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TRACKING THE TRACKERS: DOES CITIZEN SCIENCE HELP OR HINDER RARE
CARNIVORE RESEARCH

By

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Citizen science has gained a strong foothold in wildlife research in recent years. The quest for information about wildlife existing at the most extreme locations at the lowest densities requires more people than most research projects can pay for. Using volunteers for everything from wilderness monitoring to aquatic studies has become common practice in the face of budget short falls and efforts to gain public support.

While reporting on citizen science used in small carnivore studies, I found a group of volunteers poised to help researchers learn about animals like wolverines, lynx, fishers, marten and wolves. Compelling people chasing captivating wildlife across some of the harshest winter climates on earth reveals much about the human spirit. Their stories will both inspire readers, and also question the sanity of the researchers and volunteers.

But what limitations and problems come with using citizen scientists?

A system based on paid wildlife technicians with years of education in wildlife research has largely shifted to volunteers with a few hours of training. Volunteers often overestimate their abilities, resulting in compromised data collection. Coordinating volunteers takes away field time from those organizing research projects. Finally, those working for free are often less reliable than paid researchers.

At an undisclosed location high in the Helena National Forest of western Montana, Kalon Baughn snapped his head around and fishtailed his snowmobile to a stop. He calmly shut the engine off, rose smoothly and swung his leg over the seat and set foot on the snow. He walked a few feet and peered down for a moment, then Baughn reached for the notebook in his pocket and began to write.

The lynx had skirted the edge of the snowmobile path, leaving an unmistakable line of tracks heading east. Baughn crouched near one track and cocked his head slightly to the side.

“These have to be a day and a half old,” he said pointing. “You see how the sun blew them out here.”

Baughn took a GPS reading and walked back to his snowmobile.

“It’s too bad we’re not really studying lynx this year. I’d love to backtrack it,” he said. “Let’s go find a wolverine.”

Baughn yanked the pull start on the snowmobile and its nasty bellow broke the tranquility of the late winter morning. The track spun hard, sending snow away in chunks as the machine lurched forward.

The scene replayed a few miles farther up the Forest Service road. Something had punched tracks through the dusting of powder on top of several feet of hard packed snow.

Baughn stepped from the road grade and sank immediately past his knees. He continued to posthole over to the track.

“It’s a wolverine!” he yelled, practically leaping out of the snow.

Baughn looked like a hound dog, jumping from track to track. He quickly pointed out features – the appearance of a fifth toe, the imprint of a metatarsal and the furtive arc that makes up the main pad.

“Did I mention that I have the best job in the world?” he said.

Baughn is a wildlife technician for Bozeman, Montana-based Wild Things Unlimited, an independent research firm specializing in wolverines and lynx, two of the rarest carnivores in the state.

Research on wolverines, lynx and fishers has ramped up in the last two decades. Lynx were listed as threatened in 2000 and wolverines were listed as warranted but precluded for listing in 2011 under the Endangered Species Act. Fishers are a candidate for listing.

Biologists fear that habitat fragmentation and climate change will have major impacts on these species, and are trying to gather as much information as possible about populations and distributions.

Baughn specializes in documenting and identifying wolverines using motion-activated trail cameras. His research with Wild Things has produced some incredible results over the last four winters.

The first winter of 2010-2011 he documented three wolverines. He got around 300 photographs using trail cameras, as well as DNA samples from scat and hair. The next year, Baughn found eight wolverines, and his camera traps netted more than 2,000 pictures. Last year, five wolverines visited his sites 67 times, for an astonishing 18,000 images.

The number and variety of photographs allow Wild Things to identify individuals based on markings. They documented female wolverines' breeding success by observing lactation and identified one individual with extreme hair loss possibly due to mange.

Wild Things' 2012-2013 research coincided with a Forest Service study in the same area. Several agency wildlife technicians ran hair trap sites using bait to lure animals in order to survey the wolverine population and gather genetic samples. By the end of winter, they documented one wolverine. Baughn documented five with only occasional help, using a combination of backtracking and baited and non-baited camera traps.

While Wild Things documented five times the number of wolverines, it is important to note that the Forest Service crew used different techniques and protocols. The Forest Service also needs to monitor a much larger area that includes the smaller Wild Things' study area.

Perhaps the most surprising thing about Baughn is that he began his work as a citizen science volunteer for Wild Things. He has no biology degree, no fancy credentials. His name appears on no peer-reviewed literature. He has a degree in art from the University of Wisconsin and makes his living as a commercial artist. Baughn simply knows how to find rare carnivores on a scale that rivals anyone, and that skill has made him invaluable to Wild Things.

Besides the sheer number of images, Baughn has advanced camera trapping beyond what many biologists thought possible. While he reluctantly uses bait to gather DNA with hair traps, roughly half of his camera traps use no bait of any kind. He spends day after day every winter following the wolverines in his study area, finding places they frequent, and places a camera in those locations.

“I consider this to be as truly non-invasive as possible,” he said. “It’s really exciting knowing that I can contribute to the scientific world.”

Baughn obviously is not the typical citizen scientist, but he is far from being the only member of a vast and diverse group of lay observers who contribute time and results to an extensive array of research projects. And they provoke debate among scientists by their mere presence.

Citizen science in today’s research world: is it science at all?

Researchers at Cornell University first coined the term “citizen science” in the mid-1990s, although it has used volunteers to study birds for decades. By using citizen science, Cornell’s studies have expanded over massive areas of North America and the world.

Citizen science now goes far beyond the study of birds, with volunteers monitoring water quality, collecting data on amphibians and plants and, in the last 15 years, gathering DNA samples of rare carnivores.

The use of citizen science in rare carnivore research coincides with an emphasis on landscape-scale conservation going back two decades. The daunting shift from localized research to massive ecosystems required more people on the ground.

Non-profits and the National Science Foundation also saw a need to include public outreach as a requirement for funding. This requirement gave researchers the incentive to use citizen scientists as their data collectors.

Although exceptional citizen scientists like Baughn do come along, this shift to a larger, lay labor force has many wildlife biologists concerned. Scientists spend considerable time trying to remove errors from their data streams. The possibility of introducing more errors by using volunteers with minimal training has scientists scrambling to find the best ways to use them.

Some citizen science, like Cornell’s research into birds, water monitoring and counting of easily identifiable animals, has produced high quality data that scientists confidently rely on. These studies often include very large sample sizes where errors have a relatively small impact. Rare carnivore research is concerned with very small populations in remote areas, and even one error could have major impacts on results.

Beyond simply the challenges of working with the public, some researchers take issue with the term “citizen science”.

Citizen science only contributes in the data collection phase of a study. Some researchers point to this as evidence that the word “science” has been misused. To the public, the term may seem like a clever catch phrase. For scientists who spend

their lives working by a rigorous, time-tested method, the word “science” stands in high regard, and is not something to be thrown around.

The making of a super citizen scientist

After stints in Wisconsin and Colorado, Baughn grew tired of city life. He moved with his girlfriend to Montana near the Helena National Forest. They lived in a tent, doing dishes and bathing in a lake. Their lives even became the subject of reality TV, as a film crew from the Discovery Channel documented them for a show about people living off the grid.

Baughn loved his new life, but he came back one day to find his girlfriend gone. She had lasted a year and a half, but the lifestyle proved too difficult, he said.

“It destroyed me,” he said. “I never intended to live out here alone. I couldn’t even paint anymore.”

His spirit shattered, Baughn turned to wildlife for redemption. He set up motion-activated cameras to photograph the animals living around his home. He hoped to get images to help his painting. After he started getting photographs of mountain lions, Baughn became obsessed. Capturing the image of an animal in its natural state went from hobby to borderline addiction.

“In the back of my mind, I kept thinking, ‘I’d really like to start donating or helping scientific efforts with my skills in camera trapping,’” he said.

Baughn was in Helena doing laundry when he picked up the newspaper and discovered a class in tracking animals offered by Wild Things Unlimited co-founder Steve Gehman. Perhaps best known for two decades of wolverine and lynx studies outside of Bozeman, Gehman and his wife, Betsy Robinson, are both university trained scientists. His research includes studies of brown bears on Kodiak Island, Alaska, and wolves, bears and caribou in the Arctic National Wildlife Refuge.

Baughn decided to attend the class and see what the professionals thought about his budding camera trapping skills. Gehman seemed skeptical, he said.

“I just said, ‘let me show you what I can do,’ and I think he was impressed when I emailed him the cougar pictures,” Baughn said.

Gehman invited Baughn to become a citizen science volunteer, spending his free time looking for tracks and contributing to Gehman’s research. In the first winter of 2010-2011, Baughn and Gehman followed some wolverine tracks and decided to put a camera where it stopped to check out a rodent’s burrow. Sure enough, the wolverine came back and they got pictures of it without using bait.

“He was very excited to volunteer,” Gehman said. “He learned a lot on his own with the cameras. It shows you don’t have to have a degree.”

While most wildlife technicians are not Ph.D.-level biologists, they typically do have a biology background. They are often graduate or undergraduate students with training in wildlife research, or post-graduates in wildlife biology that become professional technicians. Some techs do come from outside the world of biology, but the few who do prove their competency under the training of a lead biologist before going out to do research alone.

After that first winter as a volunteer, Gehman hired Baughn as a wildlife technician for Wild Things.

For Baughn, the last four winters working with rare carnivores, and the wolverine discoveries in particular, helped him with the dejection that caused his life to stall.

“Wolverines brought me back,” he said. “It’s hard not to get wrapped up in it.”

Baughn admits that his obsession with wolverines may go too far at times. When wolverines do not show up on schedule, he worries about them, concerned that they have died and that he might be partly responsible.

“I’m really worried about habituating these animals and they end up going, say, into a wolf trap because they came to my baited site,” he said. “I’m very hypersensitive. I know how easy it would be to trap these out in one season.”

At a conference in Seeley Lake, Montana, Baughn presented Wild Things’ findings and his camera techniques to some of the most respected wolverine, lynx and fisher researchers in the region. The conference took place in Seeley Lake, Montana, before this year’s winter research season. The presentation felt like a bit of vindication for Baughn.

“I don’t think a lot of them believed me before,” he said. “To my face, the pros seemed very interested and wowed by the presentation.”

Baughn is an exceptional observer and even the pros say his hard work has earned the good luck he has in the field.

“What Kalon does is out of the ordinary for your average person,” Pat Shanley, Forest Service biologist for the Helena National Forest, said. “He hasn’t gone into it willy nilly. He’s put in a lot of research, time and energy. He’s a good one to have out there.”

Baughn realizes that his success could inspire others to attempt their own camera trapping. He hopes aspiring citizen scientists take the time to learn from a scientist

and do their research before attempting to lure in a rare species for a photo. He also realizes there's nothing he can do to stop them.

"I don't think someone would intentionally do something wrong," he said. "But you never know if someone is out snowmobiling and finds a den and decides to put a camera on it – you just don't know."

Some wildlife biologists share Baughn's concerns. The permeation of people into the backcountry through citizen science and general recreation might provide researchers more data, but also has the potential to disrupt wolverines and other species..

"It's definitely a double-edge sword," said Rebecca Waters, Bozeman Montana,-based wolverine researcher.

The potential impact of people on carnivores has made biologists very protective of the animals' known locations.

Shanley, the biologist, points to the seasonal closure of McDonald Peak in Montana's rugged Mission Mountains as one place where authorities have taken steps to reduce human and wildlife interaction. Every summer and early fall, grizzly bears congregate in the high mountain basins in search of lady bugs and cutworm moths as they bulk up for winter. The Confederated Salish-Kootenai Tribes close the area from mid-July to October so that people do not disturb the bears.

Similarly, biologists work to ensure they don't release information that could jeopardize small carnivores in the wild.

"We're careful with how much information we share with the public," Shanley said. "We don't know what their (rare carnivores) threshold and response would be. We don't want people going out to find them just for fun."

The thrifty scientist: Doing more with less

Snow flew 50 feet in the air, blown by the helicopter's spinning props as the soft yet noticeable jolt of the ground announced its arrival. Wolverine researchers Tony Clevenger, Rich Klafki and volunteer Frances Stewart began packing gear while the deafening roar of the engine waned.

The team emerged from the helicopter into a remote valley of Alberta's Yoho National Park. The winter scene resembled an Ansel Adams photograph with avalanche chutes and sublime peaks reigning in every direction. Clevenger led the way, tunneling through waist deep snow to the helicopter's gear hauler that contained snowshoes, barbed wire, and a couple of beaver carcasses.

The team snowshoed to a nearby tree and got to work crafting the hair trap. Clevenger took a strand of barbed wire, and using staples to secure it, made several passes around the tree. With one hand he held a skinned beaver above the wire, and with the other drove a long nail through its tail and into the tree. He drove several more, and then wrapped a few strands of smooth wire around the beaver to anchor it in place. Lastly, the team hung a cloth soaked in a fur trapping lure called Gusto, which overwhelms the area with a skunky stench so foul a wolverine might smell it miles away.

An animal looking for an easy meal must pass over the barbs and will likely leave some hair and get its picture taken. Known for their ferocity, wolverines can easily tear the carcass from the tree. The nails and wire are only meant to keep it at the site for as long as possible.

Clevenger surveys wolverines across an area encompassing Kootenay, Banff and Yoho National Parks for Parks Canada and the Western Transportation Institute at Montana State University. In the second and final year of the study, his team ran 51 bait station hair traps in the winter of 2012-2013. They hoped to determine population size and wolverines' ability to successfully traverse the Trans-Canada Highway, which cuts through the national park like a river of noise and activity.

Although Canada has built more than 60 wildlife bridges and tunnels for animals to cross the highway, biologists had seen very few wolverines using them. Through DNA analysis, Clevenger hoped to see how many wolverines he could document using both sides of the highway.

When biologists survey an area for rare carnivores, they typically make a grid over an area, and place a hair trap somewhere in each grid cell. The gridding makes the survey systematic for scientific purposes, but has nothing to do with the terrain on the ground. A gridline could run along a flat river bottom, or climb and drop down a steep ridgeline before dropping and climbing again.

Clevenger, his techs and volunteers placed most sites by cross-country skiing up creek bottoms with all the necessary gear in tow. For a few truly inaccessible areas, he helicoptered in a team. They check each site three times a winter with a month between each check.

Clevenger chose hair trapping for gathering DNA because it costs less than live trapping and using tracking collars. It wasn't that hair trapping might provide better data or that he couldn't lure any wolverines to his traps, but he had a budget and needed to cover a massive area.

He consulted with other researchers before going with hair traps. The tipping point came when Jeff Copeland, a wolverine researcher for the U.S. Forest Service, said he could run 10 years of hair trapping for the cost of one year of live trapping, Clevenger said.

But that didn't solve all Clevenger's challenges. He still had a huge landscape to survey. Clevenger turned to the public for volunteers willing to join his team. He needed people capable of cross-country skiing or snowshoeing across the unforgiving landscape in frigid winter temperatures. Although Banff bustled with Canadians who frequented the beautiful mountains in the name of winter recreation, few had ever thought to do so with a 40-pound beaver carcass strapped to their backs.

In interviews that went out on Calgary radio, he invited people to volunteer for the study. The response was overwhelming.

"Before long we had over a hundred emails. We started calling it the monster," he said.

Clevenger and his technician, Mirjam Barrueto, went to work selecting the best, most intrepid volunteers for their citizen scientist pool. They first cut the number down by eliminating those who didn't cross-country ski or have avalanche safety training. With still far too many, the team tried to dissuade volunteers from participating by telling them that so many had volunteered, they might only get out once all winter.

"I don't think it really deterred many," Clevenger said, laughing. "I wouldn't recommend the shotgun approach like we did. We never expected a hundred people."

Barrueto and another assistant in Calgary spent several hours a week coordinating the remaining 80 volunteers. The citizen scientists arrived each day with little more than skis and an eagerness to help and learn. After a quick briefing at the Parks Canada building in Banff, they loaded up and headed out with a tech for the day's adventure.

Clevenger's project design of pairing volunteers as assistants to trained techs, passes the scrutiny of most biologists. Volunteers have constant supervision and someone to answer questions and explain protocols.

U.S. Forest Service wildlife biologist Scott Tomson believes the integrity of a project hinges on the quality of citizen scientists. The best way to ensure that quality is to pair volunteers with techs or biologists, he said.

Tomson runs 50 to 60 hair traps in the southwest Crown of the Continent region of Montana. In working with such important species, he feels he must concentrate on producing the best science he can. For Tomson, that means the cost of citizen scientists outweigh the benefits.

“For me to deal with a new revolving door of volunteers is more trouble than it’s worth,” he said.

If Tomson feels the risk of using volunteers is greater than the benefit, Clevenger believes they are an important part of his study.

Clevenger’s groups went out five days per week with two to three volunteers per group. The initial over-recruitment aside, the citizen scientists showed interest and performed well in the field, he said.

“It’s largely wolverines just fascinate people, where they live and survive,” he said. “They’re these mysterious animals that are fierce and aggressive with all these caricatures and we don’t know much about them.”

With two years of research in the Banff area, Clevenger has developed a dedicated core of volunteers. He now plans to pull from that group before doing another open role call for volunteers. This group has the experience and trust of his techs, and that goes a long way.

An Army of Citizen Scientists

A melting fortress of muddy snow lined the forest road in northern Idaho. Lauren Mitchell, biologist and wolverine project coordinator for Friends of Scotchman Peaks Wilderness, led a group of kids from nearby Sandpoint, Idaho. The group examined their snowshoes, unlocking the puzzle of straps and snaps before sliding them over heavy boots. One stepped from the hard road onto the snow berm, then over into the trees. Another followed.

The crusted snow made for easy travel. A clear-cut framed the backdrop against a pale sky and rolling forested hills. The season lingered between the dug-in heels of winter and the inevitable coming spring. Trees dripped with the vestiges of the last snow.

The bait station rested less than a mile above the road. Mitchell led the way, followed by a stream of students, their teacher and librarian.

They approached the bait station: a sturdy spruce tree complete with stiff wire gun brushes and a small wooden sign that identified the site. Above it all, the partially decayed beaver carcass resembled a giant raisin, wrinkled and browned by the elements. A wolverine had not visited.

The students crowded around the tree. Wondering eyes prowled the gun brushes for any strands of hair. Their excitement grew when they found a few small white wisps tangled in the copper wire – ermine hair, the camera later revealed.

Mitchell picked this site for students from Lake Pend Oreille Alternative High School to use as an outdoor classroom. She helped the students make this bait station their own. As they plucked a few hairs from one brush, the disappointment of not attracting a wolverine seemed to mix with the pride of participating in a real scientific study.

“It’s really encouraging to see how many people get excited about the project and just about getting out there and contributing,” Mitchell said.

This site was just one of 17 that Scotchman Peaks ran over the winter, and one of dozens throughout the Idaho Panhandle run by Idaho Fish and Game and other citizen groups.

Idaho Fish and Game launched the Idaho Multi-Species Baseline Initiative in 2010 to establish populations and distribution data for rare and common species. The information will aid the agency when it reassesses the State Wildlife Action Plan in 2015. Idaho Fish and Game partnered with 15 citizen science groups to assist with the survey.

Unlike Clevenger’s study in Canada that only allows volunteers to work as assistants to technicians, the Idaho Fish and Game study trains citizen scientists and then uses them to run their own baited hair traps complete with motion-activated cameras.

The agency provided equipment for the site and a day of training, but the citizen groups provided the boots on the ground. While Michael Lucid, wildlife biologist for Idaho Fish and Game, gave the groups accolades for their contribution to the project, he made it clear, much like Clevenger, that free labor played an important role in the decision to work with volunteers.

“If we had the money they (the groups) had, we could do a similar amount of work with less people,” Lucid said.

The Sandpoint, Idaho-based Friends of Scotchman Peaks advocates for federal wilderness designation of the 88,000-acre Scotchman Peaks’ Roadless Area along the border of the Idaho Panhandle and northwest Montana. Experienced backpackers and backcountry skiers make up a big chunk of their membership, so Idaho Fish and Game found just what it wanted when recruiting volunteers for the massive citizen science project.

The advocacy group hoped the Idaho Multi-Species Baseline Initiative would raise awareness of wildlife in their area and help develop a cooperative relationship with Idaho Fish and Game. Scotchman Peaks also hoped it might help their case for wilderness designation.

“If we found a wolverine, it substantiates the wilderness values,” Phil Hough, executive director of Scotchman Peaks, said. “Even if we didn’t find a wolverine, a

wolverine is the sexy star, the real benefit is establishing the data for the suite of rare carnivores.”

Wilderness and proposed wilderness areas offer some of the largest intact ecosystems for rare and endangered species. The initiative would develop a baseline, or snapshot in time of species population and distribution. Future surveys then have a reference point to see if populations shrink or expand both in numbers and range.

The group took the chance that the Scotchman Peaks and the surrounding area held the rare carnivores they hoped for.

“There’s a little bit of risk there that if we establish there aren’t any animals there, it doesn’t make the positive case (for wilderness),” Hough said. “Even if we didn’t find any of these things, the relationships and awareness we built were all positives for us.”

Scotchman Peaks did not find a wolverine in 2012-2013. They did find several fishers, plenty of marten and bobcats, and a goshawk that excited researchers on another project studying the raptor, which is listed as a “sensitive species” by the U.S. Forest Service.

“Research projects don’t always go the way you want it to, and that’s why you do research,” Mitchell said of not finding a wolverine.

Mitchell, who has a bachelor’s degree in environmental science and an associate’s degree in forest technology, reflected on the season and called it a success. They strengthened a relationship with Idaho Fish and Game and the awareness of animals like wolverines, lynx, fishers and marten circulated through Sandpoint.

Scotchman Peaks’ volunteer Jim Mellen spent his winter skiing up to 24 miles in a single day to run hair traps. He agreed that his awareness of wildlife was strengthened by participating.

“I enjoyed it immensely, and I like a challenge,” Mellen said. “I’ve learned a lot about other species. It’s exciting to see what’s out there.”

Although the quality of data ranged from group to group, Idaho Fish and Game has been happy with the contribution of citizen science to the initiative, Lucid said.

“We actually get a lot of good work done with volunteers and the opportunity to engage them with Fish and Game and an actual conservation project,” Lucid said.

What are the concerns with citizen science?

Although varying degrees of data quality work for Idaho's purposes, other biologists have serious concerns about the difference between the quality of data collected by volunteers compared to that of highly trained technicians.

Scotchman Peak's wolverine coordinator Lauren Mitchell typically works with techs or biologists when she's not with the group. The 90 volunteers she coordinated for 17 stations brought a wide variety of experiences and attitudes.

"Some volunteers are really great and very good about following the protocol and they are very good at following the details and instruction. Some volunteers, you have to stay on them," Mitchell said.

Experience matters. Research shows a significant increase in the ability for amateurs to follow directions and correctly identify species the longer they participate in a study.

Scientists conducting a Breeding Bird Survey in France in the late 2000s studied the proficiency of the volunteers that participated. Volunteers observed birds and documented them by species and location. Expert birders then looked at whether the amateurs made correct identifications. The volunteers demonstrated an average increase of 4.3 percent between the first and all subsequent years.

No studies exist that test the ability of citizen scientists to correctly identify tracks or run hair traps, but biologists expect data quality to vary from group to group and to be of lower quality than that of techs.

Mike Schwartz specializes in genetics as a research ecologist for the Forest Service's Rocky Mountain Research Station in Missoula, Montana. The research station analyzes the majority of DNA samples from the rare carnivore studies across the West and Canada. When it comes to citizen science, Schwartz sees plenty of possibilities for success, as long as biologists adapt for increased errors that may occur.

"You need to recognize that citizens are highly motivated and are an excellent resource," Schwartz said. "Recognize that citizens don't have the same level of training as many of the technicians you've worked with in the past."

Scientists like Schwartz simplify and then make detailed protocols for citizen scientists to follow.

"Some processes, you can still use people that are relatively untrained and still reduce that error rate. There are other processes where you can't," Schwartz said.

Setting up hair traps and collecting samples is one process that Scotchman Peaks' volunteer Mark Cochran – a chiropractor by trade – thinks citizen scientists, with

the proper preparation and attitude, can perform well. Cochran has participated in the study for three seasons.

“I feel like it was really good training and specific to what we were needing to do,” Cochran said. “My team was very conscientious, I think.”

Scotchman Peaks volunteer Mary Franzel, agreed that setting up a hair trap and a motion-activated camera were simple tasks they could easily understand and follow.

“I felt like Fish and Game and Phil did a good job training people,” she said. “The worst thing that could happen is that you aim the camera wrong and don’t get a picture. It’s hard to screw it up.”

As another way to eliminate errors, Schwartz’s lab does not accept samples from people they don’t know. His lab can tell whether a particular sample comes from a particular species, but they cannot tell if that species came to that spot and left that sample, he said.

Beyond simple mistakes people might unintentionally make in the field, scientists also worry about people intentionally skewing data. Finding a federally-protected species could have major effects on the management of an area. That means the temptation exists to plant DNA.

With some studies recruiting groups that also advocate for the protection of the study area, scientists must stay on high alert for any results that appear out of the ordinary, Schwartz said.

“We have to be careful because there’s people out there with misguided ideas,” Schwartz said. “Probably 99.9 percent of the citizens are hard-working, work well with you in the field and improve your data. You could still have two people out there corrupting your data set.”

The thought that someone would plant DNA might seem farfetched, but it has happened in the past. In perhaps the most famous case of DNA planting, the scientists themselves crossed that ethical line.

In 2000, three samples of lynx hair from captive animals ended up in hair traps in Washington State. Seven biologists admitted to planting the samples. The scientists asserted that the purpose of the planting was to test the capability of the lab, but the appearance of impropriety drew serious media attention and criticism. The scientists received discipline in the case but were not fired.

Schwartz said following up on unusual results is important to safeguard the validity of studies. If an animal appears in an unusual place, professionals will go to the area

and attempt to verify it. If it cannot be verified, the sample is excluded from the data stream.

Advocacy sometimes gets a bad rap and becomes synonymous with trying to mislead people, said Scotchman Peaks' director Phil Hough.

"In its purest form, advocacy is grounded in stewardship work, so advocacy doesn't mean you can't participate in an objective study," he said.

When people decided to participate in the study through Scotchman Peaks, most of them were not thinking about it in terms of a grassroots campaign, they simply wanted to have fun and share their interest in nature, Hough said.

Hough added that participating in the study has actually worked as a boon for Scotchman Peaks and their other work. People interested in learning about fishers and wolverines come to the Friends as a way to participate in the study and end up learning about the group's larger mission of protecting the landscape.

"We then reap the benefits in how Scotchman Peaks is known to a wider range of people," Hough said.

Who's really better, pros or amateurs?

While some scientists push back against the encroachment of citizen science into their research, some studies have shown citizen scientists can reliably produce quality data when compared to professionals.

A 2010 University of Montana study by Jami Belt, now the citizen science coordinator for Glacier National Park, compared the accuracy of citizen scientists and biologists when it comes to counting mountain goats. The comparison came as a subset of the larger question of whether ground surveys could match the quality of data from traditional aerial surveys.

Belt had citizen scientists and biologists go to the same point, at the same time, and count goats without disclosing their counts until afterward. She found that citizen scientists found just as many goats as the pros. Mountain goats, with their white fur, stand out fairly easily, so those results did not surprise her, she said.

Belt then had citizen scientists and biologists go to predetermined points at different times and count goats. She compared how much each visit varied from the others. The results: citizen scientists actually had less variability in their results than the biologists.

"The researchers' detection rates were higher, but the volunteers visited the sites more frequently so they had a slightly more stable count," Belt said.

Goats can easily hide behind a ridge or in alpine trees, meaning that during any site visit, observers could miss them. By having more site visits, volunteers saw the same number of goats more often, resulting in a truer population estimate. Citizen scientists had produced better data.

Belt's results apply to other studies looking at easily identifiable animals. A white mountain goat standing on a black cliff does not resemble any other animal in the Glacier ecosystem, so the chance for misidentification is small.

In a more technical study comparing citizen scientists with professionals, Ashley Shelton of Saint Mary's University in Halifax, Nova Scotia, analyzed water-testing data generated by amateurs and professionals.

In the 2013 study, Saint Mary's trained citizen scientists in the use of various instruments to test water temperature, pH, conductivity, discharge and dissolved oxygen. Shelton predicted that the citizen scientists would successfully produce data within the acceptable range of the controlled group of professionals.

The citizen scientists did produced data within appropriate error ranges for all the tests except dissolved oxygen. Shelton concluded that testing for dissolved oxygen, which can vary depending on stream flow and depth of where the sample is taken, did not provide strict enough protocols, and would require additional training for citizen scientists to meet standards.

Shelton also concluded that the monitoring program design and highly technical or subjective measurements may not be suitable to citizen science researchers. She further concluded that those tests with reduced variability and simple methods of data collection could provide useful data and be integrated with water data gathered by professionals.

The Belt and Shelton studies show the importance of determining research that citizen scientists can perform effectively. Belt's study showed that more people on the ground performing a relatively simple task frequently produced the best results. Shelton's study showed that only the tasks with very minimal interpretation produce adequate results.

Because no studies exist comparing citizen scientists with professionals in rare carnivore work, biologists can only look to studies like Belt and Shelton's and draw conclusions.

Citizen scientist or volunteer: Does the name make a difference?

Retired wildlife biologist from the Rocky Mountain Research Station, Jeff Copeland, gained notoriety as the lead biologist in the Glacier National Park wolverine study in the early 2000s. He appeared prominently in Douglas Chadwick's "The Wolverine Way," which chronicled the dedication and tenacity of both the researchers and

several of Glacier's wolverines. He believes many groups doing citizen science with rare carnivores are actually not doing science at all.

"Scientists take pride in the term science," Copeland said. "Just because your group has science in the name doesn't mean you're doing science. I know that scientists are uncomfortable with that."

Citizen scientists can provide manpower and resources that help projects, but the projects need to ask well-defined scientific questions that affect management, he said.

The pros and cons of using citizen scientists from a data reliability standpoint do not operate independently of the incredible public awareness of important wildlife issues these projects create. Although projects are marketed to volunteers as providing important data for wildlife biology, from a research standpoint, many biologists see public outreach as the most beneficial value.

"The primary contribution of citizen science has always been and will always be among the agencies, awareness in the public," Copeland said.

Wolverine biologist Rebecca Waters and her colleagues at the Northern Rockies Conservation Cooperative produced track ID cards, which many groups and agencies do. The goal was to encourage people out recreating to report rare carnivore tracks. The cards are about public outreach more than science, she said.

"We knew the scientific information that comes out of that is actually going to be pretty poor, but we were always pretty clear that the constituency building and the educational aspect of it was the greater of the two outcomes," Waters said.

Forest Service biologist Scott Tomson also questions whether people can learn the art of animal tracking from a card or in one of the many "tracking classes" offered around the West. Despite his disenchantment with citizen science as a researcher, he believes the educational values do make volunteer engagement worthwhile.

"I've been doing this stuff for a long time, and the concept of getting a whole bunch of people out to look at a track doesn't generate much," he said. "But if the goal is out there to get people interested and support funding then I'm all for it."

For his part on the Idaho Multi-species Baseline Initiative, Michael Lucid saw some impressive changes in the citizen scientists he worked with. When Scotchman Peaks began the study, many had no idea that fishers even existed, let alone inhabited the surrounding forests.

"When we started working with the Friends and the other groups, hardly any of them knew what a fisher was. They were really cool the first time they got a pic of a fisher, they didn't know if it was a wolverine or not," Lucid said.

Even though they did not find a wolverine, simply learning about wolverines made the whole experience worthwhile, said Scotchman Peaks' volunteer Eric Grace.

"I now have a lot more respect for them. There's a huge excitement level in people that know a lot more," Grace said.

Scotchman Peaks' volunteer Mary Franzel and others relished the opportunity to volunteer.

"People feel like they're really doing something and not just busy work, not just taking tickets or something like that, but that what they're doing is neat and special and they're (Idaho Fish and Game) making different policies based on all this info that they (volunteers) helped gather," Franzel said.

The extent that the data makes a difference depends on the quality of the study, but the enthusiasm for rare carnivores is palpable among the volunteers who consider themselves lucky enough to have the opportunity to learn about the animals in their natural setting. If the true goal of citizen science is to generate that enthusiasm, then it certainly seems to be successful.

But beyond the excitement lies the basic question of whether or not what volunteers do should be labeled as "science". Wildlife technicians, many of them with biology degrees and years of field experience, do not even carry the moniker of scientist and they too only contribute as data collectors. For a field like science, which spends a great deal of time categorizing and labeling things, to carefully identify workers, it's safe to say that the Cornell appointed term "citizen science" does not accurately reflect the role lay people play in scientific research.

For some volunteers, the label may give them a feeling of legitimacy as real contributors to the study. For others, the contribution itself is what matters. And some volunteers are looking at the label "citizen science" and acknowledging that it does not quite fit.

"It doesn't make a bit of difference what you call me," Scotchman Peaks' volunteer Mark Cochran said, "Citizen scientist is a cool term, but if you call me a volunteer that's fine too. Honestly, citizen scientist is probably a stretch. I'm certainly not a wildlife biologist myself."