LUCKY DOGS

Rescued from the pound, single-minded dogs sniff out the scat of endangered animals, trumping more technical tracking methods.

BY SAMUEL K. WASSER

Tucker strains at his leash in response to the scent of orca scat near San Juan Island in Washington (background), but ignores the source, top photo, when the scent vanishes. The author developed methods for studying wildlife by analyzing feces, which trained dogs locate.

FRED FELLEMAN, WAVE

Frehley was emaciated and frenetic when we found him at the local animal shelter. His former owner, unable to handle his boundless energy, had kept him locked in a crate in a tiny apartment—no place for a border collie. With no outlet for his insatiable urge to play, Frehley would chase his own paws in circles to the point of exhaustion. It took Heath Smith, the lead dog trainer in my program, half an hour to get Frehley to stop whirling long enough to even notice the ball he'd brought. Such neurotic behavior puts off most would-be pet owners, and the dog might well have wound up euthanized like so many others of his kind. Fortunately for Frehley, we recognized in him the single-minded drive of a born conservation canine.

Once Frehley was in our care at the Center for Conservation Biology (CCB) at the University of Washington in Seattle, it didn't take long to redirect his obsession with his paws into an obsession with playing fetch. A few months of training, confidence building, and gentle encouragement transformed him into a top-notch detection dog with a remarkable new skill: the ability to locate scat from a variety of endangered species over vast wilderness areas. And all for the simple reward of a favorite ball. Frehley and our team of dogs like him—professional poop chasers—have entirely changed my program's approach to studying endangered species, from orcas in Puget Sound to giant anteaters in Brazil.

HUMANKIND'S UNBRIDLED DEMAND for resources is putting immense and complex pressures on wildlife. It is urgent to understand those pressures, their scale, and how best to mitigate them. Central to that work is the study of the affected animal populations, and the most common sampling methods include traps, camera traps, hair snags, and radio-telemetry tags. But those methods all suffer from collection bias: samples are more readily collected from some individuals than others, so the data they provide is incomplete at best. Trapping and tagging can also be expensive, and disruptive or even dangerous to the very animals the studies intend to help.

In the mid-1980s, my program, the CCB, began developing methods for studying wildlife populations in a safe and noninvasive manner—by examining their scat. We pioneered ways to measure hormones in feces that indicate reproductive health, as well as emotional and nutritional stress. We also developed methods for confirming the species, sex, and individual identity of the animals based on DNA in the scat. Over time we've refined our techniques, and now, from scat alone, we can acquire a fairly comprehensive picture of the distribution, health, and well-being of many species without even having to see the animals. But how best to find the scat?

While attending a talk, in 1997, on the use of hounds for hunting, I was struck by the idea that detection dogs might provide a solution. I approached Sergeant Barbara Davenport, the lead narcotics-dog trainer at the Washington State Department of Corrections, for help developing a method to train dogs to find grizzly-bear scat. She readily agreed, and before long my team of biologists was training alongside police officers and prison guards who were learning to handle drug-sniffing dogs. Soon thereafter, Davenport and I had developed methods that would form the basis of the CCB's training program for scat-detection dogs.

Selecting the right dogs is critical. They must have an extraordinarily strong love of toys, ignoring all distractions—cats, other dogs, wild animals, even food—just to play fetch. As with Frehley, we rescue most of our dogs from the pound, where they often wind up thanks to their obsessive personalities. We commonly screen more than 250 dogs just to find one with the right qualifications. That's the lucky dog that gets the dream job: tromping through the woods, sniffing poop, and playing ball.

CLAY MYERS/NETWORK.BESTFRIENDS.ORG

Gator, an Australian cattle dog, leaps for his favorite toy, a reward for finding a scat.

A new dog quickly learns that it gets the coveted ball whenever it detects scat from the correct species. Next, it learns to sit by the scat, as a visual cue for its handlers. Finally, it masters finding scat hidden outdoors. Properly trained dogs, working with human handlers, can detect scat from as far as one-third of a mile away, and can simultaneously detect scats from several target species while ignoring scats from all nontarget species. The handler must keep the dog in view as they move through the environment and must recognize the dog's split-second behavior change when it first detects a target scent: excited by the prospect of a ball, the dog shifts direction and speeds up, wagging its tail (if it has one). Those behaviors evaporate if the dog loses the scent. The handler must quickly assess why—a shift in the wind, an obstacle—and help the dog find the scent again.

When a dog and handler work well as a team, they can find a great many scats from numerous individuals of one or more target species, distributed over huge areas. The samples provide a rapid snapshot of the animals' numbers, density, habitat and dietary preferences, ranging patterns, physiological health, and more. All of that information can be correlated with environmental disturbances.

Unlike inanimate sampling devices, scat-detection dogs learn and improve over time, and they can cover an area more thoroughly. They also have far less collection bias. Stationary devices typically use lures, which can alter animal movement or selectively draw animals based on gender or dominance rank. Dogs, on the other hand, locate scat where the animals left it naturally. Compared with radio tracking devices, the dogs provide data on a broader spectrum of individuals at a fraction of the cost—and without the disturbance of capturing and immobilizing wild animals.

IN 1999, MY PROGRAM BEGAN its first major study using scat-detection dogs, which served as a trial of our methods. We examined the effects of human land use on grizzlies and black bears in a 2,000-square-mile area of the Yellowhead Ecosystem in western Alberta, Canada.

KATHRYN PURCELL, USFS

After finding a scat of a Pacific fisher (an endangered relative of weasels), Mocha watches her handler check its freshness. The author's team collected some 700 Pacific-fisher scats in northern California after a decline in live-trap catches suggested the population might be crashing; back in the laboratory, trained dogs will help determine the number of individuals represented in the collection.

My team compared results from the dogs with data from hair-snag stations and radio-collared bears, gathered independently by other researchers. Many biologists were skeptical that the dogs would measure up, but we proved otherwise.

DNA testing of scat samples showed that the dogs detected four times more individual grizzly bears per square mile than the hair-snag stations did. Statistical tests confirmed that sampling by the dogs was unbiased—all bears in the population had an equal probability of being detected. Radio telemetry provided massive amounts of data on the movements of nineteen collared bears during each of the study's three years. In the end it showed the same bear distributions as the scat, but at more than thirty-three times the cost (about $1 million for telemetry versus $30,000 for the dog sampling). Moreover, two grizzly bears died and one was seriously injured as a result of the trapping—high stakes for a population of only a hundred threatened animals.

Today—many projects later—my program is studying numerous species across the United States, Canada, and Brazil. Perhaps the most challenging of those projects is in northeastern Alberta. The province has tremendous oil reserves trapped in tar sands, which require a special, expensive extraction process. The resulting environmental disturbance is hard to exaggerate. Even before extraction begins, during exploration for tar-sands deposits, new roads carve up pristine wilderness, small trailer cities spring up to accommodate hundreds of workers, and immense equipment appears, some airlifted in by helicopter [*see photograph on next page*]. Machines that produce enormous vibrations search out ideal spots for oil wells.

One of the first corporations to begin working in the area, in collaboration with the native Chipewyan Dene tribe, asked us to monitor the long-term effects of its activities on caribou, moose, and wolves; caribou are threatened in all of Canada and are declining even more dramatically in Alberta. In 2006, the company began exploring—the prelude to a decade of planned extraction—at its 430-square-mile lease site, and we began monitoring a 1,000-square-mile area that includes that site and others.

Both the exploration activities and our surveys are restricted to winter, when the spongy, boglike habitat, called "muskeg," freezes; come spring, everyone disappears, and all is quiet until the following winter. Mason, a lanky three-year-old black Labrador retriever, is one of four dogs that have so far braved two Alberta winters on the project. Each winter morning before dawn, Mason's handler would suit him up in a fleece safety vest and boots, and they'd head out into the cold. Mason and the other dogs found more than 2,500 scats throughout the huge study site during the winters of 2006 and 2007. They had no trouble finding scat that was hidden beneath two or more feet of snow, and sometimes so frozen the handlers had to chisel it free.

Judging by the fluctuations of hormones in the scat over time, tar-sands exploration seems to be having physiological effects on all three species. In general, the hormone cortisol increases (reflecting mounting emotional or nutritional stress, or both) and thyroid hormone decreases (reflecting mounting nutritional stress) in scat as exploration activity gears up and peaks. Intriguingly, the moose and caribou appear to recover as soon as the work crews start packing up to go home, but still well before spring arrives—so it's not the renewal of food supplies that alleviate the animals' stresses. Not so for the wolves: their nutritional and emotional stress levels increase right through the end of the season, suggesting that the disturbance makes it progressively more difficult for them to catch prey.

Development also seems to be changing the animals' habitat use. The scat's location shows that wolves and caribou have developed a preference for the new artificial linear features crisscrossing their habitat: roads, "cutlines" cleared for seismic mapping of tar-sands deposits, and paths above underground pipelines. Wolves had the strongest preference, followed by caribou—raising concern that attraction to the exposed areas could be making caribou more vulnerable to predation by wolves. Moose, by contrast, preferred good feeding grounds over linear features, a strategy that served them well: hormones in their scat showed smaller nutritional deficits than in the other two species.

Since 2006, the number of oil leases issued in the area has skyrocketed. Only time will tell how the animals will bear the mounting disturbance, particularly once year-round tar-sands extraction begins, but we hope our findings can guide efforts to soften the blow of development.

FAR FROM THE CHILLY ALBERTA muskeg, the Cerrado of Brazil, a tropical savanna, is a biodiversity hotspot that is home to thousands of endemic species. It's also among the world's most threatened biomes. As with Alberta's tar sands, the destruction is partly driven by humanity's unquenchable thirst for fuel: vast fields of soybeans and sugarcane, grown for biodiesel production, are replacing natural savanna at a staggering pace. Landowners near Emas National Park, a large preserve in the Cerrado, are required to set aside 20 or 30 percent of their land (depending on the location) as reserves of natural habitat. But my graduate student Carly Vynne and I suspected that the park and the private reserves might be insufficient to sustain wildlife populations, particularly if the private reserves are located outside huge cultivated fields, rather than within them to provide stepping stones between patches of natural savanna.

So Vynne and I have been using the dogs to monitor how maned wolves move within the patchy landscape of the Cerrado, with the secondary goal of studying distributions of puma, jaguar, giant anteater, and giant armadillo. All five species have large home ranges and are reclusive, so they're difficult to study; scientists know little about whether and how each lives outside the park, and almost nothing at all about the endangered giant armadillo.

Over vast stretches of park and farmland, Vynne and Mason, along with five other dog teams, have located an impressive amount of scat from all five species, which gives us a pretty clear picture of where the animals spend their time. Although the species differ in their behavior, they all live both inside and outside the park in virtually every type of natural habitat, but shy away from extensive cultivated fields. With very few exceptions, the samples discovered outside the park were in or near patches of natural habitat, showing the importance of locating the private reserves within farmland. We are currently analyzing hormones indicating emotional, reproductive, and nutritional stress in the maned-wolf scat to see whether the wolves' health is better inside or outside the park and whether it's compromised when reserves are small and far apart, as we predict.

DAVID DODGE/THE PEMBINA INSTITUTE

Exploration for tar sands, a source of oil, mars a forest in northeastern Alberta, Canada. If developers discover sufficient deposits in an area, pipelines, extraction facilities, and additional roads soon follow. Scat-detection dogs are helping to determine the effects of such exploration on caribou, moose, and wolves.

WITHOUT QUESTION, OUR DOGS' most surprising feat is their successful tracking of whale poop. In our first whale project, Rosalind M. Rolland, a marine scientist at the New England Aquarium in Boston, Barbara Davenport, and I used dogs to find the conspicuous scat of North American right whales in Nova Scotia's Bay of Fundy. The scat is orange, stinky, and floats. Soon enough, dogs were locating it at more than four times the rate achieved by multiple human observers. They even detected a few samples from farther than one nautical mile away.

Then, two years ago, my graduate student Katherine Ayres and I began a pilot study to investigate why an endangered population of orcas, or killer whales, in Puget Sound had declined by 20 percent in the late 1990s and had since recovered only slowly. We planned to examine scat for toxins and for hormones indicating emotional, reproductive, and nutritional stress, to determine the relative importance of three possible culprits: inadvertent harassment by commercial and private whale-watching boats, a decline in the whales' main food of Chinook salmon, and PCB contamination. But orca scat is much harder to find and collect than right-whale scat. It's similar in color to seawater, sinks quickly, and, being slimy and fish-laden, is hard to remove from the water. A dog, we hoped, would help us get to the poop before it sank.

We chose Tucker for the job, a happy-go-lucky black Lab who hates to swim. Tucker rides calmly on the boat's bow, sniffing air currents wafting across the water. In spite of his fear of the deep, he practically pulls his handler off the bow as soon as he catches a whiff of orca scat. We steer into the wind, toward the airborne cone of scent emanating from the scat. If the boat exits the scent cone, Tucker loses interest immediately. So we turn the boat perpendicular to the wind until Tucker again tries to leap into the water; then we steer back into the wind. And so we snake our way to the whale poop. We can't play fetch on the boat, so we reward Tucker with a bout of tug-of-war with his beloved Kong toy—a rubber and rope thingamabob—as soon as we retrieve the scat.

BUD MARKS, CFCB

Dog and handler search for the scat of caribou, moose, and wolves in an area of northeastern Alberta disturbed by tar-sands exploration. Boglike habitat permits exploration and research activities only during winter, when the ground freezes.

Our pilot study gave us the green light: DNA confirmed that all the samples we collected were indeed from orcas. We found that stress hormones were higher on weekends, when whale-watching peaks, than on weekdays—the first solid evidence that boats are indeed affecting the whales. Thyroid hormone in the scat also tracked the availability of salmon, providing the first measure of nutritional status in orcas. Scat collection continues, providing a data trove that should allow us to sort out how whale watching, food, and toxins—probably in combination—are affecting orcas.

A NUMBER OF SCIENTISTS have expressed an interest in using scat-detection dogs for their own research, and my colleagues and I have been happy to instruct them in our methods or provide trained dog teams. But to disseminate our techniques widely and to make sure they're done right, the CCB needed to expand. This past spring we completed construction of a state-of-the-art facility with indoor–outdoor kennels for thirty dogs. Housing is available on-site for handlers in training. The facility is ideally situated, on the University of Washington's 4,300-acre Center for Sustainable Forestry in the foothills of Mount Rainier.

The next frontier is to use dogs to sort out how many individual animals are represented in a given collection of scat. That will reduce the need for DNA analysis—an expensive, lengthy, and occasionally error-prone task. (DNA is often degraded in scat, and related individuals' DNA is quite similar, particularly in endangered, low-diversity wildlife populations.) After two years, we've worked out a technique that engages the collaborative sniffing power of three dogs to identify and match scat from the same individual. Impressively, the dogs beat DNA analysis for precision, paws down. With the new facility complete, we'll soon begin using the technique experimentally.

Teasing apart the tangle of pressures people are placing on wildlife is a daunting task that grows more urgent with each passing year. By combining the ancient tool of canine olfaction, perfected through millions of years of evolution, with modern genetic and endocrine technologies, my team and I aim to help address some of the world's most critical conservation problems.

Samuel K. Wasser is Director of the Center for Conservation Biology at the University of Washington in Seattle. In addition to pioneering methods for extracting hormones and DNA from scat and for using dogs to locate scat samples, he has also developed techniques to acquire DNA from elephant ivory and genetic tools to track the burgeoning illegal ivory trade across Africa.

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