Yellowstone Science

A quarterly publication devoted to the natural and cultural sciences

Predator Restoration Realities
Wolves: The Next Generation
Early Yellowstone Narratives
Probing Old Faithful

Volume 3 Number 3

Remembering Ten

Even in a group of wolves that were, because of the historic circumstances, extraordinary, Number Ten stood out. A large, gray male with Hollywood-perfect photogeneity, he arrived in Yellowstone from Alberta on January 19, and was placed in the pen at Rose Creek with a mother and daughter pair, Nine and Seven, who had arrived on January 12. Nine, the mother, was believed to be in estrous, and was herself regarded with special interest for that reason. Nine and Ten got along famously, and signs were good that they had mated by the time their pen was opened on March 22.

What made Ten stand out was his singular behavior when humans were around. Twice a week, biologists brought meat to the pens, dragging in various elk, deer, moose, and bison parts and leaving them for the wolves. The wolves in all three pens became agitated as soon as they were aware of the approaching biologists, and typically fled to the far end of the acre-size enclosures, where they paced or ran anxiously back and forth along the fence. All the wolves, that is, except Ten. Ten took a more assertive position, running wide circles around the people as they worked. He never exhibited aggression, but he didn't run away, either. His behavior brought him great admiration and high hopes for what he might bring to the Yellowstone wolf population gene pool, as it brought fear that this was just the sort of behavior that might get him killed.

No secret had been made that wolves would be lost in this project; the officially announced projection was that 20 percent or more of the wolves would die of a variety of causes in these first years. But I don't think many of us were prepared to lose Ten, certainly not so soon or so pointlessly. In late April, as he and Nine were roaming the country near Red Lodge, Montana, he was illegally shot, skinned, and beheaded by a man who was later apprehended. Nine gave birth to eight pups about the same time, on private property about four miles from Red Lodge. Without her mate, her chances of raising the pups, or of surviving herself, were slight, and so she was captured and returned to her pen on Rose Creek.

It was impossible not to take Ten's death personally. This beautiful animal, its offspring, and the resource they are a part of deserved better than such mindless human violence. But it would be too easy, and ultimately quite destructive, to make too much of Ten's death—to turn this wild animal into a martyr to human foolishness. The wolves are already overloaded with symbolism that has little to do with their real lives. The illegal killing of Ten may be symptomatic of many things, but it also might be viewed merely as proof that a few people haven't learned to use their firearms responsibly, rather than as a broader indication that a lot of misguided people are out there randomly gunning for gorgeous predators.

We should probably remember Ten for lots of things, including his exhilarating beauty and his exciting sense of himself in our presence. We should probably resist remembering him too much for being a victim, if only because that ultimately will just cheapen his memory and make us think too much like the person who killed him. Anyway, with a little luck perhaps we'll also get to remember him through seeing some of his pups as they make their own ways across the Yellowstone landscape. PS

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On the cover: Greater Yellowstone's first known wolf puppies in more than 60 years were born near Red Lodge, Montana, in late April, and transported to a pen in the Lamar Valley in May. See the story on page 17. NPS photo by Doug Smith.

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Yellowstone Science is published quarterly, and submissions are welcome from all investigators conducting formal research in the Yellowstone area. Editorial correspondence should be sent to the Editor, *Yellowstone Science*, Yellowstone Center for Resources, P.O. Box 168, Yellowstone National Park, WY 82190.

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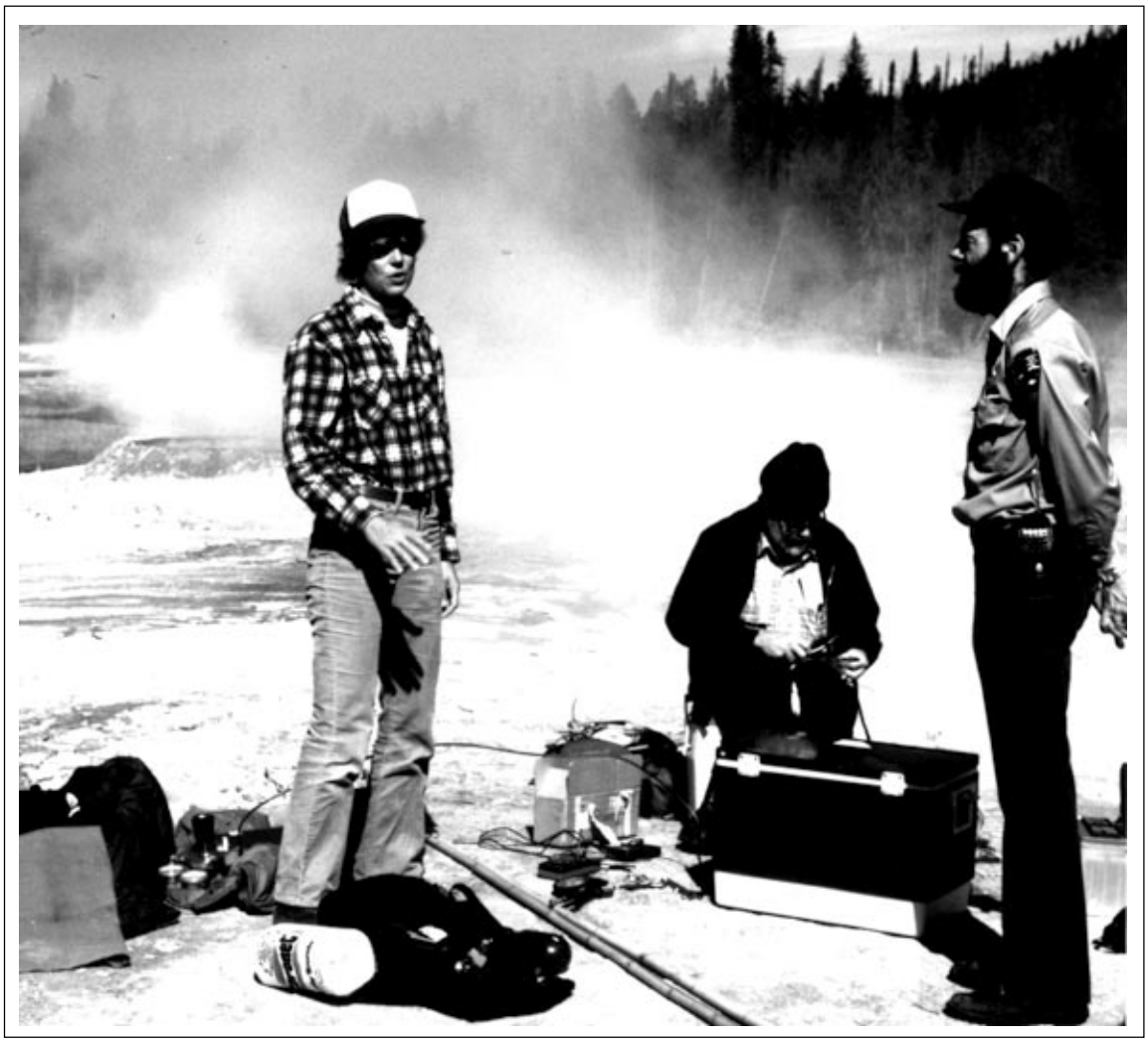
A Journey Toward the Center of the Earth

Video Adventures in the Old Faithful Conduit



by Susan W. Kieffer, James A. Westphal, and Roderick A. Hutchinson

Why would a researcher spend the major part of her professional career studying Old Faithful Geyser? And why would a team of three researchers spend a major part of a year designing, building, and lowering a video camera down into the formidably hot and tortuous conduit?

Researcher Susan Kieffer started studying Old Faithful in 1976 as an analog to volcanoes. She had some ideas about heat and mass transfer in volcanoes and about how complex gassy fluids moved when volcanoes erupted. To test these concepts, she decided to see if she could understand the heat and mass transfer and the eruptions of Old Faithful—a smaller, more regular, simpler, and far more accessible geological feature than any erupting volcano.

The three authors, Sue, Jim, and Rick, from left to right, prepare equipment. All photographs and drawings courtesy of Susan Kieffer.

Kieffer started her work using her family bank account to buy a super-8 camera and to fund the drive to Yellowstone, and

she had her 8-year-old son as a field assistant. She obeyed strict park rules about remaining on the boardwalks for observations, filming eruptions from a distance and analyzing the movies to determine how fast the fluid comes out of the vent (about 180 miles per hour!).

However, a major problem was that the real action of Old Faithful occurs underground, as every observer who sits patiently through episodes of Old Faithful's "preplay" (the time when the geyser occasionally spurts small amounts of water prior to a full eruption) knows. Where does water enter the conduit? What is its temperature? How much of it is there? Does it heat up between eruption cycles? Or, does it enter so hot that it actually cools down while waiting to erupt?

Kieffer brought seismometers to Old Faithful in the late 1970s and early 1980s and monitored the seismicity in an attempt to decipher the underground activity by remote observations. During that work, she discovered that Old Faithful has seismic signals much like those observed at active volcanoes—so-called harmonic tremor, or long-period volcanic seismicity. Those signals told her that there was enough heat in the system to boil at least some of the water during the intervals between eruptions.

In 1983, she was discussing her frustration about not being able to observe Old Faithful's underground activity with a planetary science colleague, Jim Westphal of Caltech. The two decided to team up to build a probe to measure pressure and temperature in the conduit during recharge (the period when the geyser's chamber is refilling with water, or "recharging") and eruption. It took nearly a year, and the very skilled design and fabrication talents of Caltech's Victor Nenow, to build a probe that could do the measurements. They also had to satisfy Kieffer's and Westphal's rigorous criteria (and National Park Service regulations) that the probe should not get stuck nor cause any damage to the geyser conduit. The probe had to be small (less than 3 inches in diameter), flexible enough to maneuver through expected twists and turns of the conduit, and yet rigid enough to resist being tied into knots by the wildly circulating water known to exist deep in the conduit. The probe had sensors at 10-foot intervals so that the researchers could measure temperature and pressure every 10 feet in the conduit.

The video camera, in the foreground, is only about 2 inches in length. Behind it is the thermally-insulated container in which it is lowered into the conduit. The tape marks are at 1-foot intervals.

With Westphal and Kieffer manning various electronic and pressure controls and sensors, park research geologist Rick Hutchinson inserted the probe into the geyser during the spring and fall of that year. The scientists were able to record the rise of water from nearly 70 feet deep in the conduit up to about 16 feet during the geyser's recharge cycle because each sensor recorded the increasing pressure as water rose up the length of the probe. Wild fluctuations recorded by the temperature sensors indicated that convection was violent in the conduit as hot water from the bottom mixed with cooler water near the top.

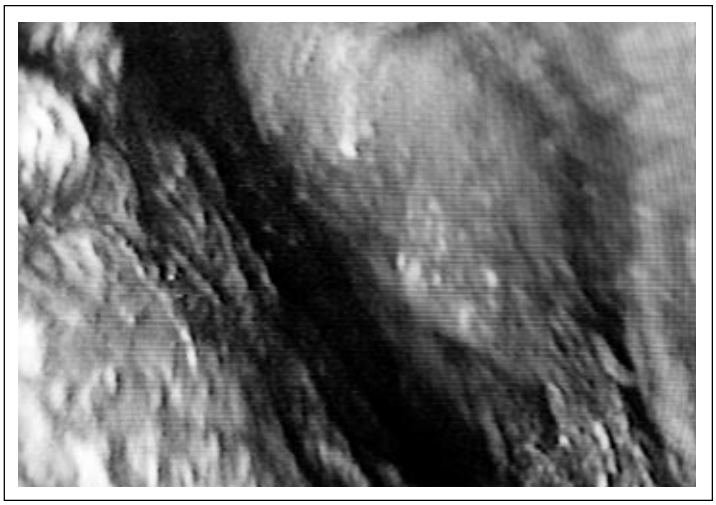
This experiment was difficult; the temperature sensors corroded, and the leads to the pressure sensors tended to kink and even break as the probe was tugged about by the wild currents in the conduit. Probably the most important result of the measurements was that even though the interval patterns are currently different than they were 50 years ago, the temperatures still had the same values as when measured back in 1942: 118° C at the bottom, 92 C° at the top. Much had been learned about the roiling underworld, but the data were fragmentary and deemed not worthy of publication.

In 1991 Jim Westphal was awarded a MacArthur Fellowship, a prize that included unrestricted funds to be used in any manner that the awardee chose. At about the same time, miniaturization of video equipment was progressing at a rapid rate, and Jim decided to use some of the MacArthur funds to answer the question of what was happening in the depths of Old Faithful. Again with his colleague Victor Nenow, he designed and built a vacuum-insulated ice-cooled video system to lower into Old Faithful. Two versions have now been built and inserted into the geyser, each carrying its own lighting system to illuminate the conduit, two thermocouples to monitor the conduit and camera temperature, and leads to send the information back to monitors and recorders on the surface.

What does the conduit look like? Where the conduit intersects the surface, it is an elongated fracture about 2 x 3.5 feet in dimensions. At 22 feet underground, it narrows to only 4.125 inches width. The camera had a viewing angle of 55°, and in most places the camera did not record the extent of the conduit in every direction. The walls are covered with rough sinter, and fractures can be observed. It is notable that the fractures are not sintered shut, that is, they do not get sealed by the deposition of sinter: either the rate of sinter deposition is negligible, or perhaps the fractures are active and kept open by the many small earthquakes that occur near Old Faithful.

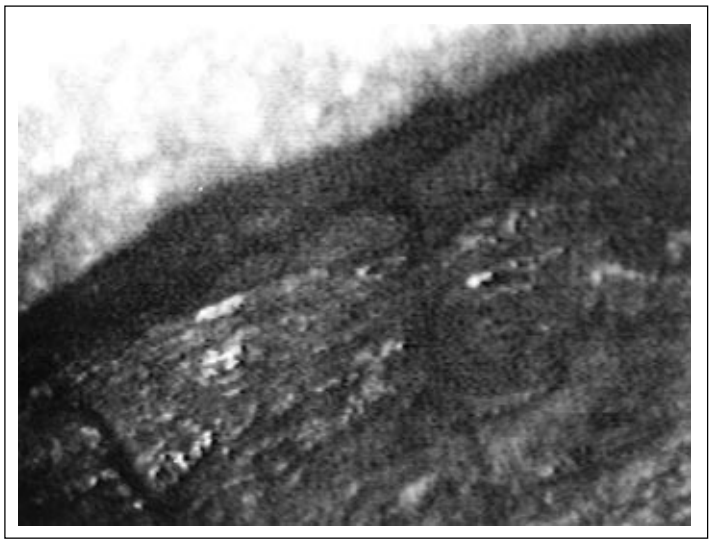
Between 30 and 34 feet, two substantial ledges were discovered. These ledges provided Rick with his greatest challenges in lowering the camera up, down, over, and everywhere to get to greater depths.

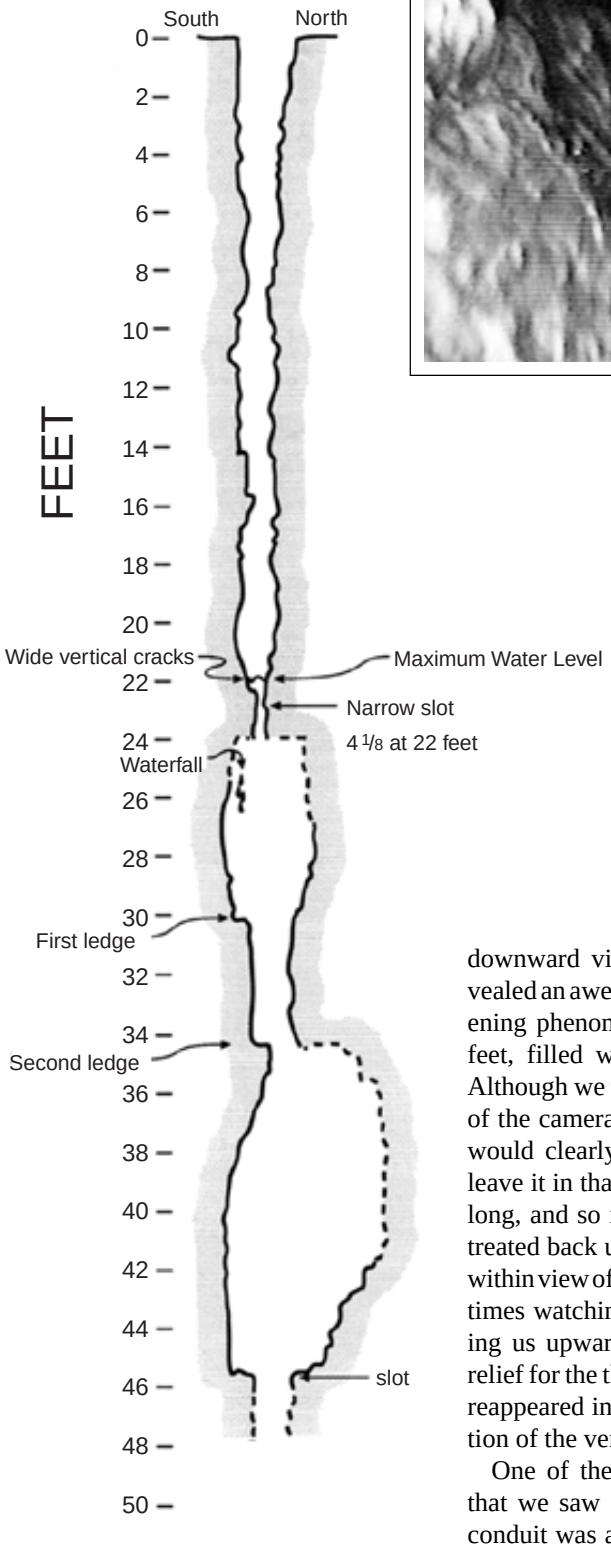
Between 35 and 45 feet, we encountered a large cavern—so large that the quartz halogen bulbs on the camera could not illuminate the walls and we felt that we were in a black void. However, the



Left: The narrowest place observed in Old Faithful's conduit.

Below: Rough, knobby sinter covers the walls of the conduit. Two open fractures descend down the side (upwards across the bottom half of the picture).



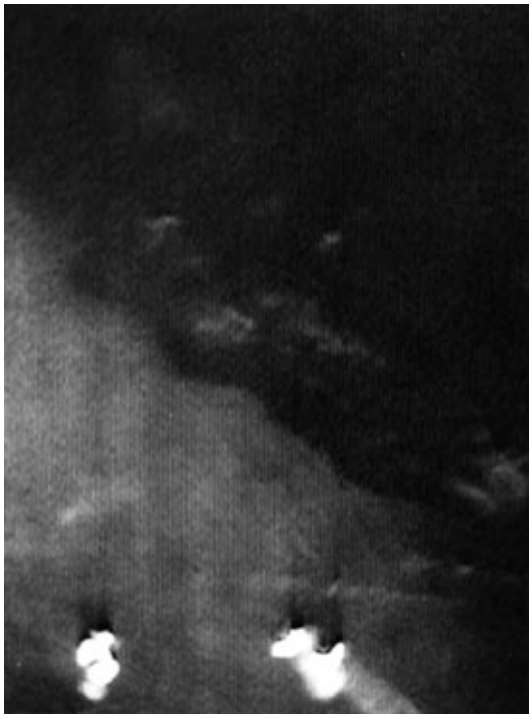


Schematic diagram of the conduit as documented by the camera.

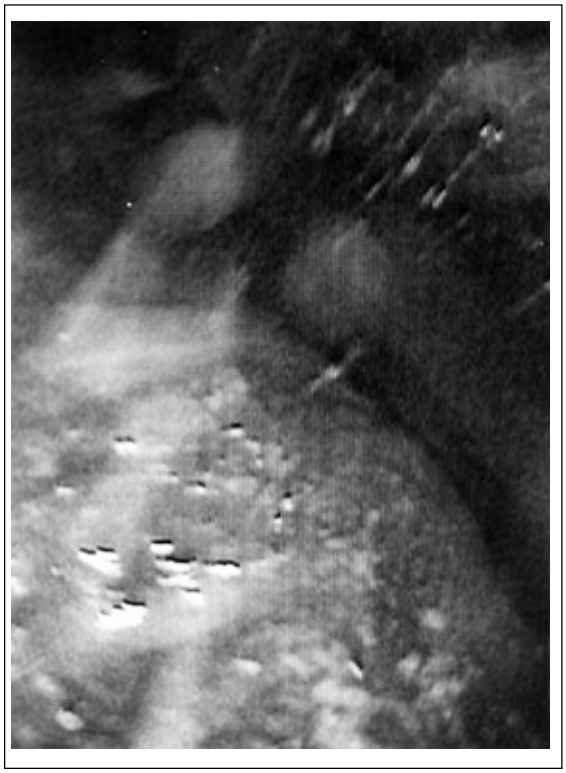
downward view from this position revealed an awesome and somewhat frightening phenomenon: a slot at about 45 feet, filled with roiling boiling water. Although we were able to submerge one of the cameras in this water briefly, we would clearly be running great risk to leave it in that hostile environment very long, and so in all cases, we hastily retreated back up the conduit once we got within view of this roiling caldron, sometimes watching the rising water following us upward! It was always a great relief for the three of us when the camera reappeared intact back in the sunlit portion of the vent near the surface.

One of the most interesting features that we saw each time we were in the conduit was a small waterfall at 24 feet depth. We have some tentative evidence that this water is relatively cool (about 80° C), and we are speculating that this may be high-level groundwater finding its way into the conduit. This is of particular interest for several reasons. First, we speculate that it may be changes in this recharge of cooler water that control the changing intervals of Old Faithful (at present, the intervals are lengthening, which might suggest more cold water at the present time than in the past). Second, mixing of hot and cold waters is a very important catalyst for mineral precipitation. Perhaps we are viewing the mixing of hot and cold waters that will eventually precipitate enough silica to cause Old Faithful to stop erupting. If Old Faithful keeps on changing, or suddenly changes its pattern of eruption, we would hope to put another camera in to obtain observations for comparison with the data we now have.

Old Faithful has been a rich source of data for the investigators as well as a source of spiritual inspiration for millions of people. Since Kieffer started these studies, volcanoes have erupted all over the solar system, and she has applied



The slot-like cauldron filled with roiling water (light area, lower left). The two especially bright spots at the bottom are oscillating water drops descending into the cauldron.



The waterfall (the streaks emanating from the upper right corner). A few gallons a minute of water—perhaps at a relatively cool temperature of 80°C—flow continuously into the conduit.

Looking down toward the large dark cavern near the 40-foot level (bottom left, black area). A round pool of water sits on a ledge (middle, left), and a bright stream of water pours down toward the ledge and pool (the light streak emanating from the top of the photograph). This water is "bank storage," draining back toward depth after a preplay splash.

her growing body of knowledge about geysers and how they erupt to volcanoes and geysers on Io (a satellite of Jupiter) in 1979, the eruption of Mount St. Helens in Washington in 1980, historical eruptions of Kilauea Iki in Hawaii, and most recently, geyser eruptions on Triton (a satellite of Neptune). In addition, she has applied the concepts to try to understand the origin of mineral deposits in veins in the Earth**'s** crust, where silica, calcite, and gold were precipitated in ancient hot spring environments much like the present environment under Yellowstone.

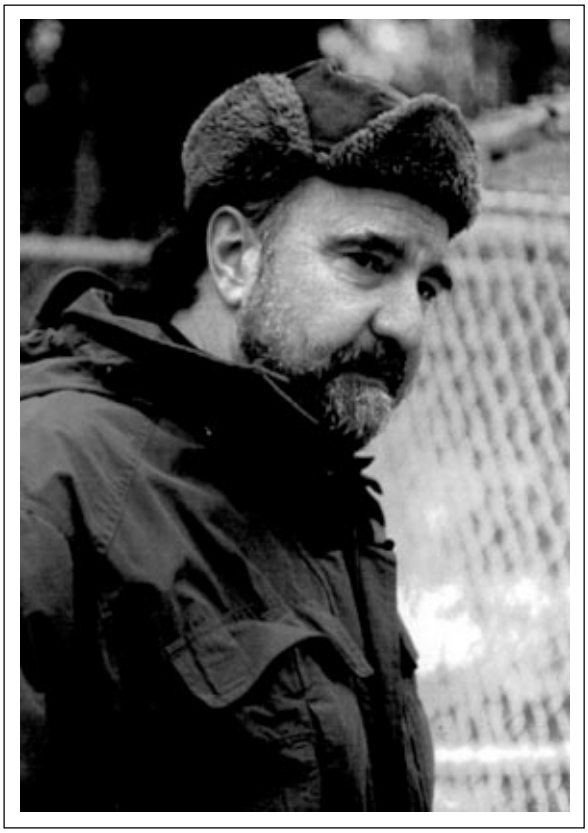
You are welcome to share all of the video data obtained by going to the Old Faithful Visitor Center and seeing the video "Journey Toward the Center of the Earth" prepared by the investigators.

Susan W. Kieffer was an assistant professor of geology at UCLA when she started these studies in 1976. She continued them through work with the U.S. Geological Survey, Arizona State University, and, currently, the University of British Columbia where she is professor and head of geological sciences. James A. Westphal is professor of planetary science at California Institute of Technology. Roderick A. Hutchinson is the National Park Service research geologist in Yellowstone.

Wolf Realities

Yellowstone's new wolves challenge science and mythology

Mark Johnson/NPS



The effort to restore wolves to Yellowstone has had no more faithful, expert, and effective friend during the past 20 years than L. David Mech. Long regarded as this country's foremost wolf authority, Mech has been studying the animal for more than 35 years. His book-length works include The Wolves of Isle Royale, The Wolf: Ecology and Behavior of an Endangered Species, *and* The Arctic Wolf: Living with the Pack. *Mech, a biologist with the National Biological Service and an adjunct professor at the University of Minnesota, has been widely honored both for his remarkable scientific productivity and for his long labors on behalf of wolf conservation and public education. He has been an important advisor to Yellowstone managers for many years. This interview took place on March 29, just a few days after the first pen was opened to release the wolves, so it to some extent focuses on those first exciting days when the wolves were still near or in their pens, and suspense was high about what they would do.*

YS: A rational, objective, but totally uninvolved person might look at the wolf restoration program, and all the trouble and conflict—what Hank Fischer of the Defenders of Wildlife calls "The Wolf Wars"—and wonder if it's worth it. How would you respond to that? The rage and exasperation on both sides of the issue, the financial costs, and all the rest—why do this?

DM: It's worth it for several reasons. It's worth it just because we ought to do it. We are restoring the wolf to restore the ecological integrity of the park. If you question that, then you might as well question everything else that's done here that almost everyone agrees is worth doing because Yellowstone is so important to the nation and the world. I don't know what it costs to run the park, but I'm sure it's substantial; why is that worth it? It's the same argument, really.

And as far as the costs are concerned, I agree it's not cheap, but if you cost it out over the next 50 or 100 years, it costs relatively little. If you want to get really practical about it, and really do justice to the economic analysis, you have to factor in what the wolf will *earn* the regional economy. The studies that have been done indicate that the economic value of wolf restoration will far outweigh the costs.

But by almost any standard, I think it's worth it to restore a major component of your most visible ecosystem here, the ungulate-predator ecosystem. You know the wolf is very conspicuous by its absence and in a natural area of such worldwide significance, it's worth it.

YS: Yellowstone is already a complex place, with a surprisingly complicated predator-prey system. The grizzly bears and coyotes already kill about a third of the new elk calves every year, and the other predators, including black bears, mountain lions, and a variety of smaller ones, are undoubtedly having all sorts of effects on the ungulates and other herbivores. With all this predator-prey interaction already in place, how will the wolf fit in? Will it have a big enough influence to be what the ecologists used to call a keystone species?

DM: Oh absolutely! As we were driving back from the pen sites today, we came across the heart of the northern winter range. I don't know how many dead elk there are out there, but you don't have to walk or drive very far to see one. When the wolf is established here I'd be surprised if you find that many dead ungulates lying around. I think they're going to be taken care of before they reach that point. Now that's not going to be next year or the year after. It may be ten years or more. But the wolf is going to have that kind of influence on your ungulates. It certainly does every place else.

Wolves and the Modern Mythology

YS: One of the biggest public perception problems facing wolf restoration has been the persistent misunderstanding of how wolves will affect livestock. There is an element in the regional community just convinced that countless cattle and sheep will be killed very quickly. All the data indicates otherwise. We frequently use the example of Minnesota, which has a much higher density of both wolves and livestock than the area around Yellowstone, and which has amazingly few problems with depredations on livestock. But this isn't a belief that will be changed by mere facts.

DM: What helps more here in the West, I think, is pointing to Montana. In northwestern Montana there has been a well-documented natural colonization of wolves, and what's going on up there is an easily recognizable analogy to what will happen here. When ranchers point out that Minnesota is different from Wyoming and Idaho, you can respond by saying, "But how different is Montana? You have the same livestock, the same methods of livestock management, and the same general environment in Montana as in Wyoming and Idaho. If the 70 or so wolves in northwestern Montana are killing an average of one or two domestic animals a year, why are you folks so worried here in Wyoming and Idaho?" It's pretty hard to refute that.

YS: One of the frustrations of educating people about real wolves and what they do has been the reluctance of many Americans to consider all the Canadian parks—there must be at least a dozen of them—that have wolves and don't have significant problems with wolves killing livestock.

DM: That's true, and I don't know why that has been so difficult for people.

YS: But you've worked a lot in Canada. Why won't we learn anything from our neighbors to the north?

DM: Our general public really doesn't know much about Canada. Wolf biologists do because we're interested, we're near Canada, and some of us have worked up there for years, but most people just don't know what Canada is like. And how many of these ranchers who are so concerned about wolves have been to Alberta or British Columbia? Not that many.

YS: In your years of researching wolves and working with wolf management, you've been exposed to all of the different constituencies, including a lot of people who have either always supported wolves or have come around to supporting wolves. What advice can you give to someone trying to start a restoration program, as far as how to gain public support? Is there a dominant theme, like a key message, that reaches people best when you're trying to explain to them why wolves matter?

DM: Not that I can think of. I think you deal with three kinds of people in an issue like this. You've got the kind that are very much anti-wolf. You may not realize it at the time because they're very vocal and get a lot of media attention, but statistically there aren't that many of these people around. Locally there may be, but statistically it's a low percentage, less than 25% of the public certainly. And then you have perhaps another 25% that are pro-wolf. That's a guess but it's probably about right. And then you've got this mass in the middle, this 50% that aren't really committed but they're open to reasonable arguments.

YS: Maybe that's the question: what arguments work?

DM: Most important, they don't have to be profound arguments. They don't have to be anything more complicated than explaining that the wolf was wrongly and unnecessarily wiped out of the park and we have the chance to restore it. Say this to many of the noncommitted people, and they'll say, "Sounds like a good idea."

YS: Is there anything to say to the really hard-core wolf haters that might change their minds?

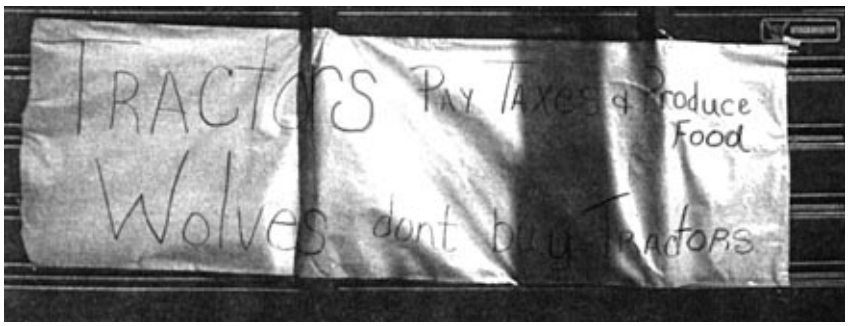
DM: No. There isn't going to be any argument that's going to convince them. It's a religion with them. They just don't like wolves and typically they also don't like grizzly bears or cougars or any other predator.

YS: It's cultural.

DM: It's even more than cultural. It's a frontier religion kind of a thing. I don't even try to persuade them.

YS: It seems that what we're dealing with among the people who really hate wolves is their dependence upon received wisdom. Most of them have never seen a wolf in the wild, and most of their parents didn't either. Their knowledge of wolves is deeply ingrained in their culture, but it's based on opinions held by their ancestors three or four generations ago. Minnesota has had wolves pretty much continually, and so the wolf opponents there have had to deal with the reality of wolves rather than folklore; has that made Minnesotan attitudes different?

NPS photos



Wolves stirred strong feelings on both sides of the reintroduction debate, and demonstrators of both persuasions made appearances in Yellowstone in recent years. The above sign proclaimed the valuelessness of wolves, while the demonstration (left) demanded their return to the park.

DM: The real difference between here and Minnesota is that in Minnesota, the anti-wolf people are not saying they don't want wolves, they're only saying they want wolves controlled. They used to say they didn't want them 20 years ago—"Wipe them out, they're no good for anything." But first of all, some of those people died off, and second, it has been less and less socially acceptable in Minnesota to say that. The wolf is seen by enough of the general public as being a positive animal that there's actually been a shift in position among these other folks—the farmers whose livestock are being killed—to the point that they're saying, "Control the wolves; we don't want you to wipe them out but control them."

There have been a lot of factors involved in making people realize that the wolf is valuable. Some of it is the result of media coverage that makes all the different position holders more aware of the values held by each other. There's also the wolf's protection under the Endangered Species Act. Now that there is a potential fine of $20,000 for killing a wolf, anybody can see that the animal has a whole different value to society than it did when the only money associated with it was a $35 bounty for killing one. The penalty for killing a wolf has more effects than merely acting as a deterrent to prevent people from killing one. That penalty also alerts them to how much these animals may matter to their neighbors, and to people far away. It officially places more of a value on the animal. Combine that with the resulting media attention and things like the International Wolf Center in Minnesota, which as you know has been very successful in educating people to what wolves are really like, and people from all over the world are now coming into wolf country and making the wolf into a revenue-generating attraction. As all that happens, attitudes change. Even those who continue to hate wolves don't dare say it anymore up there.

YS: It must make a difference that year after year all those people in Minnesota are exposed to the really trivial livestock losses to wolves. That's the reality. But in the West, the only reality is an inherited perception of the wolf as a catastrophic killing machine that's going to bring western civilization to an end.

DM: I'm glad you mentioned that because that's a very important point. In Minnesota, people know the reality; even the wolf haters know the reality of the situation. Here, the folks have an exaggerated and almost hysterical view: "Wolves are going to kill my kids, they're going to wipe out my herds," that kind of thing. Minnesota has 2,000 wolves, and those awful things don't happen, and nobody there is going to say they happen because they know from their neighbors or their own experience that wolves aren't like that. If they did say them, nobody would believe them because they know better. At worst, the wolves will kill a few cattle or sheep, and some turkeys, so it's not considered a serious problem. In Montana people are actually afraid wolves will wipe out their livestock, but in Minnesota, wolves kill far less than one percent of the livestock in wolf range each year.

YS: Any guess at how long it will take before that hysteria starts to moderate in the Yellowstone area?

DM: I can make a guess because I think we have just passed through that stage in Montana. Ten years ago in northwestern Montana, you had that same kind of hysteria, but what I'm hearing from wolf biologists and managers who have worked in Montana in the last 5 years is that they're finding some pretty reasonable viewpoints out there, now that the wolves are actually there and functioning and not killing people and wiping out livestock herds. One pack of wolves denned and lived in the middle of a pasture with cows all around, and didn't even kill one for a year. So from that, my guess is that maybe 10 years after wolves are reasonably well established you'll see some moderation in the hysterical rhetoric. It could be less than that, maybe 5 years, but the hysteria is strong right now. I testified at the legal case [*involving one of the lawsuits filed to stop wolf restoration*] in Cheyenne in December and I heard what was being said. Some of those folks were certain that as soon as the wolves were released in the park the first thing they would do was go to so and so's ranch and kill all his livestock. When that doesn't happen for a few years, you will see a moderation in those views.

First Impressions of the New Wolves

YS: Advocates of wolf restoration have frequently quoted you as saying that Yellowstone was simply outstanding wolf country. When you made that assessment, what part of the Yellowstone set-

Jim Peaco/NPS

Yellowstone's new wolves have had no apparent trouble taking local prey species, most of which were familiar to them. Wolf Project Leader Mike Phillips (left) and Wolf Biologist Doug Smith investigate a successful kill during the ongoing monitoring program that is part of wolf recovery in Yellowstone.

ting were you looking at?

DM: I was looking at the prey base. A lot of people might think that the most important thing is habitat, but for wolves, habitat is prey. Remember that a thousand years ago wolves lived everywhere, in just about every habitat on the northern half of the planet. It doesn't really matter what the plant life, topography, or climate is; if there is prey and protection from humans then wolves can live there. That's all they need, and Yellowstone has both a great prey base and good protection.

YS: So what is the biggest challenge for wolf restoration here?

DM: The challenge is dealing with how far wolves move. Once the wolves are restored, the park and surrounding wilderness areas, where wolves should be allowed to thrive, will always be a natural reservoir for wolves that will disperse elsewhere. I don't know of another land carnivore that travels as far as wolves do. You can draw a radius of 550 miles around the park, that's where these wolves could be expected to disperse to. That's why the experimental nonessential designation was so important. It allows managers more freedom to deal with wolves that venture to where nobody wants wolves to be.

YS: Let's get back to the current restoration efforts. Would you contrast for us your observations of the first week of the Idaho wolves versus the first week of the Yellowstone wolves? The Idaho wolves were released in "hard" releases, just let out of the shipping containers, while the Yellowstone wolves went through 2 months of acclimation, held in large pens, before they were released. There is a great deal of interest in what we can learn from those two different methods.

DM: Well that's a very good contrast because it illustrates the difference between a hard release and a soft release. In the hard release the wolves were released and just about as soon as they could figure out where the sun was they started heading back north, in the general direction of their home in Canada. One of them went 120-130 miles or so. So far here in the park, we're getting just casual exploration of the area immediately surrounding the pens. And it's clear that, whatever the wolves ultimately decide to do, there is no immediate intention to run off in some particular direction or another. They walk and circle around, zigzagging here and there, and ending up back near the pens. In these first few days, there has been a lot of inspection of the pens themselves, and then the wolves gradually moved outward in what I would call exploratory moves. That is quite different from what we saw in Idaho.

YS: If you had to characterize what's going through the heads of these Yellowstone wolves, is it that they have achieved a comfort level with that little basin they're in around the pen and they don't feel the urge to leave?

DM: It seems that they don't yet feel the immediate urge to just "home." If what we've done by penning them for 2 months has worked, they may not now have any concept of home other than where they are. That's the whole idea. Rather, the concept they should have now is that "Here I am—I'm free, I can explore, and I can make my way around here." That should be the only impulse they should have, plus "I'm hungry, lets find something to eat!"

In a sense, this is very much like what happens to a dispersing wolf, one that has left home on purpose to find its own place; it's not going home. In fact, it's doing the opposite of homing. It's searching for a place to find a living and a mate. In the case of these animals, they already have their mates, so it's just a matter of searching around here to find a good place to make a living.

Now we may be wrong. It's too early to tell. It may be that after a week of this they suddenly remember a place in Canada and want to head back. But right now they are doing everything we would expect them to do if they weren't going to go home. And so everything looks good so far [*See page 17 for an update on the wolves*].

YS: It is important to keep in mind that this whole project has been billed as an experiment, including the hard release versus the soft release. Besides getting wolves restored, the whole idea is to learn.

DM: Right, and we'll learn so much in the next week about that experiment. I can't wait for the next week to come and see where these wolves are going to be.

YS: Let's talk about the way the releases have gone over the past week. How surprised should we have been by the wolves' reluctance to leave the pens? With hindsight, can you see anything we knew that might have suggested that this would happen?

DM: No, there was no precedent for this. The closest we have to this experience

involved a pack of four that I held in a pen for three or four weeks. It was a wild pack, captured and held for 3 or 4 weeks in Minnesota and then flown to Michigan and held for another week in a pen there. We wanted to do a soft release, just open the pen and let them come out on their own, but it ended up being a hard release. We sort of pushed them out of the pen. So we didn't really learn anything from that to apply here.

I guess the fact that none of us did predict that they wouldn't just rush out of the pen is good evidence that we really didn't have any basis for thinking that. But in retrospect you can begin to understand what might be going on. They have been restricted to that enclosed area for so long that when they are immediately outside of it they may not even have the concept of inside and outside. I know at the Crystal Bench pen, those wolves have been released but now they're pacing along the outside of the pen kind of like they did on the inside. And when you think about it, how would they know what side of the fence they are on? It's a fence, it's not something they've had a lot of experience with. They have to explore in order to learn and they're intimidated by anything new. Until they are motivated to overcome that intimidation, the natural thing is to stay with what you know and that's the pen.

The behavioral dynamics of the packs are especially interesting at this point, and they give us a lot to wonder about. For example, one of the wolves at the Crystal Bench pen has gone about a third of a mile from the pen. I have a theory about that one. I think it's not an alpha animal because if an alpha animal went out it would go farther and it would have the alpha of the opposite sex with it, so we would see tracks of a pair. What could be going on is that at this time of the year some of those younger animals are driven to disperse from the pack. About 25 percent of them should be leaving right now, and there are four of the young ones in the pen, so at least it's not unusual to think that one might be predisposed to leave. We're not sure what happens with that, but there is certainly evidence from captive raised wolves that a certain amount of aggression goes on among the pack members that drives an individual away from the others, though in a captive pack all it can do is move to the opposite end of the pen. Well, in the case of the Crystal Bench pack, when the individual gets to the opposite end of the pen, it may notice that there's an opening there and move out.

On the other hand, the other thing that often happens with these individuals is that they kind of like to stay with the pack, even though they've been driven away. So what they do in the wild is trail along behind the pack. That may be what's going on right now. This animal may have been kicked out, so it moved away in order to avoid the aggression, but is kind of hanging around because it still wants to stick with the pack.

YS: Speaking of interesting things to wonder about, the wolves have all of us here asking each other questions that only the wolves can answer. For example, what are the chances that one of those females might decide to den in the pen, or even use one of those boxes as a den?

DM: I think that it's really unlikely for a couple of reasons. One is, I'll be surprised if we get reproduction this first year because captivity during this time of year is very stressful. The Minnesota wolves that I moved to Michigan actually bred in the pen, but they never had pups. We've had a couple of wild female wolves that we put in cages and kept for years and they never came into estrous. So there is a certain stress associated with being held captive. Because of that, I'll be surprised if you have reproduction this year.

YS: There has been some evidence of breeding behavior in all three pens, but we have tried not to get our hopes up, considering the stress of the situation.

DM: But! On the other hand, I haven't been right about much of this yet and so maybe that's good reason to hope. As Steve Fritts [*U.S. Fish and Wildlife Service biologist*] has said, we must expect the unexpected.

YS: There is an assumption here that the presence of plenty of winterkills and lots of live elk will help make the wolves feel at home and may reduce the likelihood that they'll take off and travel a long distance. Does it matter to the wolves whether or not the available meat is live or dead?

DM: I don't think so. I think food is food.

Jim Peaco/NPS

Dave Mech assisting with carcass tied to tree in an effort to coax the captive wolves from their pen.

YS: Will the size of the pack be a significant factor in their ability to kill prey here?

DM: It rarely is. Single adult wolves have been recorded killing every major North American prey species, including moose, musk ox, and bison.

YS: So it isn't an advantage for the Crystal Bench group to have four young wolves besides the alpha pair?

DM: I view the pups as being more of a liability than a help, because that alpha pair has to feed them. If I were trying to have the highest chance of a pack getting established, I would rather have several pairs of adults to start because all they would have to do is support themselves, produce pups, and then start the pack like they would do ordinarily.

History and the Future

YS: The Yellowstone wolf restoration project has been celebrated as the first restoration of a large carnivore in the western national parks, and a lot has been made of what an important precedent it is. Do you see what we're doing here as a historic event?

DM: Oh absolutely! And it's historic not only because it's taking place in Yellowstone. It's also historic in terms of the

NPS

Doug Smith/NPS

Wolf puppies were not always as welcome in Yellowstone as they are now. In 1922, a litter of pups (upper left) was captured on Blacktail Plateau after their mother was shot. This litter was kept and shown at park headquarters at Mammoth Hot Springs for a few days. The photograph was donated to the park in 1994 by William Bickett of Ephrata, Washington. Mr. Bickett and his brother Wally are the children in the photograph with the wolf puppies. The puppies were eventually destroyed by order of the park superintendent, in keeping with park policy on predator control. The new litter of pups (upper right) have received a far warmer welcome, and are currently being held for release later this year.

restoration of a very controversial animal, especially an animal that was deliberately exterminated from the park. There are a lot of parks around the world that don't have their full complement of species, but those missing species were eliminated long before the park was even created. Here in Yellowstone, wolves were exterminated intentionally by early managers, and now a later generation of managers is restoring them.

YS: You've often commented on who does these things. It is said that the government wiped out the wolves, but it wasn't that simple.

DM: Right. The wolves were wiped out of the park by the government, but we can't just say it was the government because the government was doing what the public wanted: the government reflected the public will at the time. And that's exactly the same thing that's happening now. It's the same government, but it's doing exactly the opposite and again, it is a reflection of public attitude. So in a sense there is a symbolic aspect to it, that one hopes may be a kind of an example of what we can expect from the public. I think that direction is going to continue—that public attitude is going to continue to get better and better toward the environment. We're not going to go back to the days where you exploit everything to the Nth degree. We're going to continue to move toward being far more respectful of nature. I don't mean necessarily that we're going to stop all hunting and trapping and all of that kind of thing because that will have to go on for practical reasons. But we are going to become more and more respectful of what small part of the natural world we do have left.

YS: In that future you are describing, do you see large carnivores being restored to other large national parks or other wild country in the west?

DM: I don't see why not. I think that we are always going to have to do it carefully because of the down side of it.

YS: You mean possible problems that develop from conflicts between carnivores and private property?

DM: Yes. I think that certainly has been well considered in the Yellowstone wolf reintroduction, and if we can restore the wolf to Yellowstone, there aren't many carnivores I can think of that we can't restore to other national parks. I think the wolf, both in terms of its biology and its public image, is probably the most challenging carnivore to try to restore.

YS: It is likely that even out there in the larger conservation community, most people have little idea of how complex and difficult it was to get to this point with Yellowstone wolf restoration—just getting the first animals here was a monumental task. Perhaps it's even better that they don't know what a political and logistical challenge it is, or they might not be as excited about restoring wolves and grizzly bears to Colorado and other places. Do you think that this restoration effort in Yellowstone will pave the way? Will each subsequent restoration be easier?

DM: I'm not sure they are going to get progressively easier, in terms of the politics, but Yellowstone is going to serve as an example that people can point to and say, "Well wait a minute, we were able to restore the wolf to Yellowstone and take care of the legitimate issues and the false perceptions that surrounded the wolves. And if we could do it there, why shouldn't we be able to restore wolves and other carnivores in other places?"

Not that the problems are going to be the same; the biological problems with, say, restoring the grizzly bear someplace may be more horrendous than the biological problems of restoring the wolf to Yellowstone, but I don't think the politics could be any more horrendous. And the biology you can deal with if you can get by the politics. So in terms of trying to persuade the public or the politicians, by pointing to Yellowstone wolf restoration as an example, it will be a good model.

Black-throated Sparrow in Yellowstone

First record of the species

by Terry McEneaney

In the annals of ornithology, Yellowstone National Park is not noted for its diversity of birdlife, yet over the years an interesting array of birdlife has been documented. The black-throated sparrow (*Amphispiza bilineata*) has recently been added to the list of rare and unusual birds documented in the park.

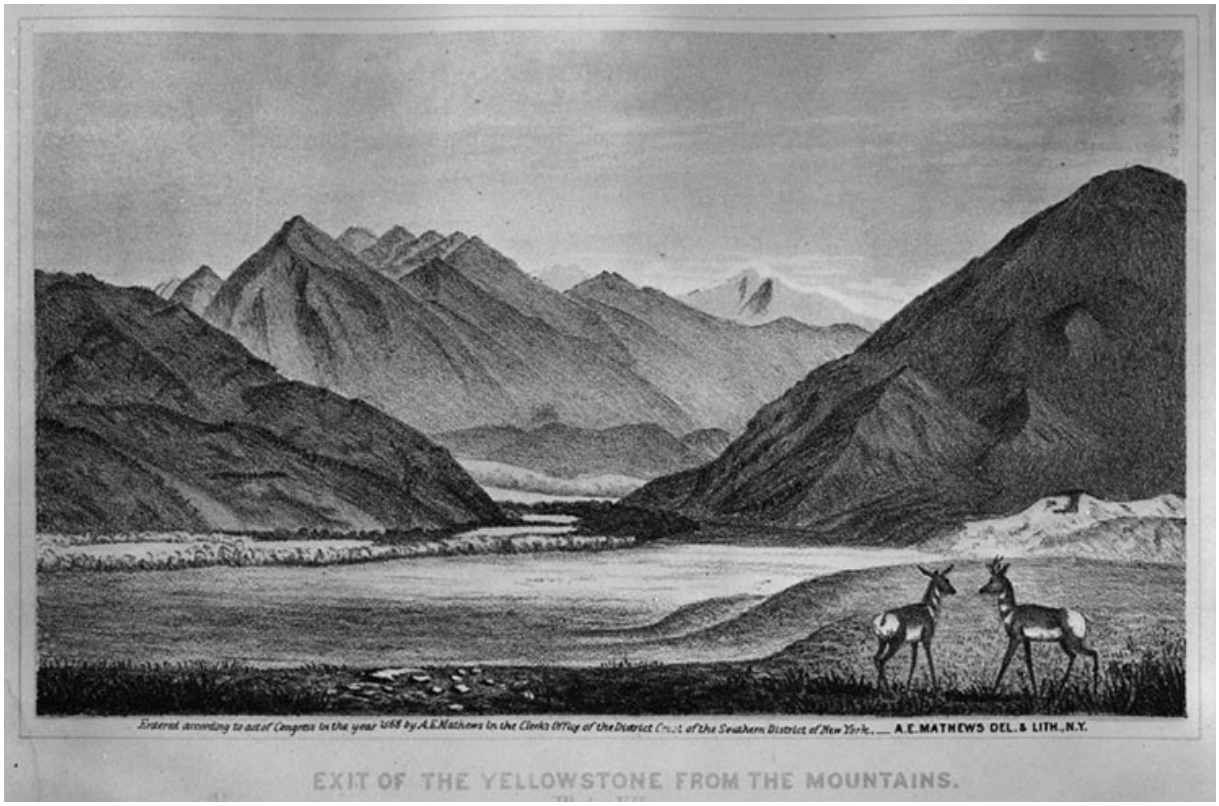
On April 18, 1994, at approximately noon, I observed and photographed a black-throated sparrow at Steamboat Point on the north shore of Yellowstone Lake. The habitat in which the bird was found was a mixture of open meadow, big sagebrush, juniper, lodgepole pine, and low-growth vegetation associated with geothermal features. The bird observed on this date is described as follows: a diminutive sparrow slightly smaller than a dark-eyed junco (*Junco hyemalis*); with a black chin and neck, with the darkness extending into an inverted black triangle on the breast and terminating at a point on the lower breast; gray-black bill and legs; black lores; dark iris; bold white supercilium and submoustachial stripe; brown back and mantle; brown wings with black streaks especially on the scapulars; dark gray head; broken white crescent-shaped eye-ring below eye; dark gray tail with white tail edges; white belly; cream gray flanks; light gray undertail coverts; and underside of tail dark gray with white web patches near the distal end of the tail.

I observed this black-throated sparrow for approximately 15 minutes, and it appeared very tame, at times approaching within four feet of me. The bird also sang repeatedly. The song was a five-note bell-like song, with the first two notes being very clear and distinct, followed by a three-note trill.

So what is the significance of this find, you may ask? The black-throated sparrow is a characteristic bird of the arid southwest. It is a "desert sparrow" of sorts that rarely ventures out of its habitat, which is composed of arid brush and riparian washes, desert scrub, thorn brush, mesquite, and juniper. The bird is typically confined year-round to a geographic area that extends from central Mexico and Baja Mexico to west Texas, southern New Mexico, southern Arizona, southern Nevada, and southern California. The summer range of this species is more spread out to the north, including northern Arizona, northern New Mexico, southwest Colorado, Utah, southern Idaho, Nevada, and east-central California. Observations of the black-throated sparrow outside of the ranges described above are considered casual due to the lack of observations. According to P.D. Skaar's *Montana Bird Distribution,* there are only two records of the black-throated sparrow in Montana, both from Missoula County. And according to the Wyoming Game and Fish Department's Distribution and Status of Wyoming Birds and Mammals, casual records exist only from the Green River, Jackson, and Laramie latilongs in Wyoming.

At first glance, Yellowstone does not appear to be a paradise for a diversity of birdlife because of its harsh climate, but the park continues to surprise even the most ardent avian observer.

Terry McEneaney is Yellowstone's bird management biologist, and author of books on the birds of Yellowstone and Montana.



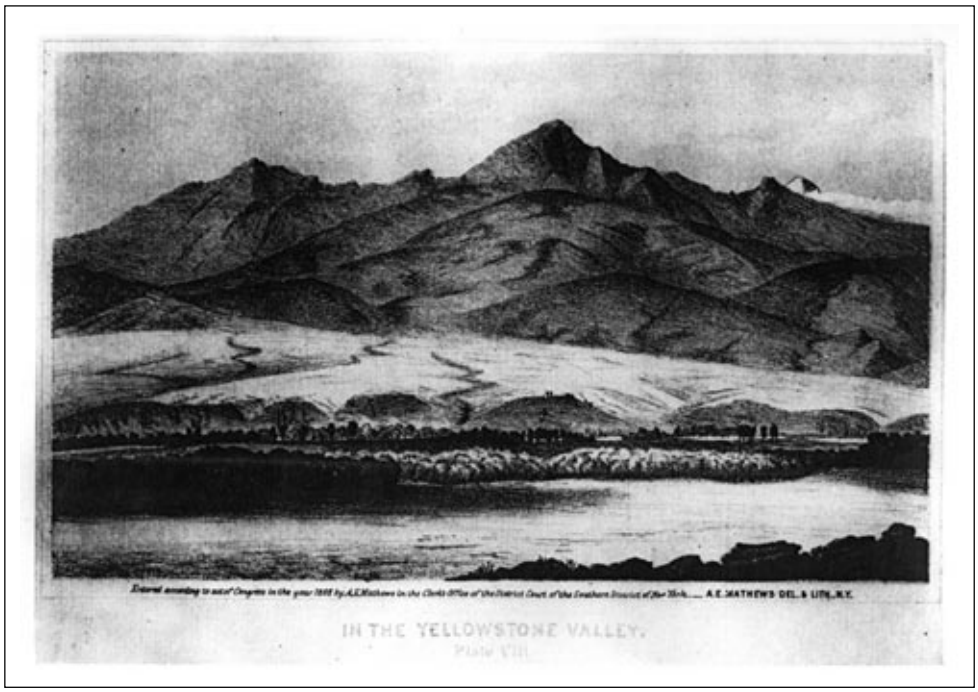
Two Little-Known References to the Yellowstone Country from the 1860s

by Lee H. Whittlesey

Aubrey L. Haines, in his books *The Yellowstone Story* (1977) and *Yellowstone National Park: Exploration and Establishment* (1974) performed the monumental task of writing the history of the Yellowstone Plateau prior to its formal discovery in 1870. But as Haines himself stated about his own books, "You have every right to exclaim, with the Queen of Sheba, 'The half was not told me!'" Indeed there are many small corners of Yellowstone history left to be explored.

Following the fur trade era (1822-1840) and before its formal discovery (1870), the Yellowstone plateau was visited by numerous Euro-Americans, most of them prospectors searching for gold or other minerals. Few of these men (all of them that we know of, with one possible exception, were men) left full accounts of their travels. But fragmentary accounts of their trips found their way into Montana Territorial newspapers, where the peripatetic Haines generally discovered them during his many years of research.

Only a few of these accounts made it into 1860s books, with most appearing in newspapers or unpublished documents such as diaries. In all cases, we do not know from where the authors got their material, but probably in most cases it was from a wandering prospector. Men like George Huston, William Hamilton, George Bacon, George Rea, Gilman Sawtell, "Uncle" Joe Brown, George Bruffey, James Dunlevy, A.H. Hubble, James Gemmell, John Dunn, A. Bart Henderson, Newton Seward, Lou Anderson, Legh Freeman, George Reese, and the large DeLacy party are all known to have prospected or simply visited present Yellowstone National Park in the 1860s. Unfortunately, they left us little in the way of information, and, at least for the present, we know little about their trips to the upper Yellowstone country.



Recently, Yellowstone-area references in two rare books have come to my attention; these are noteworthy for their observations of Yellowstone before its formal discovery and exploration.

Alfred E. Mathews wrote the rare book *Pencil Sketches of Montana*, which he self-published in 1868 in New York. It contains his sketches and text about Montana Territory. On page 75, he stated that "The source of the Yellowstone is a clear, deep beautiful lake, far up among the clouds; that is kept cool by drippings from the eternal glaciers. Near this lake the river makes a tremendous leap down a perpendicular wall of rock, forming one of the highest and most magnificent waterfalls in America."

Mathews also enlarged our information base on the wildlife of the region. Among other things, he described the upper end of what is now known as Paradise Valley, including with his narrative a sketch of the valley where the Yellowstone River leaves Yankee Jim Canyon. On pages 74 and 75, at the beginning of the chapter entitled "Exit of the Yellowstone from the Mountains," he describes this sketch and then discusses the animals he saw: "In the foreground of the view are seen two antelopes: these animals are quite numerous in the region, and during two days that the author remained in the valley, he saw many large and small herds: elk and mountain sheep also abound, and have been frequently seen in immense droves."

Another rare book is John C. Van Tramp's *Prairie and Rocky Mountain Adventures; or Life in the West . . .*, published at Columbus, Ohio, by Gilmore and Segner in 1866. On page 50, Van Tramp noted: "According to the most recent reports there is, between the head of the Madison river and the upper waters of Yellowstone [river], a volcanic region of perhaps 100 square miles in extent, in which some of the volcanoes are said to have lately been in a state of eruption. Hot springs are found not only in this region but in various others . . . ."

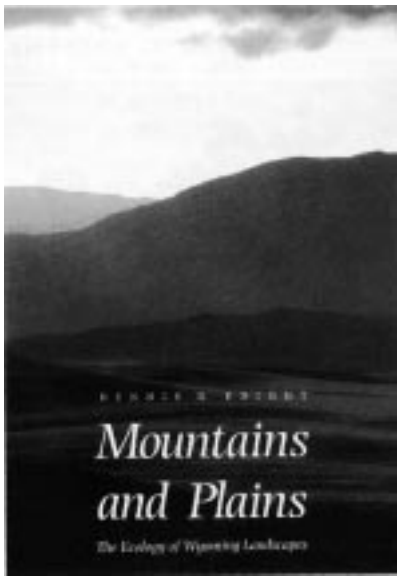
The Van Tramp statement may have been taken from information shown on both the 1851 hand-drawn map by Jim Bridger and the 1851 manuscript map by Father DeSmet (if Van Tramp had occasion to ever see those maps or talk to Bridger or DeSmet). Or perhaps his information came from an 1860s prospector, one of those shadowy men whom we wish had left us more information.

These books represent two more sources to add to the list of scarce historical references to present Yellowstone National Park area during the 1860s. Aubrey Haines once observed that the rate at which these early accounts were still being discovered suggested that many more still waited to be found. It seems that is still true, and the hunt for these little historical treasures continues.

Lee Whittlesey, who has been researching Yellowstone history for more than 25 years, is Yellowstone's historian-archivist and the author of numerous books and articles about the park's history. His most recent book , Death in Yellowstone, *was published this spring by Roberts Rinehart, Inc.*

Book Review

Mountains and Plains: The Ecology of Wyoming Landscapes by Dennis H. Knight. Yale University Press, New Haven, 1994, 338 pages; $40.00.



"Heated debates over ecological phenomena frequently develop when sweeping generalizations are made" writes Dennis Knight, and to convince us of that he takes us on a journey of Wyoming's landscapes to examine the workings and diversity of various ecosystems. In *Mountains and Plains*, we are introduced to the physical settings, the major biological players, and the land-use controversies associated with the grasslands and steppe, the foothills and mountain forests, and the alpine regions of Wyoming. With the patience of an experienced professor, Knight goes beyond the descriptive to instruct us in ecological processes. We learn about nutrient cycling in grasslands, the importance of keystone species like beaver in the riparian zone, and the complex plant-animal interactions that determine mosaic patterns within conifer forests. In landscape after landscape, we see that the physical and biological realms coexist naturally in a fragile, dynamic equilibrium. The disharmony of the last century, brought about by agriculture, logging, mining, and urban development, stands in stark contrast to the prehistoric condition. In the 1820s, bison, elk, deer, and antelope outnumbered people by 150 to 1. By the 1950s, they outnumbered people by no more than a factor of two, while livestock were five times more abundant than people.

The book is divided into six parts. The first part provides the backdrop, describing aspects of the historical and modern setting of the state. The book adopts a telescoping view of time, mentioning briefly the long-term geological events that shaped the broad physiography of mountains and basins. More attention is given to the climatic and vegetational changes that accompanied the Quaternary ice ages, and particular those following the last glaciation. The postglacial environment fashioned the landscapes and biota that have contributed to the range of resources available for human utilization. More important, perhaps, this prehistoric stage sheds light on the range of ecological processes that naturally occurred prior to Euro-American settlement.

Riparian environments are described in Part Two. These habitats are more important ecologically and economically than their area would imply. Although stream and lakeside communities constitute less than 1 percent of the region, 80 percent of the native animals depend on these habitats for food, water, shelter, and migration corridors. These habitats form a fragile continuum from high elevation to low, and they are especially vulnerable to urban development, livestock grazing, reservoirs, and irrigation.

The upland ecosystems are arranged by elevation starting with those of the plains and intermountain basins and ending with those of the mountains. Part Three of the book focuses on the dry, cold, and windy landscapes of the lowlands, including grasslands, sagebrush steppe, desert shrublands, and dunes and badlands. These are as diverse and complex as the forested regions, although much of the action takes place below the ground where it is more difficult to study. The chapters discuss some of the adaptations that plants have undergone to survive the rigors of drought, fire, short growing seasons, and herbivory. They also describe the paths of energy and nutrient flow through these ecosystems and the extent to which cycling is abetted by disturbance. The chapters on sagebrush steppe and desert shrublands provide excellent discussions on the physical and biological controls of species distributions, which ultimately determine the pattern of vegetation types.

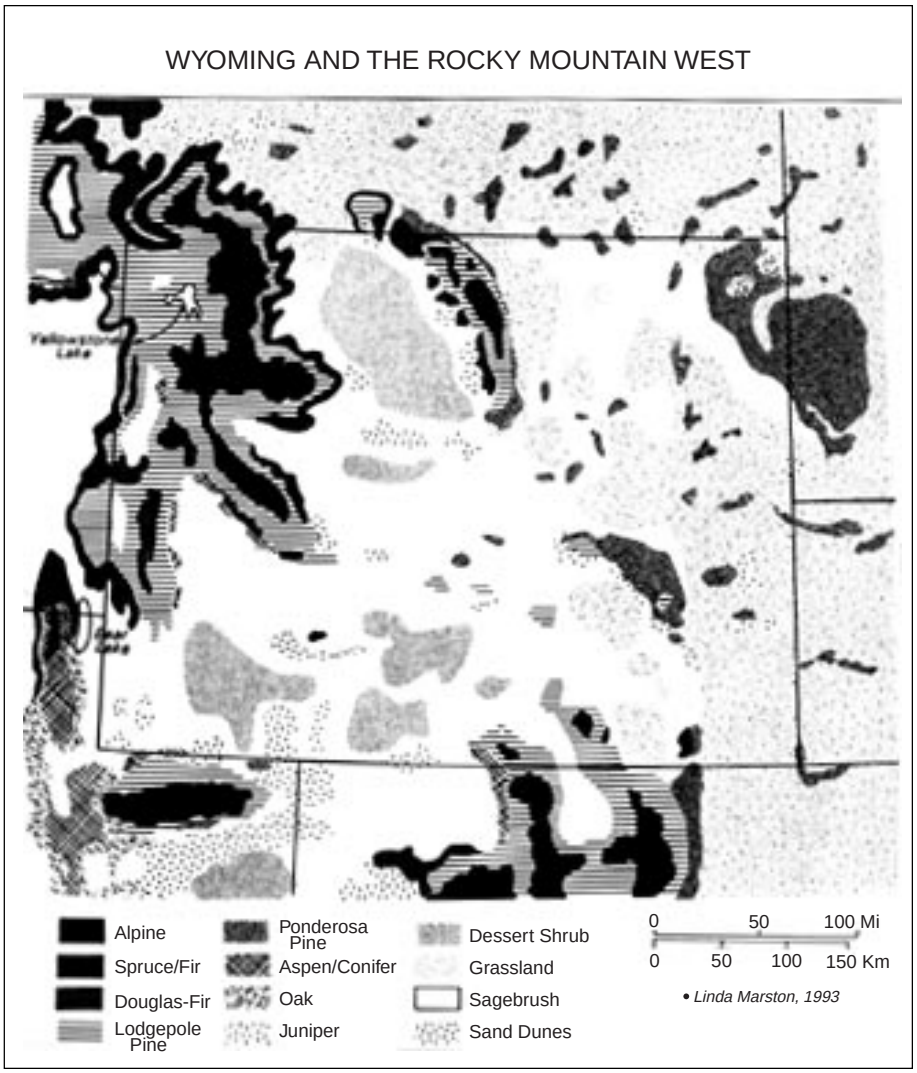
The ecosystems of most concern in the Yellowstone region, i.e., the foothills transition, the mountain forests, and the subalpine and alpine zone, are presented in Part Four. The description and emphasis of this section clearly reflects Knight's interest in plant ecology, plant-animal interactions, nutrient cycling, and the ecology of forest disturbance. The foothills region represents an important transition between harsh conditions of the lowlands and the closed forests above and thus provides critical winter habitat for elk, antelope, deer, and moose. The mosaic of vegetation types is highly variable and reflects biogeographic history, geologic substrate, and mesoscale and microscale climate. The expansion of juniper in some regions and the decline of aspen in others are attributed to the effects of climate, fire suppression, and grazing by livestock and native ungulates. Knight advocates research at the scale of landscapes to determine the magnitude and cause of recent and ongoing vegetation changes.

Mountain forests cover about 22 percent of Wyoming, and their diversity is a function of climate, topography, nutrient conditions, and history. Although only six tree species are common in Wyoming forests, their adaptations vary considerably among mountain ranges, and the effects of fires, insects, and severe weather account for interesting mosaics of forest, meadow, and shrubland. The interactions between beetle infestation, fire, and fungal attacks are lucidly described, and readers will find this information relevant to understanding vegetation patterns in Yellowstone forests. Separate chapters are given to a discussion of mountain meadows and alpine regions, and, although they comprise a relatively minor component of Wyoming's area, they illustrate the sensitivity of high-elevation communities to subtle variations in environment. The relations among soil type, moisture, slope, and wind reinforces the idea that these, like other ecosystems, are polygenetic and spatially heterogeneous.

The fifth part of the book describes areas of special interest: the Yellowstone

Plateau, Jackson Hole and the Tetons, and the Black Hills, Bear Lodge Mountains, and Devils Towers. I turned to this section when first examining the book, and, perhaps like reading the last pages of a good mystery ahead of time, I was initially disappointed. The descriptions of the ecology seemed cursory, and the leap into management issues seemed without context. Later, I realized my concerns were unfounded, because the first fourteen chapters provide a clear framework on which to evaluate the resource management debates that center on northwest Wyoming. A Yellowstone specialist may find the chapters on Yellowstone and Jackson Hole somewhat superficial in their treatment of wildlife issues, the aspen decline, and fire management. But, it is important to remember that the focus of this book is all of Wyoming, and Greater Yellowstone is an excellent venue to discuss resource management issues that affect wide regions. Knight is a consummate diplomat in his balanced discussion of controversies associated with the management of elk, bison, wolves, and grizzly bears. In each case he falls on the side of natural regulation as an appropriate response. He notes, for example, that at a recent conference in Yellowstone no evidence was presented to suggest excessive grazing by elk. Instead, forage fluctuations appear to vary with climate more than with grazing intensity. While acknowledging that aspen and willows have been visibly affected by ungulates, Knight advocates a better understanding of the relationships between succession, fire, climate, and herbivory in assessing the present status of aspen and willow at the landscape scale.

Controversies concerning fire management are described along familiar lines—those who advocate continuing a policy of natural burning and those who argue for prescribed burning and other management techniques to "control" fire. Knight notes that only a policy that allows wildfires to run their course will maintain the present mosaic within Yellowstone's forests. In discussing the natural regulation policy, he writes "there is merit in taking a passive or semipassive approach to wildland management. To exercise active management consistently with precise goals preempts the opportunity to learn about ecological phenomena that have occurred for millennia. This in itself is one of the major scientific values of wildlands that should be protected" (page 231).



The last part of the book on sustainable land management provides a forum to advocate long-term land-use planning in Wyoming. Knight urges that we use the natural and semi-natural landscapes as a teaching tool to better understand the environmental constraints needed to achieve sustainability. He is a champion of ecosystem management to preserve landscape mosaics, biodiversity, and natural areas in ways that will lend themselves to stable interactions between economy and environment over the long term. Unfortunately, this goal has not been achieved in Wyoming's short history, nor have other western states been more successful.

I recommend *Mountains and Plains* to readers interested in Wyoming and the ecology of the intermountain West. It will also provide basic knowledge for those interested in the preservation and protection of wildlands. The book is written in a nontechnical style that makes it accessible to a wide audience. A useful glossary, an appendix of scientific names, and a comprehensive bibliography are invaluable resource material. The photographs are illustrative, but they are black and white and rather drab. This is no coffee-table book of pretty pictures; instead it serves as a stimulating primer on the ecology of the Intermountain West and the scientific inquiry that these landscapes engender.

Cathy Whitlock
Department of Geography
University of Oregon

Gains and Losses for the Wolves; Big Gains for Wolf Watchers

As we reported in the previous issue of *Yellowstone Science*, all three groups of Yellowstone's new wolves were released in late March, and began a wide-ranging exploration of the park and nearby lands. An immediate side-effect of that exploration has been outstanding wolf-watching opportunities for the public, especially in the Lamar Valley. In early May, the wolves started the long process of dispelling myths (see interview with David Mech on page 6) by debunking the notion that no one would see them. The road through the Lamar Valley, one of the quietest parts of the park's road system, has witnessed a growing number of "wolf jams," as visitors, professional photographers, and park staff have sighted either individual members of the Crystal Creek group on an almost daily basis, sometimes seeing most or all of the six members of this group together.

The wolves have been observed playing, resting, chasing elk, and interacting with grizzly bears and coyotes at carcasses. Watchers have witnessed several predations on elk (both adults and new calves), and the wolves have even shown some cautious interest in the new bison calves, though, what with the vigilance of the bison cows, no successful predations have been observed. The visibility of this pack may decrease as the elk move to summer ranges farther from the road, and as visitor use of the valley increases, but this first spring's experience suggests that Yellowstone will provide excellent wolf viewing in the future.

The fortunes of the three wolves in the Rose Creek group have been mixed. The young female separated from the adult pair right away, and has stayed in or near the park, sometimes in the Hellroaring Creek drainage, sometimes north of the Lamar Valley. The adult pair spent much of early April a few miles north of the park in the Absaroka-Beartooth Wilderness Area. They were not located after April 13 until park biologists, making a telemetry flight on April 24, located them on the north slope of Mount Morris in the Custer National Forest, about 30 miles northeast of the northeast corner of the park. On April 26, while in the same area, the male's (#10) radio collar signal became erratic, and on April 27, U.S. Fish & Wildlife Service agents found the partially dismantled collar hidden in a drainage culvert. They found no sign of the male, who was presumed killed.

Probably about the same time, the female gave birth to eight pups—four males and four females—on private land about four miles from Red Lodge. Biologists discovered the pups in a hastily made den on May 3, and, knowing that without the help of the male the mother would be hard pressed to provide for them, began leaving her road-killed wildlife to supplement her food supply. Because of the location of the animals in a relatively high-risk area, the U.S. Fish & Wildlife Service decided to return them to the park. On May 18, biologists captured the entire group and moved them by helicopter to the Rose Creek acclimation pen.

This capture illustrated the extent of the harm done by killing the male, because it highlighted the risks and expenses involved in having to handle the wolves more than was planned. The mother was captured first, but when the biologists went to the site of her den, they discovered that she had moved the pups. It took several tense hours to locate the new den and reunite the pups with the mother for the quick flight to the park. No date has been set for their release, but it will probably occur in late summer when the pups are larger.

In the meantime, on May 7 the skinned carcass of #10 was discovered, with the head missing. Rewards offered by the federal government and conservation groups led to a report that a Red Lodge man, 42-year-old Chad McKittrick, had killed the wolf. On May 15, a search warrant was issued for his house. McKittrick admitted to the killing, and surrendered the animal's hide and skull to agents. On May 16, he was charged with the killing.

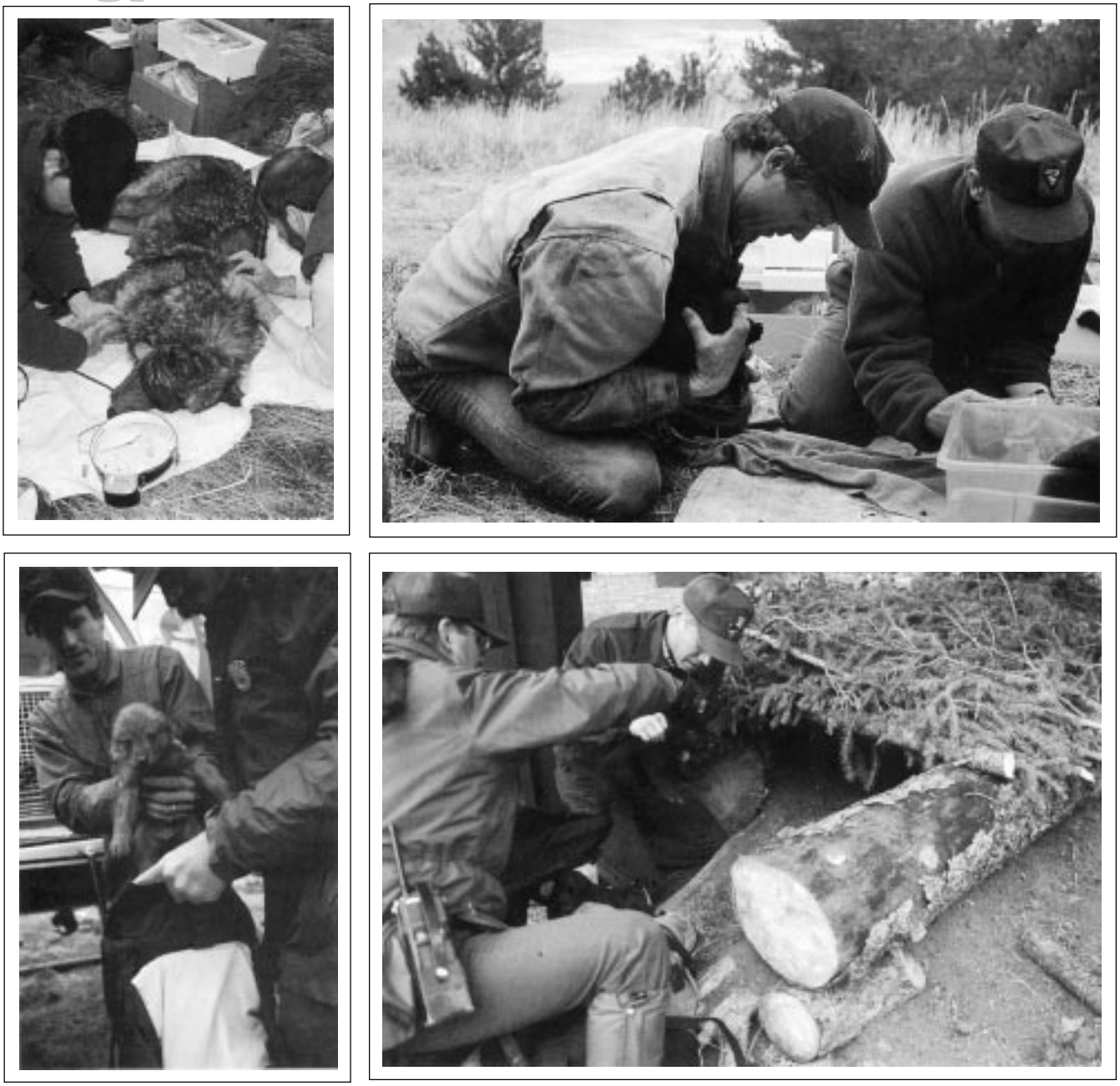
Until mid-April, the Soda Butte group of five wolves stayed in or near the northeast corner of the park. By April 22, they had moved about 15 to 20 miles north of the park in the Absaroka-Beartooth Wilderness, and have moved up and down the same drainage ever since, with some individuals, and on one occasion most of the pack, moving all the way back into the park. The alpha female has stayed in the same small area for several weeks now, and there is speculation that she, too, may have a litter of puppies. Biologists hope to investigate that situation soon.

Park biologists are accumulating substantial amounts of information on the wolves and their activities. Besides gathering the telemetry data, NPS biologists have examined numerous kill sites and have recorded many extended first-hand

Memorial Day weekend in Lamar Valley: one of the many "wolf jams" that occurred this spring as visitors watched the wolves in action.

Jim Peaco/NPS

NPS photos



The capture and transport of wolf 9F and her pups from near Red Lodge, Montana, to Rose Creek in the park was a dramatic episode in the wolf project. Upper left: Prior to her transport, NPS Wildlife Veterinarian Mark Johnson collects a blood sample from 9F, while U.S. Fish & Wildlife Service Biologist Joe Fontaine completes a physical examination. Upper right: NPS Wolf Project Biologist Doug Smith (left) and Mark Johnson preparing the puppies for the flight. Lower left: After the flight, the puppies were placed in knapsacks for the short hike to the pen. Lower left: Yellowstone Research Administrator Wayne Brewster and Wolf Project Leader Mike Phillips placing the pups in artificial "den" in the Rose Creek pen.

observations of wolf behavior.

While the wolves appear well adjusted to their new surroundings, the fate of the wolves and the reintroduction project is the subject of debate. Montana Senator Conrad Burns has announced his intention to cut off all funding for wolf recovery, and Montana Congressman Pat Williams has responded by promising to defend that funding on the grounds that allowing the program to continue will in the long run be the most efficient way to ensure control of the wolves. As reported in previous issues of *Yellowstone Science*, three lawsuits are pending on various aspects of the wolf reintroductions in Yellowstone and Idaho, and these cases will be heard later this year. Now that there are actual wolves running loose, being observed, and being photographed, public enthusiasm for the project seems to be higher than ever. With all this attention and controversy, the future promises to be interesting if not entertaining. Stay tuned.

And, by the way, the puppies have blue eyes.

Proceedings of 1992 Bear Conference Available

Bears—Their Biology and Management, A Selection of Papers from the Ninth International Conference on Bear Research and Management, has just been published by the International Association for Bear Research and Management (IBA). The conference, held in Missoula, Montana, February 23-28, 1992, produced the largest number of papers of any in this important conference series, and resulted in this 587-page volume, which contains 68 papers and abstracts related to bears and bear management worldwide.

Several papers deal with greater Yellowstone, including "Grizzly bear use of army cutworm moths in the Yellowstone ecosystem," by Steve French, Marilynn French, and Richard Knight; "The reproductive biology of female grizzly bears in the Northern Continental Divide Ecosystem with supplemental data from the Yellowstone Ecosystem," by Keith Aune, Richard Mace, and Daniel Carney; "Chromatographic (TLC) differentiation of grizzly bear and black bear scats," by Harold Picton and Katherine Kendall; "Evaluation of an aversive conditioning technique used on female grizzly bears in the Yellowstone ecosystem," by Colin Gillin, Forrest Hammond, and Craig Peterson; "Bear management in Yellowstone National Park, 1960-1993," by Kerry Gunther; and "Insights into the economic value of grizzly bears in the Yellowstone recovery zone," by Cindy Swanson, Daniel McCollum, and Mary Maj. Many other papers relate to issues important to bear conservation in Yellowstone and the northern Rockies.

Yellowstone Center for Resources staff played a central role in the production of this volume. Paul Schullery was co–editor, Mark Johnson was an associate editor, Sarah Broadbent was technical editor, and several other staff members provided additional assistance.

The volume is available from the IBA for $45.00, for which price you also receive the separate monograph *Density–dependent population regulation of black, brown, and polar bears*, edited by Mitchell Taylor. The proceedings and monograph may be ordered from Michael R. Pelton, Department of Forestry, Wildlife & Fisheries, University of Tennessee, Knoxville, TN 37901.

Mobility of Conference Participants

As reported in our previous issue, the proceedings of our 1991 plant conference, "Plants and Their Environments," were published earlier this year. Because almost 3.5 years had passed since the conference, we attempted to check all participant addresses before sending each person a copy of the proceedings. In the process, we were able to produce some primitive demographics.

Of approximately 175 people attending this conference, 120 were entitled to a copy of the proceedings as paid registrants; most of the rest were attending at the student rate (which did not include the proceedings) or were park staff or other local support (it seemed best not to include students in this analysis anyway, because they are by definition mobile). Of the 120 participants entitled to a copy, we did not learn the addresses of 23, those being coauthors of presented papers or posters who received their copy from us through their senior author. This left us with 97 identifiable, known-address participants. Of these 97, 28 (29%) had moved since registering for the conference in 1991. Of the 28, 12 had moved to another state, and 2 had moved to another country.

Already being well out on an analytical limb with such a small, accidental sample, we did not hesitate to reach a little further and compare it to national averages. According to a U.S. Bureau of Census report for 1994, 14.1 percent of Americans with graduate or other professional degrees moved during the most recently studied year. If it took 3.5 years for 29 percent of our participants to move (we are assuming they have only moved once), then an average of about 8.3 percent moved per year. Whether this means that Yellowstone-related research is conducive to greater job stability, or that Yellowstone-related researchers are in a rut, or that Yellowstone-related research is meaningless background noise in a depressed job market, or something else, or absolutely nothing, we cannot determine. We sincerely hope that subsequent conference proceedings are published too promptly for us to repeat this exercise.

Those interested in obtaining a copy of the proceedings may do so by sending $20.00 to the Yellowstone Association, P.O. Box 117, Yellowstone National Park, WY 82190.

Keynote Speakers Named for Predator Conference

Most of the keynote speakers for this September's "Greater Yellowstone Predators" conference have been announced. Presenting the Leopold Lecture Tuesday night will be L. David Mech, one of the world's leading authorities on wolf ecology and conservation. Mech, a longtime advisor in Yellowstone wolf restoration efforts, is the author of many papers and articles, as well as several important book-length works, including *The Wolves of Isle Royale*, *The Wolf: Ecology and Behavior of an Endangered Species*, and *The Arctic Wolf: Living with the Pack*. Mech is with the National Biological Service, and is also on the faculty at the University of Minnesota. The Leopold Lecture is named in honor of the late A. Starker Leopold, who for many years was an important force in national park sci-

ence and management.

The address at the Superintendent's International Luncheon will be presented by Stephen Herrero. Herrero is a leading carnivore ecologist from the University of Calgary, and is author of many important papers on bears and other carnivores. His 1985 book, *Bear Attacks—Their Causes and Avoidance*, was most often named in a recent survey of bear specialists as the outstanding contribution to bear literature in the past 25 years. The Superintendent's International Luncheon provides an opportunity for a leading figure to provide a global perspective on a topic of importance in research and resource management.

Two of the conference's three days will feature opening keynotes. One will be delivered by Steve French, cofounder with Marilynn French of the Yellowstone Grizzly Foundation. In the past decade, the foundation's work has been recognized as contributing significantly to our understanding not only of bear behavior in Yellowstone but elsewhere, and more recently the Frenches and their colleagues have undertaken broad-ranging genetic analyses of the bears of the world. Steve will speak about the results of recent mitochondrial DNA research that relates to bear research and conservation worldwide.

The other opening keynoter and the conference summarizer will be announced later.

The conference, "Greater Yellowstone Predators: Ecology and Conservation in a Changing Landscape," will be held September 24-27 at the Mammoth Hot Springs Hotel, Yellowstone National Park. For additional information on registration, contact the Conference Program Committee, Yellowstone Center for Resources, P.O. Box 168, Yellowstone National Park, WY 82190.

Helping the Wolves

The beginning of wolf restoration in Yellowstone continues to draw great attention and interest, and now that many people have actually observed free-ranging wolves in Yellowstone, excitement over the reality of wolves has likewise increased greatly. Public enthusiasm for the wolves has expressed itself in many ways, including a number of unsolicited donations from individuals, and a number of inquiries from people wanting to make such donations. A procedure has been established through which tax-deductible donations may be made; all money will go directly to supporting wolf restoration. Checks should be made payable to the Yellowstone Wolf Recovery Fund, and sent to the Yellowstone Association, P.O. Box 117, Yellowstone Park, WY 82190.

Obsidian Conference Scheduled for September

"Obsidian Studies in the Central and Northern Rockies" is the subject of a symposium being presented at the Second Biennial Rocky Mountain Anthropological Conference in Steamboat Springs, Colorado, September 27-30. For more than a century, a variety of researchers have worked to sort out the complex use patterns and distribution of western obsidian, the most notable source of which has been Obsidian Cliff in Yellowstone National Park. The Steamboat Springs conference will provide an overview of past and present research, consider a number of methodological issues (including the blood residue analysis reported in the Spring 1995 issue of *Yellowstone Science)*, and discuss issues relating to how obsidian studies provide information on obsidian sources. The conference promises to provide a great deal of interesting information and dialogue on current topics relating to this important resource. The proceedings will be published.

Those wishing further information should contact the conference organizer Cal Jennings, Department of Anthropology, Colorado State University, Fort Collins, CO 80523, (303) 491-7360, email caljenn@lamar.colostate.edu.

What Was Studied in Yellowstone Last Year?

Robert Lindstrom, management assistant in the Yellowstone Center for Resources and coordinator of the park's research permit system, reports that 222 research projects were underway in Yellowstone National Park in 1994. Of these, 71 were in the physical sciences, 60 were in wildlife topics, 34 were in microbiology, 32 in forestry/range/plant ecology, 21 in fire, and 20 in archeology and social sciences. This is a decline from the 1991 total of 308 projects

Out of a reported $5,932,033 spent on this research, National Park Service funding totaled $986,255. Other federal agencies provided a total of $3,716,051: state agencies provided $435,059, universities provided $418,208, nonprofit organizations provided $234,265, and all other funding (for example, personal funds provided by researchers for their own work) totaled $133,195.

Volcanic and Tectonic Hazards of Yellowstone

Before it became famous for its wildlife and other ecological features, the Yellowstone region's world fame was based on its geological characteristics, especially the extraordinary collection of geysers, springs, and other hot-water features protected in Yellowstone National Park. Most visitors to the park are unaware that in the big picture, the geysers and springs are just surface expressions

Late News: Soda Butte group of wolves have at least one puppy

As we were packing up this issue of *Yellowstone Science* to take it to the printer, we received word that the Soda Butte group of wolves, who have been spending most of their time in the Absaroka-Beartooth Wilderness Area a few miles north of the park (see page 17), have also produced at least one puppy. Wolf Project Leader Mike Phillips, on a flight over that area on the morning of June 16, spotted an adult wolf with one puppy. At this point, we have no way of knowing if more, or how many more, pups might have been nearby but out of sight, but average litter size in wolves is five to seven, and the observation of the single pup suggests the possibility that there may be others. The latest news confirms that at least two pairs of wolves bred successfully in their acclimation pens last winter.

of far larger processes of greater interest to most geologists. The Yellowstone caldera's magmatic system—the molten rock and crustal structure upon which the park rests—has continued to exercise its authority over the region's topography, and at some time in the future will produce additional massive eruptions on the scale of the many past eruptions that geologists have tracked across the western United States and into the present park. As a part of the ongoing studies of this system, a team of U.S. Geological Survey (USGS) scientists with a long interest in Yellowstone have recently made some guarded predictions about volcanic hazards of life here.

Daniel Dzurisin, Kenneth M. Yamashita, and Jack Kleinman, writing in the *Bulletin of Volcanology* (1994) 56:261–270, reported on uplift caused by magmatic activity below the Sour Creek Dome, just north of Yellowstone Lake. The dome rose an average of about 14 mm per year from 1923 to 1976, and about 22 mm per year from 1976 to 1984. From 1985 until 1993 it subsided at a rate of about 19 mm per year.

The researchers concluded that none of this indicates a "significant short-term increase in volcanic hazard" (that is, an actual eruption, as with lava on the surface of the earth), but that the Yellowstone area does continue to face high probability of other activity: "The greatest short-term hazards are posed by moderate to large . . . regional earthquakes and small hydrothermal explosions. Damaging earthquakes, with the potential to disrupt infrastructure and trigger locally hazardous hydrothermal events within Yellowstone National Park, should be expected to recur every few decades. The human impact of such earthquakes can be mitigated by an effective earthquake response plan."

Though it is not possible to predict the precise location of hydrothermal explosions, the researchers said that "the small areas affected combined with low visitation rates to large parts of the park mean that this is not a serious problem. Much larger hydrothermal explosions, of the scale responsible for the formation of Mary Bay, Indian Pond, and several other similar features in Yellowstone . . . are possible but much less likely."

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