Yellowstone Science

A quarterly publication devoted to the natural and cultural sciences

Paleoindian Use of Obsidian

The Gift of Mushroom Pool

Data Ownership Questions

Why eat burned bark?

The Last Old Wolf

Volume 1 Number 4

Additions

We have always assumed *Yellowstone Science* would be flexible and evolving, rather like the resources it celebrates, and so we're pleased that this issue contains some additions.

First, we debut a new category of feature article—a "forum" department. When we originally invited researchers to contribute to *Yellowstone Science,* we introduced the idea of a forum, and encouraged them to submit essays that reached beyond their specific discipline and addressed the larger issues of science in Yellowstone. At the time we didn't imagine that the first of these would come from the park's staff, but that's how it worked out. Perhaps John Varley's essay on the hidden assets of parks will inspire other contributions.

Second, we have stretched our original plan for our interviews, to include a non-scientist. Because of its great historical interest, Leo Cottenoir's experience with a wolf half a century ago struck us as perfectly appropriate for this department.

Third, we've launched what we hope will be a series of "historical vignettes," exploring the colorful, instructive, and occasionally whimsical past of research in Yellowstone.

Last, and less visibly, we've advanced a step in our environmental responsibilities. From the beginning, *Yellowstone Science* has been printed on recycled paper. Unfortunately "recycled" may sound better than it is' some recycled paper, including the kind we used at first, cannot be recycled a second time. We have now switched to a paper that can be repeatedly recycled.

This issue represents the completion of our first year, making it a good occasion to again thank the Yellowstone Association for support in the production of *Yellowstone Science,* and to thank all the contributors for their valuable information, interpretations, and insights. We look forward to much more of the same.

PS

Yellowstone Science

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Volume 1 Number 4 Summer 1993

Jim Peaco/NPS

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On the cover and above: Mushroom Pool, part of the Great Fountain Group in the Lower Geyser Basin, source of the thermophilic bacterium Thermus aquaticus. *See John Varley's essay, "Saving the Parts," beginning on page 13. NPS photos of Mushroom Pool by Jim Peaco.*

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Recyclable

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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Why Do Elk Eat Burned Bark?

Another surprise from the fires of 1988

by P. J White and Robert A. Garrott

NPS

During the summer of 1988, fires burned extensive areas of lodgepole pine forest in Yellowstone National Park. The impacts of these fires on the park's ungulate populations are of particular interest because they affected elk habitat and food availability. It is not known how these fires will affect elk in the long run.

To study the effects of the 1988 fires on elk, we initiated a study of elk food-selection behavior, using 28 radio-collared cows in the upper Madison River drainage. In this study, we related food selection to physiological condition as well as to reproduction and survival rate.

In early December 1991, we were puzzled by the feeding behavior of several elk in the Firehole Canyon. As we watched, these elk fed exclusively on burned lodgepole pine bark for more than an hour. This feeding behavior was intriguing to us because we expected elk to prefer grasses, forbes, and browse over burned pine bark. Bark stripping of burned trees by elk has not been previously reported in the scientific literature.

Elk in the upper Madison River drainage continued to feed extensively on burned lodgepole pine bark throughout the winter, despite an apparent abundance of alternative forage plants in their winter ranges, including sedges, grasses, aquatic plants, and unburned lodgepole pine. We documented radio-collared elk feeding on burned bark during 65 of 173 foraging bouts in burned lodgepole pine forests. About 24 percent of all foraging time in these burned areas was spent eating burned bark. In addition, researchers working on the northern range of the park also observed elk feeding on burned bark since the 1988 fires.

Why eat burned bark?

Normally, lodgepole pine is considered a poor quality food for elk; they generally limit their pine diet to needles and twig tips. Although elk may strip bark off of live trees such as willows or aspen, or even dead unburned lodgepole pine trees (i.e. trees that died from causes other than fire), the consumption of live lodgepole pine bark has not been observed.

Lodgepole pine is unpalatable to elk compared to deciduous browse or grass, because it contains high quantities of plant chemicals called secondary compounds. Secondary compounds in pines include terpenes, phenols, and resin acids. It is generally assumed that plants produce secondary compounds like these to protect themselves from herbivores, such as elk or deer. Secondary compounds may have an offensive odor or taste, or may adversely affect the digestion and physiology of animals that eat them.

Because elk were indeed eating burned lodgepole pine bark, we hypothesized that the 1988 fires had somehow changed the chemistry of the bark, making it more appealing to elk or improving the nutritional value of the bark by removing many of the secondary compounds that normally protect the trees. Temperatures greater than 122-140°F. (50 to 60°C.) that are needed to kill these trees, might have vaporized or just chemically changed the compounds.

Another possibility is that the fires, which occurred in the summer when the sap-producing processes of the trees are most active, may have trapped more sugars in the bark than would normally be present in the winter; this increase in sugar might have been sufficiently attractive to result in more elk feeding on the bark.

To determine if changes did occur from the fires, we collected bark from burned, live, and dead-unburned lodgepole pine trees. Ten to twelve samples were collected for each of these three groups. To minimize potential chemical variation from other factors, we collected samples from trees within the same vicinity, using trees that were approximately the same diameter and collecting all samples from the same height above the ground. Samples were then shipped to the University of Wisconsin, where Dr. Walter Jakubas extracted secondary compounds. Samples were also analyzed to determine fiber and sugar content, and *in vitro* trials were conducted to assess the digestibility of the bark. *In vitro* studies estimate the extent of digestion and give us an index of the energy value of foods.

Mark Johnson

What did the fires change?

Chemical analysis and digestibility trials indicated that the 1988 fires did alter the composition of lodgepole pine bark and improved the quality of the bark as forage for elk. Burned bark contained 50 to 90 percent fewer secondary compounds than bark from live trees. Also, burned bark was more than two times as digestible as live bark in the *in vitro* trials.

Nutrient tests indicated that crude protein levels were almost twice as high in burned bark. This may be due to a lower ratio of organic matter to nitrogen because the organic matter was burned up. The fires appeared to concentrate minerals such as calcium and phosphorus in the bark, but the sugar content did not appear to have changed with burning.

Surprisingly, burned bark did not differ significantly from dead-unburned bark in its nutritional value. Secondary compounds were similar, possibly because chemical changes of the sort that occur in a fire can also take place as the result of weather. Dead unburned trees in Yellowstone rapidly weather, losing their bark and drying out for several years after the death of the trees.

Mark Johnson

We might have expected trees that died from causes other than fire and were subsequently subjected to long periods of weathering to have protein and carbohydrate levels different from burned trees, because insects and fungi can alter protein and carbohydrate levels in bark. We did not find such differences. The similar levels noted between burned and dead-unburned bark may be because our burned samples were also weathered. Burned samples were collected three and one half years after the fires of 1988, giving insects and microbial decomposers more than enough time to act on the burned bark.

Nutritional Value of Burned Bark

The nutritional quality of a food source is determined by a combination of digestibility, nutrient availability, secondary compounds, and the nutritional needs of the animal. The nutritional quality of burned bark is similar in several respects to other winter forage that elk use extensively. Crude protein of burned bark is similar to that found in winter grasses, but lower than that found in winter browse such as willow, serviceberry, or buckbrush.

The digestibility of burned bark appeared similar to that of winter browse, but our *in vitro* trials may have underestimated digestibility, because *in vitro* trials only simulate digestion that occurs in the rumen and do not consider digestion that occurs in the hindgut. Therefore, nutrient availability and digestibility estimates must be considered minimum estimates and the actual nutritional quality of burned bark may be greater than our results suggest. Indeed, radio-collared elk that fed extensively on burned bark remained in good physiological condition throughout the winter of 1991-1992. This was demonstrated by physiological tests conducted on urine samples from the radio-collared elk.

Foraging Efficiency

Consumption of burned bark by elk in Yellowstone National Park may be related more to the ease with which they can obtain the bark than to its nutritional quality. Large ungulates often appear to select foods based upon availability rather than upon nutritional quality. This may be especially true during the winter, when elk do not have enough surplus energy to search for the most nutritious foods. Because burned lodgepole pine in Yellowstone occurs in dense stands, elk may be able to consume large quantities of bark with little effort. We speculate that the low energetic costs of consuming burned bark may be one of the primary reasons that elk used this food source so much during the winter of 1991-1992.

Overall, the 1988 fires in Yellowstone National Park appear to have created an additional food source for elk by

P.J. White

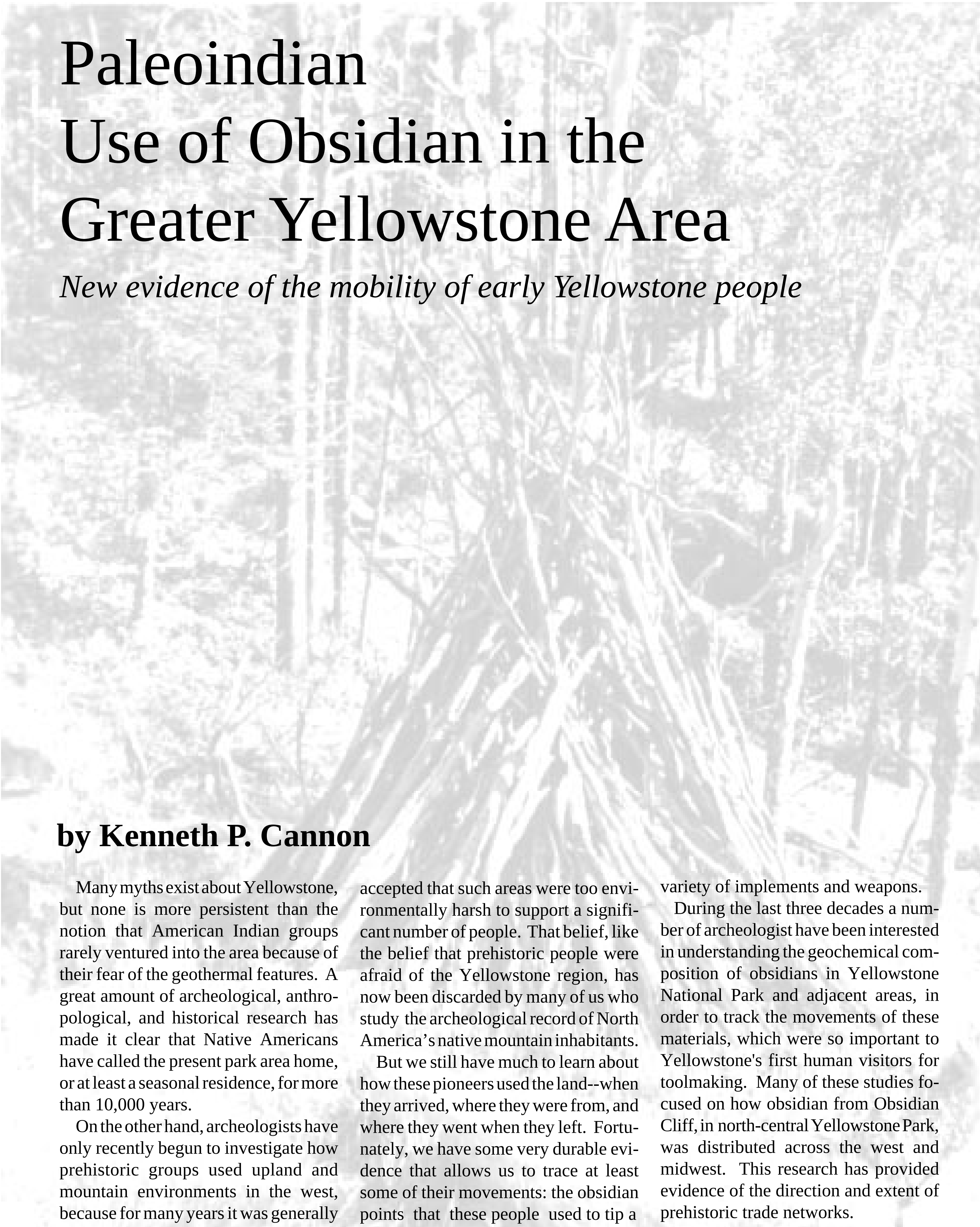
NPS

The photographs of elk eating bark were all taken during the authors' study in the Firehole-Madison drainage. Photographs of trees scarred by feeding elk were taken in the summer of 1993 on Blacktail Plateau in northern Yellowstone National Park; these show the very distinctive markings left by the elks' teeth.

charring the bark of lodgepole pine. We hypothesize that by reducing the levels of secondary compounds in the bark, the fires essentially removed a major barrier that previously prevented elk from eating lodgepole pine bark.

During the next two winters, we will continue to investigate the ecological significance of this novel forage. Specifically, we intend to 1) estimate the total biomass of burned bark on elk winter range, 2) quantify the use of bark by elk, 3) compare the quality of burned bark to alternative forages available to elk in the winter, and 4) compare the physiological condition of wintering elk that feed extensively on burned bark with the condition of elk that do not use bark to any great extent.

P.J. White is a doctoral student in the Department of Wildlife Ecology, University of Wisconsin, Madison. Dr. Robert Garrott is a professor in the same department. The scientific paper (coauthors Wally Jakubas, Robert Garrott, P.J. White, and David Mertens) containing the complete results of this study has been accepted for publication by the Journal of Wildlife Management.



Paleoindian Use of Obsidian in the Greater Yellowstone Area

New evidence of the mobility of early Yellowstone people

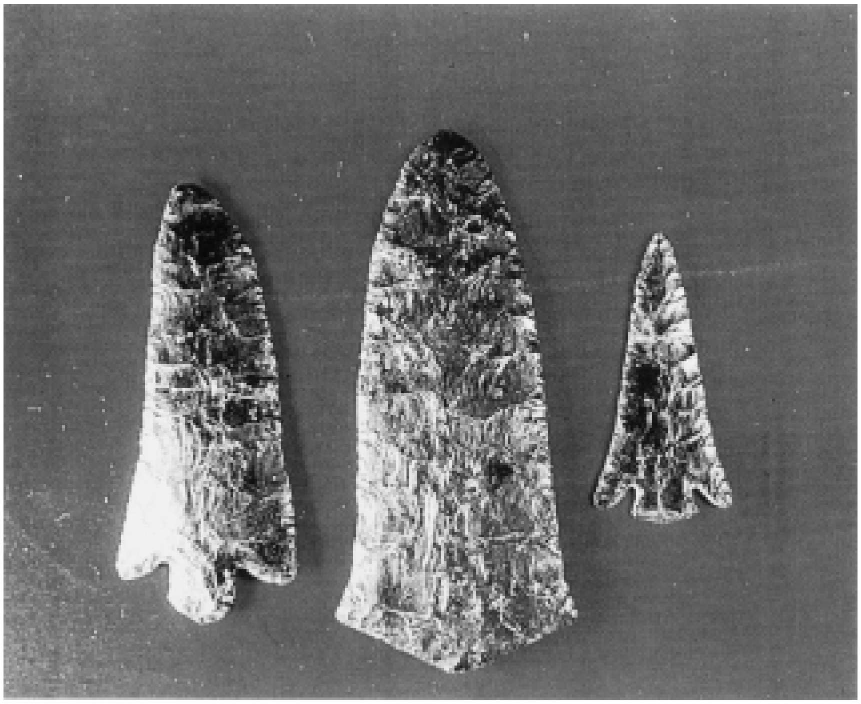
by Kenneth P. Cannon

Many myths exist about Yellowstone, but none is more persistent than the notion that American Indian groups rarely ventured into the area because of their fear of the geothermal features. A great amount of archeological, anthropological, and historical research has made it clear that Native Americans have called the present park area home, or at least a seasonal residence, for more than 10,000 years.

On the other hand, archeologists have only recently begun to investigate how prehistoric groups used upland and mountain environments in the west, because for many years it was generally accepted that such areas were too environmentally harsh to support a significant number of people. That belief, like the belief that prehistoric people were afraid of the Yellowstone region, has now been discarded by many of us who study the archeological record of North America's native mountain inhabitants.

But we still have much to learn about how these pioneers used the land--when they arrived, where they were from, and where they went when they left. Fortunately, we have some very durable evidence that allows us to trace at least some of their movements: the obsidian points that these people used to tip a variety of implements and weapons.

During the last three decades a number of archeologist have been interested in understanding the geochemical composition of obsidians in Yellowstone National Park and adjacent areas, in order to track the movements of these materials, which were so important to Yellowstone's first human visitors for toolmaking. Many of these studies focused on how obsidian from Obsidian Cliff, in north-central Yellowstone Park, was distributed across the west and midwest. This research has provided evidence of the direction and extent of prehistoric trade networks.



The points discussed in this article mark the beginning of a long tradition of expanding use of Yellowstone-area obsidian. The raw material used to produce these obsidian spear blades (left) was much more recently imported from Yellowstone to present Ohio, where such elegant ceremonial pieces were used in religious ceremonies by Hopewellian peoples. The largest blade is about 10 inches long. Yellowstone obsidian was apparently widely traded between the park area and Ohio in the centuries just prior to EuroAmerican settlement. Photo courtesy of NPS/ Hopewell Culture National Historical Park.

One of the first studies was conducted by archeologists from the University of Michigan, who were interested in locating the source of obsidians found with high-status individuals buried in earthen mounds in the Ohio River drainage. These studies, and subsequent ones, have shown that Obsidian Cliff is the main source for such obsidian in the midwest, specifically the upper Mississippi and Ohio River valleys.

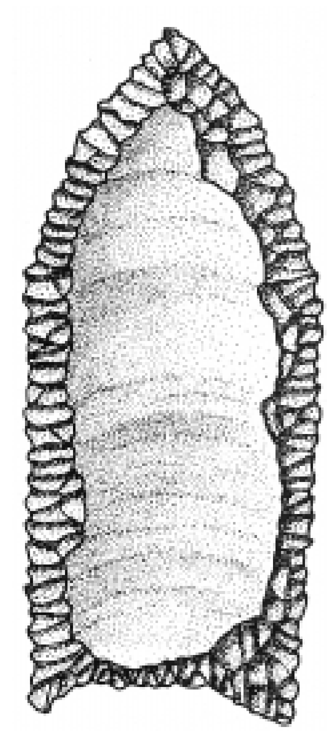
During the late 1970s and early 1980s, archeologists from the State University of New York, Albany, continued geochemical studies of obsidians to locate the sources of obsidian artifacts found in the park. These studies suggested that material from Obsidian Cliff was almost exclusively utilized by prehistoric peoples in the park. However, at least one obsidian sample was from an unknown source, and it was insubstantially attributed to a volcanic flow in Yellowstone Park.

Since 1989, the National Park Service's Midwest Archeological Center, in Lincoln, Nebraska, has been involved in survey and testing of sites in Yellowstone, mainly as part of archeological investigations relating to park lands that will be affected by future road reconstruction. An integral part of this research has been the identification of obsidian sources used by early inhabitants of the area.

We determine the age of these artifacts through a process known as obsidian hydration, which is based on the rate at which obsidian absorbs water at its surface. By measuring the thickness of the "hydration layer," that is the layer that has absorbed water since the artifact was chipped from a larger piece of obsidian, we can determine the date of manufacture. So far, we have analyzed approximately 500 artifacts, but this paper will focus on the earliest of those, from the Paleoindian Period, 12,000 to 8,000 years ago.

As of this writing, the only clues to Paleoindian occupation of the Yellowstone Plateau come from artifacts recovered from the surface rather than from excavations. The earliest human occupation of the area is suggested by a Folsom projectile point discovered in the Bridger-Teton National Forest, during research by Forest Service archeologist Jamie Schoen. The obsidian point, dating between 10,900 and 10,200 years ago, was sourced to Obsidian Cliff.

Large, fluted (that is, with a concave



Folsom point, representing the earliest evidence of human occupation of the greater Yellowstone area. All points are illustrated approximately actual size, and were drawn by Janet Robertson.

depression running the length of the point) Folsom spear points have been excavated in the basins east and south of Yellowstone National Park, associated with the bones of an extinct bison species, as well as with pronghorn and elk bones. Thanks to this and other discoveries, we know that humans were using the Yellowstone area since shortly after the ice departed, but we still wished to know more about their movements and patterns of use.

As part of our current study, eight Late Paleoindian obsidian points (all surface finds) were analyzed by Dr. Richard Hughes of Geochemical Laboratory. Dr. Hughes used x-ray fluorescence spectrometry to determine the geologic sources of the obsidian. X-ray flourescence is a nondestructive technique by which the obsidian is bombarded with x-rays, allowing rare radioactive elements to be counted in parts per million. Most obsidian contains the same elements; what x-ray fluorescence tells us is the relative proportions of those elements in each sample.

Each obsidian source has its own unique "geochemistry," depending upon the underlying geology of the region that produced it. Thus, once the major known sources have been subjected to x-ray flourescence spectrometry, an artifact can be analyzed and compared to the sources until a match is found.

In our study, substantial evidence of human occupation comes from Agate Basin and Hell Gap point types, which Dr. Hughes dated to approximately 10,000 years ago. The earliest point type represented in our analysis is the Agate Basin point, which came from Obsidian Cliff.

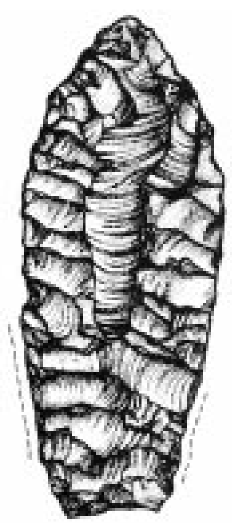
The Hell Gap type of point is represented by one complete point, whose source was Bear Gulch, Idaho. Three Hell Gap type bases (that is, the base of the point only) have also been found; Bear Gulch and American Falls, Idaho, were identified as sources for two of the bases, while the source of the third base has not been identified.

Incidentally, independent corroboration for this dating is provided by two Hell Gap artifacts from the Indian Creek site in west-central Montana. Obsidian hydration dates of 9,850 (plus or minus 278) and 9,650 (plus or minus 248) years ago were calculated for these artifacts by Dr. Les Davis of Montana State University.

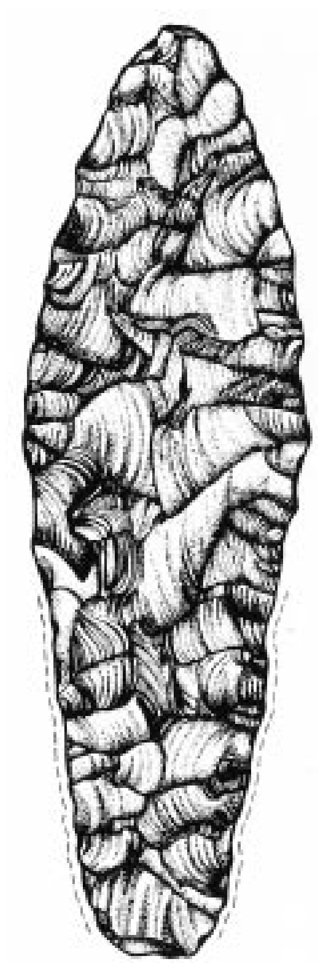
An additional Paleoindian spear point type, known as the Alberta type, was dated at 9,500 years ago. This point, which consisted of the base only, was also sourced to Bear Gulch, Idaho.

Two reworked (that is, broken and worked to a new point) lanceolate points (spear points) attributed to the Foothills-Mountain Complex also were analyzed. The Foothills-Mountain Complex is an archeological tradition found only in the foothills and mountains of the Central Rocky Mountains. Their economy was focused mainly on bighorn sheep and mule deer, supplemented by plants and small game.

These Foothills-Mountain Complex points date to between 8,500 and 9,000



Agate Basin point, sourced to Obsidian Cliff, Yellowstone National Park, and dated to about 10,000 years ago. Dotted lines indicate areas where grinding occurred during reworking.

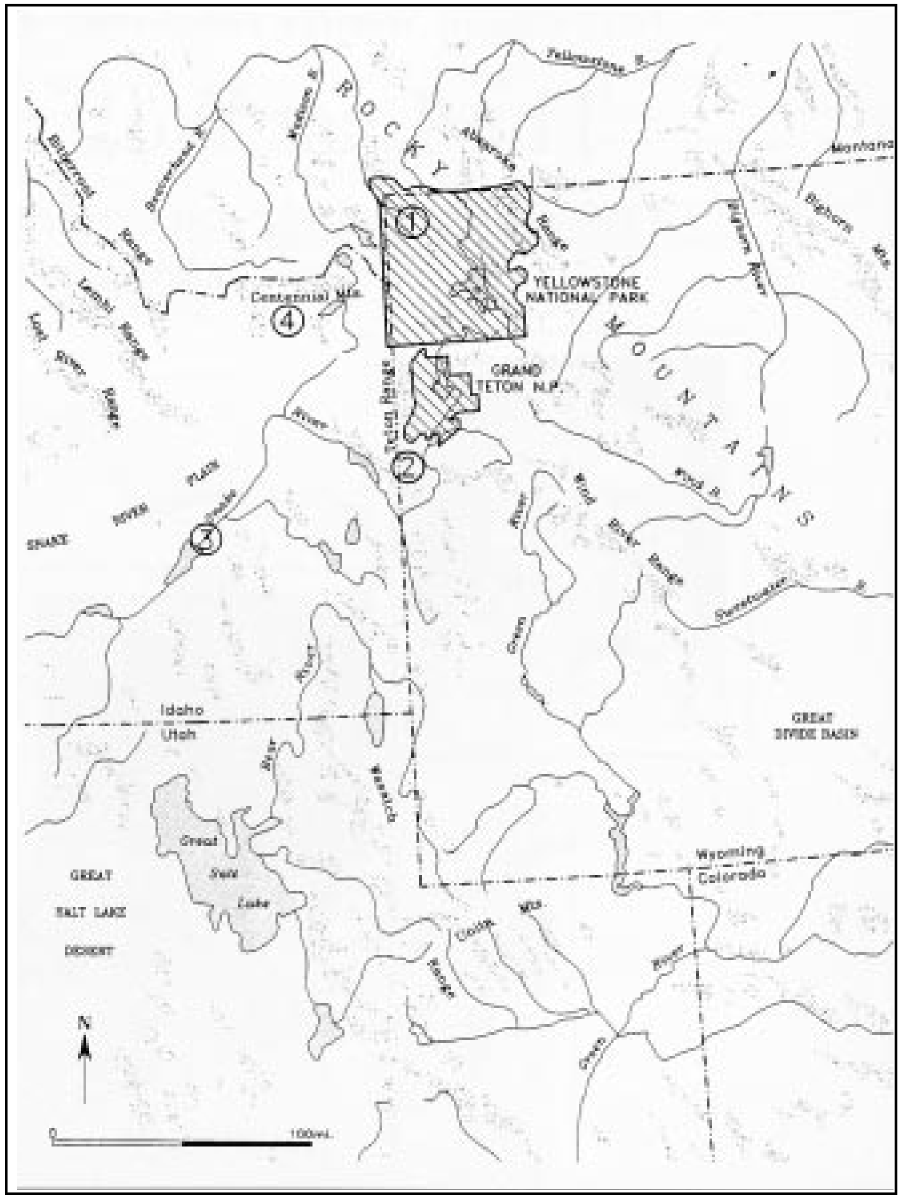


Hell Gap point, sourced to Bear Gulch Idaho, and dated to approximately 10,000 years ago.

Heavily reworked Late Paleoindian lanceolate point, sourced to Teton Pass, Wyoming, and dated to between 8,500 and 9,000 years ago.

Recent archeological research indicates that even the earliest human occupants of the Yellowstone area were quite mobile, and were taking advantage of obsidian from several areas, including the park's now-famous site. Sources of obsidian used by Paleoindian peoples in the Yellowstone area: 1. Obsidian Cliff; 2. Teton Pass, Wyoming; 3. American Falls, Idaho; 4. Bear Gulch Idaho.

Carol Moxham



years ago. The first is a heavily reworked and beveled point with evidence of grinding along the base. A significant number of small "step fractures" present on the edges of the tip suggest utilization as a drill. This point was sourced to Teton Pass, Wyoming.

Reworked late Paleoindian lanceolate point, sourced to Bear Gulch, Idaho, and dated to approximately 8,500 to 9,000 years ago.

The second lanceolate point has also been reworked along the blade. The flaking pattern is parallel-oblique with grinding along the base. The concave base appears to be fortuitous (that is, happenstance rather than intentional design), and post-dates the final flaking episode, as indicated by the differences in the amount of weathering. This point was sourced to Bear Gulch, Idaho.

Obviously these early people were not dependent upon Obsidian Cliff for their obsidian. Other sources represented in the assemblage are located some distance from Yellowstone National Park (see map). Bear Gulch, Fremont County, Idaho, is 59 miles (90 km) to the west; American Falls, Power County, Idaho, is 174 miles (280 km) to the southwest; and Teton Pass, Teton County, Wyoming, is 76 miles (125 km) to the south.

Like a number of previous investigators, we find ample evidence that humans moved considerable distances in and around the Yellowstone area. As in later prehistoric periods, it is clear that Paleoindian people were highly mobile, and transported the products of their culture considerable distances as they went about their business.

Continuing analysis of obsidian from Yellowstone will contribute substantially to understanding Paleoindian group mobility patterns. An important result of our recent studies, one that has been relatively unappreciated until now, is evidence that prehistoric groups had contact, either through direct access or by trade, with areas to the west. The study of obsidian, in concert with other studies, will provide us with a better understanding of how prehistoric groups moved and settled on a yearly and seasonal basis in order to maintain economic autonomy.

Kenneth Cannon, an archeologist with the National Park Service's Midwest Archeological Center in Lincoln, Nebraska, has been conducting archeological investigations in Yellowstone National Park since 1989.

Yellowstone Science Interview: Leo Cottenoir

The Last Wolf, 1943

A remembrance of the last verified wolf killed in Greater Yellowstone

Dick Baldes

In our Winter 1993 issue, we reported on a possible wolf killed by a hunter in Wyoming just south of Yellowstone National Park in the fall of 1992. DNA testing has since revealed that animal to have been a wolf, closely related to the Nine Mile pack in northwestern Montana. Thanks to friends in the U.S. Fish and Wildlife Service, we can provide you with a firsthand account of the last previous verified wolf killed in greater Yellowstone.

Leo Cottenoir, now 83, was working as a sheepherder on the Wind River Reservation in 1943. Mr. Cottenoir's tribal affiliation is with the Cowlitz tribe in southwestern Washington, but married a member of the Shoshone tribe as a young man and thus lives on the Wind River Reservation.

This interview was conducted on September 28, 1992, by Dick Baldes, Wind River Reservation Project Leader, and David Skates, Assistant Project Leader, U.S. Fish and Wildlife Service. Our thanks to Leo, Dick, and David for their cooperation in completing this fascinating oral history project.

DB: How did you happen to kill this wolf?

LC: If any lambs were out late in the evening, we left them out with a lantern or flagging so that coyotes wouldn't bother them. We were cutting out lambs this morning, and we heard this coyote yipping, and the herder said, "You'd better get on your horse and ride up there and see if they're bothering those ewes and lambs." So I rode my horse about half a mile up Muddy Creek.

They were all right, but then I heard some coyotes yipping further up country, so I got on my horse and rode up on a ridge, and looked down on an old reservoir the Soil Conservation Service had put in years before, and it looked like an old coyote and two pups down there. I thought they might have got a lamb down, and were feeding on it, so I rode back down the hill and into the draw. As I got close to the reservoir, the coyotes took off through the rocks, and I took a shot at them (I had my rifle) and missed them, and this wolf came out of the rocks. It was a wolf and two full-grown coyotes, instead of a full-grown coyote and two pups.

DS**:** Did you know that it was a wolf at the time?

LC**:** Well, he started down and I knew it had to be a wolf because it was so much bigger than the rocks. It was going through my mind about the wolf stories I'd heard, and I shot at him. He was coming toward me. I shot and missed him twice on the hillside, and I shot [again]. I knew I'd hit him, because you know when you've hit an animal with a rifle [because of the sound of the impact]. He went around a little knoll where I couldn't see him, so I reloaded the rifle, and [saw that] he was lying there on the hillside. I watched him a while, and he didn't move, so I went up there and he was dead.

I'd shot him through the lungs—I'd torn his heart and lungs up. He got away probably 50 or 60 yards after he was hit. So I went to put him on my horse, but the horse wasn't going to stand still, because he smelled that wolf and that was something strange. I got the saddle blanket back on, and took him back to

camp. The old sheep herder seen him, and he said, "My gosh, where did you get the lobo?" Of course, he'd seen wolves when he was younger. He was a man, oh, about in his sixties—in his late sixties.

DS**:** This wolf was killed in May?

LC**:** In the twenties. The 23rd or 24th of May. There was an article in the [Wyoming State] Journal about it in the fifties, it was 1953, I guess, because it had been 10 years before that I brought this wolf in.

***DS*:** So it was May of 1943. Did you realize at the time that this was probably the last wolf killed in Wyoming?

***LC*:** I never had any idea. I thought if there was this one, there would be more of them.

I don't have any idea where he could have come from. I know he did come from Owl Creek, over the mountains. My father-in-law had seen his tracks when he came over.

***DS*:** At the time, did you think it was a wolf with those two coyotes, or did you think it was a coyote?

***LC*:** No, [at first] I thought it was a full grown coyote and two pups. Probably a half mile from where I'd seen them, they circled down in the draw there. But, boy, he sure looked big when he did come out of there. It went through my mind, I'd read stories about wolves attacking people, or something like that. I completely missed him twice [laughter]. When he turned sideways, I got him.

***DS*:** When was the last one killed prior to that time?

***LC*:** Nobody seemed to know. It had to be, like I said, the last one [killed] by Croskey [a rancher in the Owl Creek Mountains] was 1914 or along in there.

***DS*:** So this was the first wolf killed since 20 or 30 years prior? There hadn't been anything killed that had been documented?

***LC*:** Well, the fact was, the bounty had been taken off them 20 or 25 years before, because there weren't any more killed. That's why there weren't any killed, except for coyotes. I ran into a den of coyotes, a den of six pups, and brought them into the sheriff's office there—they had a bounty on them—and he gave me five dollars apiece for those pups.

***DS*:** How big would you say this animal, this wolf was?

***LC*:** Seventy, eighty pounds—seemed like it, anyhow. Because the horse didn't want to stand still. He was big, two, three times as big as a coyote. You can see he's much bigger, two or three times bigger than a coyote, much bigger, and they have such long legs, and big feet, too.

***DS*:** And the reason you didn't get a full mount is that the hair was slipping pretty badly?

***LC*:** Yes, Engle [a local taxidermist] said he'd like to have mounted the whole thing. I'm surprised, as well as the head's hair is staying on, that he couldn't have mounted the whole thing at the time. The way this has stayed, looked like the whole thing would have stayed right, too.

***DS*:** Looks good.

***LC*:** I believe his [the man who killed the previous wolf] name was Croskey, he used to have a store over there by where Paul Hines store is now, probably about 1912, 1914 or around there. The wolves were bothering the cattle so the stockman put a bounty on an odd-colored one and then they would kill any color of wolf they seen just so they could collect the bounty, and of course it had to be this certain off-color one that the bounty was on, but that's how they got rid of the wolves.

***DS*:** Yeah, they got a whole bunch of wolves for the price of a few.

***LC*:** Yeah, but I guess they did business; the stockmen were leary. Up around Yellowstone they are worried about [wolves] killing calves, but no more than they would kill, I don't think a single wolf [would kill many]; it would have to be a pack like those dog-like animals in Africa, hyenas. They hunt in packs.

***DS*:** Did you hear the fellows prior to your generation talk about wolves being hard on cattle or was it primarily sheep?

***LC*:** Well, I think it was probably cattle, especially calves. Just like most predatory animals will either get the weak or the young because they're easy to get.

I still think they ought to have wolves in there. They are a native animal, native to the country and something that has always been there. Fact of the matter, man is the greatest predator there is anyhow, regardless of the predatory animals. Cause he will kill, he's always after something to kill. If it was deer or antelope or rabbits or prairie dogs, he's always shooting at something. If they had their way everything would be extinct, there wouldn't be anymore animals.

***DB*:** Leo, when you first walked up on the wolf and you probably knew that it was something really rare, did that bother you a bit, knowing that, thinking back, that it probably was the last one?

***LC*:** Well, no. But it was kind of sad to think that he was the only one that I'd ever seen and I killed him. Of course, at the time I was thinking there was nothing else I could do. But at the time he was endangering my sheep herd. If I hadn't killed him, he would have been just like the coyotes.

Coyotes were a problem, still are a problem. I've killed several of those. You'd use to get up early in the morning. Coyotes would come in about daylight and they would never kill a small or weak one; no, the fattest one was the one they'd get. And the first thing they did was cut it up and eat the stomach out of a lamb and get the milk out of it.

***DS*:** I've heard of that.

***LC*:** And sometimes they would get to chasing an old ewe, and they wouldn't kill it right away, but chew the bag just to get the milk. They are a cruel animal. They say they never get a weak or poor one but always a choice lamb every time. In some ways it's sad to have killed the only one [wolf] that was around, but in other ways I'm glad it was me that got to get him because somebody would have got him, I'm sure.

***DS*:** Do you think there were any other wolves in the area?

***LC*:** That I don't know. I was wondering. He was a mature male and you'd think there would be other wolves, females or pups or something else because he had to come from a long ways to get there and I never have heard of anyone over on the Owl Creek side that saw a wolf either.

***DS*:** During the time after or before you killed this wolf, did you ever hear any howling at night?

***LC*:** I never did, no. But they say this Ralph White, the rancher over on Five Mile Creek, or what we used to call Tea Pot, but it's the Five Mile conservation district, he said he thought he heard them howling at night over there, but nobody ever saw one.

***DS*:** Was this after?

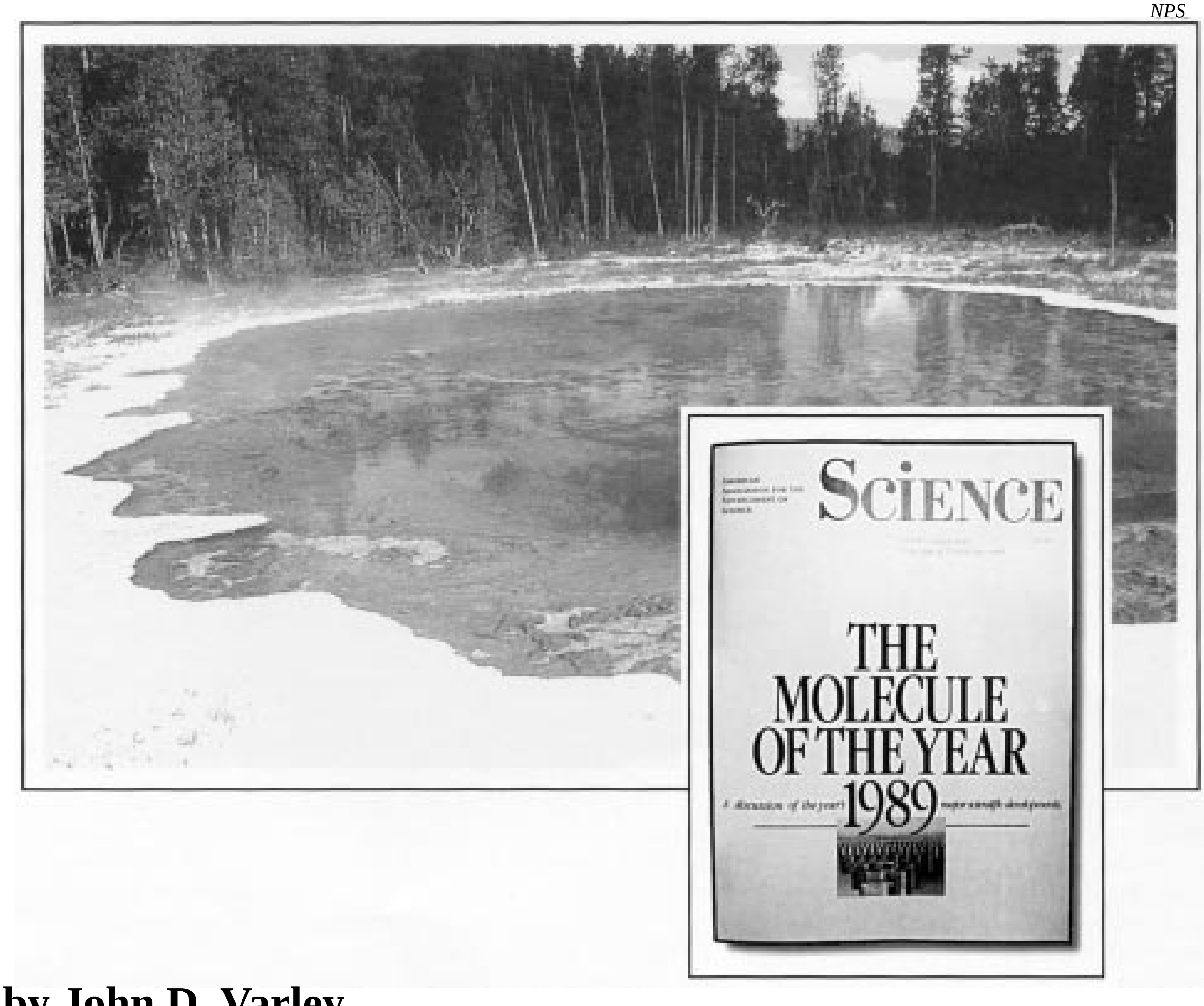
***LC*:** This was after I killed it.

Yellowstone Science Forum

Saving the Parts

Why Yellowstone and the research it fosters matter so much

NPS



by John D. Varley

Some historic events are celebrated with near-heroic fanfare, but some seem to come and go with little or no folderol. In the case at hand, the event came and went, at least in Yellowstone, without black ties, champagne, or (most amazing of all) even anyone claiming to be the father of the idea. On both coasts, there were celebrations and honors of various kinds, perhaps the biggest being a cover story by the prestigious journal *Science* (December 22, 1989), unabashedly proclaiming the honoree "The Molecule of the Year."

The event was the use of the DNA polymerase molecule—named Taq polymerase—and its incorporation into an *in vitro* DNA amplification procedure called by Kary Mullis, its discoverer, polymerase chain reaction (PCR). Dubbed by one knowledgeable biochemical research director as the "Swiss Army Knife of Molecular Biology," the combination of the molecule and the technique it spawned has become recognized as one of the most revolutionary biological events of this century, and among the most significant since the discovery of DNA.

The newly discovered molecule and the technique were certainly worthy of celebration. Taq polymerase and the basic PCR procedure allowed scientists to take a gene, or even more remarkably, a segment of DNA within a gene, and within a matter of hours replicate exact copies of that segment a millionfold. In short, they could turn a needle in a haystack into a stack of needles: a sort of biotech photocopying machine.

The revolutionary dimension of this story is in the wide-ranging application of the PCR procedure, which is perhaps best known to most people by its common name of "DNA fingerprinting." In human medicine it has improved the diagnosis of myriad genetic diseases (including sickle cell anemia and Alzheimer's), and has been invaluable in detecting infectious agents and hard-to-culture pathogens in people, other animals, food, and water.

The PCR procedure has, in one important example, facilitated the best and most accurate test for the HIV virus in humans. Human organ transplant matches between donors and recipients have become greatly improved in the quality of the match and the time it takes to do the procedure. In their laboratories, scientists are even pursuing the historical curiosities of diseases that may have afflicted long-buried people such as Abraham Lincoln.

To most people, perhaps the criminological applications of DNA fingerprinting are best known. In criminal cases, the DNA of a single cell (!) from blood, hair, semen, or virtually any other tissue can be amplified using PCR, and then transformed into "bullet-proof" courtroom convictions or acquittals.

Of course, the process has also created almost endless historical complications. As the newspapers inform us almost routinely now, aged pieces of evidence are coming out of storage, in some happy instances even causing the release of innocent people from prison. Courtroom paternity cases, for decades decided on the "believability" of fathers, mothers, and children involved, have become simplified because parentage can be determined with virtually 100 percent accuracy.

In even more diverse applications in basic science, PCR techniques are rewriting the book on plant and animal evolutionary relationships and potentials, ranging from the most fundamental agricultural products to the search for the genetic identity of biblical "Eve." As scientists examine our prehistory by looking at the DNA of 30-million-year-old insects preserved in amber, 12,000-year-old wooly mammoths frozen in Siberia, and 4,000-year-old Egyptian pharaohs, *Jurassic Park*-like scenarios take on more and more plausibility, at least in our wildest fantasies.

Where does Yellowstone fit in this story? An excellent case could be made for a Yellowstone celebration of this historic discovery if only for the insights PCR procedures are giving park scientists. The "DNA fingerprint" of the mysterious wolf-like canid shot in the fall of 1992 near Yellowstone's south boundary was amplified and determined to be not just a pure wolf, but a wolf descended from western Montana's famous Nine-Mile Pack. The last wolves killed within Yellowstone in the 1920s, whose remains were stored in the Smithsonian collection for nearly 75 years, are now being analyzed so we can truly know genetically what a Yellowstone wolf once was, and know what a potential restoration population should be. The technique is also being explored as a possible means of identifying individual grizzly bears from their scats (dung). This could, in turn, lead to the long-sought-after method of obtaining a precise estimate of the population of grizzly bears in the greater Yellowstone ecosystem.

Perhaps no genetic arena is more confused than that of Yellowstone sportfish species. For more than seven decades, trout stocking practices intermixed and hybridized the park's native cutthroat trout so that managers were hard pressed to decide what Yellowstone's original native trout really were, what populations warranted special preservation, and which were destined to be second-class citizens. The DNA analysis has simplified these management dilemmas considerably, giving us some remarkable insights in the process. For example, one native cutthroat population from a tiny backcountry stream has been identified to be genetically monotypic, perhaps to have originated and descended from a single pair of trout several thousand years ago.

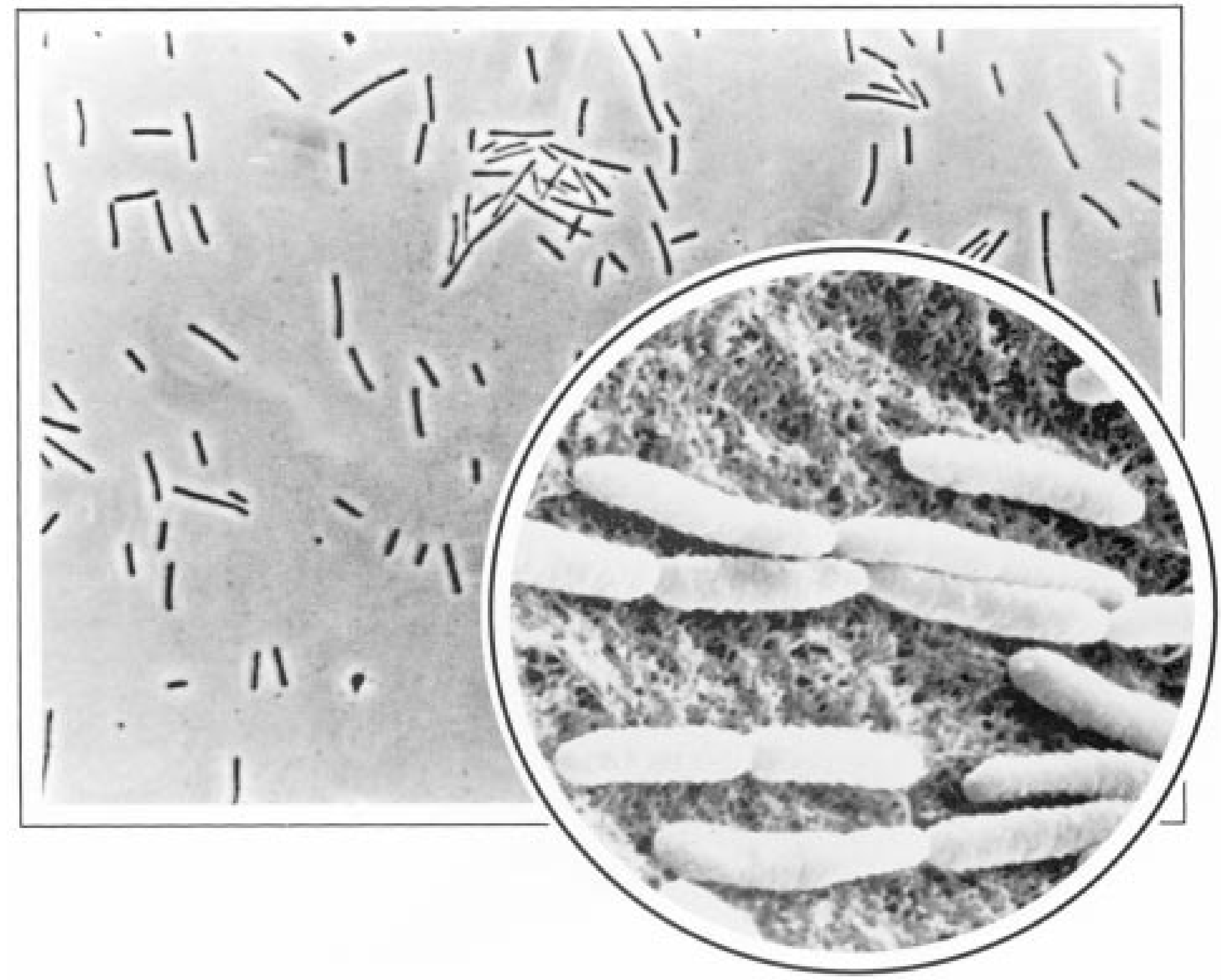
There are many such examples of how Yellowstone fits in the DNA fingerprinting story; we could celebrate the molecule of the year and the PCR process solely for the scientific enlightenment it has given us, plus the subsequent legal and policy ramifications it has wrought. But there is an even more important, more instructive story to be told; one that has its source in the worldwide national park, biodiversity, and preservationist movements.

This tale begins with a very familiar name in the history of Yellowstone Park science: Dr. Thomas Brock (Indiana University and the University of Wisconsin). To Dr. Brock and his colleagues back in the 1960s, the isolation and naming of a strange new thermophilic bacterium from Mushroom Pool, part of the Great Fountain Group in the Lower Geyser Basin, didn't portend the stupendous event it would later turn out to be. In fact, the popularity of the organism that Brock and Hudson Freeze named *Thermus aquaticus* was limited to a few specialized scientists interested only in how organisms adapt to life in hostile temperatures, that is until the PCR procedure was discovered.

To make a long, complicated, and fascinating story short, the Taq (short for *Thermus aquaticus*) polymerase discovered and extracted from the bacterium was an enzyme that performed its tasks very well at the high temperatures required in the biochemistry laboratory. The bacterium takes on a chill at temperatures below 160° F. This unique feature, called heat- or thermo-stability, when combined with the polymerase chain reaction concept, quite literally allowed the DNA fingerprinting procedure, and a host of other PCR applications, to become reality.

Let's dwell on this event for a moment. Here in the world's most popular geothermal region, an obscure, primitive, hot spring bacterium is discovered that contains an even more obscure

Bob Ramely



Photomicrographs of Thermus aquaticus *YT-1 as shown by phase contrast (background) and scanning electron (inset) microscopy. This thermophilic bacterium favors geothermal waters with temperatures above 160°F. (Scanning electron micrograph taken by Dr. Richard Wilson, University of Nebraska Medical Center, Omaha, Nebraska.)*

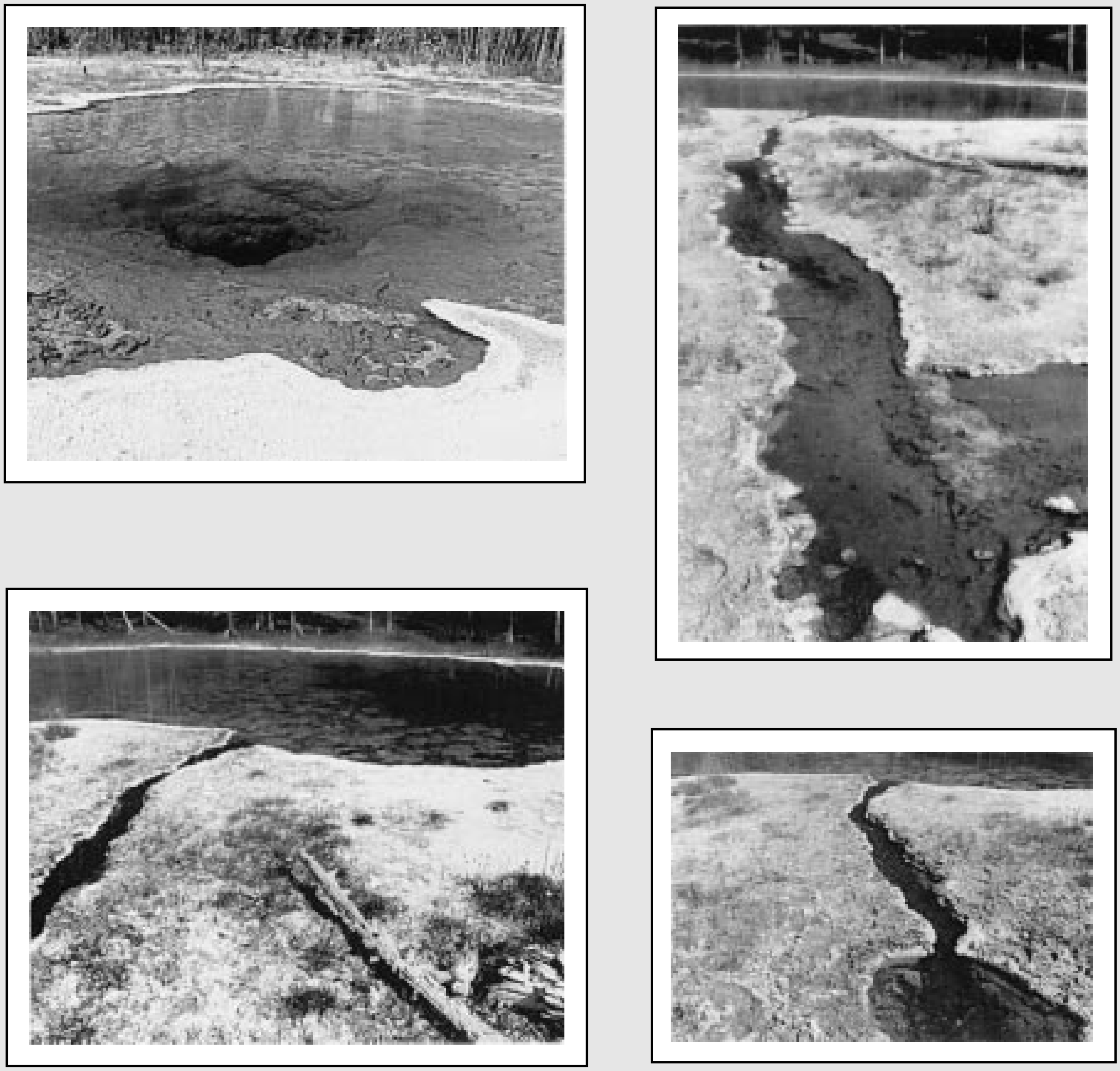
enzyme that in turn establishes a procedure that promises to change the world for the better. Steven Spielberg aside, it would be hard to concoct a story this unlikely.

But isn't the story only more proof of what so desperately drives today's worldwide preservationist movement? Aldo Leopold is said to have summed it up like this: "The first step in intelligent tinkering is to save all the parts." In the rancorous discussions now underway concerning preservation of tropical rain forests, ancient forests in the northwest United States, and countless other special and threatened places, one of the arguments favored by many is the so-called utilitarian case: saving our unique ecological heritage for the direct benefits it can provide humankind. Traditionally, campaigns to protect wildness, or naturalness, emphasized intangibles, like esthetic enrichment, or spiritual fulfillment, or something called recreation. But we sell our ecological and geological reserves short if we don't also point out what they may give us in the way of unexpected miracles.

The fact is that *Thermus aquaticus* was available for discovery there in Mushroom Pool because the feature and its basin were not available for more destructive, short-term uses. Taq would have had a vastly diminished chance of discovery, indeed of survival, in New Zealand, Iceland, Chile, Nevada, California, or almost any of the world's other once-major geothermal areas, because they were not protected, and are now sadly unproductive. Our celebration of Taq is thus tinged with a vague sense of waste: what else, around the world, have we lost already, and how much more can we afford to lose?

Dr. David Ward (Montana State University) and Dr. Norman Pace (Indiana University), noted geothermal microbiologists, have used PCR and other techniques to demonstrate that most hot-water organisms have yet to be described, and are just becoming known to the scientific world. How much more will they give us if we continue to care for them and protect them?

Jim Peaco/NPS



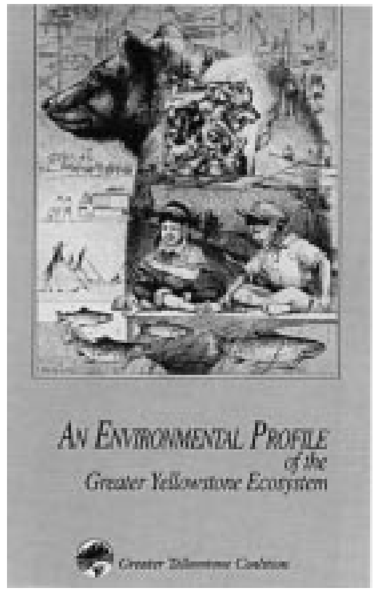
Mushroom Pool, in the Great Fountain Group in the Lower Geyser Basin, was the site of Dr. Thomas Brock's discovery of Thermus aquaticus, *the high-temperature bacterium that led to a revolution in DNA research and technology. The pool was named about 100 years ago, according to one contemporary account, because of "the vegetable formation growing in it."*

In June 1993, Yellowstone hosted its 100 millionth visitor. Virtually all of these people came to see, feel, and explore; to experience and celebrate the park's inspirational and educational values. It is safe to say that few of these visitors saw the park as a pragmatic and utilitarian asset that could in any material way enrich their lives. But the polymerase chain reaction breakthrough has already saved or positively influenced countless lives, and it will continue to reshape our world, and it will turn into a multibillion dollar industry. The next wonderful discovery like this one may occur as a result of work in a tropical rain forest in Brazil (as in *Medicine Man*, another movie with as cautionary a tale as *Jurassic Park*), or in an arctic protected area, or in any of a thousand other protected areas or reserves. But because of the efforts of a small army of "life in boiling water" specialists, another miracle could just as easily happen again in Yellowstone. Here, we have saved the parts for intelligent tinkering.

John D. Varley worked in Yellowstone Park for eight years as assistant project leader of the U.S. Fish and Wildlife Service fisheries project, and for ten years as Chief of the Research Division. In March of 1993, he became the Director of the Yellowstone Center for Resources.

Book Review

An Environmental Profile of the Greater Yellowstone Ecosystem. Dennis Glick, Mary Carr, and Bert Harting, editors. Greater Yellowstone Coalition, Bozeman, Montana, 1991. 132 pages; $18.00 (paper)



An Environmental Profile of the Greater Yellowstone Ecosystem is crafted to provide an introduction to the ecology of the greater Yellowstone ecosystem (GYE) and the "future being created for the Ecosystem by current development plans and activities." The book is remarkable in scope and provides the best available overview of ecological issues in the GYE. Dennis Glick, Mary Carr, and Bert Harting have done a superb job of summarizing complex ecological and policy issues into a very readable format that is accessible to scientists and nonscientists alike. This volume lays background for the Greater Yellowstone Coalition's (GYC) "Blueprint for the Future" document, that should appear before this review is published, where the GYC will offer its views on future management of the area.

Mind you the *Profile* is not a definitive treatise on any of the topics covered—presentations are too brief and the scope too broad to expect depth in coverage. Sometimes I worried that certain topics were given insufficient review because details were omitted that may prove fundamentally important. But overall the treatments appear balanced and insightful, and to my mind, controversial issues were presented fairly. The editors confront conceptually challenging topics such as ecosystem resilience and stability in a lucid manner that indicates a powerful depth of understanding.

Particularly impressive to me was the discussion on sustainable development in the final section entitled "The Future of Greater Yellowstone." Since the establishment of Yellowstone National Park as the world's first national park in 1872, Yellowstone has been a paradigm for conservation, a paradigm of nature preservation. But during the past decade our global perspective on conservation has changed. Cogent arguments have been developed that the future well-being of life on this planet depends in part on stemming the current extinction crisis. Although this might call for nature preservation, the preservation paradigm can be a difficult one to justify on a planet inhabited by 5.5 billion people. Creative alternatives usually exist whereby sustainable yields of natural resources may be compatible with protection of biodiversity. It is insightful to imagine how the GYE can be a blueprint for sustainable development.

The global extinction crisis is largely a tropical phenomenon because species richness is so great in the tropics, and development often goes unchecked in developing countries. From the standpoint of biodiversity, the GYE actually has little to offer that is unique. In fact, I think that the *Profile* misleads by suggesting that species protection is one of the significant functions of the GYE. For example on page 121 it is stated that the GYE is one of the "last strongholds in the lower 48 states for several species listed as threatened and endangered including the grizzly bear, the peregrine falcon, the whooping crane and the bald eagle." This is an overstatement for each of these species and in fact false in the case of the whooping crane. If the Yellowstone caldera were to erupt again tomorrow, how many species would be lost? We may lose a few species unique to thermal areas in the park, e.g., Ross' bentgrass, but few others.

The *Profile* touts the GYE because it is relatively intact and large in area. Yet we are hard pressed to identify the value of the GYE's structure and function. Beyond aesthetic values, how would we be worse off if development of the GYE were to have proceeded without federal protection?

The region's great beauty means that it is a favorite area for recreation. Recreation and tourism are playing an ever more important role in the economy of the region. This economic incentive will ensure that the area's scenic beauty is protected.

And by protecting areas for recreation and scenic beauty we accomplish nature protection as well. So the task of integrating sustainable development with preservation of biodiversity may be an easy one in the GYE relative to other regions.

It will be relatively easy to do it right in the GYE and by so doing we will show how it can be done. In an open market, economic natural resource development can have disastrous consequences if unrestrained due to monetary incentives for excessive resource extraction. Because so much of the GYE is in federal ownership, government regulations and economic incentives can be manipulated to ensure that resource development is sustainable. Indeed, in the GYE we can show how agriculture, mining, recreation, and nature protection can coexist at an ecosystem scale. Thereby Yellowstone can continue to be a paradigm for conservation into the twenty-first century.

The *Profile* helps to place the ecology of the GYE into perspective and identifies management issues of importance. Realistically, nature preservation in the GYE may contribute little to the global campaign to reduce species extinctions and loss of genetic diversity. But by practicing exemplary sustainable development the GYE can continue its role as a global model for conservation.

Mark S. Boyce
Department of Zoology & Physiology
University of Wyoming

Surprises from Mule Deer Study

Early in 1993, the Northern Yellowstone Working Group, representing Yellowstone National Park, Gallatin National Forest, and the Montana Department of Fish, Wildlife and Parks launched a study of northern Yellowstone mule deer. This is the latest in a series of cooperative initiatives by the group, which is concerned with the ecology and management of the various ungulates that inhabit the northern winter range in the park and on federal, state, and private lands to the north. The park is the lead agency in the mule deer study, with NPS ecologist Peter Gogan the principal investigator, working with Dan Tyers of the U.S. Forest Service and Tom Lemke of the Montana Department of Fish, Wildlife and Parks.

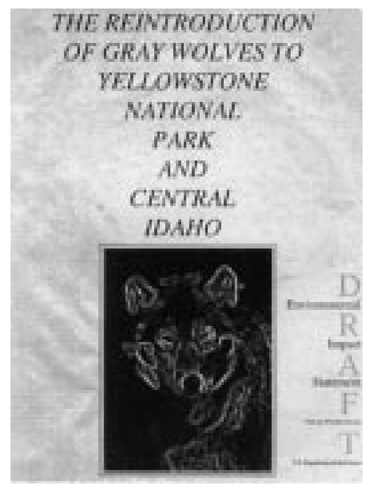
The study's goal is to investigate the movements and ecology of this herd, which has never been subjected to a comprehensive study. In late February and early March, personnel from participating agencies captured and radio-collared 60 adult female mule deer, using a net-gun fired from a helicopter. As of mid-July, 53 of the collared deer were still alive, and some had traveled considerable distances (and in suprising directions) from the Yellowstone River Valley where they were captured.

Deer captured on the west side of the Yellowstone River are now distributed from Cinnabar Basin and the west side of Electric Peak to the Madison Canyon, and even southwest of West Yellowstone, Montana. Deer captured on the east side of the river now range from just east of the northern Yellowstone winter range to east of Cooke City, Montana, and the Mirror Plateau in eastern Yellowstone Park. Two of the deer captured on the east side of the Yellowstone River have crossed the river and the Gallatin Mountain Range to summer just north of the Big Sky ski development. Two other deer from the east side of the Yellowstone River moved to Hebgen Lake and West Yellowstone. Three deer last located in mid-May are apparently somewhere else.

For those familiar with traditional views of Yellowstone's winter range, these findings are of great interest, because for many years it was assumed that mule deer on this range parallelled the elk in their movements (none of the deer moved to Yellowstone Lake). We can anticipate that this study will offer much more information, and maybe more surprises over the next three or four years.

Draft Wolf EIS Released

Researchers in many disciplines may be interested in the draft Environmental Impact Statement (DEIS), "The Reintroduction of Gray Wolves to Yellowstone National Park and Central Idaho," released by the U.S. Fish and Wildlife Service in early July. Wolves have been the subject of extensive research in Yellowstone recently, ranging from paleontology and archeology to prey species population modeling and regional economic impacts of wolf restoration. This wealth of new information was brought to bear by the authors of the DEIS. The draft preferred alternative in the DEIS calls for the reintroduction of an "experimental population" of wolves into the Yellowstone area.



Copies of the draft DEIS are available for reading at all public and high school libraries in Montana, Idaho, and Wyoming. Comments on the draft will be accepted until October 15, 1993, and hearings will be held in surrounding communities in August and September. Comments and requests for additional information should be sent to the U.S. Fish and Wildlife Service, Yellowstone NP/Central Idaho Gray Wolf EIS, P.O. Box 8017, Helena, MT 59601 (1-406-449-5202).

Freedom of Information Request for Grizzly Bear Data Raises Tough Questions

On March 19, 1993, the Sierra Club Legal Defense Fund, Inc. (SCLDF), on behalf of itself and the Wild Forever Grizzly Bear Project of the Greater

Yellowstone Coalition, The Wilderness Society, and the Sierra Club, submitted a Freedom of Information (FOI) Act request to Secretary of Interior Bruce Babbit for scientific data generated by the Interagency Grizzly Bear Study Team (IGBST).

The request was comprehensive, for "all scientific data prepared, compiled, maintained, or analyzed" by the Interagency Grizzly Bear Study Team.

The SCLDF maintained that the data compiled by the IGBST was used extensively for management of the bear without adequate public opportunity to evaluate it: "Given the repeated use by federal land managers of the scientific reports and conclusions of the Study Team to develop grizzly bear management and recovery activities, it is absolutely critical that the underlying scientific data developed and used by the Study Team be available for public review and analysis."

The Department of the Interior, through National Park Service Regional Director Robert Baker, at first denied the request. Baker argued that the data was gathered under a six-agency (three state and three federal) cooperative agreement that created the IGBST and its oversight body, the Interagency Grizzly Bear Committee (IGBC), and that the FOI request had been misdirected in the first place, and should have gone to the IGBC.

Baker further pointed out that the data from the IGBST was by policy made available to the public after it had "gone through the refereed peer-review process" and been published in the scientific literature. He offered all population and habitat data that had been published to date, and said that subsequent data would be released as soon as pending publications were out.

Negotiations ensued, resulting in the release of some of the data, including habitat and life history data but not overflight data on bear locations. The specific outcome of the FOI request, in fact, may be less interesting than the greater implications and consequences of such requests. Besides the basic question raised by the SCLDF regarding the public's right to access this information, their request raises vexing issues regarding research conducted by employees of federal agencies.

One involves the rights of the federal scientists themselves, whose professional standing is in part dependent upon their data and its publication; if their data is not "theirs," at least until publication, and must be surrendered without notice, their ability to function as professionals may be seriously compromised. As well, if they are not able to protect their data until publication, other investigators will be understandably reluctant to participate in studies with them, and the ability of federal agencies to attract top-rate contract researchers may also be diminished.

Another important issue is the protection of the resources represented by the data, especially rare, threatened, or endangered species. Unlike cultural resources on federal lands, natural resources do not have absolute protection under the law. That is, if a federal land manager in the southwestern United States determines that an Anasazi site is too fragile or is impossible to protect adequately, that manager has the legal means to deny the public access or information about it.

On the other hand, if a land manager determines that wide public knowledge of a threatened natural resource will harm that resource, the manager may have insufficient legal support to protect that information. Grizzly bears have substantial economic value of several types, including their worth to the tourism industry and the illegal trade in their parts (a bear gall bladder alone is worth $300, and an entire bear is worth thousands). If the IGBST data on locations of bears were released, aircraft tour businesses, poachers, and a variety of other legal and illegal interests would have an unparallelled and very specific schedule of bear activity areas in greater Yellowstone.

Issues of this sort are not new, nor are they likely to go away. Other federal areas face similar situations, including those threatening numerous plant species—rare cacti in the southwest and American ginseng in Great Smoky Mountains National Park are two examples. These situations have prompted a movement to strengthen protective legislation, but under current Freedom of Information Act stipulations, managers of endangered species throughout the nation are faced with the risk of having to divulge, to anyone who asks (regardless of their stated or suspected intentions), information on highly vulnerable species. We plan to keep *Yellowstone Science* readers posted on any new developments in this story.

Bear 148 Returns

One of the two adult grizzly bears assumed killed in the 1988 fires has reappeared after five years. Bear 148 was a 177-pound, five-year-old female when she was first trapped in Gibbon Meadows on June 25, 1988, by the Interagency Grizzly Bear Study Team (IGBST) as a "research bear" (as opposed to a management action to deal with a "problem bear").

During July and early August 1988, she was radio-located several times in the Carnelian Creek-Tower Creek area, and was last located on August 2 near Observation Peak. After the area she frequented was burned, the IGBST was never again able to pick up her collar's signal. Continued research trapping in that area over the next few years seemed to confirm that Bear 148 must have perished in the fire, with the destruction of her collar.

On July 19, 1993, she was again trapped during research operations, this time near Canyon Village (local newspapers mistakenly reported this as a management action). She had shed her collar, but was identifiable by ear tags. The IGBST estimated that Bear 148, now 10 years old, weighed 175 pounds. She may have lost her collar prior to the fire's passage in 1988, allowing it to be burned without her.

Renee Evanoff

Historical Vignettes

Lost Opportunities Department

The National Academy of Sciences 1992 report on research in the parks concluded, as had numerous previous reports, that the National Park Service has never done justice to its many responsibilities in resource-related research. We offer the following memorandum as an example of the magnitude of this problem even half a century ago.

This July 8, 1943, memorandum (it was marked "AIR MAIL") was written by Yellowstone Superintendent Edmund B. Rogers to the regional director, regarding the need for more research on Yellowstone's northern range, which even then was a perennial topic of debate and controversy.

The memorandum's foremost entertainment value is in the name of the scientist whom Mr. Rogers was reluctant to fund to the tune of $500, but the memo is also suggestive of the high risks facing any manager who assumes a resource issue has a simple answer, or that research is not "essential work." Now, almost 50 years and a few generations of research later, there still isn't a great deal of "confidence in the program by interested agencies and the general public."

MEMORANDUM for the Regional Director, July 8, 1943
Region Two

Reference is made to your memorandum of July 3 enclosing a copy of the Acting Director's letter dated July 3 to Mr. Aldo Leopold regarding a proposed study of the northern Yellowstone elk herd.

It is noted that the purpose of a study by Mr. Leopold would be to assist in arriving at conclusions regarding the current management program and to establish greater confidence in management measures. While an investigation by Mr. Leopold would be helpful it is our opinion that the first step in the current management of the northern herd is to have a meeting of the three interested agencies at which time the Director or the Regional Director can make an authoritative statement as to what the National Park Service proposes in the way of future elk reduction. When such a statement is made it should automatically take care of confidence in the program by interested agencies and the general public.

We do not approve of the proposal to charge Mr. Leopold's salary, per diem and other expenses to the Yellowstone allotment for fiscal 1944 as present information indicates a large reduction in funds which will be adequate for essential protection and maintenance only. The proposed study would cost approximately $500 and we do not believe that this amount of money should be diverted from essential work to research at this time.

Edmund B. Rogers
Superintendent

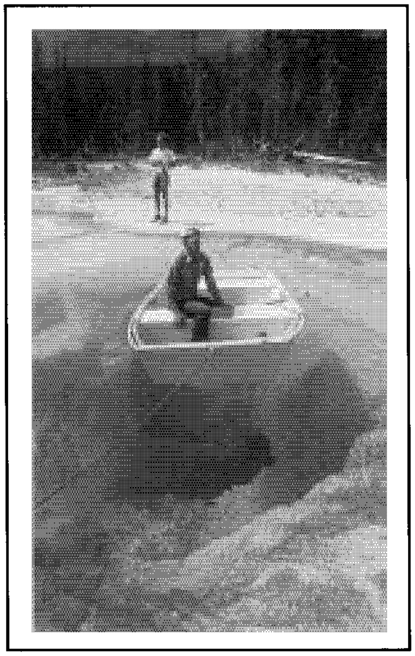
In Mr. Roger's defense, it must be noted that this happened during World War II, when park budgets were, in fact, much leaner than usual. But we are still left with this lingering sense of something that should have happened—the father of wildlife management meeting the mother of all park wildlife controversies—but that, for the want of $500 and a little broader understanding of the problem, did not.

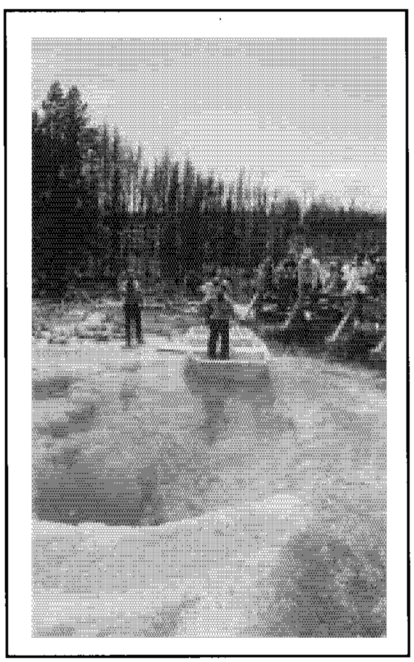
P.S.

Hot-water Boat Navigates Park Springs

Following the example of researchers at the University of Auckland, New Zealand, Yellowstone National Park recently launched its first thermal pool watercraft. Completed in 1992 by Livingston, Montana, boatbuilder Mark Poppert, the four-by-eight foot craft was christened Little Dipper after a spirited local name-the-boat contest.

Charles Goldberg





Little Dipper and its crew at work on Morning Glory Pool in the Upper Geyser Basin, with an attentive audience of park visitors.

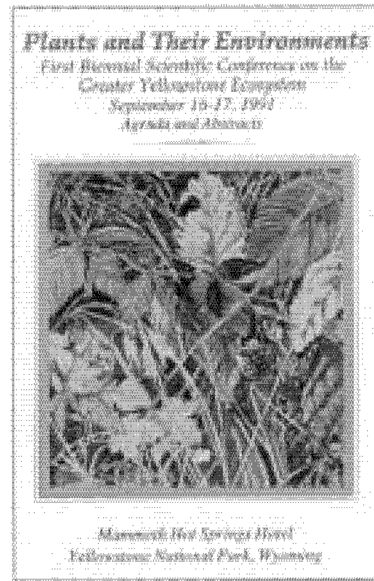
Little Dipper serves both resource management and research roles. Perhaps most important, it facilitates the monitoring of feature changes and cleanup of vandalized pools, but it also provides new opportunity to study some of the park's most spectacular attractions. It has already been used on some of the most famous pools, including Morning Glory and Grand Prismatic. In July of 1993, the latter yielded previously unknown information to Little Dipper's crew of NPS Research Geologist Rick Hutchinson and Physical Science Technician Tim Thompson: Grand Prismatic's surface temperature is 160°F (71°C) and the maximum depth found so far is about 122.7 ft (37.4 m). This is almost 50 percent deeper than any other thermal feature in the park.

The boat is quite simple in construction, similar in some respects to a small, squared-off version of the McKenzie River boats popular among trout fishermen on western streams. There is a work port along the hull that allows direct access to the water.

Of course, safety is the first question on most people's minds when they hear of a boat designed for lethally hot water (one boating situation in which life vests are more or less irrelevant). Little Dipper is extremely stable. Prior to its use in the park, West District Resource Management Coordinator Craig McClure put the boat on a small cold-water lake, stood on the gunwales, and tried to capsize it; he couldn't. As far as the heat affecting the crew, Hutchinson says that the plywood, with its resin coating, turns out to be a very good insulator.

As a matter of principle, use of the boat is kept to the absolute minimum. It is an obvious intrusion on the setting, launching it requires extreme caution to prevent damage to the delicate shoreline formations of pools, and the uniquely hazardous work environment demands the highest concern for safety.

Update on Plant Conference Proceedings



The proceedings of the 1991 conference, "Plants and Their Environments," have been delayed beyond anyone's lowest expectations, but are now expected to appear this coming winter, probably early in 1994.

The proceedings are being produced as a technical report by the National Park Service's Natural Resources Publications Office in Denver, a branch of the U.S. Government Printing Office. The publications office has experienced a number of problems that have slowed the process considerably.

Those who attended the conference will recall that a copy of the proceedings was included in the registration price. If you registered for the conference in 1991 and your address has changed since then, please notify Sarah Broadbent, Yellowstone Center for Resources, P.O. Box 168, Yellowstone National Park, Wyoming 82190 of your new address so that we can send you the proceedings when published.

The proceedings includes 23 papers and 13 abstracts from the conference. At this point, all 36 have undergone the peer-review process and are in various stages of editing.

When the proceedings are published, we will provide ordering information in *Yellowstone Science*.