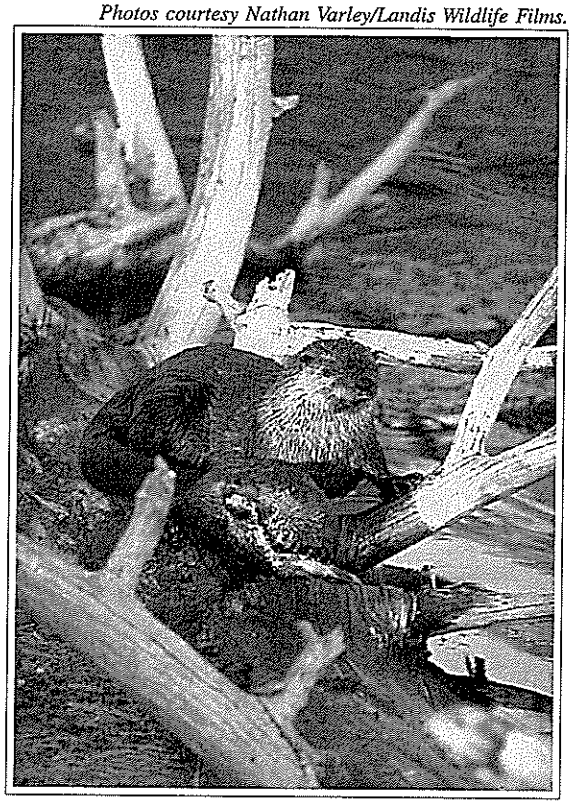
Photos courtesy Nathan Varley/Landis Wildlife Films.



Yellowstone's River Otters

Enigmatic Water Weasels

by Nathan Varley

The charismatic river otter (*Lontra canadensis*) is one of the most enigmatic members of Yellowstone's fauna. Since otters have not been studied extensively in the park, substantive questions exist regarding the local population status and ecology of this amphibious species of the weasel family. Ranger and visitor reports have confirmed the use of most major lakes, rivers, and large streams in the park by otters, but their elusive nature has made observation of these animals difficult. Blending the goals of cinema and science, Bob Landis, a wildlife cinematographer with more than 30 years of experience in Yellowstone, and I set out to document the lives of these fascinating animals. Despite the challenges, our efforts resulted in what we believe to be an exceptional natural history film, *The Yellowstone Otters*, as well as a report to the park currently in preparation.

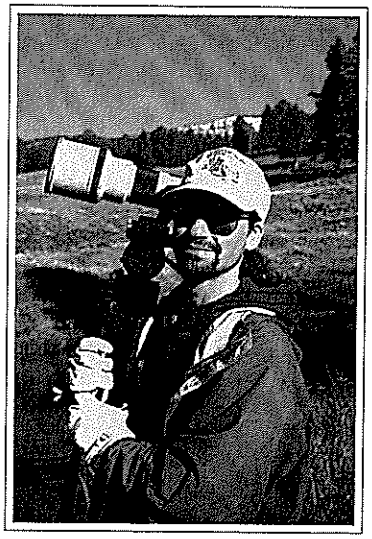
The Power of Observation

In conjunction with the production of an educational documentary film, we conducted a survey to gather general ecological data on resource utilization, movements, habitat use, and behavior of river otters in Yellowstone from April to August, 1997. Otters are, on the whole, difficult to locate. We commonly heard park visitors relate their otter experiences and end with the assumption that because *they* had seen them, otters were common. "Otters are everywhere," one person told me.

Well, otters are everywhere, until one starts looking for them, and then they are found in very few of the places one chooses to look. My approach was to search riparian corridors for otters or signs of otters including tracks, slide marks, and scats. Surveys were conducted across a variety of available park habitats that afforded easy access from roads. We searched the shorelines of slow-water stretches of the Yellowstone River, from the outlet of Yellowstone Lake through Hayden Valley to the brink of Upper Falls. We also searched the shores of the lake from Sedge Bay west and south to the West Thumb Geyser Basin. Tributaries of the Yellowstone on the northern range were surveyed, including stretches of the Lamar River, Soda Butte Creek, Slough Creek, and the Gardner River, all of which are smaller waterways with predominantly fast-moving water. The portion of the Madison River within the park was also surveyed. Some observations were made opportunistically during winter months.

Using standard methods to estimate otter abundance, we measured the quantity of otter presence through observation of individuals or sign per survey distance. When otters were located, they were observed with aid of 8-12x binoculars or a 20x-60x spotting scope. Otter pups were

Above left: Mother otter rests her eyes as pup eats fish. Below: Author in Lamar Valley. Photo by Bob Landis.



typically less than half the size of adults and always found with one or more adult females. Adult otters weigh from 7 to 9 kg (15 to 20 pounds) and can be up to 1 m (3 feet) long.

Detection and Discovery

Otters were not easily found. During the study, 451 hours were spent trying to locate and observe otters; only 15 percent (69 hours) of that time was spent observing the animals. The subjects of 98 percent (67 hours) of the observation time were two groups of otters—both females with pups, whose home ranges were restricted by brood-rearing, making it easier for us to locate them on a regular basis. General survey effort (May 11 to July 19) also reflected our poor success in finding otters: in 53 surveys of shoreline habitat totaling 188 km (113 miles), otters were found at no less than 15-km (9-mile) average intervals.

This low survey success rate may result from many factors combining in unknown proportions, and the degree to which the survey results relate to true otter abundance is unknown. It is difficult to detect animals whose secretive nature includes nocturnal activity, the use of habitats inaccessible to humans, and an ability to move a long distance in a short time.

Other studies have found otter activity patterns to be crepuscular (active around dawn or dusk) or nocturnal—our survey results supported these conclusions. We spent 18 days (187 daylight hours) with a female and her two pups (the northern range group) that were active only 30 percent (56 hours) of the time we watched them. The otters spent the remaining 70 percent within a den. On more than a third of the mornings, we arrived to find them returning to the den, as if they had been on night shift, leaving behind only the scraps from fish they had caught and fed on during the night.

If otters spend two-thirds of their average day in a den as this group did, then it's not surprising that they are not often seen during daylight surveys. These resting sites provided security and made otters difficult to find. Beaver lodges, log jams, hollow logs, bank recesses, rock recesses, and even culvert pipes were used by otters for dens.

Some den entrances were under water making them imperceptible in most situations. Were it not for the sudden appearance of an otter, I would not have discovered one such den. One evening in Hayden Valley, much to my surprise, a pup appeared only an arm's length away from me. The pup used a latrine site where scat and urine are frequently deposited (thought to be important "scent posts" in otter society) from which I was collecting scat samples. The scats, complete with fish bones and scales, were commonly found at this site along with other telltale signs including clumps of balled-up grass. After leaving me a fresh sample, the pup quickly dove back into the water and vanished beneath a subsurface bank that concealed a den!

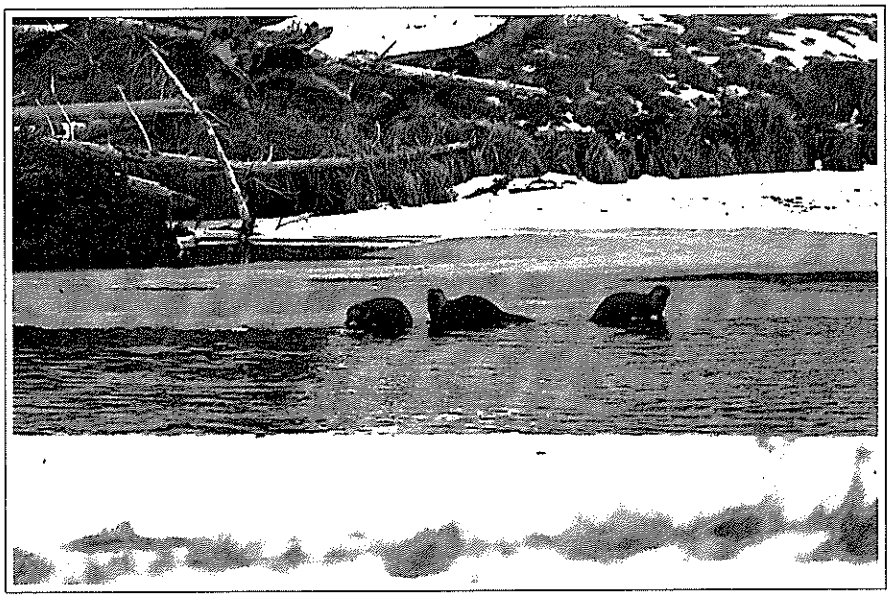
Travelers Over Water, Land, and Ice

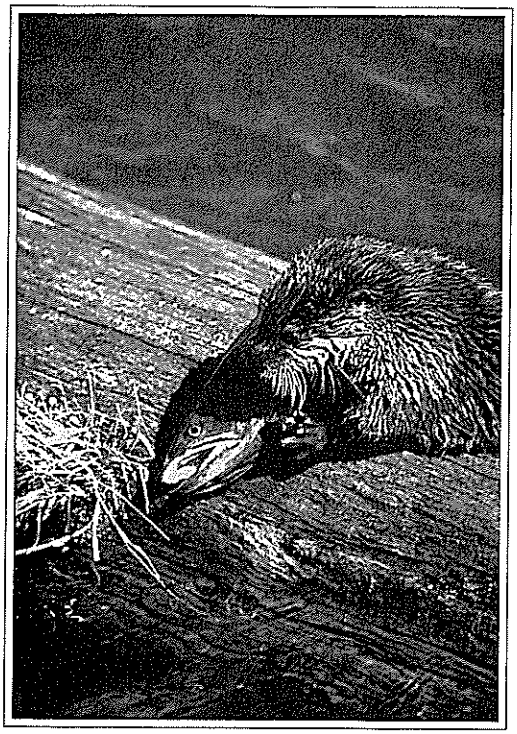
Home ranges for otters in the Rocky Mountain west vary from 8 to 78 km (5 to 47 miles) of linear shoreline distance, and within these ranges they typically travel from 2 to 5 km (1.2 to 3 miles) per day; however, much longer movements are common as we discovered. The longest distance traveled by otters observed during our survey was a group of four adult otters that swiftly descended the Yellowstone River 10 km (6 miles) from Mud Volcano to Alum Creek. They then moved upstream in the Yellowstone for a total of 12.5 km (7.5 miles) in just less than four hours. In May, we tracked another group for 22.5 km (13.5 miles) along a trail through thin ice, snow, and sand along the shore of Yellowstone Lake.

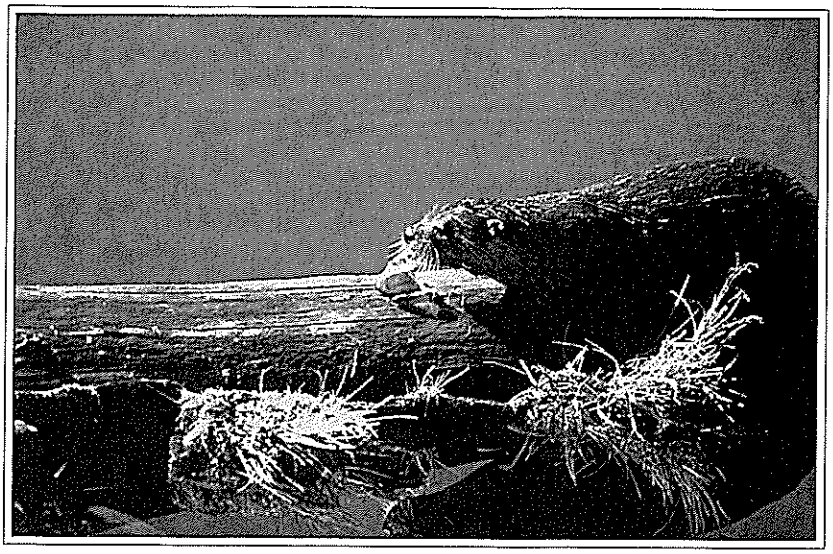
Perhaps our most interesting observation of traveling otters involved a group of four adults located on May 12 in Hayden Valley. This group traveled down the Yellowstone River 9 km (6 miles) to the brink of Upper Falls in an hour. They then traveled back up the river after being turned back at the falls because the overland route otters typically take around the falls includes a portion of the park visitors' trail to the overlook. As we watched, visitors on the overlook platform marveled at an amazing show—swimmers at the very brink of the falls! Surviving this feat, the performers moved back up the river ending their afternoon journey. Overall, we found that otters had the capability to travel remarkable distances, leading me to believe the park has just one population of otters continuous over all major waterways.

Predator and Prey

One of our primary interests was to document otter interactions with other Yellowstone animals. Otters are both predators and prey, as we had opportunities to observe. Accounts of predation attempts on otters are rare in the literature. Natural enemies of otters in Yellowstone include gray wolves, coy-







Otters are quite successful at catching fish. Mother (above) and pup (left) with large cutthroat trout. During the study, one female caught, on average, 2.5 large trout per day for 18 days. Below left: Otter family in winter. The log jam in the background was used by this family as a den.

otes, red foxes, and bobcats, all of which may prey upon otters.

We witnessed one attempt at predation upon otters on April 17, when three coyotes attacked two adult otters using an overland route near the Blacktail Ponds. The otters were caught well away from their hole in the ice and fled from the coyotes at a gallop. One otter escaped by returning to the hole while the coyotes closed in on the other. One coyote attempted bites to the otter's back, just behind the head, while another coyote came from the otter's other side. Still another coyote, perhaps a pup, was cautious and tentative and ran behind. The otter continued to try to escape by alternately fighting and running. When surrounded by the coyotes, it rolled to its back where it would seem to be more vulnerable; however, from this position it was able to lunge swiftly and accurately, biting a coyote's muzzle at least once. In the end, the otter appeared to have escaped—though blood on the coyote's muzzle suggested the encounter had consequences for the otter, the coyote, or both.

Coyotes and otters interacted frequently, but we saw no other interactions that appeared to have been predation attempts on the otters. Particularly in winter, we often saw coyotes monitor the activities of otters perhaps for the opportunity to steal fish. Feeding otters often attracted other scavengers as well, including bald eagles, ravens, and even pelicans. Most of the attempts to take fish from otters that we witnessed were unsuccessful; furthermore, after successful attempts the otters replaced their loss quite quickly. In early May, an otter was fishing in a flooded side channel of the Yellowstone River and came up through a slushy layer of ice with a medium-sized trout. A bald eagle had been watching the fishing otter from a perch 200 m (700 feet) away and flew at the otter. The eagle swooped in low and fast, scaring the otter which had just come through the slush. Surprised by the eagle, the otter ran out of the hole at a quick burst. The eagle banked and landed near the hole, waited a minute, then hopped over to the hole and onto the trout. After three dives, the otter caught a sucker and ate it only 40 m (131 feet) from where the usurper perched with a second eagle who had joined the first in eating the trout. The observation suggested that the otters' hunting success rate could accommodate such losses to scavengers.

Factors Limiting Otters?

The hunting success rates of otters have not been well documented. In our study, 38 to 62 percent (lake and inlet, respectively) of one female otter's dive attempts ($n = 84$) resulted in catching a fish, while 40 percent of the dives of another female ($n = 18$) resulted in a successful catch. These rates compare roughly to values found elsewhere for otter predation, and in contrast with the capture success rates of other carnivores, are quite successful.

Studies have shown that otters generally exhibit disproportional selection for such slower-moving, bottom-dwelling prey as crustaceans, sculpins, and suckers. The predominance of faster-moving trout as available prey in Yellowstone has been suggested as a factor that may limit the abundance of otters. This assumes that otters have difficulty in capturing trout, which did not appear to me to be the case.

The otters' relationship with their prey poses some interesting questions. With Yellowstone's world-renowned trout population we might expect an otter population to be equally robust. Perhaps prey availability is not a factor that stands alone in determining otter numbers. The predator-prey relationship may be more complicated by local prey abundance only during summer, when mothers are rearing their pups. After the emergence of pups from the den, a brood-rearing female occupies habitats with the resources she needs to raise her dependent,

less-mobile pups. In our observations, a female raising a pup used a restricted home range of 5 km (3 miles) linear shoreline distance where otter habitat was exemplary: calm, slow waters with seclusion, secure dens, and abundant prey. A different female caught, on average, 2.5 large trout per day for 18 days within a core area of 2 km^2 (0.77 mi^2).

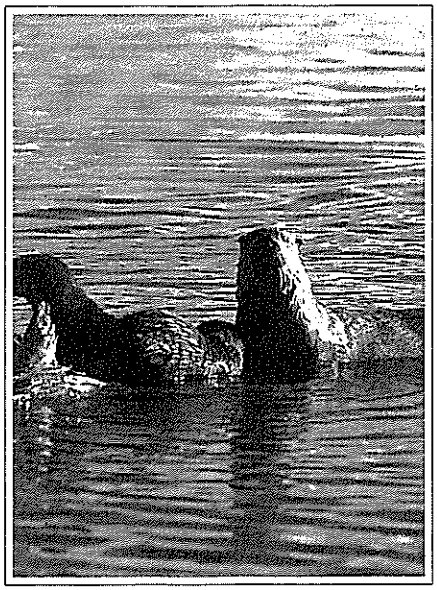
Riparian Neighbors

A strong association between beaver and otter occupation has been well documented in other areas. In addition to providing good den sites, beavers can alter riparian areas by building dams that form productive pond habitats preferred by otters and their prey. The relationship between beavers and otters may occasionally extend to sharing the same den! A few years ago a Yellowstone ranger reported seeing several beavers near a lodge on a pond near the Snake River. Several days later, he reported with some chagrin that there was a family of otters swimming in and out of the beaver lodge; yet, he was certain he had correctly identified the animals seen earlier as beavers. He was relieved when told that, though he did not find the species together, river otters' use of occupied beaver lodges is well documented in scientific literature.

Few beavers inhabited our survey areas, and we encountered no beavers while searching for otters. However, three abandoned beaver lodges along the Yellowstone River still serve as frequently used otter dens.

Otter Society

In many species, social interactions effectively limit population growth, but few reports exist concerning social strife among otters in the wild. Long, linear home ranges of otters frequently overlap to form a non-territorial, spatial distribution. Within these overlapping home ranges, activity centers associated with dens, landings (sites where otters often come to shore), and latrines are found. For example, otter movements in Hayden Valley and Lamar Valley seemed to begin and end at predictable locations such as certain beaver lodges or logjams, respectively. Their frequency of use suggested that otters had a traditional or learned use of these sites.



Mother and pup rest on partially submerged log. Logs, which are safe from many predators, are often used as secure places to eat fish.

Traditional use of a den or landing and the associated latrine may serve as a communication network in which scats, urine, and anal gland secretions advertise the presence of individuals. Melquist and Hornocker (1983) wrote in their landmark monograph:

> "scent marking may be a form of covert aggression, but it would not prevent [other otters] from using a particular area...the individual and the current space is defended without reference to fixed spatial boundaries."

They reported that while there is no defense of a site, there is defense of the space currently occupied. This strategy may well serve a population of highly mobile carnivores confined to long, narrow home ranges. Our only glimpse into this world occurred along the Yellowstone River on June 27, when four otters entered the occupied den of a female with a pup. No indications suggested that the meeting was hostile; rather, the four emerged several hours later and traveled down the river. The female and her pup, appearing unharmed, left the den minutes later and did not return in the following days. While difficult to interpret, communications may have taken place in this exchange that address aggression, tolerance, and avoidance within the society of otters. Unfortunately, we were unable to observe what occurred within the den.

The Status of Yellowstone's Otters

Initially, we perceived an apparent scarcity of otters. Then, as we slowly became familiar with their elusive nature, we reconsidered and felt perhaps they may not be scarce, just hard to find. In the end, the question remained unanswered. To get at it further, the factors that determine otter abundance need to be studied further. While observing and documenting otter behavior, we found little to directly contribute to an understanding of this critical aspect of ecology, but we could speculate on which factors might be involved; prey relationships, habitat quality, and social interactions seem worthy of investigation.

Factors explaining population regulation in otters are largely unknown elsewhere, as well. In most documented cases, otter mortality was heavily influenced by human-related factors including trapping, road kills, and illegal kills. In the protective sanctuary of the park, these mortality sources would theoretically be less consequential. If this is true, Yellowstone offers us a good opportunity to study otters under natural conditions and to further delve into the enigmatic world of the water weasel.

Literature Cited

Melquist, W.E. and M. G. Hornocker. 1983. Ecology of River Otters. Wildl. Monogr. 83:1-60.

Nathan Varley has lived in Yellowstone Park for more than 20 years. In 1994, he earned a M.S. in Fish and Wildlife Management at Montana State University, studying mountain goat ecology in the Absaroka Range. Since then he has worked with a variety of wildlife species including wolves, moose, and otters. More recently, he has been instrumental in the creation of a biological consulting company which specializes in ecological research, filming, and interpretive enterprises in Yellowstone.

Draft Report Released on Brucellosis Science

In December 1997, the NPS welcomed the release of a draft National Academy of Science (NAS) report on brucellosis in bison and elk in the greater Yellowstone area (GYA). The review was commissioned last May by the Department of Interior to evaluate existing science related to the concern that bison or elk could transmit the bacteria *Brucella abortus* to cattle. The organism can cause the disease brucellosis in cattle, which often results in abortions by infected animals. A vigilant national regulatory effort has reduced the number of infected cattle herds in the United States; the goal of the national brucellosis eradication program, developed cooperatively by the states and the Animal and Plant Health Inspection Service (APHIS), is eradication of the disease from cattle by 1998. The disease can affect humans, but as the NAS report states, "human brucellosis is not a widespread health threat today in North America."

The NAS review determined that eradication of brucellosis from wildlife in the GYA is not now technically feasible. But studies were identified which could lead to the development of techniques to make eradication a real possibility in the future. The primary finding in the report is that risk management is critical to controlling the disease in the GYA until a proven, effective vaccine and a practical delivery mechanism for inoculating elk and bison are found. The report emphasized that brucellosis affects both elk and bison and encompasses the entire GYA, not simply Yellowstone National Park; the authors stated that "it would be impossible to vaccinate all GYA elk."

Efforts to address brucellosis in wildlife have intensified in recent years, as the disease in cattle has diminished radically. The states of Montana, Idaho, and Wyoming have been working with the NPS (especially Yellowstone and Grand Teton national parks), other land-management agencies, and several research agencies to determine how to protect the cattle industries while sustaining, wild, free-ranging herds of bison and elk in the GYA. A Greater Yellowstone Interagency Brucellosis Committee is working to secure funding for continued brucellosis research and related planning and management activities.

A final version of the NAS report will incorporate questions and comments from the Interior agencies that commissioned the study.

Wolf Population Growing

As of January 15, 1998, there were at least 85 gray wolves in the greater Yellowstone population, including 22 adults, 15 yearlings, and 48 pups less than 1 year old. Free-ranging wolves made up 9 packs, and 4 wolves remained temporarily penned following an incident of livestock depredation last fall; plans are to release the captive wolves in the spring. The largest family continued to be the Rose Creek pack, which numbered 15 wolves living in the western part of the Lamar Valley, although recently it appeared that 2 wolves dispersed from the group. U.S. Fish and Wildlife Service agents are investigating the illegal shootings of 2 males from the Druid Peak pack in December 1997; the incidents occurred east of Yellowstone.

Also in December, U.S. District Court Judge William Downes found that the wolf reintroduction program in Yellowstone and central Idaho violated the intent of section 10(j) of the Endangered Species Act because of the lack of geographic separation between fully protected wolves already existing in Montana and the reintroduction areas in which special rules for wolf management apply. The judge wrote that he was "especially mindful of the concerted efforts of the Government and wolf-recovery advocates to accommodate the interests of stockgrowers and others who may be adversely affected by the wolf recovery program," and reached his decision "with the utmost reluctance." He ordered the removal of reintroduced wolves and their offspring from the Yellowstone and central Idaho experimental population areas, but immediately stayed his order pending appeal. The Department of the Interior asked the Justice Department to appeal the case, and an appeal was filed with the Tenth Circuit Court of Appeals on February 6, 1998. Meanwhile, until a final court order is issued, wolves will be protected and managed just as they have been.

In January 1998, park staff arranged for Helicopter Wildlife Management to capture and radiocollar 17 wolves from 5 packs as part of long-standing plans to continue monitoring the progress of the recovery effort. The capture operations were completed without injury to either human handlers or wolves. Helicopter Wildlife Management donated the equipment, personnel, and helicopter time used to net-gun the wolves, and radio collars were purchased with private donations. Another attempt to collar wolves from the remaining packs will occur in March.

Photo courtesy William Campbell.

Cascade Geyser Rejuvenates

An old tourist pleaser from the last century, Cascade Geyser—located in the Upper Geyser Basin not far from Old Faithful—rejuvenated on January 9, 1998. It began several hours after a small earthquake just one mile away, which appeared to trigger an eruption of another major geyser, Giantess. Though Giantess' eruptions typically last for days, this one aborted after just three hours, and Cascade began dumping chocolate-brown water into the nearby Firehole River. The geyser quickly cleaned its throat and subsequent eruptions, visible from Old Faithful, have been spouting 10 meters (30 feet) tall about every six minutes. Cascade Geyser has a history of erupting for short periods of time, especially after earthquakes, but it had not

been observed at all since 1992 when it "burped" once to a height of about one meter. Eruptions to its full height hadn't been seen since before 1912.

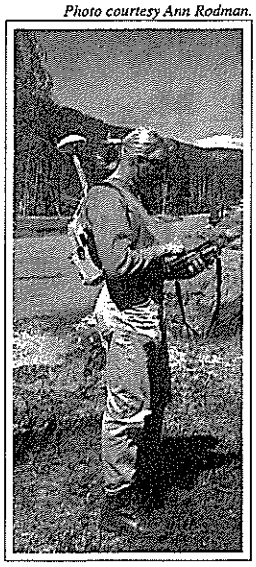
IGBST Gets New Leader

Beginning in February 1998, the Interagency Grizzly Bear Study Team (IGBST) will have a new leader. Dr. Chuck Schwartz, formerly a research coordinator with the Alaska Department of Fish and Game, arrived to replace the retired Dick Knight (*see interview, this issue.*) Schwartz has been director of the Moose Research Center and leader of an interagency team studying brown bears on the Kenai Peninsula. He has expertise in black and brown bear ecology and management, ungulate physiology and nutrition, predator-prey dynamics, and population management. He envisions continuing the ongoing research with additional emphasis toward a systems approach to studying grizzly bears in greater Yellowstone.

Celebrating "People and Place"

More than 225 persons attended Yellowstone's fourth biennial science conference on "People and Place: The Human Experience in Greater Yellowstone," held October 12-15, 1997, in Mammoth Hot Springs. Highlights of the conference included author T.H. Watkins discussing the difficulties with consensus during the A. Starker Leopold Lecture; professor Donald Worster speaking on a comparative perspective of the conservation movement in North America for the Superintendent's International Luncheon; and a humorous evening talk by Patricia Nelson Limerick on "Lessons and Lesions of History: Yellowstone and Progress." Retired park historian Aubrey L. Haines was present for the first lecture in his honor, in which U.C.L.A.'s Peter Nabokov discussed "Reintroducing the Indian: Observations of a Yellowstone Amateur." Abstracts from the conference are available by calling (307)344-2203 or via email: Tami_Blackford@nps.gov

Photo courtesy Ann Rodman.



Park Staff Test GPS Accuracy

Global Positioning Systems (GPS) are increasingly touted for use in research and mapping projects. Staff from Yellowstone's Spatial Analysis Center recently conducted their own accuracy tests on GPS units available in the park. They chose test locations to represent the best and worst possible conditions under which measurements are taken in the park. Three readings were taken at each of three survey sites (two "ideal" sites and one "bad" location), using the park's TotalStation, a traditional survey instrument that measures accuracy to no less than one centimeter. The overall results were reported to be very positive. In fact, errors were less than expected; in particular, the measurements taken under forest cover (much of the park) were generally satisfactory, although the researchers caution that the maximum error of approximately 9 meters, taken under heavy forest canopy, is not much better than digitizing from a 1:24,000 U.S.G.S. topographic map. Satellite orientation, selective availability, atmospheric conditions, surface reflectance, and distance between a known base station and the GPS unit used may all affect the accuracy of field measurements. In the future, the park hopes to provide additional training and access to GPS units to its scientists and resource managers.

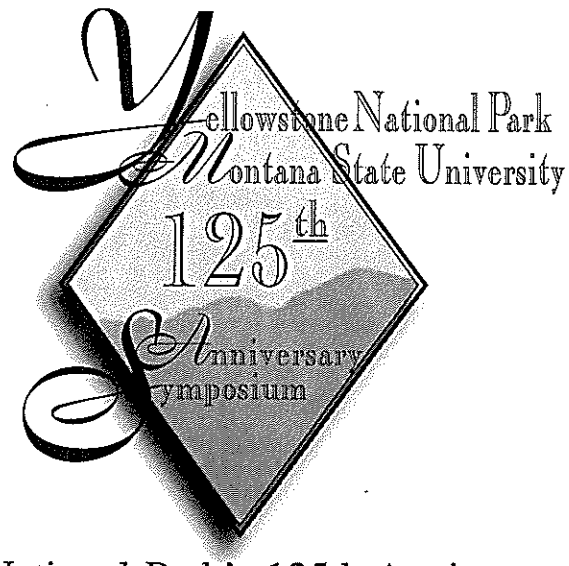
Archeological Research Reveals New Information

During the 1997 field season, park staff, cooperators, and volunteers contributed to park archeology studies and made a number of new discoveries. The general patterns of obsidian use are beginning to emerge through determination of the sources of obsidian found in a variety of locations. For example, along the Yellowstone River upstream from Gardiner, Obsidian Cliff obsidian dominates the samples sourced so far, but Bear Gulch obsidian from southern Idaho is present in minor amounts. The obsidian in the gravels at Park Point, on the east shore of Yellowstone Lake, is from an unknown source. As more samples are taken, the researchers hope to determine if distinct patterns of obsidian use can be identified for people at different times in the past.

Along the Yellowstone River corridor, data from three eroding roasting pits/hearths were salvaged and two other sites were tested. All the sites were prehistoric in age and had been severely damaged by the 500-year floods that occurred earlier in the summer. One site contained Intermountain ware (radiocarbon dated at A.D. 1320±70 yrs.) from the most recent period of prehistoric occupation. This is only the second prehistoric ceramic site identified in the park.

A historical archeology crew led by Ken Karzmiski from the Museum of the Rockies tested the Soda Butte Soldier Station along the Northeast Entrance road. When the Army managed Yellowstone, there were 16 such posts throughout the park. The archeology work, in combination with archival data, is clarifying the chronology and function of select features at the site.

Of particular interest is the discovery of very young bison calf bones at a Lamar Valley site. A radiocarbon age of 2480±70 years B.P. was obtained using a bison ulna. This is the first archeologic site in the park that clearly shows occupation during a particular season, based upon the timing of bison calving activity in late spring.



Yellowstone National Park's 125th Anniversary Symposium

May 11 - 24, 1998, at Montana State University
Bozeman, Montana

A two-week symposium commemorating 125 years of Yellowstone National Park's influence on scholarly research and creative activities will be held at Montana State University, Bozeman, Montana, and is designed to attract an international audience of world class researchers. The goal of the symposium is to highlight the interplay between universities, natural areas such as Yellowstone, and humankind.

Conferences include:

National Parks in the Global Ecosystem
The Greater Yellowstone GEO-Ecosystem; An Integrated View of Geology and Biology
Life in Extreme Environments
Fire and the Yellowstone Ecosystem: Ten Years of Study and Change

Workshops include:

The Greening of Yellowstone
The Greater Yellowstone Data Clearinghouse: A Paradigm for Sharing Information
Biosphere-Geosphere Linkages in Yellowstone: Defining a New Generation of Ecosystem Research in Greater Yellowstone

Field Trips include:

Two days in Yellowstone National Park in conjunction with
"The Greater Yellowstone GEO-Ecosystem, An Integrated View of Geology and Biology"
One day in the park in conjunction with "The Greening of Yellowstone"
One day in the park in conjunction with "Fire and the Yellowstone Ecosystem"

Exhibits include:

Art, Photography, Library documents exhibits, and a Film Series
Other: Concerts, Black Tie Ball,
Special Opening and Closing ceremonies at MSU and at Old Faithful,
Yellowstone National Park, with many distinguished speakers.

For further information: Carolyn Manley, Conference Coordinator,
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