the challenge. The 57-year-old researcher has earned a reputation among colleagues for good-naturedly plowing ahead with limited resources, often coming up with unusual solutions along the way.

Collins' boss refers to him as "MacGyver with a Ph.D." because of his resourcefulness, penchant for inventions and ability to get fieldwork done inexpensively.

"We can't supply him with a big budget to conduct his research but that doesn't stop Bill," said Earl Becker, Fish and Game's research director for the Southcentral region.

Ever resourceful, Collins built the remote pen using roadbed fabric as fencing material with electric wire around the top. The whole pen cost less than $2,000 in materials and transportation costs, and can be dismantled for reuse at another field site.

For roughly the same amount he spent on the Nelchina pen, Collins constructed a more permanent 12-acre pen for captive animals at the University of Alaska's experimental farm in Palmer by salvaging fencing from the state Department of Corrections and converting an Army-surplus trailer into a field laboratory.

Collins also once fashioned a leaf stripper out of old tires, a wooden box and a garden tiller engine after growing weary of hand-processing 1,200 pounds of moose forage.

"It worked great," Collins said, laughing at how long he had spent picking leaves by hand.

Potential Impact On Predator Control

Flying over the birch and spruce forests, rolling hills and lakes of the Nelchina basin, one can't help but think of the contentious debates over wildlife management that have focused on this landscape. While Spalinger and Collins are research biologists and not wildlife managers, politics inevitably figure into conversations about their work because of their study area. The Nelchina basin, also known as Game Management Unit 13, has had a long, controversial history of predator control, and therefore has been the focus of numerous biological studies. Both sides of the predator debate take a keen interest in biological research conducted in the region.

The Nelchina basin once supported bountiful populations of moose and caribou, and served as a breadbasket for local subsistence hunters and urban sport hunters from Anchorage and Fairbanks. During the 1980s, the moose population in the region was as high as 1.8 moose per square mile, Spalinger said. By 2000, that number had dropped to about one moose per square mile.

Wolves and bears are widely considered to be the main cause. In some years, the percentage of calves that lived until their first birthday was less than 10 percent—an extremely low survival rate. To help the moose population recover, the Alaska Board of Game in 2001 began allowing hunters to use snowmachines for wolf hunting and, in 2003, reinstated aerial wolf killing.

But rarely in the natural world are animal declines caused by just one thing. Some biologists, particularly habitat scientists, wanted to know if poor nutrition might be playing a role in limiting Nelchina's moose population. If so, it could help explain why moose there have some of the lowest reproductive rates in the state.

Who builds a 20-acre moose pen in the middle of nowhere? Scientists, hoping to learn what moose eat and why some moose are more fertile than others. The pen is located in the Nelchina basin, in Southcentral. The researchers surgically implanted fistulas, or ports, in the sides of moose and caribou [FACING PAGE], so they can see what the animals eat and how it gets digested.

Cow moose in the Nelchina basin tend to wait longer to reproduce, don't get pregnant every year, and have low rates of twin births compared with moose in other parts of the state, according to Spalinger and Collins.

While theirs is not the first habitat study in the region, it is one of the most promising, Becker said.

Vic Van Ballenberghe, a retired moose biologist and frequent critic of predator control, said Collins' and Spalinger's research builds on other studies that have linked nutrition to the reproductive performance of cow moose. Van Ballenberghe said such studies are "critically important" because they may help managers avoid overstocking the range—something Van Ballenberghe thinks happened in the past. For him, it comes down to this: Why kill predators to boost the moose population if the habitat can't support more moose?

Bob Tobey, ADF&G's Glennallen-area biologist, agrees that Nelchina habitat is relatively poor when compared with other moose ranges, and he blames the region's high elevation, short summer and late green-up. But Tobey does not believe overstocking was ever a problem in the Nelchina basin. If biologists can increase moose numbers through predator control, he said, food supplies will be adequate to support a larger population.

Politics aside, the work is groundbreaking scientific research, Becker said. And the findings so far have turned up some interesting results.

Not All Leaves Created Equal

As part of their work to understand why Nelchina moose appear to have low reproductive rates, Collins and Spalinger and some of their students have also studied moose in other parts of the state, including Denali National Park. The biologists estimate that about 40 percent of cows in Denali National Park give birth to twins each year, compared with of about 18 percent in Nelchina.

They also found that the nitrogen—a nutrient essential to protein absorption—from Nelchina plants is far less digestible than nitrogen from Denali plants. That could help explain why cow moose in Denali produce more calves than Nelchina moose. Healthier, better-nourished cows have a better chance of conceiving and carrying calves to term.

"Our results suggest that protein availability can affect moose productivity," Spalinger concluded during a talk last fall at a gathering of wildlife biologists in Anchorage.

Their work also indicates that not all moose browse—even plants of the same species—is alike. The nutritional quality of food appears to vary significantly between regions.

"I used to think a diamond willow was a diamond willow," Collins said. "But apparently that's not the case."

Why nutritional values vary widely within the same plant species is not well understood. But the researchers do know that tannins—chemicals that are sometimes produced by a plant—

interfere or bind with nitrogen to make the protein less available to moose for digestion.

Tannins are thought to be a survival strategy, particularly in boreal forests where nitrogen is limited because of the cold environment, to keep the plants from being eaten. While it takes energy for the plant to produce tannins, the chemicals help keep precious nitrogen within plant systems, and out of animal systems.

"It's basically an arms race between plants and herbivores," Spalinger said.

What triggers the plants to produce tannins or what other factors affect the nutritional value of plants is less understood. Potential explanations involve variations in geology and soils, climate, browsing by other animals, and the frequency of forest fires and how those factors affect plant growth.

Taking Science Into the Field

Collecting and analyzing plants has provided the researchers with some answers, and digestion experiments on the captive moose at the experimental farm in Palmer have helped. But to really understand the nutritional choices that moose make in the wild, and to know whether they compete with caribou over the same forage, Collins and Spalinger transported tame moose and caribou to their study area by moving them in a sling suspended beneath a helicopter. Three moose were transported in during the winter, and two moose and three caribou were moved during the summer.

No one had previously taken tame moose into an Alaska field setting or worked with tame animals so far off the road system.

While fieldwork went generally well, transporting the animals proved problematic. The researchers lost a caribou on the way into the field site when the sling rotated, trapping the animal's nose between two other caribou. Tranquilized during transport, the caribou was unable to move, and it suffocated. Collins called the incident "very disturbing" and the first time he had ever lost an animal after years of transporting more than 100 deer, moose, elk and caribou. While animal losses sometimes occur as a part of biological research, Collins believes the problems might have been avoided had they used rigid containers rather than slings. A scientific committee tasked with examining how biologists handle wild animals will review the accident and may recommend further changes. The project, however, still produced results by allowing researchers to observe the animals and to collect forage samples from the same plants moose were eating. That same level of information could not have been gleaned from studies of wild moose, or from experiments with captive moose not in the field, the researchers said.

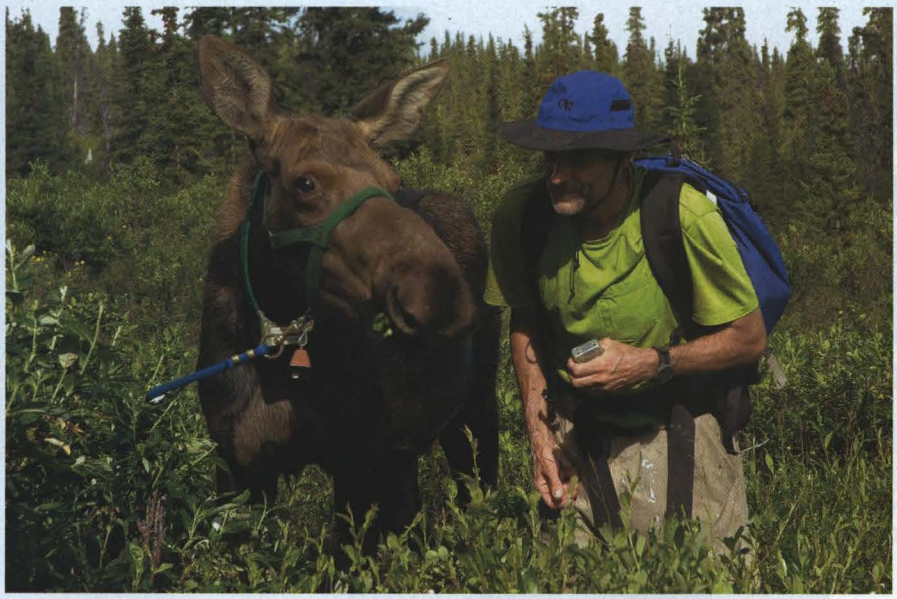
Because Collins bottle-raised the moose from birth, he has a bond with the animals that allows him to handle them, and even to lead them around on a rope. The tame moose follow Collins around a pen in Palmer like friendly ponies. They poke bulbous noses in his side—a sign they want their ears rubbed—and frisk about when Collins slathers fly ointment on their legs. In the field, the moose were slightly more aloof, but still comfortable around humans.

"Look at that," Collins said as he sat a few feet away from one of his moose, observing its dietary choices. "He

knows I'm here but he doesn't care. His ears don't key in on me. I'm part of the safe zone. It allows me to get into his space and see what's going on."

A Partnership Comes Together

Besides being known for his field inventions, Collins has earned a reputation for his spartan field camps. Colleagues say Collins, who enjoys competing in wilderness races, seems to have a higher-than-normal threshold for personal discomfort.



BILL COLLINS / ADF&G; FACING PAGE: ELIZABETH MANNING / ADF&G

Don Spalinger watches closely as a tethered moose nibbles on shrubs in the 20-acre pen built for field research. The moose are so used to Spalinger they don't mind his presence as they graze. Tame moose [FACING PAGE] follow Collins around at the research farm in Palmer where they are raised. He says they like having their noses rubbed and ears scratched.

Until Spalinger took a new tent into the field last summer, Collins had been sleeping in a drafty, moldy canvas affair with a hole chewed in it by a porcupine. And during one winter field season, a pilot forgot to unload Collins' sleeping bag and some other gear. The biologist spent a week sleeping in just his clothes at 20 below zero before the pilot realized his mistake and delivered the bag.

Spalinger shrugs and laughs. "It's always an adventure going out in the field with Bill," he said.

If Collins is the quirky inventor and animal handler of the research duo, Spalinger is the thoughtful professor who brings extensive experience with lab techniques and research design to the project.

Long before the two biologists met, they were among the first to pioneer nutritional studies using captive animals in the Lower 48. Collins used hand-raised elk and deer in Utah; Spalinger worked with captive mule deer in Washington state.

It was Spalinger who first suggested to Collins that he incorporate captive animals into his Nelchina habitat studies. Collins had been working exclusively with plants and expected to find signs of overbrowsing on the range. Instead he found ample moose food, which didn't support the slow reproductive rates for moose in the region.

"Every time I went into the field I'd come out more confused," Collins said. "Then I'd go into Don's office and we'd talk about it."

Those discussions led to questions about the nutritional quality of plants in the Nelchina basin and to the researchers' current collaboration. So far, the biologists have finished two seasons of fieldwork—three weeks in November of 2005 and four weeks last summer. They hope to return for at least one more field season in early spring of 2008 aimed at understanding the nutritional value of the plants around green-up.

Variety is the Key to Survival

In the field, Spalinger and Collins fall into the rhythms of the moose. The human separation of day from night falls way to the moose's cycle of eating and resting.

Like bears, moose must pack on pounds during the summer so they will have enough stores to survive winter and bear young. But unlike bears, moose have a four-chambered stomach that acts like a mini-factory, fermenting plants and pulling out the nitrogen or protein. Nitrogen feeds bacteria in a moose's gut, and the moose digests the bacteria. Like other ruminants, moose regurgitate their food and chew it a second time after initial digestion. The bacteria in a moose's digestive system adjust to the moose's diet to efficiently digest whatever the animal is eating.

Collins and Spalinger observe moose as they seek to understand what the animals eat and how they choose to expend their energy.

It quickly becomes clear that eating is a moose's main business. They spend concentrated times feeding, punctuated by periods of resting and ruminating, or processing their food. Moose lie down for many hours each day but rarely sleep, Collins said. "Every once in a while, you'll see the ears go limp, but not for long." he said. "The heavy sleepers probably got weeded out of the population by wolves."

The researchers also spend many hours observing "bite counts" to determine exactly what the moose eat.

It's tedious work made easier by the animals' feeding habits. Rather than taking a bite of this and a bite of that, moose focus on one kind of plant for multiple bites before switching to a new species, Collins said.

They do this even if two plant species are adjacent, or overlapping, by gingerly selecting the plants with their tongues and incredibly dexterous, bulbous noses. Collins compared it to people who eat all their mashed potatoes first, then their vegetables, then their meat.

Collins and Spalinger have also found that while there is some variation in the diets of individual moose, the animals end up eating similar balanced diets. Collins said that indicates that they have an internal awareness of their dietary needs and an instinctive knowledge of which plants can meet those needs. Subsequent analysis of diets showed that the tame moose and their wild counterparts were utilizing

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DON SPALINGER

Understanding what moose choose to eat and the nutrients they get from their forage can help scientists better manage wild moose populations.

MOOSE: *Continued from* ***page 29***

the same species and quantities of forages, demonstrating that the tame animal methods are legitimate tools for studying the population at large.

Another of their discoveries involved diamond willow and felt-leaf willow, long considered to be the most important moose foods. Prior to taking tame moose into the field, Collins and Spalinger were surprised that wild moose apparently ate much less diamond and felt-leaf willow than observed in diets of moose in other ranges. They also observed wild moose digging through about three feet of snow to obtain dwarf birch, a species previously considered to be of little value to moose.

Collins said the two willows are still important to a moose's diet but neither the tame or wild moose ate as much of it as expected. Dwarf birch and gray willow composed much more of the moose's diet than anticipated.

Again, tannins appear to be part of the explanation. Collins and Spalinger found that while the birch offered less overall nitrogen than willow species, it contained fewer tannins and therefore possessed more digestible nitrogen than the diamond or felt-leaf willow. The biologists theorize that birch may help moose balance their diet by aiding in the digestion of other plants.

A mixed diet seems to help moose handle toxins found in most plants, Collins said. Moose that eat the same plant species for days on end eventually start to suffer nutritionally.

"You can't maintain the moose on a single species," he said. "They start to load up on toxins from that particular species and their digestive system just shuts down. It overwhelms them."

Spalinger and Collins hope their fieldwork will help the public understand that answers to biological questions are rarely simple. Often, the more researchers learn, the more complicated the puzzle becomes.

In an interesting twist to their habitat studies, biologists last year found unusually high twinning rates—about 52 percent—in the Nelchina basin, according to Becky Kelleyhouse, Fish and Game's assistant area biologist in Glennallen.

No one can explain the aberration, but Kelleyhouse, Tobey, Collins and Spalinger suspect that favorable weather conditions played a key role. But what the crucial weather conditions were—or what other factors may be responsible—is not yet understood.

To Collins and Spalinger, the discovery doesn't necessarily contradict their work. It simply shows that in nature, even when biologists think they've found some answers, the truth may be even more complicated. Still, habitat likely will prove to an important part of the puzzle, they said.

"People want a simple answer to things," Spalinger said. "That's just human nature. But there may not be a simple answer. We have to understand that, and come to accept that."■

Elizabeth Manning is a former newspaper reporter who now works as a wildlife educator with the Alaska Department of Fish and Game. She lives in Anchorage and wrote about the search for bird flu in the July 2006 issue.