Yellowstone's Bald Eagles

Is the park a "black hole" for the national symbol?

by Al Harmata

To most of us, the term "black hole" conjures up images of celestial vacuums sucking all matter into dense, dark oblivion. In the early days of bald eagle research and management in the greater Yellowstone ecosystem (GYE), those of us involved often referred to Yellowstone National Park (YNP) as a black hole for the population. Little did we know.

In the 1950s and early 1960s, investigations quickly identified 10 to 13 resident pairs in the park each year. During population lows of the 1960s and 1970s, researchers determined that breeding bald eagles needed to produce a minimum of 0.7 young per pair each year in order to maintain at least a stable number of adult pairs in a population. Further investigation revealed that the park's eagle pairs were not producing enough young to maintain adult population levels.

Interestingly, the number of breeding pairs did not decline during the "DDT era" (the 1950s and 1960s), when bald eagle numbers across the continent declined so drastically due to the chemical's effects on eagle reproduction. How could Yellowstone eagles have maintained their population for over 30 years and through the DDT era if they didn't produce enough young?

One answer may be that resident adults lived a *very* long life. In fact, some North American eagles are known to have lived at least 17 years; one lived more than 22 years, and one 28 years. But recent data suggest that longevity of GYE bald eagles is considerably less.

Another possible explanation was that the Yellowstone Park population was bolstered by birds from other areas of the GYE or farther away. But significant differences existed among the three population units of greater Yellowstone eagles. They were different in time of breeding, preferred nest trees, food habits, and productivity. Based on these criteria, the three population units (the Continental Unit to the west and north of the park, the Snake Unit to the south and southwest, and the Yellowstone Unit in the park and east of the park) were thought to be distinct entities, and we suspected that little interchange occurred among them. So the question was, how did they survive so well? That was the objective of this study, and other recent studies.

Tracking Eagles

Back in 1979, Kurt Alt (now a biologist with Montana Department of Fish, Wildlife & Parks) and I initiated an extensive eagle leg-banding program in the GYE, including Yellowstone Park. We put U.S. Fish & Wildlife Service (USFWS) aluminum bands around the lower legs of nestling eagles. The birds wear these bands like loosely fitting bracelets for their entire life. Each leg band has a number unique to the individual, much like a Social Security number, and a brief instruction to the finder to "avise" (*sic.*) the USFWS, Bird Banding Laboratory (BBL) in Washington, D.C. of the circumstances of the "encounter" (the term "encounter" involves a variety of experiences; banded eagles may have been observed dead or alive, captured, or had their band number observed at a distance). Through this

Aluminum leg bands in place on an eagle banded in Grand Teton National Park. All photos courtesy of the author.

Eagles were fitted with solar-powered "backpack" transmitters that did not interfere with flight or other activities.

technique, we hoped to answer basic questions about bald eagles in the GYE, such as how long do they live, where do they winter, what kills them, and where and at what age do they tend to breed. Answers to these questions would then give us insight on how population stability in Yellowstone was achieved.

In 1985, through the visionary impetus of Bob Oakleaf, Nongame Coordinator of the Wyoming Game & Fish Department, a research project was arranged with the Fish & Wildlife Program in the Biology Department at Montana State University. This intensive study focused on bald eagles breeding along the Snake River in Wyoming, but also included, almost by accident, Yellowstone.

In addition to continued banding, this study employed radio transmitters on eagles between 1985 and 1989, and colorbands from 1985 to present. Young bald eagles were banded and radio-tagged in their nest before they could fly. Nests in trees, some more than 52 meters (170 feet) high, were reached using modified mountaineering techniques developed by Dr. George Montopoli, a climbing ranger in Grand Teton National Park (GTNP).

If the nest was big enough and eagles were only to be banded, George or Kurt performed those duties in the nest. If the eagle was to be radiotagged, it was lowered to the ground in a large canvas bag with a rigid, soft floor to prevent injury and minimize stress. There the eagle was fitted with a solar-powered transmitter "backpack," measured, and photographed. The procedure took between 20 and 40 minutes, depending on cooperation level of the eagle, and then the bird was hoisted back into the nest.

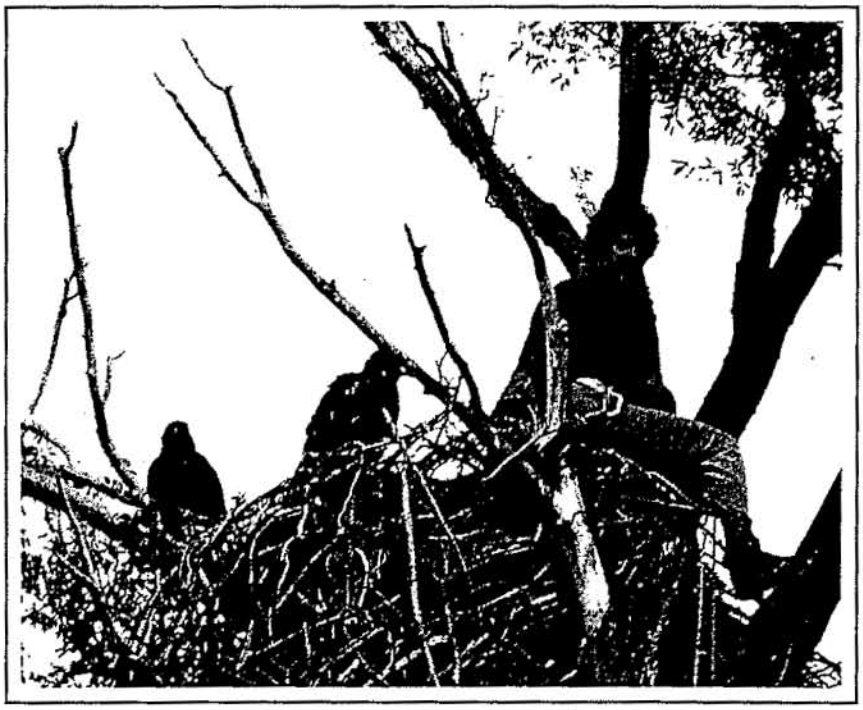
In banding more than 500 nestling bald and golden eagles between 1972 and present, only one was injured. That was due to a suspected genetic condition that resulted in abnormally thin long bone cortices. This bird did not behave normally and probably would not have survived in the wild, so it was remanded to captivity.

Banding Results

With little funding or support from managing agencies, we banded nine eagles the first year, including four in Yellowstone Park. By August 1993, 316 eagles had been banded, 287 as nestlings. Only 12 percent of nestlings were banded in Yellowstone Park itself, mostly because relatively few were produced there, but also because of logistics and weather problems.

Slightly less than 15 percent of all eagles banded in the GYE were subsequently encountered. Those encountered outside of the GYE were in five western states, and revealed various causes of death. Locations of encounters revealed a generally westward movement of immature eagles in autumn and return during spring.

Only one Yellowstone Park eagle was encountered outside the GYE, but the oldest bird encountered had been banded as a nestling near Eagle Bay on Yellowstone Lake. It was a 12-year-old male, whose death was possibly the



Dr. George Montopoli developed modified mountaineering techniques to safely reach eagle nestlings in trees as much as 170 feet high.

Dr. Montopoli banding a nestling from a precarious perch high above the ground.

Eagle 700 exhibited an unusual "pied" plumage pattern when compared to her sibling.

result of secondary organophosphate poison used for control of ground squirrels. He was found near Molheron Creek just off the Yellowstone River near Corwin Springs, Montana. Sadly, his sister had been found dead in May 1983 near Elk Creek in Island Park, Idaho, an apparent victim of a leg-hold trap set for furbearers or coyotes.

Eagles colorbanded in the GYE were observed alive in six western states and one Canadian Province. The GYE eagles seem to like to winter in California. In February 1992, we captured a GYE eagle at Big Bear Lake, less than 30 miles from the Los Angeles Basin. He was radio-tagged there and next located back in the GYE in summer 1992 at Cliff Lake in southwestern Montana (along with another immature eagle we radio-tagged at Big Bear). We found him again in southern California in January 1993 *and* 1994!

Eagles colorbanded in Yellowstone Park were observed mostly in the GYE, but only one in the park. Three were seen on the Snake River near Jackson, Wyoming, and one was seen at Cliff Lake in southwestern Montana. The lack of sightings in the park was mostly due to the small number of birds colorbanded, limited search effort (researchers were only in the park while banding birds or when flying over on radiotracking flights), and relative remoteness of areas frequented by bald eagles in the park. But we did learn that Yellowstone eagles, at least immatures, visited other population units when in the GYE. A sighting of a Yellowstone eagle, banded in summer 1993, near Bakersfield, California, in February 1994, further showed the propensity of GYE eagles to winter in California.

Radiotracking

Radio-tracking young bald eagles provided much more information on movements in a much shorter period than banding, but was much more expensive. Generally, tracking data showed that eagles stayed near their natal nests until early their first autumn.

About mid-September to mid-October, the eagles began moving west-southwest, mostly along major river drainages but often directly cross-country and over mountain ranges. They moved as far west as northcentral California and came back to the GYE as early as mid-March, but most returned in April and May. Then, they wandered the ecosystem for the summer, often covering more than 100 miles (161 kilometers) in a day. Movements of two of the 21 young bald eagles radio-tagged illustrate typical movements of juvenile and immature bald eagles produced in the GYE.

Eagle 700

On June 11, 1985, a nestling female bald eagle, produced at the Butler Creek site on the Snake River, southwest of Jackson, Wyoming, was fitted with a solar-powered transmitter. She was designated 700 because of her transmitter frequency, 148.700 mHz. She exhibited a previously unrecorded plumage coloration in bald eagles. From the time 700 fledged (left the nest for the first time) on June 26 until she left the GYE on her first autumnal migration in mid-September, she remained within 2,600 feet (800 meters) of her natal nest. She was away all winter because we periodically searched for all radio-tagged eagles throughout the GYE by aircraft and she wasn't located.

We next located 700 on April 30, 1986 on Palisades Reservoir in eastern Idaho. She had survived her first winter and returned to the ecosystem of her birth. She stayed on the reservoir until late May. More exciting, and indicative of things to come, we next detected her radio signal on Yellowstone Lake and triangulated her location to the Eagle Bay area, a minimum of 82 miles (132 km) from her last location!

Over the next 4 years, 700 was often located in Yellowstone, the alleged "black hole," mostly in association with Yellowstone Lake. In spring 1987, she

was at South Arm and again at Eagle Bay. In summer 1988, she was on the Flat Mountain Arm and Heart Lake. And in 1989, an adult bald eagle wearing a transmitter and colorband was seen near LeHardy Rapids on the Yellowstone River. Could it have been 700?

923, A Yellowstone Eagle

On July 15, 1987, the male of two siblings produced at the Eagle Bay nest site on Yellowstone Lake was tagged with a transmitter frequency .148.923 mHz. He was intermittently monitored during summer from Lake Butte, 10 miles (15.5 km) northeast of the nest. By early August, 923 was traveling as far as 5.5 miles (9 km) from the nest, possibly as far as Flat Mountain Arm and The Promontory. On September 7, he was still on Yellowstone Lake near the nest site, but on October 10, he was located near Soda Springs in eastern Idaho. Obviously, he was beginning his first autumnal migration.

On the first aerial survey in spring of 1988, 923 was located on Upper Red Rocks Lake in southwestern Montana. By May 6, he had moved to Henry's Lake, Idaho, and by mid-June was back in Yellowstone. When first located on Yellowstone Lake, he was in the company of 944, another eagle that had been radio-tagged in a nest on Yellowstone Lake.

As Al Bath, the tracker, carefully worked his way through the thick lodgepole pine near Lake Lodge, he was startled to meet, in the dense, dark forest—another radio tracker! The other tracker was following grizzly bears. After introductions, they followed their respective signals, and were surprised when they found their animals together. Along a small stream known for spawning cutthroat trout, the bear was snagging spawning trout, opening the gut, and eating the roe. She then discarded the carcasses.

When the bear moved off about 10 feet (3 meters) both eagles pounced on the carcasses. The bear and eagles remained in the vicinity about one week, but discretion dictated minimizing observation time. The grizzly then moved to Pelican Valley, again visiting streams full of spawning cutthroat. Within one day, the eagles were there too. During subsequent aerial and ground surveys, 923 was located mostly in the Southeast and South Arms of Yellowstone Lake. He was last located in the GYE on October 21, 1988, on the west shore of the West Thumb of Yellowstone Lake.

Late in 1987, during a trip to California, I detected a signal from another young GYE eagle, 827, from a hill 13 miles (21 km) west of Canby, 31 miles (50 km) south of Tule Lake Sump. I eventually located 827 on the southern end of Klamath Basin National Wildlife Refuges (KBNWRs), which span the Oregon-California border. He was there with nearly 600 other bald eagles, feeding on waterfowl killed by an outbreak of avian cholera. This established KBNWRs as a place to search for GYE eagles in ensuing years.

In November 1988, a receiver was sent to KBNWRs and personnel scanned for GYE eagles. This time, 923 was located on Tule and Klamath Lakes in northern California and southern Oregon, along with 827! They remained in the Klamath Basin until mid-December.

On March 30, 1989, 923 was located near Fishing Bridge in the park, and on April 14, he was seen by Terry McEneaney, Yellowstone Park Resouce Management Biologist, farther downstream on the Yellowstone River near LeHardy Rapids. Cutthroat trout are abundant in this section of the Yellowstone, and 923 was undoubtedly exploiting this blue ribbon fishery. By April 24, 923 was on the south shore of Yellowstone Lake near Breeze Point, and on May 12 was observed on Holmes Point on the southeast corner of Mary Bay. Proximity allowed close inspection of plumage, bands, and transmitter package. All were in excellent condition.

As in 1988, 923 spent most of the summer on Yellowstone Lake, at the mouth of the Yellowstone River on the Southeast Arm, and at Outlet Creek on the South Arm. On October 5, he was at West Thumb, indicating he may have been in the initial stages of his second autumnal migration. Subsequent ground checks around Yellowstone Lake failed to detect 923.

On February 25 to 28, 1990, 923 again was located in the Klamath Basin area, roosting 2 miles (3.2 km) southeast of Worden in southern Oregon. Monitoring then ceased, and when it resumed on March 4, no signals were detected. Timing of locations suggest 923 may not have wintered in the Klamath Basin but only visited there during migration.

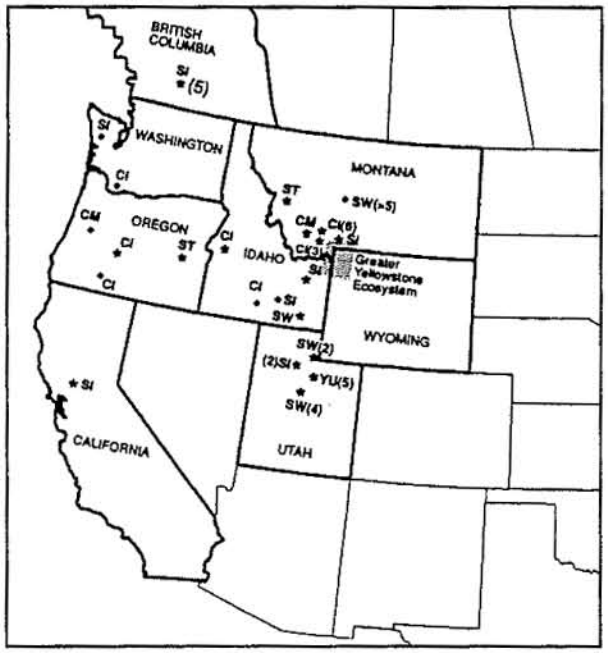
Long-range, migratory movements of 923 and other GYE eagles are shown in the maps on page 18. Funding ran out in early 1990, and we could no longer track radio-tagged eagles, despite functioning transmitters. Pleas for continued funding fell on deaf ears. Reluctantly, we relinquished contact with the young eagles we knew so well, and left them to wander the west unmonitored.

On January 17, 1994, I received a call from the Utah Division of Wildlife in Ogden. An adult bald eagle wearing a backpack transmitter had been found dead near the Weber River, about 12 miles (20 km) east of the Great Salt Lake. The band number revealed it was 923, who died of unknown causes about January 5, 1994. His peregrinations throughout the west have ended, but he will continue to contribute to the conservation of his species for years. He will be mounted with radio and bands intact, and exhibited along with an account of his life at the Fishing Bridge Visitor Center.

Survival

Survival of GYE juvenile and immature bald eagles radiotagged as nestlings or recent fledglings was high. Of 17 bald eagles with functioning radio transmitters, a remarkable 82.5 percent were alive in April after their first winter. After two winters, 58.8 percent were still alive. Nearly 77 percent of the birds that survived their first winter also survived their second. Fifty percent of those surviving their second winter and 42.9 percent of those surviving their first winter also survived their third winter. A third of the eagles were still alive after four winters.

A decrease in survival was evident in



Left: Extra-regional sightings of GYE colorbanded eagles. Letters indicate which population unit they originated in: SW=Snake Unit, Wyoming; SI=Snake Unit, Idaho; YU=Yellowstone Unit; CI=Continental Unit, Idaho. BA stands for breeding adult. Right: Extra-regional locations of leg-banded GYE eagles. Additional abbreviations: CM=Continental Unit, Montana; ST=Snake Unit, Tetons. Diamonds indicate direct encounters; stars indicate indirect encounters. Numbers in parantheses indicate age of eagle at time of encounter.

the third year and probably reflected actual phenomena rather than any problems with equipment or data. All young eagles radiotagged in Yellowstone survived at least four years, but lack of detections afterwards was most likely the result of transmitter failure rather than eagle deaths. We've seen at least three GYE eagles that were wearing our radios that we couldn't detect with a receiver and one that shed his transmitter after four and a half years.

Movements of Immature Bald Eagles

The GYE eagles showed a unique movement away from natal areas (home nests). The traditional popular view was that most birds move north and south during migration. Unlike Canadian-born bald eagles, which move south in autumn, or Florida eagles which move north, immature GYE eagles move *west*. Band encounters suggested and radiotracking verified that GYE eagles (such as 700, 827, and 923, discussed earlier) went to coastal and interior Oregon, Washington, and California as far south as Los Angeles.

Virtually all young eagles left the GYE their first autumn, departing between mid-September and mid-October. Juveniles apparently did not need to leave the GYE; juvenile eagles from Canada spend the winter in the GYE, indicating that requisites for survival are present. Competition with Canadian migrants was probably not a factor in causing local juveniles to migrate from the GYE, because most GYE eagles were gone before the Canadian birds arrived. Regardless, survival of immature eagles leaving the GYE during winter has probably been higher than those that did not, resulting in a population with a genetic propensity to migrate west as immature birds. The GYE eagles left their natal areas well before food resources dwindled or became unavailable due to snow cover or ice. In fact, waterfowl (a favored prey for eagles) numbers in the GYE actually may have been at peak when young eagles departed.

Migration was primarily southwest to the Snake River plain in Idaho and northern Utah, then west to the Pacific coast states. Traveling without parental guidance, the eagles moved alone. The exact route was influenced by topography and weather, while rate of travel may have been dictated by chance encounters with locally abundant food, adequate roost sites, and flying conditions.

The somewhat unusual east-west bald eagle migration pattern between the GYE and the west coast also is consistent with the theory of "genetic memory"; when they left the GYE, eagles possibly went to regions of historical abundant salmon runs of the Pacific coast. Dates and locations of band encounters on the west coast suggest that juvenile eagles wandered from Los Angeles in the south to Puget Sound in the north, where their genetics "told" them to look for salmon runs that are either greatly reduced or extinct.

Immature eagles returning from the west coast may search for vacant nest sites or available mates. Virtually all radiotagged immatures visited their natal nest areas and then dispersed throughout the ecosystem and, in some cases, beyond.

Young eagles were radiotagged in all population units, and each was detected in every other population unit at least once, seasonally exploiting fish spawning runs or waterfowl concentrations. Immature eagles also seemed to move freely among territories of nesting and

non-nesting adult bald eagles throughout the ecosystem without eliciting aggression from resident adults. As autumn approached, immature eagles moved gradually back toward their parent's territories, often as close as a few hundred yards from their natal nest. Such movements may suggest that recruitment and pioneering of bald eagles occur primarily in spring and fall.

Immature eagles were found primarily on lakes within the GYE although the Snake River as well as smaller rivers and creeks throughout the ecosystem received periodic use by concentrations of immatures. Young eagles seemed to quickly key in on temporal concentrations of prey and carrion and regularly were found either along water bodies where fish were spawning (i.e., cutthroat trout in YNP and Henry's Lake, Idaho, in spring and whitefish in Cottonwood Creek in GTNP in autumn) or areas where ungulate viscera piles left by hunters were available (early elk hunts in Jackson Hole and late elk hunts in GTNP and near Gardiner, Montana). Some areas previously overlooked as important bald eagle habitat because of lack of breeding adults may be of critical importance to these "floating" immatures that move great distances from one food source to another.

As eagles age, the timing of their movements may change; there may be a tendency for them to leave the GYE later in fall and return earlier in spring. Juveniles almost all left the GYE in mid-September, returning in mid-April to early May. Two-year-olds and older birds tended to leave in middle to late October, returning from middle to late March. Some eagles may have remained as late as mid-January, leaving the GYE for only one month. Decreasing time away from the GYE was probably facilitated by increasing knowledge of routes and terrain as eagles grew older.

The patterns of their movements may also change as they age. Though basic movement patterns remained the same, variability in both extent and frequency of long-range movements increased as eagles grew older. Movements of older immatures suggest increased wandering outside of the GYE in summer, especially north into Montana and possibly Canada. Indeed, when eagle 827 was four years old, he was located with a mate and young at a nest site on the Missouri River near Helena, Montana, in 1991, 208 miles (335 km) due north of his natal nest, 114 miles (184 km) outside of the GYE.

In addition, the male of a productive pair nesting on the Madison River in southwestern Montana since 1989 was banded as a nestling in the GYE (colorband sighting). Clearly, the highly productive GYE population has provided recruits to expanding populations outside of the GYE. That more recently banded eagles are being found outside of the GYE may indicate all available breeding habitat is filled. The number of breeding areas in the GYE in recent years is leveling off, and instances of combat between adults are increasing.

Yellowstone Park's role in GYE eagle ecology

The value of Yellowstone to GYE bald eagles is in its importance as an area that enhances survival of young eagles produced throughout the GYE. The diverse, abundant, and unpolluted food base in Yellowstone contributes significantly to the fitness of young eagles. The more eagles that survive, the healthier the populations and the more resilience they have to rebound from natural environmental catastrophes like earthquakes, fire, volcanic eruptions, and severe human-caused contamination. High survival more than offsets the low production in Yellowstone and even provides a surplus to bolster eagle numbers in areas outside of the GYE.

Though more than two million people visit the Park each year, vast areas of eagle habitat are left undisturbed during important times of the year. These areas of the park are functional refuges, where immature eagles can feed, bathe, pair bond, play, loaf, and sleep without human disturbance. The freedom to just be eagles in prime habitat, without wasting valuable energy avoiding humans and their activities is relatively rare in the United States, and conditions that promote that freedom should be protected with fervor.

Al Harmata, a long-time eagle researcher in the greater Yellowstone area, is a research professor in the Biology Department at Montana State University.

There were fears that GYE bald eagles eventually would become extinct because they didn't produce enough young. Thanks to the broader view provided by movement data from this and other studies, it has become obvious that Yellowstone is not an ecological island, and that areas outside the GYE, such as the west coast, are also important for maintaining a viable population of bald eagles.

Movements of bald eagles also showed us something profound. Their summer wanderings essentially defined the limits of the GYE, indicating that there is in fact an ecosystem out there, not just some ethereal, academic concept with no basis in reality. If one species is dependent on an intact ecosystem, must there not be a multitude of others that also are? In pursuit of everyday survival, the young eagles have provided justification and even impetus to conserve and protect large areas of the GYE in order to maintain the biological integrity of Yellowstone National Park.

So is Yellowstone a black hole for bald eagles? The resounding answer is "NO," but the rest of the world is. We must be vigilant in our care for the global ecosystem if we wish to ensure the continued existence of the Yellowstone eagles.

Superintendent Bob Barbee Leaving Yellowstone

Our more distant readers, who do not routinely see the headlines in regional newspapers, will be interested to learn that Yellowstone Superintendent Robert Barbee is moving on to a new assignment. As part of what NPS Director Roger Kennedy describes as "a nationwide effort to diversify the senior management of the NPS," Barbee will become the Regional Director of the Alaska Regional Office, moving to Anchorage in September.

Barbee's move was part of a major shift of top NPS personnel announced in late May, in which half a dozen superintendencies and other key positions changed hands. This promotion moves him into a resource-management arena that is perhaps more complex and controversial than that of Yellowstone.

Science in Yellowstone changed dramatically during Barbee's 11-year term, which was characterized by a steady heightening of public interest in management issues. Greater Yellowstone ecosystem coordination, wolf restoration, grizzly bear recovery, geothermal resource protection, fire management, ungulate-range management, and visitor-use management were among the issues elevated to higher levels of public attention and concern, with corresponding growth in scientific research both by the NPS and by numerous other investigators. Major research initiatives on wolf restoration (resulting in two large reports to Congress), grazing-related issues (resulting in one soon-to-be-published report to Congress), geothermal development near the park, and other subjects were carried out during Barbee's term here.

In 1983, when Barbee arrived, Yellowstone hosted 90 research projects; that number had tripled by 1993. He also established the park's biennial scientific conference series, and led the park through the recent reorganization of research and resource management functions that resulted in the Yellowstone Center for Resources.

Barbee's previous assignments in his 34-year NPS career included superintendencies at Redwood National Park, Hawaii Volcanoes National Park, and Cape Hatteras National Seashore, as well as other assignments at Yosemite, Big Bend, Carlsbad Caverns, and Rocky Mountain National Parks, and Point Reyes National Seashore.

Michael Finley, current superintendent of Yosemite National Park, will become Yellowstone's new superintendent in October. Finley, 47, has also served as superintendent of Everglades National Park and Assateague Island National Seashore, and Associate Regional Director, Management, in the Alaska Regional Office.

Brucellosis Symposium September 26-28

A "National Symposium on Brucellosis in the Greater Yellowstone Area" will be held September 26-28, 1994 in Jackson, Wyoming. The symposium will be hosted by Governors Sullivan (Wyoming), Racicot (Montana), and Andrus (Idaho) along with Secretary of Interior Babbitt, and Secretary of Agriculture Espy. The symposium will serve as a forum and educational meeting for the public, including members of conservation and livestock organizations, wildlife and land managers, veterinarians, stockgrowers, agency and animal health regulatory officials, and members of the newly established Greater Yellowstone Interagency Brucellosis Committee. Invited experts and agency officials will explain issues and policies regarding problems associated with brucellosis in bison and elk of the greater Yellowstone area. The Greater Yellowstone Interagency Brucellosis Committee was formed by the state and federal agencies to solve the problems of brucellosis in greater Yellowstone while protecting the integrity of the region's elk, bison, and cattle populations. For further details on the symposium, contact Becky Russell, Wyoming Game and Fish Laboratory, P.O. Box 3312, University Station, Laramie, Wyoming 82071, 1-307-766-5616, FAX 307-766-5630.

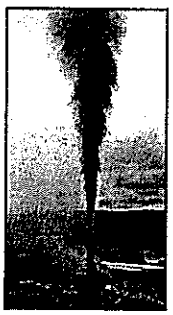
Hydrothermal Monitoring Weir Vandalized

On April 3, NPS Research Geologist Rick Hutchinson discovered that the park's main hydrothermal monitoring apparatus in the Norris Geyser Basin had been vandalized during late winter or early spring. This monitoring weir is a deeply notched steel plate set across a stream. A float, placed upstream from the plate, electronically tracks water level, allowing for a continuous record of total stream flow. The weir plate and float assembly were intentionally torn out, resulting in collapse of the structure. A nearby vent pipe for an underground instrument vault was also broken off.

The monitoring weir has been operating since 1987, to gather baseline data on variations in water and heat flow through the Norris Basin. It is a joint project of the NPS and the U.S. Geological Survey. Water flow data collected at the weir is being used to clarify the relationship of regional and local seismic activity to changes in Norris thermal features. The data may also help to explain the mysterious alterations in pool levels, water temperature, turbidity, and geyser activity around the basin that often occur in the fall (these clusters of changes have been dubbed "the Norris fall disturbance"). Water flow information is combined with measurements of chloride concentrations taken at the weir to estimate heat flow in the area. Estimates made using this methodology indicate that Norris is the hottest thermal basin in the world.

Because prior research has shown a high probability that Mammoth and Norris share an underground source for thermal fluids, water and heat flow data from Norris are critical to understanding hydrological connections between Norris, Mammoth, and proposed geothermal wells outside the park. Rick Hutchinson has ordered repair parts for the weir and hopes to have it back in working order this summer.

USGS Research Well Update


Jim Peaco/NPS

Yellowstone Science readers may recall our report (Winter 1993) on the U.S. Geological Survey (USGS) research well whose valve failed in November of 1992, resulting in a spectacular steam "leak." The sealing of the well required a specially constructed valve assembly, and the USGS decided to check all the other research wells in the park. This is a report on that process.

As background, we will explain that in 1967 and 1968, the USGS drilled 13 research holes in various park geothermal areas. These wells, named Y-1 through Y-13, were created to study geothermal dynamics of aquifers in the park. Six of the wells were plugged after data collection was completed, in the 1960s. The well that leaked in 1992, Y-8, was sealed in late November of 1992.

An examination of the remaining six unplugged wellheads has since revealed that significant deterioration had occurred in three. Because of the expense of mobilizing the equipment to seal the old wells, and because of the inevitability of repairs, the USGS decided to permanently seal five of the remaining holes. This work was completed in October, 1993, using a bentonite and concrete slurry. Only Y-7, in Biscuit Basin was left unplugged; it currently has no well-head pressure and does not flow water when left open. Y-7 is currently being used by microbiologists as a source of moderate-temperature water samples.

Call for Species Occurrences

The Greater Yellowstone Conservation Data Center, in the Yellowstone Center for Resources, is developing a Natural Heritage Program database on the status and distribution of rare plant and native animal species in the Greater Yellowstone Ecosystem. In the process, they are compiling a species list, including all organisms (procaryotes and eucaryotes) found in Yellowstone and Grand Teton National Parks and the John D. Rockefeller, Jr. Memorial Parkway. They would appreciate submissions of species lists from researchers working in or near any of those areas.

Lists should be sent to Pete Feigley, Greater Yellowstone CDC, P.O. Box 168, Yellowstone National Park, Wyoming 82190, (307) 344-2157. Please include your name, address, phone number, and research interest or research project title.

For more information about the Greater Yellowstone Conservation Data Center, see the *Yellowstone Science* interview in the Spring 1993 issue.