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Cover: The peacefully idyllic scene on the cover of this issue belies the quandary it presents to park management at Delaware Water Gap NRA. (See story on page 3.)

Guest Editorial

Good hard scientific data, as a phrase, is hardly synonymous with "sugar coating," yet when it comes to tough, unpopular management decisions, such data often can make a bitter pill go down more easily.

I've had my share of such situations in the course of my eight years as Director of the Indiana Department of Natural Resources and my six years as a member and sometimes-chairman of the Great Lakes Fishery Commission, and I know first-hand how important it is to have the facts AND to be able to put your hands on them when you need them.

So the first thing I want to tell scientists and resource managers in the field is that I am committed in every way to GIS - Geographic Information Systems - as one of the most important tools of the future. It gives us a tool for developing common bonds between our parks and the regional geographic systems of which they are a part. Compatibility, so that data can be shared throughout the System, and retrievability, so that the immediacy of so many of our problems can be met with immediate, informed response: these are my primary concerns as I tackle the responsibility of directing the National Park Service.

Indiana was my training ground and it was a microcosm for the tasks now at hand. There I managed parks, forests, reservoirs, fish and wildlife areas, and was responsible as well for state museums and memorials, historical resources, and coal mine reclamation. It was in this position that I learned other valuable lessons. I found that by minimizing confrontation and looking instead for common goals, it was possible to make common cause of unlikely partners. The results can be surprisingly satisfactory for conservers and developers, for the environment and the human society it supports.

I take very seriously the fact that our great National Park System is an environmental barometer for the world - and the opportunity this gives us to contribute baseline information about worldwide conditions and change. We have taken global climate change as a



NPS Director James M. Ridenour

Departmental responsibility - to study it, to understand it, and to cooperate in efforts to meet those changes with all the wisdom and stewardship we can muster.

Our parks and biosphere reserves are prime sensory stations for feeling and dealing with global environmental conditions. They also afford us unparalleled "classroom" opportunities for educating the public, for bonding us to our historic and cultural past, for appreciating our natural grandeur, and for inspiring us to work toward a future worthy of our roots.

An informed public is our best hope for meeting the challenges posed by change; our park-based science and resource management is the wellspring of this vital information.

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Managing Artificial Environments with RTE Species

Editor's Note: Ever since Eden, mankind has had to deal with choices. Having to decide is nothing new. But the ethical dimensions facing us at every turn now – whether we're looking inward to the human womb or outward to the National Park System – are a whole new and distressing ball of wax. For National Park resource managers, a question even more important than "When does life begin?" is "What is natural?" Charged as we are by our mission to maintain natural areas in a state of "naturalness," we are increasingly beset by situations that challenge us to define that sticky term.

Following are two articles that deal with this dilemma. Whatever the outcome in these two cases (deer vs. plants and beavers vs. plants), we can be sure that the overarching question of where to draw lines and on which side to "rule in favor" will remain with us. In the meantime, we can take pride in the human ingenuity shown at Delaware Water Gap, where a delicate human finger is trying to balance the scales.

By Elizabeth Johnson

The only limestone fen in Delaware Water Gap National Recreation Area and in this part of the Pennsylvania occupies a 3-4 acre site, partially in a powerline right-of-way. The area under the wires is cleared periodically of woody vegetation allowing for the development of dense herbaceous growth. Populations of three plant species cataloged as rare, threatened and endangered in Pennsylvania grow in the treeless portion of the fen. Each species has special requirements for its survival which are met here by the periodic clearing. Open area must be maintained to perpetuate capillary beaked-rush (*Rhynchospora capillacea*), it is not tolerant to shading. Brook lobelia (*Lobelia kalmii*) reaches the southern limit of its range at the site, and may be declining due to competition from other herbaceous species. Shrubby cinquefoil (*Potentilla fruticosa*) (pictured in *Park Science*, Fall 1988, p. 21), also occurs at the southern limit of its range and is a vigorous population at present, probably because powerline clearing activity reduces competition from canopy species.

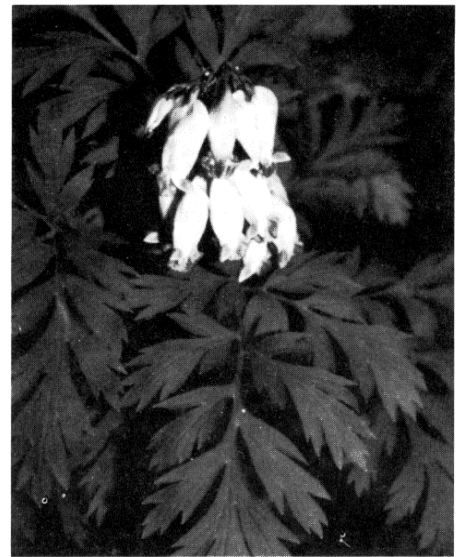
All is well. The powerline right-of-way is kept clear without herbicides, the fen is frequented by few besides botanists and black bears. Enter the beaver (*Castor canadensis*). The beaver were particularly industrious, excavating and constructing a 2 foot high earthen dike, that extends a horizontal distance of almost 200 feet to create an artificial impoundment. The beaver-created wetland has artificially raised the water level in the fen area, creating new habitat for the state endangered bog turtle (*Clemmys muhlenbergi*), which is found in the area, as well as for other reptiles, amphibians, mammals, birds and insects, many of which may be rare, threatened or endangered.

While the plant species in the fen may adjust to the new water level, they may not be able to compete with other wetland species that will benefit from the influx of nutrients brought by the additional water.

The question becomes: How can we have it all – rare plants, bog turtles, wetlands, beaver? The scales appear to be somewhat balanced in this artificial-natural situation. Beaver have created additional wildlife and plant habitat that may impact fen habitat artificially maintained by human clearing activities. The answer at Delaware Water Gap NRA has been to install a "beaver fooler" in the dam (See *Journal of Wildlife Management* 27(3): 471-476). These consist of several lengths of perforated PVC pipe inserted at a level that will maintain enough water to satisfy the beaver while avoiding impact to the fen. Continuous monitoring of the situation and constant adjustment to the system are vital. Local volunteers and State Natural Heritage Program personnel provide assistance. We doubt that the beaver will stay in this area long,

since their food source is finite, and we want to insure that the rare plants remain when they move on.

Johnson is Resource Management Specialist at Delaware Water Gap National Recreation Area.



Dicentra eximia



Lobelia kalmii



Potentilla fruticosa

Related story on page 4

White-tailed Deer Workshop Addresses Inter-regional Issues and Conflicts

By Susan P. Bratton

From April 15-17, 1989, NPS research scientists, managers and resource management specialists met with University-based ecologists and wildlife managers to discuss present issues and future management options for white-tailed deer herds resident in National Park Service areas in the east. The training workshop, held in Atlanta, was organized by Michael Soukup and Allan O'Connell of the North Atlantic Region, and was hosted by the Science and Resource Management Division of the Southeast Region. The initiative was sponsored by the Wildlife and Vegetation Division, NPS Washington Office. Attendees represented parks and regional offices in the North Atlantic, Mid-Atlantic, National Capital, Southeast, Midwest and Rocky Mountain Regions, as well as the Wildlife and Vegetation Division.

White-tailed deer (*Odocoileus virginianus*) are the most common large herbivore in the NPS areas east of the Mississippi, and they also inhabit western parks such as Yellowstone and Big Bend. Well-adapted to successional forest and field communities, white-tailed deer populations have increased in recent decades, causing a series of managerial problems, including frequent traffic accidents, heavy browsing of native forest communities, reduction of herbaceous plant populations, and depredation of crops and horticultural plants. Under intensive hunting or predation, or in poor habitats, deer populations can remain low. In fact, managers of a few park areas, such as Big Cypress National Preserve, are concerned that deer numbers may be below desirable levels. In these areas deer are an important prey item for the endangered Florida panther, found in both the Everglades and in Big Cypress.

Several presentations at the meeting documented concerns about intensive deer grazing and browsing. North Manitou Island of Sleeping Bear Dunes National Lakeshore has an introduced population of white-tails that has removed most tree seedlings and saplings. Catocin Mountain Park is experiencing bark stripping from deciduous trees and depredation of rare plant species. Deer at Fire Island National Seashore are in the process of removing most of the herbaceous species from the understory of the Sunken Forest, an unusual maritime forest community. Historic parks, such as Morristown and Valley Forge, have very noticeable browse lines. Gettysburg has large herds of deer that invade crop lands, including areas managed by the park as part of the historic scene. Enclosure projects in several of these parks indicate eliminating deer grazing allows regeneration of forest understories.

Although white-tailed deer are very popular with park visitors, they sometimes become safety hazards. Of high concern are the property damage and personal injuries resulting from deer-automobile collisions and incidents such as those at Fire Island, where deer confront people strolling down island boardwalks. In the east, small park areas or those surrounded by suburbs often have greater difficulties with these sorts of human-deer interactions than do the larger parks.

The presentations by wildlife biologists documented deer population levels, nutritional condition, reproductive rates and parasite burdens. A series of telemetry studies has been completed, indicating deer herds are

variable from park to park in terms of their fidelity to the park area. Deer at Valley Forge and Morristown are unlikely to travel far outside the park, whereas a percentage of the deer population at Saratoga NHP move seasonally across park boundaries. The size of deer home ranges and the amount of movement between park and private lands influence management options.

During the workshop a vigorous debate arose between the wildlife biologists from the State University of New York at Syracuse and the plant ecologists and the wildlife biologists from the southeast. The SUNY researchers suggested that it was not clear whether the fluctuations in the deer population we are observing today are "unnatural" and may have occurred historically. They therefore question any decision to intervene in (i.e., reduce) these populations in natural zones. This leaves the difficulty that the NPS must try to differentiate between increases in deer numbers due to "natural processes" and those due to "human intervention."

The researchers from the southeast, in contrast, argued that the high deer populations had not been historically present, were reducing vegetation diversity in forests and wood lots, and may eventually modify the forest canopy structure as well. The increase in edge zone area in eastern sites with mixed fields and forests, provides optimal habitat for deer, but does not represent the historic distribution nor scale of disturbance patches. The plant ecologists suggested that, under present environmental conditions, when deer herds decline due to disease outbreaks, the temporary reduction in grazing pressure is not adequate to release the forest understory.

This discussion led to a major point at the Conference: Each park must clearly articulate its management goals for vegetation and wildlife. These can be very different in (and within) different parks, and it is not as simple as it sounds.

Some parks with legislated hunting are attempting to reduce or stabilize deer herds through public hunts. Park managers also reported poaching as a continuing impact on deer, and some site managers felt automobile accidents were a factor keeping deer herds in check. Cumberland Island National Seashore reintroduced bobcats in the fall of 1988, and although bobcats may not lower the deer population significantly, early results from the project do indicate bobcats are consuming deer as one of their favored prey items.

A number of parks are considering some form of deer hunting or controlled deer removal to lower populations—primarily for the purposes of vegetation restoration or preserving cultural biotic resources, such as

historic woodlots. Increased interest in animal rights inhibited a recent taking of deer on Fire Island by state-selected and supervised hunters, even though waterfowl, small game and occasional deer hunting has routinely been provided in the past under the "shall permit" language of the enabling legislation. An arguable linkage of the taking with ongoing research and monitoring was seized upon for political advantage.

Hal Greenlee of Gettysburg described his park's careful, long term program to communicate the problems created by large deer populations to the general public and discussed strategies for gaining acceptance for projected management activities. Gettysburg staff also have communicated extensively with Pennsylvania state officials in preparation for a deer management program. Like the animal rights activists, pro-hunting organizations are attempting to thwart certain park management strategies, and in this case have threatened to sue if the NPS attempts to use contraception to control deer herds in an NPS area in Pennsylvania.

The meeting concluded with a group discussion of future needs and management strategies. All attendees agreed that white-tailed deer management is a major, and potentially controversial, national level problem which will require a much more coordinated program in the future. All present also agreed that hunting was an unacceptable solution in some small parks and urban areas. Although contraception is not yet technologically feasible as a general, inexpensive management alternative, new methods, such as immuno-sterilization, should be scientifically tested. Contraception is acceptable to some, but not all, animal rights advocates. For larger parks, and those where deer move freely across the park's boundaries, contraception may never be a viable alternative.

Present legislation does not permit hunting in most historic and cultural parks, as well as most large natural area units. Larger natural areas have the option, in some cases, of encouraging or reintroducing predator populations, while most of the historic areas are too small for this strategy to be viable. The group suggested using Gettysburg as one prototype of the historic/small park problem, and obtaining national level support for dealing with the legal, technical and public relations issues. A final report on the meeting, designed as a resource paper for park managers, is being prepared. Parks interested in becoming part of the white-tailed deer mailing list and information network should contact Mary Foley in the North Atlantic Regional office.

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Crater Lake NP Research Continues To Excite, Amaze

Remarkable ... spectacular ... bizarre ...

These are among the words being used by research scientists about what they are finding during deep dives to the bottom of Crater Lake in this, their third and final year of the three year hydrothermal research program there.

In addition to water samples whose chemical analysis indicate that a connection with a deep mantle source still exists on the lake floor, one of the project's two principal investigators has discovered a scattering of murky aqua blue pools on the lake bottom.

Dr. Jack Dymond, who found the first such pool on August 14 during the submersible Deep Rover's fourth 1989 dive, called them "bizarre, remarkable - I've never seen anything like it before."

The first pool found rises slightly off the bottom with a yellow rim, kidney shaped, and approximately 3 to 4 feet wide by 8 feet long. The temperature of the aqua blue fluid in the pool is 1 degree Celsius warmer than the surrounding lake water. Dymond believes it may be a solution with high levels of dissolved salts.

Dymond's co-principal, Dr. Robert Collier, on August 6 relocated the unusual bacterial mats found last summer and probed them, finding temperatures inside the mats to be 10.1 C., approximately 6.7 C. warmer than the surrounding lake waters.

Mark Buktenica, a Crater Lake NP aquatic biologist, has gathered rock samples along the lake floor as part of research sponsored by USGS. Buktenica took the one-person Deep Rover to a depth of 1,500 feet near Lloa Rock and worked up the steep caldera wall, collecting 10 rock samples.

USGS geologist Charles Bacon, a longtime researcher at the lake, was excited by the rocks, which he predicts will help in understanding the formation of

Mount Mazama and the explosion that created the lake.

Jim Milestone, Crater Lake NP biologist, described further research this summer as having added significantly to what was learned about the bacterial mats discovered in 1988. The mats were thought last year to be only a few inches thick, but this year's work shows the mats are actually about 2½ feet thick.

"It's pretty spectacular," Milestone said, "to see these thick, flocculent mats." (See *Park Science*, Spring 1989, pp. 3-4.)

Findings from the 1989 summer research will be reported in the *Winter 1990* issue, which will be distributed early in January.

The following bulletin arrived at precisely press time for *Park Science*:

"Scientists have found the warmest water ever detected in Crater Lake.

"Oceanographer Jack Dymond measured a water temperature of 64 degrees F in a bacterial mat near the lake bottom this week (August 25), according to Jim Milestone, biologist for Crater Lake NP. The temperature is 25 degrees higher than the surrounding lake water, which is about 38 degrees F. The new mark is nearly 15 degrees warmer than the warmest deep-water temperature recorded last summer.

"The new temperature reading could eventually be significant because the USGS defines 'hydrothermal water' as water that has a temperature of at least 10 degrees C or 18 degrees F higher than the surrounding water."

Superintendent's Corner

Delaware Water Gap National Recreation Area is a 69,000 acre unit of the National Park System receiving over 2.5 million visits per year. Outdoor recreation opportunities abound, including; canoeing, rafting, fishing, hunting, hiking, and sightseeing. These uses are dependent upon the preservation of a variety of outstanding National resources including; a segment of the Appalachian Trail, a unit of the Wild and Scenic River System, geological features such as the Delaware Water Gap, outstanding wildlife including a growing population of Bald Eagle, over 83 sites listed on the National Register of Historic Places, and an abundance of historic and prehistoric archeological sites.

The safety of the public and the protection of these outstanding resources are entirely dependent upon the behavior of visitors and adjacent residents of the area. In recent years we have undertaken a number of social science studies to understand the backgrounds, values, and motivations of different user groups within the NRA. The information from this research is vital for us to determine how best to communicate the importance of the resources within the NRA, the opportunities that exist for outstanding recreation, how to use the NRA safely and, most importantly, how to use it with care and respect.

Projects such as an appropriate river recreation use study, a hunter survey, and the Visitor Services Project Survey have all contributed significantly to our management decisions and planning. It is time, however, to regularize our approach to understanding the park visitor. We need to take stock of the data we have collected and where studies still need to be undertaken. Equally important, we need to understand clearly where these types of efforts cannot significantly assist us.

During FY90 we are undertaking the development of a social science research plan for the NRA in cooperation with Dr. Gary Machlis. With funding resources always scarce, and given the inexact nature of social science, it is critical to have a comprehensive and carefully considered approach to this research.

Major and continuing efforts to understand our visitors are long overdue in the National Park Service. We can ill afford to employ the social sciences without a carefully considered and long-term commitment. We hope that a social science research plan will be the vehicle to accomplish this objective.

Richard G. Ring, Superintendent
Delaware Water Gap National Recreation Area

letters

The new regional MAB programs, such as the Southern Appalachian (SAMAB) Program, (see p. 19) represent an exciting development in the evolution of Man and the Biosphere. This approach ideally will integrate resource preservation interests of the core area of Biosphere Reserves with the surrounding areas, which usually are devoted to a variety of land uses including recreation and development. The regional approach provides a framework for cooperation among different agencies, states, communities, individuals, and, in certain cases, different countries.

I see this development as very similar to the approach that has been used successfully in the National Park Service's river conservation programs over the past 10 years. In both Congressionally mandated Wild and Scenic Rivers studies and in the state and local river conservation technical assistance programs, the North Atlantic and Mid-Atlantic Regions have been using cooperative strategies to further river conservation. Successful projects such as the Wildcat Brook Wild and Scenic River Study (conducted by NAR), illustrate how effective this cooperative approach can be for marshalling public support and obtaining longterm commitments to resource conservation from a variety of organizations.

A similar strategy of community involvement and cooperation is currently underway as part of the General Management Plan for Acadia NP and at Gettysburg National Military Park. Progress on these projects indicates this approach is proving successful.

Given the potential these projects have for providing guidance to the new regional MAB programs, as well as to parks dealing with external threats, NPS could benefit from evaluating this experience, making this information available throughout the Service, and institutionalizing this approach in NPS planning guidelines. This opportunity to learn from experience in NPS programs should not be missed!

Among references to buttress this position are:
Arnberger, Robert L. "Strategic Management Needed to Maximize Park Resources," *Park Science*, Vol. 8 (Winter 1988) pp. 18-19.

Brown, Warren Lee. *Case Studies in Protecting Parks: Accomplishments in Protecting Parks from Adjacent Land and Resource Development Impacts*. USDOI National Park Service Natural Resources Report 87-2. Washington, D.C.: National Park Service, December 1987.

Conservation Foundation. *National Parks for a New Generation: Visions, Realities, Prospects*. Washington, D.C.: The Conservation Foundation, 1985.

Diamant, Rolf, J. Glenn Eugster, and Christopher J. Duerksen. *A Citizen's Guide to River Conservation*. Washington, D.C.: The Conservation Foundation, 1984.

Mott, William Penn, Jr. "Looking Beyond National Park Boundaries." *Natural Areas Journal* 8 (1988): 80-82.

Town of Jackson. "River Conservation Plan: Wildcat Brook, Wild and Scenic Rivers Study, Jackson, New Hampshire." Typescript, July 1987.

U.S. Department of the Interior, National Park Service. "Draft Report: Wildcat Brook, Wild and Scenic River Study, Jackson, New Hampshire." Typescript, February 1988.

Nora Mitchell, Resource Mgt. Spec.
North Atlantic Regional Office

Elwha Fishery Restoration Project Reviewed

By John Aho and John Meyer

"Ladies and Gentlemen, it is time."

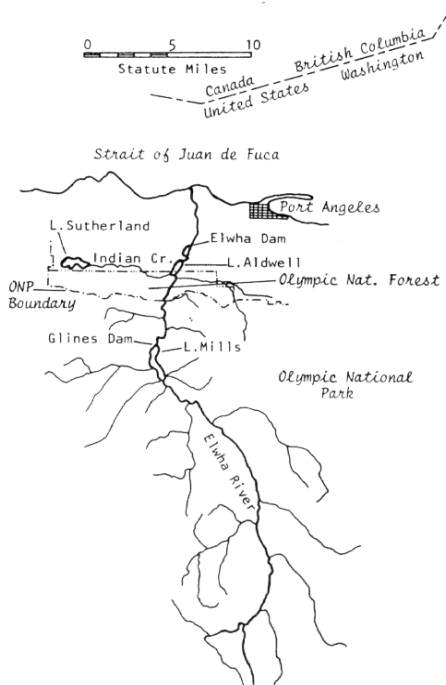
The simple words struck the delegates to the 1983 Olympic Wild Fish Conference as probably the most eloquent statement made on behalf of restoring wild salmon and steelhead trout to the upper Elwha River. The speaker was Dick Goin, a respected friend, a sportsman, and a lifelong resident of the Olympic Peninsula. His subject was the restoration to a majestic river of fish runs that ended nearly 80 years ago.

Yes, after 80 years, it is time, and time and opportunity coincide in the next few years. The dams, which produce hydroelectric power and block fish passage, require a license from the Federal Energy Regulatory Commission (FERC). Previous licenses and permits have expired. A new license is being sought by the James River Corporation, owner of the two dams. The fishery management agencies in the State of Washington, which include the NPS, have an opportunity to recommend to FERC that certain conditions accompany any license granted. Such conditions include mitigation measures to restore the upper Elwha ecosystem. These would include restoring the anadromous fish runs.

Chinook salmon fingerlings have been planted recently in the upper Elwha watershed to start again their ancient cycle, highlighting the current effort to restore salmon and steelhead runs above the two dams. Picture an early spring on the Elwha, the ice-green waters the color of glaciers. The meltwaters seep from alder bottoms and spruce terraces, gush from valley walls and side canyons, augmented by hundreds of tributaries. As the waters mix and swell, their chemistry creates a unique pattern of scents that characterize their origin. To fish, this is the smell of home and is imprinted upon every fingerling salmon. Three or four years later, after emigrating downstream and roaming the Pacific Ocean, the surviving adults will return to the Elwha. The survival of these salmon as they pass the dams, both downstream and upstream as adult spawners, is largely what the Elwha Restoration Project is about.

The effort began in 1983 at the conference, which renewed public interest and management attention to the issue of fishery restoration. The subject has recurred periodically during the preceding several decades, but like the salmon themselves, futilely attempting to leap the 100 foot high Elwha Dam, past efforts failed, leaving but a few fertile eggs to keep alive the hope of the next generation.

Most of the watershed lies within the park and has never been logged. The single development, the Glines Hydropower Project, was built in 1926-27 to enhance power production from the Elwha Project, constructed earlier between 1911 and 1914, below the boundary of today's national park. The Lower Elwha Band of the S'Klallam Tribe had long used the fishery to sustain a community at the Elwha's mouth. A treaty won for the new settlers the right to fish in common with the S'Klallams. Implied in the treaty is the belief that there were and would continue to be plenty of salmon to satisfy all needs. Much later, harvest disparity and the states' refusal to recognize treaty fishing rights (particularly for steelhead), precipitated an historic civil court case – the Boldt decision – adjudicating a 50-50 split of the harvestable fishery resource, and affirming the right of native Americans, in this case, the S'Klallams, to fish in their usual and accustomed places using their customary methods.



Elwha River drainage.

The S'Klallams contend that a major cause for the loss of their fishery was the construction of the two dams. Neither has provision for fish passage, either upstream or down. The sole mitigation for the loss of the fishery was negotiated by the State of Washington Department of Fisheries. It resulted in funding for construction and operation of a rearing channel to produce chinook on the lower river, at a cost of about \$90,000, annually, to the hydro operation.

No dollar value has been generated for the lost fisheries. However, an annual value just for chinook of about \$800,000 is reasonable, based on minimum pristine production estimates and combined sport and commercial catch values in 1988.

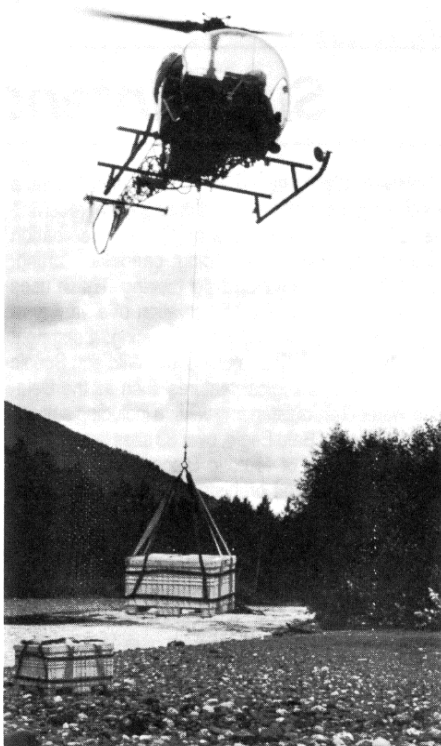
The Washington State mitigation settlement is significant, for it maintains the critically important chinook gene stock that may be used to restore this species to the upper river. While some of the Elwha spring chinook were the stuff of folk tales, their large size and stamina ensuring a place in the sporting annals, the higher value of such animals lies in their contribution to ecosystem restoration. Spring chinook stocks enter early and probe the highest reaches of the rivers, seeking the cool headwaters and shaded canyons within the park. The Elwha stock had a unique place in the ecosystem the agencies seek to restore. While the stock available from the lower river today has been changed to the introduction of non-Elwha genes, it remains the sole genetic reservoir of the original Elwha stock. When one observes these chinook massed in the cramped pool at the base of the Elwha dam, one cannot doubt that the instinct to search out the headwaters remains strong.

Early settlers shared the fishery with the S'Klallams. At Indian Creek, which enters the Elwha at the head of Lake Aldwell, the Indians traditionally had maintained a fishing camp. Thousands and thousands of pink salmon, a species noted for its mass spawning, congregated every other year. The settlers drove buckboard wagons into the creek, speared salmon with

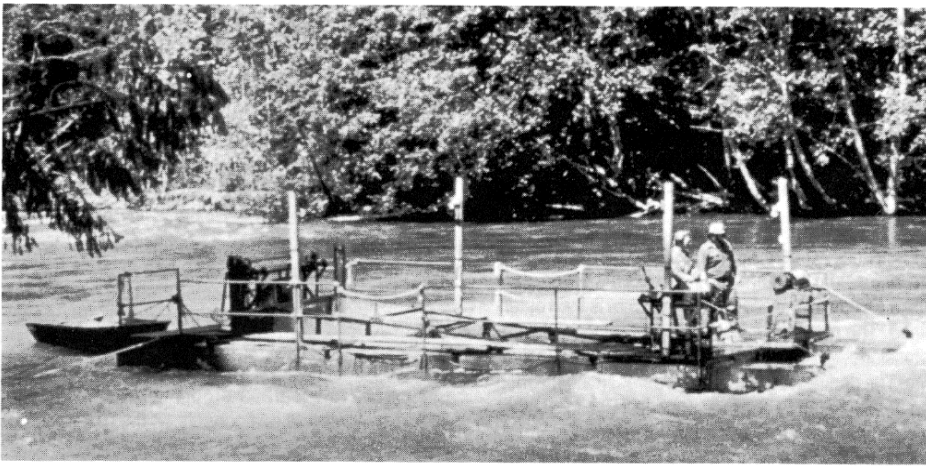
pitchforks, and loaded their wagons till they sagged deeply onto their springs.

With construction of the first dam the fishery was devastated. No longer could the many unique genetic stocks of salmon and trout reach the upper river and tributaries. This was an environmental catastrophe. At the time the dams were constructed, the economic benefit of electric power generation was the single focus. That economic base has sustained industry through today, but now proposed expansion of the Daishowa America paper mill will depend to a much greater extent on BPA power, making the two dams' importance questionable.

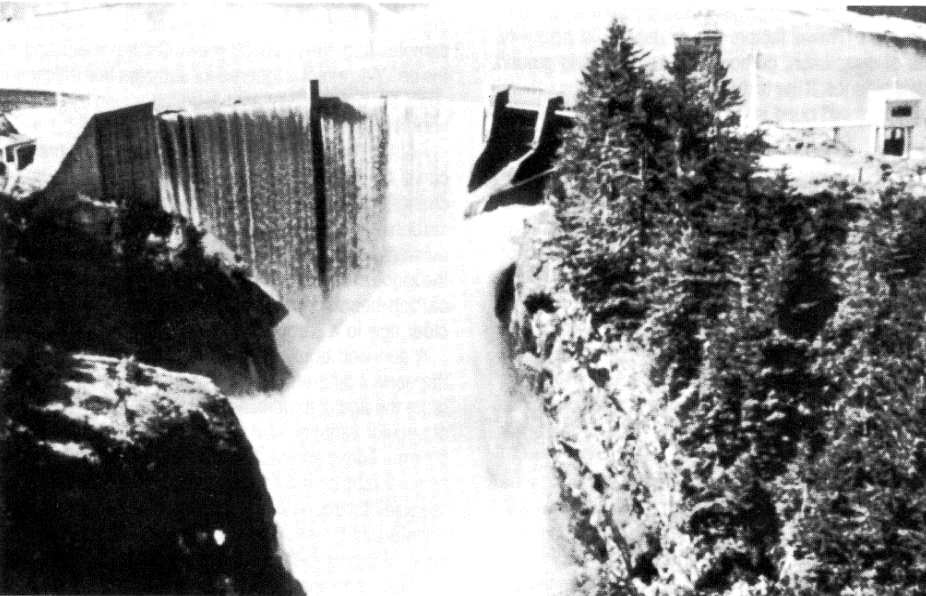
While restoring a "fishery" implies harvest, the park manager views the larger task of ecosystem restoration. Harvest is secondary to the objective of restoring ecosystem elements, community structure, and processes that existed prior to the dams. However, fishery restoration is a first, major step. Fishery restoration might be accomplished without removing the dams, but only dam removal will restore natural hydrologic processes and habitat conditions that affect populations of beaver, river otter, elk, and bald eagles. With or without the dams, restoration alternatives include using a mixed stock management approach (both hatchery and wild stocks), or wild stocks only. In stock rebuilding should hatchery outplants of fingerlings be preferred over adults? Should rebuilding rely upon natural spawning escapement? The answers to these and other questions depend on NPS management policies, park management objectives, and fishery management goals, policies and objectives of our cooperators – the USFWS, the Washington Departments of Fisheries and Wildlife, the National Marine Fisheries Service, the U.S. Bureau of Indian Affairs, and the S'Klallam Tribe.



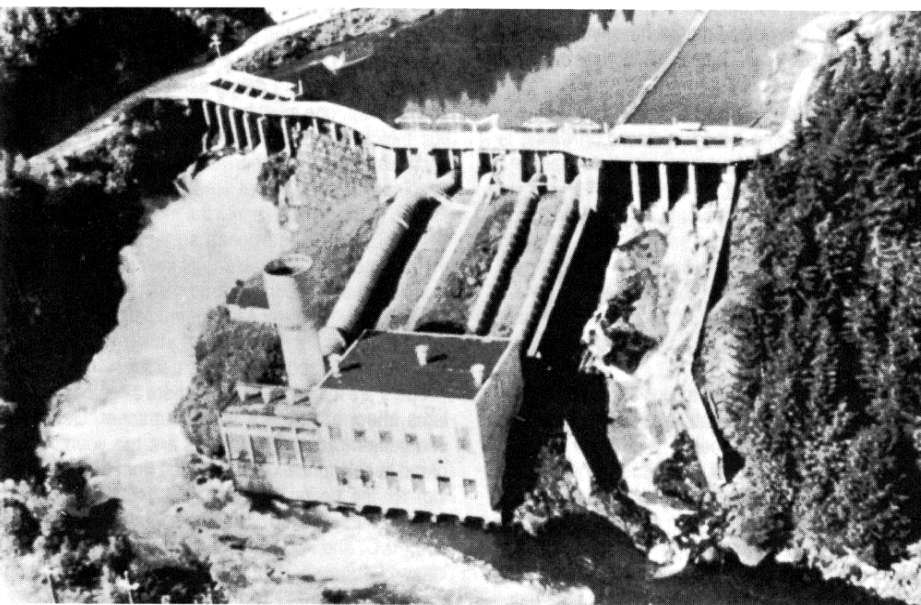
Airlifting "fish totes" carrying fry for release in the upper Elwha River.



Inclined plane smolt trap operates below the Elwha dam to sample smolt survival.



Glines Dam impounds Lake Mills within the boundary of Olympic NP. (Photo circa 1950, courtesy of USFWS archives.)



Elwha Dam impounds Lake Aldwell outside the boundary of Olympic NP. (Photo circa 1950, courtesy of USFWS archives.)

The restoration alternative with the best chance of success is dam removal. A combination of upstream and downstream passage facilities and operational accommodations would allow restoration to begin with the dams in place.

At the Glines Dam all spawners entering the trap will be grouped as up-river stocks and moved to a release site on Lake Mills, from which they will continue their migration. The Federal Energy Regulatory Commission (FERC) license applicant, James River Corporation, proposed trap and haul facilities for upstream passage at only Elwha Dam. Such an operation would involve human selection of spawners for the middle reach between the dams, confounding natural instincts of the fish to return to the reaches or tributaries upon which they were imprinted. It is generally assumed that natural selection will best produce and sustain viable genetic stocks over time. If the dams remain, the Agencies recommend a fish ladder at Elwha Dam that will accept all species and permit volitional distribution of spawners throughout the middle reach at all times of the run return.

The downstream passage alternative preferred at Glines Canyon Dam is to attract smolts over the spillway, maintaining sufficient flow during outmigration to entrain the fish, carrying them safely into the plunge pool at the dam's base. The constant attraction of the turbine intake presents a problem to be resolved by screening or turbine shutdown during periods of outmigration. New studies indicate problems also in passing fish safely over Glines Dam spillway. Some structural modification may be required there, too.

The Elwha Dam turbine intake must be screened, and the spillway presents another unique passage problem. Instead of a smooth crest-to-plunge-pool flow, the water leaves the spillway at the bottom of the gates and explodes into a raceway with exposed rock outcrops and a bend in the middle. Fish entering this flume are tossed and battered. Injury during spillway passage must be reduced. A combination of flow manipulation and spillway restructuring is planned. If screening is not used, turbines must be shut down during periods of smolt outmigration.

As several species are involved, downstream passage strategies are further complicated. Managers lack specific data about timing of smolt emigration and other behavior of the stocks currently found in the watershed and available to the project.

Support by Washington State and federal agencies, tribal governments, industry, sports clubs and other conservation organizations for restoration of the Elwha River fisheries has coalesced into a committee, the Elwha Restoration Steering Committee, which serves to communicate technical and other information to all groups affected by or interested in the restoration project. Thirteen feasibility studies carried out between 1954 and 1988 are available on the subject.

The chinook smolt emigration described at the beginning of this article is based on a plant of over 400,000 fingerlings widely distributed in the upper river in the spring of 1989. The objective is to refine information about outmigrant timing and exit selection for this stock, progeny of chinook that returned to the Elwha Spawning Channel and the lower river.

The present is a time of waiting. The agencies and the tribe are waiting for FERC to respond. Hosey and Associates, the consultant for the license applicant, and the James River Corporation are also waiting for FERC to respond. Conservation and recreation organizations are waiting for the government to act. The fish are waiting for passage to the upper river.

"Ladies and Gentlemen, it is time."

Aho and Meyer are biologists at Olympic NP.

Tips About Some Chronometric Dating Techniques

By Judy Miles

High tech analysis has opened up some new and different approaches to archeological research – avenues that do not require a degree in biochemistry or chemical engineering. One does, however, need a general knowledge of the techniques and some idea about which questions to ask. What follows is information that can help illuminate the results obtained from four of these sometimes high-priced dating techniques.

Archeomagnetism

Archeomagnetic dating is the process of determining the magnetic alignment of particles in intensely burned clay, and comparing it with the history of the earth's magnetic field in order to derive an approximate date the sample was burned. This is possible because the magnetic alignment in a sample heated to several hundred degrees centigrade tends to parallel that of the earth's magnetic field as the sample cools. Before planning archeomagnetic dating analysis into your project, make sure your sample is from the past few thousand years – that is, within the known history of the earth's magnetic pole movement.

The accuracy of the obtained date will relate directly to the extent of documentation used to establish the magnetic pathway in the 500 to 1000 square mile area where the archeomagnetic sample was collected. The regional pathway calibration is necessary because the earth's magnetic field is not uniform. If the region's magnetic history has not been documented, it can be done by sampling naturally magnetic sources. A specialist can help develop a sampling scheme. Archeomagnetic dating in the Southwest is not useful for dating artifacts from the past 200 years because the natural pole has changed very little during this period. Otherwise, the Southwest has a well documented polar curve.

A stronger, more accurate reading can be obtained from clay samples containing magnetite rather than those with hematite minerals, however the latter is acceptable. Limestone derived soils are magnetically weak and not so good for analysis. Volcanic soils/rocks in clay are contaminates and can interfere with the magnetic readings of the clay. In areas where this contaminant prevails, such as at Bandelier National Monument, the best procedure is to collect pure samples of possible contaminants (e.g., tuff rock and soils in the case of Bandelier) and analyze it relative to a sample of the feature being dated. This step corrects for the degree of contamination.

Precision in archeomagnetic analysis is probably more important than accuracy in interpreting dates, because the real utility of the technique is relative dating (or within 50 to 100 years). Two samples from one feature are too few for precision. When a third sample is taken, the confidence in precision doubles over that of two samples. Statistically, five samples from one feature are needed. To these five, other samples can be added to determine the degree of contamination.

Rock Varnish Dating

The stain on rocks called desert varnish is actually oxidized manganese (black outer surface) and oxidized iron (red stain on underside). The oxidation is a biogeochemical function of fungi and bacteria feeding on organics in the dust adhering to the rock's surface. Dating the varnish is tricky since several conditions must be met to obtain a reasonably accurate date. The technique is most successful in dating varnish on lava flows. Dating desert varnish from sandstone formations like those at Canyon de Chelly National Monument is still in the experimental stage.

The process involves chemical analysis of a sample

of the varnish to determine the cation ratio of calcium and potassium to titanium. A potassium/argon date from a sample of the associated lava flow is then determined. The resultant is used to calibrate the calcium-potassium/titanium ratio, which is a linear function over time. The derived regression line representing the ratio can then be used to obtain a numerical age from other varnish samples. However, each potassium/argon calibration is specific to an individual lava flow and should not be used to date samples from other areas.

Problems recognized by experts in dating varnish have to do with factors that influence the rate of calcification. These factors are variations in solubility, rate of dissolution, carbonate influx rate, and ground water balance. If the technique is further refined, these conditions will need to be known.

Thermoluminescence Dating

Thermoluminescence (TL) dating measures cumulative radiation exposure as seen through heat induced luminescence from a compound's mineral crystal defect structure. About a .5 gram sample is needed for TL analysis. It is standard procedure also to collect a sample of the surrounding matrix.

TL is not an appropriate technique for determining accurate absolute dates or dating samples containing metal. It is valid for relative dating or differentiating items separated by a hundred years or more. Its upper limit for dating ceramic artifacts is 50,000 years; for rock samples, 500,000 years.

A few safeguards against accidentally changing the structure of the crystals analyzed include (1) not washing porous samples such as ceramics, sandstone, and limestone; and (2) limiting exposure to sunlight and artificial white light to an absolute minimum, since light can alter the crystal defect structure.

The technique has an inherent margin of error of about 10 percent, conventionally accepted as allowable. Unfortunately, commercial TL dating laboratories no longer operate in North America but several university campuses carry out TL analysis for their own programs.

Radiocarbon Dating

Other than tree-ring dating, radiocarbon dating is probably the next most frequently used chronometric technique in archeological analysis. If a well preserved sample is obtained, treated carefully, and analyzed properly, the resulting date can be quite accurate. Such accuracy has been useful in trying to answer broad questions such as – What are some of the evolutionary stages in humans? When did humans first populate the New World? When did animal domestication occur?

Radiocarbon dating is a technique that analyzes the carbon content of organic materials, usually bone and charcoal. Recent developments have made possible the radiocarbon dating of individual amino acids extracted from bone collagen. For accurate analysis, a certain amount of organic carbon must be present. Its presence is determined through microanalysis that determines the percent of nitrogen content; less than .2 percent nitrogen means the bone collagen has deteriorated past the limits of radiocarbon dating.

Preservation of original organic carbon in bone is

lessened by hot and humid climates, alkaline soil, high degree of plant activity, handling with oily hands, and packing in organic containers. However, if the radiocarbon lab processes the samples correctly, low level contamination of the original carbon is removed.

A radiocarbon calibration curve is used in determining the calendrical date of a sample. The calibration curve is independently based on tree-ring dated samples. The comparison reveals short term/high frequency natural perturbations in the radiocarbon calibration curve known as the de Vries effect. These variations are thought to be caused by magnetic modulations of radiocarbon production rates and the effects of nondipole components on the geomagnetic field.

The de Vries effect can greatly extend the range in which the calendrical year has a statistical probability of occurring. Considering this has led to the realization that precision is ultimately reduced for radiocarbon samples from the past 400 years. On the other hand, if the de Vries effect is ignored for samples from this time span, the dates will invariably be too young by several hundred years.

Another problem in the radiocarbon calibration curve is caused by the Suess effect. These are huge changes in the concentration of carbon in the world's carbon reservoirs. Much of the flux is due to excessive burning of fossil fuels. As they burn, their carbon dilutes the modern carbon in the various reservoirs containing carbon-based materials, thus giving an erroneous older age to a sample.

A deduced equilibrium value of carbon isotopes in the earth's different carbon reservoirs is used to calibrate the age of a radiocarbon sample. There is a type of secular variation that upsets the radiocarbon equilibrium. These effects include changes in the atmospheric rate of radiocarbon production, variations in the size of carbon reservoirs, and rates of radiocarbon transfers between reservoirs. A deduced equilibrium value of carbon isotopes is used to calibrate the age of a radiocarbon sample. If production or transfer rates of radiocarbon are drastically altered within the lifetime of the organic sample, the formerly deduced equilibrium value would not represent the conditions during which the sample "lived." In these cases, if a new equilibrium value is not calculated (again through tree-ring dates), the resultant date will be erroneous.

When radiocarbon dating samples from an ocean environment, one must be aware of the marine reservoir effect that adds dead carbon in samples. Dead carbon has no radiocarbon atoms present. Sources for dead carbon include coal, limestone, oil, and volcanic carbon dioxide. It works into the marine food chain by being brought to the ocean surface via upwelling, thereby making it available to plankton. Dead carbon makes its way through the food chain to animals such as mollusks, fish, and sea mammals. Samples from these organisms will date too old, due to the dilution of their modern carbon with dead carbon.

There are major time spans where all of these problems affect dating in a specific manner. Generally unmodified radiocarbon dates are too young compared to calendrical dates (derived from tree-ring dating) for the period of about A.D. 1400 to 300 B.C. Likewise, they are too old for the periods of 300 B.C. to 6000 B.C. and A.D. 1400 to the present. Below is a litany of suggestions that will assist one in knowing when to request radiocarbon dating and how to analyze its value.

1. Know which half-life was used to obtain a radi-

The Use of National Parks by Older Americans Suggests New Service Patterns Needed

By Francis McGuire and Joseph O'Leary

The greying of America is a well documented phenomenon. The increasing numbers of older Americans are having an impact on all areas of society. The approximately 29 million individuals aged 65 or over, representing one out of every eight Americans, touch every aspect of life in the United States. And contrary to myth, the vast majority of older adults are active, healthy, and independent.

National Park Service areas are not immune from the influence of the changing population pyramid. The NPS, through its Golden Age Passport program, has invited this growing portion of the population into the nation's parks. However, not a great deal is known about the use of parks by older visitors. More information on the program and facility adaptations necessary to serve older visitors is needed.

In order to gain a deeper understanding of older users of parks, a study was initiated in 1987. Funding for the project was provided by the AARP Andrus Foundation. The Eastern National Park & Monument Association supported the project by providing copies of *Passport to your National Parks* to individuals participating in the study. Technical assistance and support were provided by the chief scientist from the Southeast Region of the National Park Service.

The study had three major purposes:

1. To examine the services and facilities used by older visitors to national parks;
2. To assess the satisfaction of older visitors with the range of services and facilities available in parks;
3. To identify use patterns of older visitors.

Three hundred individuals who had used Golden Age Passports during 1987 evaluated the parks they had visited. In all, 804 Park Evaluations were completed and 140 parks were represented. Participants

were drawn from lists of individuals who had obtained their Passports in parks in the Southeastern Region between 1984 and 1986. Therefore, respondents were over-representative of states in this region and all were relatively new Golden Age Passport users. Most of the participants were veteran park users who had visited more than 30 different parks.

What services and facilities are important to park users?

The data indicated that older visitors were primarily interested in using services and facilities considered traditional to the mission of the parks. Respondents were asked to indicate how important each of 34 attributes was in making a park "ideal." The most important areas to older park users were: upkeep of facilities (identified as either "very important" or "extremely important" by 95.5 percent of the respondents); information signs (94.1 percent); upkeep of grounds (91.8 percent); staff (89.3 percent); information sources such as maps and brochures (89.3 percent); restrooms (87.4 percent); parking (85.9 percent); visitor center (85.4 percent); scenic overlooks (81 percent); and exhibits (80.6 percent). The least important areas in an ideal park were activities such as swimming, hunting, horseback riding and boating. Auxiliary services such as food, gift shops, and lodging were not perceived as important.

Data related to motivations for choosing a park to visit also provided information on services and facilities sought by older visitors. Having lots of different things to do and see was very important to over 53 percent. Other important motivations were the opportunity to spend time with someone special (very important to 48 percent of the respondents), a feeling of security (43 percent), and being physically active (46 percent).

How satisfied are park users with the range of services and facilities available at national park service areas?

Results indicated an extremely high level of satisfaction on the part of Golden Age Passport users. Areas where performance was below a "very satisfied" standard were campgrounds, food service, picnic areas, souvenir/gift shops, lodging, medical services, and the provision of specific activities such as swimming and hunting. Of these, only campgrounds and lodging were viewed as being important.

Respondents were asked to indicate what they liked best and least about the parks they visited. A high number of respondents liked the scenery, nature and wildlife, as well as programs such as lectures. Some areas, such as staff and maintenance, received mixed reviews. Staff members sometimes were described as non-responsive to the needs of older visitors, for instance by not speaking loudly enough or by walking too fast; however, in other cases staff received high praise. There was clearly park by park variation in this area.

A major area frequently identified as "least liked" related to information in the parks. Golden Age Passport users expressed dissatisfaction with road signs, trail signs, and signs at facilities. The fact that even veteran park users were confused by poor or inadequate information indicates that the matter of "signing" may be a major problem area.

Another area frequently identified in the "least liked" category was campsite problems. This included things such as no electricity, campsites too close, not enough campsites, campsites which were not level, and no

dumping station. These responses are consistent with the finding that of those respondents staying overnight in a park the most common shelter was a motor home (28.3 percent of the overnight visitors stayed in a mobile home). This was followed by a lodge/motel (25.4 percent), and a travel trailer (18.8 percent). The qualities many of the older overnight visitors sought in a campground were related to their mechanized accommodations.

What use patterns do Golden Age Passport users display?

The participants in this study, as with the general population, were most likely to visit a park in July. However, unlike the general trend, August was not a high visitation month for older visitors. May and September were more likely visitation times than August, contrary to the use patterns displayed by general public. In over 60 percent of the cases the respondent's primary destination was somewhere other than the park visited.

Recommendations

Part of the difficulty in designing research projects to examine the needs of older park users is the individuality of the elderly. There is no one accurate model of aging. As a result, there is no single approach to serving this population group. The problem is further exacerbated by the uniqueness of each National Park Service area. Generalization therefore is speculative and suggestive rather than definitive. The following recommendations are made based on the findings of this study. Further study is needed in individual parks to verify them.

1. As more older individuals visit National Park System areas there will be increasing interest in interpretive programs, guided tours, museums, and other information and education programs. Increasingly, these programs will need to be tailored toward older visitors. For example, the pace of such programs, distances walked, speaking volume of staff, physical accessibility of facilities, use of multi-media programs to compensate for sensory deficits, and staff attitudes toward the elderly will demand new consideration.

2. Services such as parking, security and informational signs may become increasingly important. Older visitors rely on such services to make their visits enjoyable and safe. Increased attention to the availability of accessible and safe facilities and programs is warranted.

3. Activities such as swimming, boating, and fishing are not very important to most older visitors. Although they want to be active while in the park, most older visitors do not participate in outdoor recreation activities. There may be a growing need for more attention to educational programs focused on natural and cultural resources and less on recreation activities.

4. May and September are months when older visitors are more likely to be visiting National Park areas than are the general public and therefore may be opportune times for programs and services designed specifically for such visitors.

5. Overnight facilities could be modified to meet the needs of older visitors. Campgrounds and lodges may need to be redesigned. Many older visitors in recreation vehicles find the current campgrounds unsuitable for their needs.

McGuire is with the U/I/L Dept. of Leisure Studies and O'Leary with Purdue U's Dept. of Forestry and Natural Resources.

Chronometric Dating

(Continued from page 8)

ocarbon date. If it was any other than the Libby half-life of A.D. 5568 plus or minus 30 years, an adjustment must be made.

2. Have the lab assess the carbon reservoir exchange rates and adjust for this in its computations.

3. Run a test to determine the nitrogen content of a sample since it is proportional to the carbon needed for dating. This is especially important for samples that appear to be in a poor state of preservation or very old.

4. Ask if the organic samples combusted during the analytical process were allowed to set after burning in order to let their radon gas dissipate. Radon will interfere with the radiocarbon counts.

5. Do not try to radiocarbon date bone that has probably received a high degree of contamination. Samples to avoid will be those from an extremely hot and humid climate, alkaline soil, a matrix of high plant activity, and those showing or known to have been in contact with oily residues.

6. Do not try to radiocarbon date tooth enamel. Its chemical makeup is not appropriate for such analysis.

7. Do not average resultant dates; they are logarithmic numbers. Averaging should be done with count rates obtained during the analysis.

8. Remember that the notation "B.P." on a radiocarbon date refers to "before A.D. 1950."

Miles is Staff Archeologist with the NPS Southwest Regional Office's Branch of Cultural Research.

Southeast Region

Largemouth bass and yellow bullhead catfish contaminated with methyl mercury have been found in Everglades NP. Sampling conducted by the park, in cooperation with the USFWS and the Florida Department of Health and Rehabilitative Services (HRS), revealed that bass from Shark Slough were well above the Food and Drug Administration's (FDA) safety limits for human consumption. Levels of mercury in bass from the Taylor Slough drainage were lower but are still cause for concern. Mercury concentrations in bullheads also were elevated, though not as high as in bass. The park is now acting on the recommendations of the Florida HRS that human consumption of bass be prohibited for the Shark Slough drainage and limited in the Taylor Slough area.

In addition, more extensive fish sampling is being carried out in the marine and estuarine areas of the park downstream from the Shark Slough, where thousands of visitors each year harvest game and food fishes. The same sampling also is being applied to freshwater panfish in the park. As a precaution, fish sampling efforts in the adjoining Big Cypress National Preserve are also underway. No point source of contamination has been identified. Several theories, ranging from agricultural runoff, to air pollution, to natural biological occurrence in peat soils, have been advanced. There is, however, no real consensus at this time.

Dr. James F. Quinlan, Research Geologist at Mammoth Cave NP, Kentucky, has resigned from the NPS. During his 16 years at Mammoth Cave, Quinlan conducted pioneering studies of the park and its cave systems and regional hydrology. He developed new techniques for tracing groundwater flows with fluorescent dyes and authored or co-authored more than 100 scientific publications. In addition, he led more than 100 field excursions, was extensively sought as a national and international lecturer, and was active in numerous scientific and professional societies.

Much of his work was relevant to the design and construction of a 15 million dollar regional sewage treatment facility that protected the park's resources. His work also contributed to the monitoring of groundwater quality in terranes underlain by limestone and dolomite (karst). His paper summarizing newly discovered principles applicable to monitoring for pollutants in karst terranes was selected by the Geological Society of America for the "Paper of the Year Award" in 1986. Dr. Quinlan has accepted a position as Senior Hydrogeologist with ATEC Environmental Consultants in Nashville, TN, where he will head a unique team specializing in applications of groundwater tracing.

Julie Thomas has been hired as a Natural Resource Specialist at SERO. She has a B.S. in Wildlife and Fisheries Science from U/TN and has worked for the TVA in both the fisheries and wildlife branches. Prior to her employment in SERO, Thomas was a wildlife technician at Fort Bragg, NC, and worked as a seasonal/biological technician at Great Smoky Mountains NP. In SERO, she will be working in air quality and wildlife issues, GIS program development, and resource management plan coordination.

Gary Hendrix, former Research Director of the

South Florida Research Center, Everglades NP, has taken a position as Biologist with the Southeast Regional Office. He recently completed a 30-day detail to WASO to assist the Associate Director, Natural Resources, with contract preparation for a review of the NPS science and research program by the National Academy of Sciences.

Hendrix also attended a July meeting at the State Department in Washington, D.C. to review the Draft Protocol for Protected Areas and Wildlife for the Caribbean. Milton Kaufman, Monitor International, gave a presentation on proposed federal actions to support the protocol during the interim between ratification in Santa Marta, Columbia, this fall and adoption by the signing countries.

John D. McCrone, Director of the NPS-CPSU at Clemson University, Clemson, South Carolina, has resigned to accept a position as Dean of Graduate Studies and Research at Pittsburg State University, Pittsburg, Kan.

Douglas L. Inman of the Scripps Institution of Oceanography, U/Cal-San Diego, and Robert Dolan, Department of Environmental Sciences, University of Virginia, Charlottesville, have published the results of their contracted research study on the dynamics of Oregon Inlet at Cape Hatteras NS. Their manuscript, known as the "Inman Report" and entitled "The Outer Banks of North Carolina: Budget of Sediment and Inlet Dynamics Along a Migrating Barrier System," appeared in the *Journal of Coastal Research*, Spring 1989 (vol. 5, no. 2, pp. 193-237).

Stephen V. Cofer-Shabica, Research Oceanographer of the NPS/CPSU, U/GA, has published three papers in the *Proceedings of the Sixth Symposium on Coastal and Ocean Management*, sponsored by the American Society of Civil Engineers on July 11-14, 1989 at Charleston, SC. They are entitled, "The Effects of Freshwater Canal Discharges on Salinities in Biscayne National Park," "Ponds and Lagoons of Gulf Islands National Seashore," and "Fish Traps in the Coral Reefs of South Florida." Copies of the reprints can be obtained through Jim Wood, Technical Publications Editor, NPS Southeast Regional Office, 75 Spring Street S.W., Atlanta, GA 30303.

The Perdido Key unit of the Florida district of Gulf Islands NS has experienced severe erosion over the past century due to the effects of channel dredging to maintain Pensacola harbor. An effort to restore the losses, which have amounted to 25 percent of the upland area over the past 20 years, will begin in November. An estimated 5 million cubic yards of sand will be pumped along 5 miles of beach during the next round of channel dredging this winter. About 500 feet of new beach will be created, restoring the area to its approximate dimensions three decades ago.

The U.S. Navy is funding a 1.2 million dollar, 5-year monitoring program to assess the effects of the project on the island's vegetation, benthic communities, endangered beach mice, shorebirds, and physical processes. A team of NPS scientists and resource managers, and cooperating researchers from the University of Florida, the University of West Florida, and the Gulf Coast Research Laboratory has been assembled

to conduct studies to evaluate the beach nourishment project.

Midwest Region

The Midwest Region's Science and Research Division has been reorganized to include additional natural resource management functions. The name of the division has therefore been changed to Natural Resources Division. The division will continue to administer all natural and social science research; natural resource management planning; water, air, and GIS programs; endangered species management; science publications; etc., as before. Additional functions transferred from the Division of Ranger Activities are: Integrated Pest Management, Mining and Minerals, Park Threats, and Review of natural resource management action plans.

A Resource Management Specialist position has been added to the division to coordinate the resource management activities in the Region.

Terence P. Boyle, research ecologist with the NPS Water Resources Division at Colorado State University, attended the Midwest Region's Research/Resource Management Conference in Scott's Bluff, Neb., recently and presented "The use of ecoregion strategies to derive guidelines for resource inventory and monitoring program" and "Strategies to develop an aquatic resource monitoring program for seven prairie parks."

Water Resources

From William Jackson, Chief of Water Operations Branch, comes word that Nancy Driver has won the 1989 American Water Resources Assn.'s Boggess Award, established in 1973 to honor the author of the best paper published in the *Water Resources Bulletin* the previous year. Driver's paper, co-authored with Gary Tasker, "Nationwide Regression Models for Predicting Urban Runoff Water Quality at Unmonitored Sites," was published in the October 1988 *Bulletin* and was prepared while Driver was a hydrologist with the Colorado District of the USGS.

Driver joined the NPS Water Resources Division in March 1989 and serves as a senior water quality specialist in the Water Operations branch.

Marshall Flug, hydrologist with the Division, chaired two sessions at the recent meeting of the American Society of Civil Engineers 1989 National Water Conference and LIFE (Legal, Institutional, Financial and Environmental) Symposium. One session was on hydrologic modeling; the other on generating alternative instream flow benefits for environmental and natural resource management. Three papers co-authored by Flug also were presented, all addressing instream flows.

Rocky Mountain Region

A cooperative effort among the NPS, the USFWS, and Exxon Corporation is collecting data for residue analysis from the oil spill on the Yampa River in Dinosaur National Monument. Analysis of data from sediment, macroinvertebrates, and fish will be used by the NPS Water Resources Division to determine if persistent chemical residue persists in critical components of the aquatic ecosystem.

Eddies in streams and rivers may have resource importance as concentrators of organic detritus and detritus-processing organisms that support important natural resources. Terence Boyle of the NPS Water Resources Division met recently with USGS personnel in Rocky Mountain NP to discuss the potential for cooperative research in this topical area. Studies would be into the hydrological and ecological aspects of eddies that are dependent on hydrological discharge. The research is expected to yield information important to future monitoring programs.

Mid-Atlantic Region

One-half of the MAR science program is on the move. Jeff Marion, at Delaware Water Gap NRA, is moving in early October to a new CPSU being established in the School of Forestry and Wildlife Resources, Dept. of Forestry, Virginia Polytechnic Institute and State University, Blacksburg, VA.

And whoever said "historical" parks don't have important "natural" resources? George Washington Birthplace NM has made MAR history by hosting the first pair of nesting bald eagles in any of the Region's parks. Not two, but *three* eaglets were fledged successfully in early July. Congratulations to the proud parents at GEWA!

Speaking of hosts ... Shenandoah NP has been playing reluctant host to several billion gypsy moths and their voracious progeny. Advancing from the north, the gypsy moth caterpillars defoliated approximately 7,000 acres of the 196,000 acre park in 1987, 16,000 acres in 1988, and 25,000 acres in 1989. Only developed zones within the park are being treated. The park is participating in the Appalachian Integrated Pest Management program with the Forest Service and the states of Virginia and West Virginia to monitor the effects and progress of the advancing gypsy moth front and to investigate new technologies for the moths' control. Shenandoah's advice to Blue Ridge Parkway and Great Smoky Mountains: *Gear up now ... they're on their way!*

Resource management operations are expanding at Shenandoah NP. The park has hired a full-time GIS Technician, a Forest Ecologist (responsible for operation of the park's Inventory and Longterm Ecological Monitoring program), and an Entomologist (whose more immediate responsibilities will include "supervision" of the burgeoning gypsy moth population).

A small artificial wetland, constructed at Friendship Hill NHS to treat acid mine drainage, is being evaluated by Bureau of Mines (USDI) researchers. Findings indicate that significant improvements in water quality can be obtained if wastewater is forced through subsurface gravel and compost layers. Only minor improvements were obtained with surface flows only. For additional information, contact John Karish, Regional Chief Scientist.

Regional Chief Scientist John Karish reports availability of a set of reports (MAR 39-41) titled "Exploring the potential partnership role of river outfitters in managing public rivers" from New River Gorge, Delaware Water Gap and Upper Delaware.

Alaska Region

The release of more than 10 million gallons of crude oil following the grounding of the EXXON VALDEZ on March 24, 1989 represents the largest oil spill ever recorded in the U.S. By early May, oil carried by marine currents had washed ashore over a widespread area. Although the heaviest oiling appears to have occurred in western Prince William Sound, other affected areas include Kenai Fjords NP and the adjacent Alaska Maritime Wildlife Refuge. In addition, oil has washed ashore on the outer coast of Katmai NP, over 250 miles from the original spill site. Oil has impacted pelagic and near-shore water columns, benthic substrate, and intertidal and supratidal coastal habitats.

The Alaska Region began wildlife, plant, and cultural resource surveys on the coastal region of Kenai Fjords on March 31, 1989, and was soon expanded to include Katmai's coast. The surveys included counts of sea birds and marine mammals, investigation of submerged cultural resources, measurement of water quality, establishment of intertidal invertebrate and beach vegetation plots, and sampling of anadromous fishes. Survey efforts later were broadened to include potential impacts to resources as a result of proposed cleanup efforts. Initial inventory efforts have evolved into detailed oil spill impact assessment work that is underway in cooperation with the Alaska Department of Fish and Game, the USFWS and other agencies.

Shenandoah Watershed Study

The Shenandoah Watershed Study (SWAS), a combination research and monitoring program, was initiated in 1979 in the Deep Run Watershed, Shenandoah National Park (SNP). Since that time, other subcomponents of the study have been added. The Deep Run portion is the longest running record of acid deposition effects in the National Park System. The objectives of the overall project are twofold:

- 1) Evaluation and interpretation of biogeochemical cycling and acid deposition effects on watershed systems and streams in SNP, and
- 2) Baseline monitoring of streamwater chemistry and precipitation in SNP.

Recent Progress: The SWAS monitoring network has been maintained and expanded. Weekly streamwater samples are presently collected for analysis from 9 locations in 4 watersheds (North Fork of Dry Run, Deep Run, White Oak Run, and Madison Run). Quarterly streamwater samples are collected from 10 additional streams. The quantity and chemistry of precipitation is determined for one location (in the Deep Run/White Oak Run/Madison Run area) and continuous stream discharge measurements are obtained for two streams (White Oak Run and North Fork Dry Run). Field research underway during the year includes studies of both hydrologic and soil controls on streamwater chemistry. Extensive data analysis also is underway, including studies of temporal trends and elemental budgets for calibrated watersheds.

Significant Findings: SNP receives an acid deposition load estimated to be 10 times the preindustrial level. Stream and watershed systems in large areas of SNP are poorly buffered against effects of acid deposition. Acidification of streams in SNP is delayed by processes that retain sulfate in watershed soils. Acidification of one stream, Deep Run, has been documented.

David Haskell, Res. Mgt. Spec.
Shenandoah National Park

Ross Kavanagh served as Finance Chairman for the 119th Annual Meeting of the American Fisheries Society held in Anchorage, Sept. 4-8. The theme of the meeting was "Fisheries Management Controversies: Biology, Economics, and Politics." The American Fisheries Society is the oldest scientific society in the United States and, with approximate 1,200 attendees, the Anchorage conference was the largest scientific/resource management gathering ever to be held in Alaska. The meeting was jointly sponsored by the principal Alaskan land and natural resource management agencies including the NPS, fish processors, and the oil and gas industry.

A GIS data base has been prepared for the Anaktuvuk Pass area in Gates of the Arctic National Park and Preserve. The vegetation map for the data base was prepared using Landsat thematic mapper satellite imagery. It contains 17 land cover types and encompasses 1.5 million acres. Thematic mapper vegetation maps are also nearing completion for Cape Krusenstern National Monument and Yukon-Charley Rivers National Preserve.

Western Region

How is the health of your park's natural resources? Bill Halvorson and Gary Davis, Research Biologists at Channel Islands NP, hosted an Inventory and Monitoring Initiative Workshop, September 6-8, 1989, that focused on developing an action plan for the Western Region parks to use in monitoring the health of their natural resources. Participants discussed the feasibility of: (1) setting goals for monitoring natural resources in the Western Region parks; (2) drafting an action plan for developing and implementing monitoring programs; and (3) developing a standard format for Park Natural Resources Status Reports. Participants included: Tom Ritter, SEKI; Harold Smith, ORPI; Denny Fenn, CPSU/UA; Tom Stohlgren and Steve Veirs, CPSU/UCS; Lloyd Loope, HALE; Jan van Wagten-donk, YOSE; Larry Bancroft, SEKI; Judd Howell, GOGA; Don Neubacher, PORE; Dick Cunningham, WR-I; Jay Goldsmith and Dr. Bruce Kilgore, WR-NR&R; John Christiano, Air Quality, WASO; Al Greene, Senior Scientist, WASO; Stan Ponce, Water Resources, WASO; Mike Ruggiero, Wildlife and Vegetation, WASO; and Phil Wondra, GIS, WASO.



Pressured pelicans - This pelican and her four chicks are among the features of Channel Islands NP that are feeling the stress of visitation, pollution, and other unnatural pressures.

Western Region

(Continued from page 11)

"Recreational fishery and population dynamics of spiny lobsters, *Panulirus argus*, in Florida Bay, Everglades National Park, 1977-1980" is the title of a paper by Gary E. Davis and Jon W. Dodrill, published in *Bulletin of Marine Science*, 44(1): 78-88, 1989. The study concludes that the Florida Bay portion of Everglades NP is an ideal spiny lobster nursery. Juvenile lobsters are abundant there and their growth rates were the highest yet recorded for the species. The authors observed that additional studies in the Florida Bay sanctuary are needed to evaluate fully the effects of harvest on the population and to determine the potential lobster productivity of adjacent, harvested juvenile habitat.

Predator-Prey Relationships of the Great Gray Owl in Yosemite NP is the title of 86-page Tech. Report #35, published in August 1989 by the U/Cal Davis NPS/CPSU. The author, Mason Edward Reid, studied the hunting methods and influence of prey populations on the owl's diet and productivity. Pocket gophers and voles made up over 90 percent of the prey biomass found in pellets. It was felt that the gophers raised the owl's mean prey weight substantially over that of owls in Europe, where gophers are not found. Yosemite contains the southernmost population of Great Grey Owls in the world and thus probably presents its owl population with more constraining factors than are found in other areas where the Great Grays occur.

A new bridge and 4 miles of road alignment will be constructed approximately 1 mile below Hoover Dam to relieve the traffic bottleneck and dangerous conditions caused by traffic being routed across the dam. Three miles of new road will be constructed on the Nevada side of the River, and one mile on the Arizona side. Both segments of road will traverse good to excellent habitat of desert bighorn sheep.

Plans are underway to capture and radiocollar 35 bighorn in and near the project area in Nevada, and to begin a 28-month intensive study of bighorn movements, seasonal habitat use, and a quantitative assessment of habitat parameters. Design and planning for the bridge and road will commence after the movement study; data from the study will be used to insure that the construction does not block movement corridors or damage critical habitat components.

The project will be directed by Charles Douglas, Unit Leader, CPSU/UNLV. Don Ebert (Yosemite) will conduct parts of the study, movement and habitat use, for his masters thesis. The study is funded by the Bureau of Reclamation in cooperation with NPS; the Bureau also is funding a companion study on the Arizona side of the river that is being conducted by AZ Dept. of Game & Fish.

David Parsons (SEKI) participated as the NPS representative to the U/Cal Workshop on Global Climate Change and Its Effects on California. The workshop, held at UC Davis July 10-12, brought together scientists and policy makers in an effort to begin to make projections as to the potential effects of a changing global climate on natural ecosystems, agriculture, water, soil and cultural resources. UC Press will publish a proceedings of the workshop.

Parsons' presentation, "Restoring natural fire to the sequoia-mixed conifer forest: should intense fire play a role" at the Tall Timbers Fire Ecology Conference on High Intensity Fire in Wildlands: Management Challenges and Options (Tallahassee, May 18-21) was extremely well received (including a favorable review in the July, 1989 Newsletter of the Vegetation Section of the Ecological Society of America). The paper (co-authored by Nate Stephenson of SEKI and Tom Swetnam of U/AZ), which raises the question of whether locally intense fire may not have played an important role in perpetuating giant sequoia groves, will be published as part of the Conference Proceedings.

On July 24, 1989, the USFWS placed the Mohave Desert Tortoise under emergency protection as an endangered species. The emergency designation, which lasts 8 months, was necessary because of the spread of a respiratory disease throughout the tortoise populations in Southern California, Southern Nevada, and Southern Utah. These disease outbreaks have the ability to decimate adults in breeding populations and some populations have been reduced by half during the past four years. All NPS sites where the tortoise may be present must conduct biological assessments.

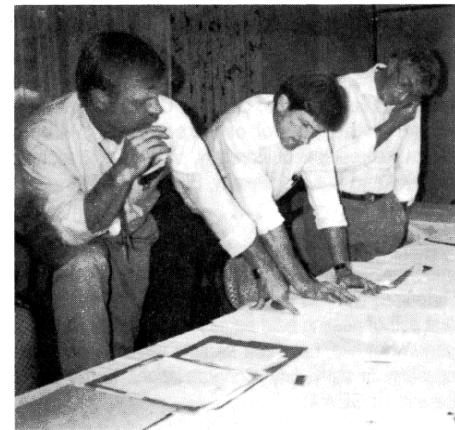
Arrangements have been completed for establishment of a new CPSU at Northern Arizona University at Flagstaff. Charles van Riper, III has been named Unit Leader and his position is being transferred from CPSU/UCD to CPSU/NAU in October, 1989. This latest CPSU, the fifth such unit established in Western Region, will primarily serve Grand Canyon, Petrified Forest, Walnut Canyon, Montezuma Castle, and Tuzigoot.

Pacific Northwest

John Aho, Olympic NP wildlife biologist, sent news of a meeting of NPS Watershed Studies Investigators and Project Coordinators at Fort Collins, Colo. May

15-17. The purpose of this gathering of the faithful was to bring Dr. Ray Herrmann up-to-date on the projects at SEKI, ISRO, ROMO and OLYM, and to discuss the future - both for the 1990 wrap-up of NAPAP and the continued role of the small watershed studies in NPS science. These long-term studies are seen as vital to the new global warming effects initiative, as well as cornerstones to the Service's Inventory and Monitoring program.

"We are pleased," Aho added, "to provide the obligatory group photo, and some rare documentary photos of the meeting participants actually working."



Poring over results, from left, are Ray Herrmann, Ted Thomas, and Bob Edmonds.

Personnel from the NPS Water Resources Division were at Crater Lake NP in July to select data collection sites for a channel processes study and to inspect water supply developments associated with State appropriative water right filings. Staff members also met with Gary Larson of the NPS/CPSU at Oregon State University, research aquatic ecologist, with regard to a fish survey he is directing on selected streams in the park.



Watershed investigators, left to right, are Frank Vertucci, USFS; Ray Herrmann, NPS; Steve Nodvin, NPS, U/TN; Annie Esperanza, SEKI; Rick Webb, SHEN; Dave Graber, SEKI; Bob Edmonds, U/WA; John Aho, OLYM; Ted Thomas, U/WA; Bob Stottlmyer, ISRO, and Scott Denning, ROMO. Absent from the photo were Dave Parsons, SEKI; Gary Davis, CHIS, and Doug Fox, USFS.

Yosemite Monitoring And Mitigating Wilderness Impacts

Nearly 90 percent of Yosemite NP's 1,189 square mile area is Wilderness, containing more than 1,050 miles of travel routes and 5,547 recorded (primarily undesignated) campsites. Although wilderness recreation is a recognized and legitimate activity, most trails and campsites cause denuded stopping points, multiple treads, accelerated erosion, loss of meadows, compacted soils, and more. Thus, the challenge has been (1) determining the extent of the problem, (2) defining justifiable standards for permissible resource damage, and (3) prescribing management actions to mitigate and limit impacts.

To meet this challenge, the park, from 1983 through 1988, completed a wilderness impacts inventory, tested rehabilitation techniques for closed subalpine camping areas and severely impacted meadow trails, and began developing a comprehensive Wilderness Restoration Plan.

Determining Problem Extent – Impacts Inventory:

Campsites were rated using 11 criteria including size, developments, vegetation composition and density, wood availability, access trails, and visual obtrusiveness. Trails and cross-country routes were rated for width, depth, gulying, associated drainage disruption, and multiplicity. Environmentally descriptive parameters (e.g., vegetation and substrate type, distance to water, trees with exposed roots) were included in the assessment. Hewlett-Packard HP71B handheld computers containing customized data entry and error-checking programs were used for field data collection.

Defining Permissible Resource Damage: Park staff developed five opportunity classes: primitive, cross-country, trailed-undesignated campsites, trailed-designated campsites and frontcountry. Each was defined by resource, social, and managerial standards. Data collected on impacts were compared to established standards, and mitigative actions are being prescribed where impacts exceed these standards.

Prescribed Management Actions: Data analyses have shown that Yosemite's wilderness is threatened and that specific management direction is possible using the impacts data. For example: 23 percent of the campsites were found to be within 25 feet of water and 56 percent were within 100 feet. This indicates that more than half of the campsites violate a federal regulation. Obliteration and rehabilitation were recommended for 51 percent of all sites because of proximity to water and trails, or visual obtrusiveness. More aggressive campsite removal and minimum impact camping programs are now being conducted. In addition, park managers are examining the enforceability of a 100 feet from water camping restriction, since natural topography and travel routes foster non-compliance in some instances.

Trail work now can be objectively prioritized, based on perhaps the most comprehensive trails database available to a land management agency. The work load is dramatically apparent: some of the more significant impacts include 62 miles of multiple tread, 67 miles of trail erosion gullies more than 4 inches deep, and 329 miles of trail through sensitive meadow vegetation.

Charisse Sydorik, Res. Mgt. Spec.
Lava Beds National Monument

Correction

In identifying Sarah Bishop, author of "Promoting Partnerships: The New NPS Challenge" (p. 11 of *Park Science*, Summer 1989), the telephone number for Partners in Parks should have been (702) 454-5547 and Bishop's doctorate field should have read "romance linguistics" instead of "education."

New RNA Report Focuses On Information Exchange

"Taking the Pulse of Healthy Land" is the lead article in a new publication, *Natural Areas Report*, Vol. 1, No. 1, edited by Sarah Greene, Forestry Sciences Lab, 3200 Jefferson Way, Corvallis, OR 97331; (503) 757-4429.

The report is an outgrowth of the February workshop in Portland, OR, which focused on the role of Research Natural Areas (RNAs) in baseline monitoring, long-term research, and protection of biological diversity. (See *Park Science*, Spring 1989, p. 11). The February workshop panels produced over 50 recommendations which, when prioritized, boiled down to a strong consensus for the following four:

(1) More specific management direction is desperately needed. This must begin with the setting of specific management objectives and development of a monitoring plan for each RNA.

(2) RNA coordinators are essential to a successful RNA program. At the very least, each agency (such as the NPS) should have an RNA coordinator at the units that contain RNAs.

(3) All agencies with units in the Pacific Northwest should adopt the Oregon and Washington Natural Heritage Plans as guides to RNA cell/element needs.

(4) Assured funding is required. (No agreement was reached, however, on where and how the necessary funding would be appropriated.)

The Pacific Northwest Interagency RNA Committee will hold its biannual meeting in Portland Nov. 16, 1989. Contact: Sarah Greene (see above).

Rare Plant Surveys In Mount Rainier NP

Eleven plant species in Mount Rainier NP occur on state threatened or sensitive species lists. Systematic surveys for rare species were initiated in 1987, using a methodology that complemented the state's Natural Heritage Program. Field surveys are conducted annually for one or two species and information is then shared with Washington state.

In 1987 a computer data base was set up, historic information collected and recorded, and field surveys initiated. *Castilleja cryptantha*, a candidate species for federal designation, was the focus for field surveys that year. Of 25 populations surveyed, 10 were relocations of historic sightings. Two historic sightings could not be relocated. Two populations were located adjacent to a developed campsite and had been impacted by human use. A temporary closure was placed on the campsite in 1988 pending a field review of the area. The field review was conducted in 1988 and the campsite was permanently closed due to its close proximity to water and the impact on the *Castilleja* population. In 1988, 35 populations of *Pedicularis rainierensis*, an endemic, state listed species, were recorded. All locations are recorded in the park's GIS system, dBase files, and with the Washington Natural Heritage Program.

Regina M. Rochefort, Botanist
Mount Rainier National Park

Reveg Notes

Western Region Organizes Task Force

The Western Region has become pro-active in managing its lands in recent years. Rehabilitation of disturbed areas is a common practice, presently accomplished through revegetation. Projects range from rehabilitating roadcuts to eradicating roads and trails, and from landscape restoration of scenic or cultural values to replacing alien species with indigenous (in some cases threatened or endangered) species.

Many standards guide resource management in NPS. However, for revegetation and restoration management these standards are essentially principles with little information on application (particularly the depth of investigation necessary for ensuring each standard is met). As a result there is considerable variation in the way individual projects are covered, and some efforts apparently do not even attempt to meet the standards.

Moreover, there is a need to adapt the new NPS Management Policies for special needs existing in the Western Region, and prepare Regional policy statements where necessary. Finally, projects crossing agency boundaries need to be identified early in order to assure that selected techniques and project implementation are complementary.

Consequently, Western Region has organized a Task Force to address these needs. The core team is composed of research scientists and natural resource managers representing coastal, tropical, montane, and arid ecosystems. Its efforts will be reviewed periodically by a larger working group (composed of WR Parks and Denver Service Center representatives) which first met in April 1988 at Golden Gate NRA.

This project will produce a Handbook of guidelines that will help managers develop plans for and carry out revegetation programs. Current research will be applied to assure that these guidelines are state-of-the-art. The Handbook will describe each guideline and list all factors that must be considered. Each factor will be discussed, normally acceptable results (and monitoring techniques) described, and significant reference materials cited or placed in an appendix.

The Handbook is expected to be available to other Regions sometime in CY90. Topics will include prescriptions, propagation, planting, erosion control, tree hazard replacement, genetic conservation, and monitoring. It will address contracting, planning links with the Denver Service Center, funding (including sources such as Federal Highways), and services available from agencies such as the Soil Conservation Service. Finally, the project will distinguish between routine revegetation and ecological restoration, and address issues such as whether a planting project should manipulate habitat for federally listed threatened, endangered, or candidate species.

The aim is to provide guidance for managers in preparing revegetation proposals and to facilitate management applications of all applicable research. Also, it will achieve a cooperative approach to cross-boundary needs, through linkages with coalitions such as the High Sierra Inter-Agency Wilderness Managers Group.

Alan Schmierer, Reveg. Task Force Coord.
WRO Div. of Nat. Resources and Research

Global Change and Biosphere Reserve Workshop Held

By Stephen C. Nodvin

A three-day NPS workshop on global change and on biosphere reserves was held at the University of Tennessee (UT) in Knoxville in August. The workshop was organized and moderated by Bill Gregg of the NPS Washington Office (WASO). Arrangements in Knoxville were made by the Cooperative Park Studies Unit at UT with assistance from the UT Department of Forestry, Wildlife and Fisheries.

Global change was the focus of the first day's discussions. Featured speakers included John Firor of the National Center for Atmospheric Research who gave an excellent overview of the mechanisms of the greenhouse effect. Robert Peters of the World Wildlife Fund discussed the implications of global climate change to biodiversity. Harry Lins of the USGS discussed agency plans and priorities that are being formulated by an interagency working group: the Committee on Earth Sciences (CES).

Other agencies' plans and strategies relative to global change were discussed by: Stan Colof, Bureau of Land Management; Tom Callahan, National Science Foundation; Anthony Janetos and Lauretta Burke, EPA; Michael Fosberg, USDA Forest Service; and Robert Van Hook and Monica Turner, DOE and Oak Ridge National Laboratory.

Gregg discussed current efforts and plans by the NPS Wildlife and Vegetation Division relative to national planning for global climate research. Ray Herrmann of the NPS Water Resources Division discussed the role of long term research and of the NPS Watershed Program within the global change arena. Stephen Nodvin discussed plans by the UT CPSU to identify potential global climate problems at park units within the Southeast Region and plans by the Southeast Region Office to assemble a global climate change assessment team.

The second day of the workshop focused on Biosphere Reserves. Perspectives on the evolution of the Man and the Biosphere program and the Biosphere Reserve concept were given by Gary Everhardt, Superintendent BLRI; Vernon Gilbert, former NPS MAB Coordinator; Roger Soles, Executive Director, U.S. MAB Secretariat; and Gregg, NPS MAB Coordinator. Other highlights included discussions of regional MAB efforts in the Southern Appalachians, public education and community involvement, and discussions of many biosphere reserve programs including and ranging from Champlain-Adirondack, the Central California Coast, and Death Valley NM.

Concurrent workshop sessions were held the third morning on: 1) the role of NPS in global change research, 2) the role of WASO, regions and parks in MAB, 3) coordinator of NPS with other agencies on global change and biosphere reserves, and 4) public education relative to the workshop's topics. Session leaders summarized each group's discussions and recommendations during the final afternoon session. Session leaders were given the charge of preparing a report of each group's recommendations for review by the workshop participants.

At the meeting's closing, Bill Gregg thanked all participants and observed that problems due to climate change may present NPS with some of its greatest challenges relative to research and the management of natural and cultural resources.

Nodvin is Unit Leader of the NPS/CPSU at the University of Tennessee, Knoxville.

In Situ Conservation

A 40-page book, *Plant Genetic Resources: Their Conservation in situ for Human Use*, published by and available from the Food and Agriculture Organization of the United Nations (4611F, Assembly Drive, Lanham, MD 20706) describes the values of plant genetic resources and their natural habitats and the problems that are caused, now and for future generations, as we continue to lose these resources.

It focuses especially on the need to conserve plant genetic resources *in situ*, that is, in their natural habitats and examines genetic diversity at ecosystem, species, population, and gene levels. The guidelines given for action have been developed keeping in mind the importance of conserving diversity at all these levels.

By Jean Matthews

Three days that changed the world it may not have been, but the August conference in Knoxville (see article by Stephen Nodvin) left its 46 exhausted participants with the distinct impression that they had begun a process of transcendence that could end in a new level of research and management of the National Park System.

Vernon C. (Tommy) Gilbert, in presenting the Southern Appalachian MAB approach (SAMAB), returned again and again to the necessity for engaging the local populace in issue-oriented activities that would show them both "what's in it for us" and "how we're tied into and dependent on" the systems that interactively support all life on earth. The focus on global climate change, played so prominently by all the media and even appearing at the recent "summits" in Europe, seems to have captured the attention of a critical mass of people – enough to make such regional approaches as those centered around the Great Smoky Mountains and the Glacier NP Biosphere Reserves eminently viable.

It was the sense of the meeting that the U.S. public in general reacts negatively to the idea of "reserves," tending to see them as "lock-ups." Gilbert strongly urged a soft-pedaling of talk about threats to parks and buffer zones, and emphasis on critical issues that face entire regions. "These are the focal points that can bring people together," he said. "Whether or not there is a global climate change underway, the world has horrendous natural resource problems – overpopulation, loss of biological diversity, pollution, etc. We simply must do more toward making a *global response* to these conditions and our response *must* include the third world – which contains over 75 percent of the world's population."

A consensus was that biosphere reserves should emphasize issues that tie them in to the overall regional resources and problems picture at the points where people's concerns already are apparent.

"You scientists talk about peer review," said Hubert Hinote, the new director for SAMAB, "but I tell you that

MY peers are the people of this region. They're the ones who will 'review' what goes on here and decide if it's worthy of their participation and support."

One clear note about funding for scientific research in the National Parks was sounded by James Callahan, associate program director at the National Science Foundation for the Division of Biotic Systems and Resources.

"If you want money from my domain," he told the conferees, "the single biggest barrier we perceive is that the investigators in National Parks never know where they stand in relation to the parks. It's not a confidence-building situation for a long-term researcher. For this reason, NPS long-term research projects are not a high NSF funding priority."

Callahan's suggestions was that the research community would respond "rapidly and positively" to a national policy favoring extra-funded research in the National parks. "We're pleased to see that NPS looks as though it's moving toward meshing its research better with other agencies," he said. "But the Park Service should pay researchers more in *money* and less in *kind*. A little seed money would do a lot of good."

"And," he continued, "you won't ever get money from NSF for monitoring *per se*. This is a task that the Park Service should be funding itself. It's *your job*! Congress has told us 'Thou shalt not thwart the will of the Congress by funding another Federal agency' so we are limited as to what we can do in that respect. We *could* assist another Federal agency to set up its *own* research program – or fund a research project in which an NPS employee is the principal investigator if that project is offered for funding by an academic institution. However, no salary or other perk could be offered through the project to such a paid employee."

"In short," he concluded, "we won't allow another Federal agency to 'pick our pocket.' Our feeling is 'Let them fund their own research.'"

Associate NPS Director Eugene Hester told the conference that the new DI Secretary wants Interior to be involved in the study of and response to the worldwide problems posed by the threat of massive global climate change. "The new NPS Director sees parks as barometers of change in the nation and the world," he said (see Guest Editorial, page 2), and biosphere reserves in parks are key places for taking the earth's temperature and pulse. We all need to be working from the same data sets and the SAMAB project is helping us do just that. So is the Yellowstone Ecosystem work – so is the California Coastal project. (See MAB Notes, this issue).

Gary Everhardt, former NPS Director and Supt. of the Blue Ridge Parkway, declared strong support "from the management side" for biosphere reserves and observed, "I'm sorry to see only three park managers here. Managers should be involving themselves in this kind of activity. Economic development and environmental quality can and must be made compatible," he went on. "The people of Southern Appalachia believe they can be. The six agencies that formed SAMAB recognized the need to put aside individual turfs and develop a model example of what can and must be done through collaborative action to eliminate or mitigate common problems."

Earthwatch: A Source Of Funds, Labor For Park Scientists

The National Park Service and Earthwatch recently have agreed to co-sponsor field research in the National Park System. Founded in 1971, Earthwatch is now the third largest private funder of scientific field research in the U.S. – after the National Geographic Society and the World Wildlife Fund. To date Earthwatch has mobilized 1,085 field seasons of 716 projects (15 in the national parks) in 85 countries, providing researchers with 21,900 volunteers and more than \$14 million in funds and equipment. Its unique formula requires public, hands-on participation in field research. Volunteers contribute both funds and labor to launch expeditions in a series of one-to-four-week teams; the principal investigator thus receives both a grant and manpower. The formula works well: annually Earthwatch now fields over 100 projects worldwide; roughly a third of the volunteers each year are past participants; and half the projects receive funding for more than one year.

For the past two summers, for example, Dr. Rolf Peterson of Michigan Technological University has used more than 100 volunteers, who have contributed over \$36,000 to track the survival of annual cohorts of moose and reconstruct the age structure of the population on Isle Royale. His assistants are non-scientists, lay people who vary in age, perspective, and training – cooks, bankers, school teachers, businessmen, stew-ardesses, students. Most have college diplomas; many have advanced degrees. Equipped with rations for six days at a time, volunteers scour the island for moose remains, collect the skeletons, examine wolf scats for clues to diet, and note the frequency of other species, such as snowshoe hare. The volunteers "proved a tremendous aid in increasing coverage of the island," says Peterson, in 1988 more than doubling the miles hiked to search for moose remains and collecting parts of 96 skeletons.

For a project to make use of the Earthwatch formula successfully usually requires dividing its objectives into bite-sized tasks, which volunteers can learn easily and quickly in the field. Earthwatch teams are ideal for inventories and surveys (e.g. vegetative plot sampling, capture/recapture census, migratory bird counts, food sampling); radio-tracking animals; simultaneous behavioral observations of various animals; paleontological and archaeological excavations; and long-term research.

The Center for Field Research – the arm of Earthwatch that solicits and reviews proposals – is now inviting proposals for work by scientists or by those working in the park system. Please allow 10 to 12 months between proposal submission and first date in

the field. For information, write The Center for Field Research, Box 403, Watertown, MA 02272; or call (617) 926-8200; FAX: 6179268532.

Biodiversity Guidelines

A 50-page book entitled *Evaluation of Biodiversity Projects* (National Academy Press, Washington, DC, 1989) sets forth criteria and guidelines for evaluating projects designed to protect or enhance biodiversity.

Michael E. Soulé, chairman of the prestigious seven-man committee that put the report together, prefaced the volume with the following words:

"It is regrettable that this document is needed. It is regrettable that the survival of biological diversity requires extraordinary initiatives such as 'biodiversity reserves.' Only a world on the brink of ecological suicide would resort to such artificial means. To the citizens of a balanced world, the phrase 'biodiversity reserve' would sound just as ridiculous as does the concept of 'developer reserve' to us.

"In denaturalizing most of the planet's tropical and temperate surface, in usurping virtually all unfrozen land and water, in polluting the highest reaches of the stratosphere, and in altering the heat balance of the atmosphere, we are fast approaching a new global, ecological threshold – our carrying capacity. As we cross this invisible barrier, less pushy species will be crowded out.

"Now 'experts' are being summoned to help slow and eventually reverse the human machine of population and denaturalization. This document was written by such experts – in the field of appropriate development and conservation biology – in response to a request for guidance in the selection, monitoring and evaluation of biodiversity-related projects in developing countries ..."

The report project that produced the book was approved by the Governing Board of the National Research Council, whose members are drawn from the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. Copies of the report can be had from the Board of Biology, National Research Council, 2101 Constitution Ave., N.W., Washington, DC 20418.

Michael Soukup To Direct South Florida Research Center

South Florida, with its sub-tropical climate, burgeoning population, and myriad environmental problems, is also the site of the NPS's South Florida Research Center. Located within Everglades NP, this unit, established in 1976 as a prototype for NPS field research facilities, focuses on the four NPS areas of Everglades and Biscayne National Parks, Big Cypress National Preserve, and Fort Jefferson National Monument.

In August, Michael A. Soukup, former Regional Chief Scientist, North Atlantic Region, became the new director of research. South Florida environmental issues are extremely complex. Delicate sub-tropical ecosystems have been abused in the name of progress and development, and the impacts on both the natural environment and the human inhabitants are only beginning to be understood. The current efforts to preserve and restore wetlands habitat have directed national and international attention to park programs, and critical management decisions. Perhaps the entire future of the Everglades depends on the quality and application of research.

Pat Tolle, Public Affairs Specialist
Everglades National Park

To the Editor:

Since you requested that I write an article about setting up the new Coastal Research Center at the Graduate School of Oceanography, University of Rhode Island, there has been a significant change in direction – I am now in Everglades NP as the Director, South Florida Research Center instead. It was a difficult choice, at first.

At the new North Atlantic/Mid-Atlantic joint CPSU, which will have four or five NPS scientists in disciplines covering the spectrum of coastal issues, I would have been able to pursue my own research area again, sharpen my scientific skills (after over 13 years in a regional office), and help prepare coastal parks for the coming conflicts over limited resources. What could be better? Then came the Everglades offer. The South Florida Research Center was created directly by Congress (in 1976) to address the formidable array of issues and threats facing a large, unique, and manipulated system. Today the stakes remain very high, and the role of science is immediately crucial. Past water management and future development-related impacts seem nearly overwhelming.

Thus, if there is one place that best demonstrates that the mission (and the future) of the Service is a highly technical one, it is here. In my discussions with park leadership there was no question that this is well-understood and that the science program would be fully supported and utilized.

After weighing all the variables associated with any new assignment, it seems clear that if one is in the Service to understand natural systems, solve their management problems, and contribute to their preservation, then – right now – the Everglades is the place to be.

Mike Soukup
Formerly Chief Scientist
NPS North Atlantic Region

Ideas For The Future: America's NRAs

An attractive 42-page booklet with full color wrap-around cover picture, entitled *Ideas for the Future: America's National Recreation Areas*, represents the best thinking of 150 individuals concerned with the management of the 32 U.S. National Recreation Areas, at a 1988 symposium sponsored by NPS and USFS.

Six concurrent sessions developed ideas as to how better to plan, operate, and maintain NRA facilities, how to develop partnerships with diverse groups and organizations nearby, how to make the public aware of the enormous resources NRAs represent, and how to mesh their resources as a cog in the larger tourism

wheel. "Promotion and marketing of NRAs must be cooperative endeavors with local, state, and regional tourism organizations," according to one summary.

Included is a discussion of networking, as a verb – "not the finished product, but the process of getting there – the communication that creates the linkages between people and clusters of people." (Naisbitt, J., 1984. *Megatrends*. NY Warner Books, Inc.)

Copies of *Ideas for the Future* are available for \$10 from William J. McLaughlin, Dept. of Wildland Recreation Mgt., University of Idaho, Moscow, ID 83843.

Another exciting edition of the NPS *Interpretation* – the Winter 1989 edition – has been produced by the Washington NPS Office of Interpretation, the Regional Chiefs of Interpretation, and the Interpretive Design Center at Harpers Ferry. This one focuses on the wolf recovery program and covers the historical record of relentless persecution, some of the hair-raising tales that have contributed to the “demons from hell” perception of wolves, and an assessment of the future for wolves.

A double page spread features excerpts from the NPS traveling exhibit, *Celebrating the Wolf*. The exhibit consists of 18 original matted and framed prints by several artists and it will be on display in the Midwest and Pacific Northwest Regions in 1990. The exhibit will be available for at least 6 years.

Interpretation contains a first-rate account, by Chicago *Tribune* staff writer Peter Gerner, of Rolf Peterson's Isle Royale wolf research. (By the latest count, only 9 wolves remain on Isle Royale.)

For more information on *Interpretation*, contact Editor, *Interpretation*, c/o Washington Office, Division of Interpretation, Box 37127, Washington, DC 20013-7127.

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Greenpeace (Vol. 14, No. 3), the May-June 1989 issue, devotes most of its issues to global warming in an article by Norman Myers, “The Heat Is On.”

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“Translocation as a Species Conservation Tool: Status and Strategy,” by Brad Griffith, J. Michael Scott, James W. Carpenter, and Christine Reed, appears in the August 1989 issue of *Science*, describing intentional releases of native birds and mammals to the wild in Australia, Canada, Hawaii, New Zealand, and the U.S., and documents current activities, identifies factors associated with success, and suggests guidelines for improving future work.

The July issue, in an article entitled “Volcanoes Can Muddle the Greenhouse,” finds that cleaning up climate records shows that large volcanic eruptions cool the climate for a few years, complicating identification of the greenhouse warming.

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Will clouds prevent or promote a drastic global warming? asks a headline in the August 12, 1989 issue of *Science News*.

“Some studies suggest,” writes Richard Monastersky, “that if the number of stratocumulous clouds over the ocean grows by 4 percent, the increase could compensate for a doubling in atmospheric carbon dioxide – saving the planet from a potentially disastrous temperature hike of 1.5 degrees C. to 5.5 C. over the next half-century. On the other hand, an increase in another cloud type – the high, ice-filled cirrus clouds – would add to the greenhouse effect.”

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An excellent quarterly entitled *Plant Conservation* is available from the center for Plant Conservation, 125 Arborway, Jamaica Plain, MA 02130-3520; (617) 524-6988. This 8-page publication, with illustrations, is the organ of The Center for Plant Conservation – a private nonprofit organization dedicated to conserving rare and endangered plants of the U.S. through cultivation and research.

The Center's network of 19 botanical gardens and arboreta is coordinated by the national office in Jamaica Plain.

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The Spring 1989 issue of *American Birds* contains a 9-page article by Charles van Riper III and four co-authors, fellow members of the American Ornithologists' Union, on “Career Opportunities in Ornithology.” Full color photos illustrate the wide range of activities open to ornithologists and describe education requirements, jobs, and salaries.

Van Riper is an NPS research scientist with the CPSU at U/Cal, Davis, and is co-author, with Michael Avery, of “Seasonal Changes in Bird Communities of the Chaparral and Blue-Oak Woodlands in Central California,” appearing in *The Condor* (91:288-295).

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An article by Tom Bonnicksen in the July/August issue of *American Forests* titled “Fire gods and federal policy” severely criticizes NPS fire policy and management as “anti-scientific-management” where parks are “quasi-religious sanctuaries where Mother Nature resides and rules.” Bonnicksen, who mysteriously cancelled commitments to speak at the recent fire conferences in Bozeman and Tallahassee, fails to give the slightest credit to the Park Service for its widely respected programs of fire management and research.

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Dogs and cats as well as people are suffering from stress-related conditions in Ito City, southwest of Tokyo, where more than 23,000 earthquakes shook the city in the three weeks since June 30. More than 250 outpatients daily reported stomach aches, insomnia, and diarrhea, “all from fear and stress,” doctors reported. Cats experience nausea, diarrhea, and loss of appetite, and many dogs suffered skin problems such as rashes and loss of hair. Coughing and trembling in dogs also were attributed to “excessive fear.”

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A study involving 85 patients with antibodies to the Lyme disease-causing bacterium in their blood, offers the first direct evidence that such active bacteria in the central nervous system can trigger a brain disorder that results in cognitive and memory deficits observed in many Lyme disease patients. The study, reported in the June 24, 1989 *Science News* (p. 390), found that many of the study subjects diagnosed with the brain disorder harbored the antibodies in their spinal fluid as well as in their blood. The patients' symptoms improved greatly after antibiotic treatment – suggesting strongly that produces “very specific patterns” rather than “everything under the sun” as has been a prevalent notion heretofore, according to study leader John J. Halperin, a neurologist at the State University of New York at Stony Brook.

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Dr. William McShea of the National Zoological Park in Washington, DC, is seeking volunteers to observe, for a second season, the feeding deer in Shenandoah NP, and to catch and release mice and chipmunks in order to calculate their populations. The study is designed to determine whether mast – the seeds of

oak, hickory, and beech trees – is the major variable determining the density and distribution of deer, mice, and chipmunks over the winter. Is the cumulative consumption of mast by deer enough to starve out the smaller fry: mice, chipmunks, squirrels, and turkeys? Are management policies that favor “charismatic megavertebrates” like deer hard on smaller animals?

Research team VIII will take the field Nov. 11-25, 1989; staging area, Front Royal, VA; share of costs, \$890.

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The UNESCO Action Plan for biosphere reserves calls for the preparation of a history of research conducted within each reserve. Dr. Caroline Rogers, Research biologist, Virgin Islands National Park, and Robert Teytaud, Island Resources Foundation, recently completed a report entitled **Marine and Terrestrial Ecosystems of the Virgin Islands National Park and Biosphere Reserve**, which provides a comprehensive synthesis of research that has taken place within the reserve itself and of other pertinent studies carried out within the region.

The report focuses on information found in over 25 reports by members of the Virgin Islands Resource Management Cooperative and which were funded by NPS in the last 5 years. Park managers, scientists, and visitors will find that it pulls together a diverse body of knowledge, some of which was previously inaccessible. It includes a description of the marine and terrestrial systems of St. John and the stresses that are currently affecting them. The island's fisheries are discussed, and there is a brief section on geology. Emphasis is placed on research, which provides a basis for effective management of the park's ecosystems. Recommendations for future research and resource management actions are presented. An extensive bibliography and an index increase the report's usefulness. This publication is available from Caroline Rogers, Virgin Islands National Park, P.O. Box 7789, St. Thomas, USVI 00801.

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From the June 1989 issue of *Earthwatch* magazine comes this quote, part of an article entitled “Fire of Life” by Mill Ingram:

Studies of Yellowstone tree rings show that major fires like last summer's have burned through the forests once every 200 to 400 years. Other studies show that 25 years after a burn, lodgepole stands show a three-fold increase in species of birds, small mammals, and ground plants. “Every scientist I've talked to has pretty much shared the opinion that these fires are natural and that they have happened in the past,” says geologist James Schmitt of the 1988 fire. Schmitt, who is running an *Earthwatch* project studying tree rings this summer in Yellowstone, coordinated a meeting of 120 researchers interested in the park and the fire. In his book *Fire in America*, Stephen J. Pyne wrote: “Wildland fire is part of a dynamic equilibrium between the production and decomposition of biomass. Its function is to recycle ... For landscapes like North America, as Stephen Spurr and Burton Barnes affirm in their book *Fire Ecology*, ‘fire is the dominant fact of history.’ ”

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Ecological Economics is the name of the brand new journal of the International Society for Ecological Economics, published by Elsevier Science Publishers. According to its editor-in-chief, Dr. Robert Costanza, the journal "is intended to be a new approach to both ecology and economics that recognizes the need to make economics more cognizant of ecological impacts and dependencies; the need to make ecology more sensitive to economic forces, incentives, and constraints; and the need to treat integrated economic-ecologic systems with a common (but diverse) set of conceptual and analytical tools."

Associate editors are Herman Daly, with the World Bank in Washington, DC; A.-M. Jansson, Askö Laboratory, University of Stockholm, Sweden; and D. Pearce, Department of Economics, University College of London, U.K. Papers presented at two workshops on ecology and economics, one in Stockholm in 1986 and one in Barcelona in 1987, appear in Vol. 1 No. 1, together with papers from the 1987 Ecological Society of America meeting in Columbus, OH.

Announcements of upcoming meetings of the International Society for Ecological Economics and related events will be published in the journal and in the Society's newsletter. Editor Costanza can be addressed at the Center for Environmental and Estuarine Studies, University of Maryland, Solomons, MD 20688-0038.

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The *New York Times News Service* reports scientists, foresters, environmentalists, and government officials are taking "the first serious steps toward an ambitious long-term goal: planting enough trees around the world to ease the threat of global warming."

The activity to stimulate the growth of new forests worldwide is taking place on a variety of fronts. The American Forestry Association – a citizens' conservation organization, has undertaken a national campaign aimed at planting 100 million new trees in American cities and towns by 1992. Industrial companies are being urged to follow the model effort of an electric company in Connecticut – AES Thames (a subsidiary of Applied Energy Services of Arlington, Va.), which is helping pay for planting 52 million trees on plantations and small farmers' plots in Guatemala to offset the carbon dioxide emitted by their new generating plant at Uncasville, Conn.

The EPA, in an investigation requested by Congress, has come up with a number of carbon-reducing remedies it considers feasible, among which are:

- Offering American farmers incentives to plant more trees on erodible lands that have been kept out of cultivation in the Conservation Reserve Program;
- Planting up to 400 million trees in urban areas of the United States – both to soak up carbon dioxide and to provide shade that would help reduce energy use in hot weather;
- Reforesting 20 percent of U.S. highway corridors;
- Managing forests more effectively to make them more dense; their total mass (and thus their carbon-storing capability) is estimated to be increasable by 60 percent.

In the U.S., DOE at its Oak Ridge lab is experimenting with "short-rotation" plantations of fast growing trees that are ready for harvest in 10 years.

**

"Where Acids Reign," by Janet Raloff, in the July 22, 1989 issue of *Science News*, tells of the mysterious increase in tree mortality in West Germany affecting

Norway spruce in the Fichtelgebirge forests high in Bavaria, beginning about 10 years ago and now affecting some 52 percent of all West Germany's trees. In some stands, all mature trees have died. Ernst-Detlef Schulze of the University of Bayreuth has unearthed new clues to the complex, synergistic web of agents responsible.

The problem is far more complex than direct pollutant poisoning from industrial fallout. The trees are sickened and weakened by the air-carried pollutants and then fall victim to opportunistic blights. Nitrogen compounds and sulfates – both the stuff of acid rain – start the imbalance by acidifying the soil, Schulze contends. The forest floor's acidity then frees toxic aluminum to compete with other positively charged ions (cations) for entrance into the thread-like, nutrient-absorbing roots of trees. Some of these cations are crucial to tree nutrition – notably calcium and magnesium.

The trees gradually develop serious deficiencies of magnesium, potassium, manganese and iron, and an acceleration of nitrogen aerosols raining into the trees' foliage and into their roots act as fertilizers – spurring the cation-starved trees to attempt further growth. In this highly stressed state, the conifers succumb to otherwise non-lethal pests and turns of weather.

The slower decline of U.S. forest suggests this country may still have time to avert a similar wholesale dieback of woodlands, but Schulze and others suggest such intervention will require stricter controls on air pollutants, especially on nitrogenous ones.

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A large number of northeastern U.S. lakes may be suffering severe and potentially unrecognized ecosystem damage from acid rain, according to a new study published in the May 1989 issue of *Environmental Science and Technology*. The most vulnerable species are ones humans consider unimportant – leeches, mollusks and insects – but they are integral to the lakes' overall health and their presence sets the stage for more prized species such as trout, pike and sunfish.

In 1976 the Canadian government's Freshwater Institute in Winnipeg initiated an experiment in which, over 8 years, sulfuric acid was systematically added to a small Canadian lake. The lake's pH was lowered from a nearly neutral 6.8 to a very acidic 5. As the carefully monitored acidification progressed, researchers found that crustaceans and many phytoplanktons disappeared, fish ceased to reproduce, and new algae appeared.

Because the scientists used summer lake-pH values in making their predictions instead of the much lower spring snowmelt values, their assessments are thought by some U.S. scientists possibly to have seriously underestimated species losses.

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An analysis of 20 years of bird surveys from across North America has disclosed a severe decline in the population of many species of songbirds, especially those that winter in South and Central America and summer in the U.S. and Canada.

The study, which overcomes limitations that had led some to discount similar findings of previous bird surveys, was conducted by Sam Droege of USFWS at the Patuxent Wildlife Research Center and Russell Greenberg, a research scientist with the National Zoological Park in Washington, DC.

"It's tragic. We're going to have fewer birds," Droege said. The survey was based on data gleaned from the North American Breeding Bird Survey, which covers the entire U.S.

Some scientists suspect the birds are being harmed by changes in their winter grounds in the tropics – others blame changes in their summer homes in temperate North America. Still others contend that forest fragmentation in North America is primarily to blame, cutting the forests into smaller patches and thus increasing the access of predators and parasites to forest-dwelling birds.

But Greenberg and his colleagues argue in their study that tropical deforestation is the most likely cause. Of the species that winter in Mexico's Yucatan peninsula, for example, 16 live in the forest and 12 live in open scrub. All 16 forest-dwelling birds declined in the past decade, while scrub-dwellers held their own or increased their numbers.

Inventory of Glen Canyon Visual Resources

An extensive inventory of viewsheds throughout Glen Canyon NRA was completed in the spring of 1988 using panorama photography and mapping. The purpose of this study was to photograph the various scenic views within the NRA and to document these views by mapping their aerial extent (viewshed). The scenic viewshed inventory will be used as a baseline to analyze potential effects of proposed development (such as mineral leasing, livestock grazing, and recreational facilities) on Glen Canyon's scenic resources.

A total of 81 overlook points were surveyed, photographed, and documented on both land and water throughout the NRA. Scenic viewsheds were surveyed and the following priorities established:

1. Signed or designated overlooks – 17 overlook points;
2. Overlooks from existing or proposed marinas – 9 overlook points;
3. Views from the main travel routes on the lake – 43 overlook points;
4. Views from access roads to Glen Canyon – 11 overlook points;
5. Views from backcountry areas – 1 overlook point.

The complete inventory consisted of two main processes. The first involved visiting each potential overlook point, documenting the location and angle of view, and photographing the entire view using panoramic techniques. The second process was sorting and labeling the photographs (a total of approximately 810 photographs), splicing the panoramas, mapping the aerial extent of the view, and mounting each overlook point documentation in a binder.

Three volumes and two appendices completed the documentation of the surveyed overlook points. As time and budget allow, more backcountry overlook points will be added to the inventory. The mapped extent of each viewshed was formatted for future addition to GIS files.

An independent study conducted in southern Utah by the Five-County Association of Governments indicated that scenery was the primary reason tourists visited Glen Canyon NRA. Viewing scenery also was rated as an extremely important activity by 93% percent of visitors who participated in the 1988 Visitor Survey at the park.

Catherine Walkinshaw, Seasonal Res. Mgt. Tech.
Glen Canyon National Recreation Area

Yellowstone's Northern Range Revisited

By Francis J. Singer

Management of elk and bison on the northern winter range of Yellowstone NP has remained a controversial subject through most of this century. Elk were artificially controlled particularly from 1935-68, and bison were fenced and cropped in the park. However, beginning in 1969 these reductions were terminated, and by 1971 a hypothesis of self- or natural-regulation of Yellowstone's ungulates was formulated by Glen Cole and Douglas Houston. Houston reported the experiment to be largely successful through 1979 in his book *The Northern Yellowstone Elk - Ecology and Management* (1982 Macmillan).

However, a series of events in the 1980s prompted renewed concern over the success of the experiment. Bison, elk, mule deer, and pronghorn antelope numbers increased dramatically. Elk counts rose from 10,500-12,000 in the 1970s to 16,000 by 1982 and then to 19,000 by 1988. Pronghorn antelope counts roughly tripled in the 1980s from 152 to 495, while the mule deer counts increased from 1,007 to 2,217. Elk largely reoccupied the portion of the northern range outside the park, effectively increasing the size of the winter range by about one-fifth. Seven of the first eight winters in the 1980s were less severe than normal. In August 1986, the NPS Washington office provided special funding through its Natural Resource Preservation Program to investigate the status of the northern range. In October 1987, Congress directed the NPS to "start a study on Yellowstone to see whether there is evidence of over-grazing."

A multidisciplinary approach was taken to studying the effects of elk grazing upon the northern winter range, and to date, 40 separate research projects involving 5 park scientists, 4 other agency scientists and 34 scientists from 18 different universities have been initiated. A series of five problem analyses has been conducted by outside scientists on key problem areas (elk population dynamics, grassland herbivory, riparian area concerns, willow ecology, and pronghorn conservation biology). Each panel has consisted of two to eight outside scientists, and their recommendations have helped shape the park's research programs.

The initial round of studies emphasized the grassland, meadow and sagebrush-bunchgrass communities, since elk derive most of their forages from them. Comparisons between ungrazed sites (within exclosures) and grazed sites were made for soil nutrients, soil compaction, soil infiltration rates, plant species abundance and production, and plant root biomass. Consumption rates by ungulates, grazing tolerances of key forage, and long-term grassland trends from LANDSAT imagery were investigated in separate university-based projects.

The paleoecological history of the northern range for the past several thousand years has been investigated through studies of pond sediment pollen histories, and for the past one thousand years cave deposits. Elk ecology studies have included radiotelemetry-assisted studies of migrations, habitat preferences, the ecological separation of mature bulls from cows and young bulls, and rate and causes of elk calf mortality.

The data suggest no statistically significant changes this century (the period of proposed elk overpopulation) in the nutrient inputs, sediment accumulation, or pollen profiles of eight northern range ponds when compared to pre-park levels. Winter range grasslands apparently are influenced very little by elk grazing.

RESEARCH ON YELLOWSTONE'S NORTHERN RANGE

Funded by the National Park Service

Project Title	Principal Investigator	Institution
Collect population statistics and monitor population size and mortality rates of elk, mule deer, and pronghorns.	F. Singer	NPS
Document sources and rates of elk calf mortality.		
The response of aspen to burning and ungulate browsing.	D. Despain	NPS
Range relations of five ungulate species.	F. Singer	NPS
An analysis of elk summer habitat.	F. Singer	NPS
Collect population statistics, and monitor population size and mortality rates of bighorn sheep.	M. Meagher	NPS
Bison ecology studies in Yellowstone National Park.	M. Meagher	NPS
Rehabilitate abandoned ranchlands dominated by exotic plants.	C. McClure, D. Despain	NPS
Evaluate condition and determine trends in elk winter range through exclosure comparisons.	F. Singer	NPS
	C. Montagne	Mont. St. U.
Moose numbers, movements, habitat and forage use, and effects upon riparian areas.	F. Singer	NPS
	T. Puchlerz	U.S.F.S.
	D. Tyers	U.S.F.S.
Determining the sources of Yellowstone River sediment and turbidity.	Numerous individuals	Several Agencies
Comparative study of winter nutrition of Yellowstone elk using snow-urine analysis.	G. Del Giudice	U. of Minn.
	F. Singer	NPS
Debris flow-dominated alluvial fans on Mt. Everts in northern Yellowstone National Park: depositional frequency and chronology of fan development.	C. Craig	NPS
	J. Schmitt	Mont. St. U.
Food habits of the Yellowstone grizzly bear.	R. Knight	I.G.B.S.T.
A study of the range use and movements of elk in the upper Yellowstone area, in and out of Yellowstone Park.	J. Swenson	Mont. Fish, Wildl. Parks
	J. Vore, H. Picton	Mont. St. U.
A study of the relationships between prehistoric humans and wildlife in the northern range of Yellowstone Park.	E. Hadly	NPS
	L. Agenbroad	N. Ariz. U.
Forage production and utilization patterns by elk and bison on all four seasonal ranges.	S. McNaughton, D. Frank	Syracuse U.
LANDSAT interpretation of grassland standing crops.	M. Boyce, E. Merrill, Marrs	U. of Wyom.
Ecology of mature bull elk.	J. Peek, D. Vales	U. of Idaho
Human disturbance of wintering elk.	E. Ables, F. Cassirer	U. of Idaho
Hunter and recreationist disturbances of elk near Gardiner, Montana.	H. Picton	Mont. St. U.
	J. Vore	Mont. Fish, Wildl. Parks
Herbivory on the northern Yellowstone winter range.	M. Coughenour, J. Detling	Col. St. U.
The status of willows: distributions and browsing impacts on the northern range.	F. Singer	NPS
Behavioral and activity comparisons of Madison-Firehole, Lamar Valley, and Mammoth Hot Springs elk.	E. Ables	U. of Idaho
Riparian vegetation of the northern range, Yellowstone National Park: classification, succession, and environmental relationships.	R. Pfister, S. Cooper	U. of Mont.
The relationships of climate to sedimentation rates in lakes and ponds on the northern range in Yellowstone National Park.	H. Wright	U. of Minn.
	C. Barnowsky	Carnegie Instit.
Factors that limit elk populations in the greater Yellowstone ecosystem.	C. Kay, F. Wagner	Utah St. U.
An intensive study of mountain lions in Yellowstone National Park and in the Yellowstone River drainage outside the park.	M. Hornocker	Wildl. Res. Instit.
Responses of major forage species to grazing by bison and elk.	L. Wallace	U. of Okla.

There were no differences in 12 soil nutrients or in runoff or sediment yield (as determined by a rainfall simulator), between grazed and ungrazed areas. However, there were higher surface bulk densities and lower soil infiltration rates in grazed areas. Several grasses that can increase when grazed, including junegrass, bluegrasses, and thickspiked wheatgrass, were more abundant in grazed areas. However, annual production of grazing-sensitive grasses – bluebunch wheatgrass and Idaho fescue – were not influenced by grazing, as were 19 other grasses, 87 forbs, and 22 shrub species found on the study sites. Root biomass and total plant cover were uninfluenced by grazing, although there was less dead litter and more bare ground on grazed sites.

The studies indicate only subtle differences between grazed sites on winter ranges and sites protected within exclosures for 27-31 years. None of the differences suggest departures from natural conditions. The park recognizes that total protection from grazing as in exclosures does not represent natural conditions. The 27-31 year old exclosures only serve to emphasize how little elk grazing affected the drier, winter range sites. This evidence further supports D. Houston's contention (1982) that precipitation patterns influenced the grasslands more than elk grazing. From 1958 to 1981, total plant cover more than doubled on grazed and ungrazed study sites apparently due to a pattern of wetter summers, at the same time elk numbers more than quadrupled following termination of the artificial reductions.

Few conclusions may be made about the effects of elk and bison grazing upon the summer range, because most of those studies are still in progress. Perhaps a greater influence from grazing summer range may be documented because ungulates graze the plants on summer range while they are growing, in contrast to grazing cured, dormant forages on winter range after these plants have transported their nutrients to their root systems in the fall. The frozen ground and protective snow cover further minimize grazing effects on winter range plants. One study, however, suggests that summer range grassland standing crops, as determined from LANDSAT imagery, are significantly correlated to optimal winter snowpack and not to elk numbers. Summer range grassland production, however, was directly correlated to elk calf crops.

Another study has found fewer plant species inside exclosures on summer ranges. Short-statured plants were less abundant inside exclosures, probably because grazing did not trim taller plants. Research on willows and aspen has just been initiated, and will include studies of grazing intensities, annual production, and the effects of drought and fire upon ungulate preferences of plants and the production of plant secondary defense compounds.

The severe drought and the fires of 1988 may help to answer several questions about the northern range. A large number of willow and aspen stands burned in 1988, for the first time this century. The opportunity has been presented to document fire responses of these species. Park biologists are predicting enhanced growth, new seedling establishment, and greater abundance of willow and aspen. Although palatability may also be enhanced by the burning, many aspen and willow stands may escape to above the height of ungulate browsing after the fires.

As a combined result of the drought, burning of winter ranges, and a severe winter in 1988-89, mule deer numbers declined 19 percent, pronghorns 27 percent, and elk 38-43 percent (of which 14-15 percent was harvest and 24-27 percent was winterkill). The

A wealth of expertise was represented at the meeting in Knoxville, TN August 1-3 on *biosphere reserves and global change*. MAB expects to become deeply involved in this gigantic issue. (See article, p. 14).

The enthusiasm in California for the biosphere reserve concept has reached an encouragingly high political level. At the **dedication of the Central California Coast BR (CCCCBR)** on August 12, U.S. Sen. Pete Wilson and former State legislators Pete Behr and W. Bill Lane, as well as Assistant Secretary of the Smithsonian Tom Lovejoy and other distinguished officials, welcomed into the biosphere reserve family Golden Gate NRA, Point Reyes NS, Farallon Islands NWR, Gulf of the Farallones National Marine Sanctuary, the Marin Municipal Water District, the San Francisco Watershed, and Mount Tamalpais, Tomales, and Samuel P. Taylor state parks. Laurie Wayburn of the Point Reyes Bird Observatory will have an exciting and challenging time as CCCBR Coordinator in guiding the component parts toward cooperative activities that will benefit the region.

How to institutionalize this cooperation will be suggested in a *feasibility study* funded this year by the U.S. MAB National Committee. The committee also funded feasibility studies for the Lake Champlain Basin-Adirondack BR and for proposed BRs in the Ozark Highlands and Gulf of Maine region.

Regional cooperation was also the subject of a **public MAB seminar** held August 8-10 in Glacier NP, in conjunction with Waterton Lakes NP and the Coram Experimental Forest – all biosphere reserves. Speakers from the NPS, Forest Service, Blackfeet Tribe, British Columbia Parks, and public and private Montana groups presented the MAB program, discussed land management objectives in the northern

opportunity now exists to document the ungulate recovery from the winterkill and response to large scale burns of both winter and summer ranges. Currently, one group of biologists is predicting fire-related enhancement of elk carrying capacity due to greater nutrient content and greater forage production in burned areas. Another group of scientists is predicting only moderately enhanced carrying capacity and only minor or no increase in elk numbers as a result of the fires. This group maintains that fire-related enhancement of forage quality is often minor (only a few percentage points) and the effects may be short-lived, lasting perhaps only 1-3 years. Additionally, elk are so efficient at selecting a consistently high level of nutritious forages, especially on summer ranges, that even though fires enhance forages, the net benefit to elk is relatively minor. The fires of 1988 have provided a unique opportunity to investigate these conflicting hypotheses on a large scale.

Abstracts from the First and Second Annual Meetings of Research and Monitoring on Yellowstone's Northern Range (January 28-29, 1988 and March 22-23, 1989) are available from J. Varley, Chief of Research, Box 168, Yellowstone NP, WY 82190. Also available from the same address is a Summary of Significant Findings dated July 15, 1989, and copies of final reports on the winter range exclosure studies (soil, grasslands) and the pond sediment studies.

Singer is a Research Biologist at Yellowstone NP.

Rocky Mountains, and explored opportunities for cooperative achievement of those objectives. The Southern Appalachian MAB Cooperative (SAMAB) was considered as a possible model.

Meanwhile, SAMAB, the first U.S. MAB cooperative, gears up for action. Hubert Hinote, a resource economist for 22 years at the Tennessee Valley Authority, has been hired half-time as executive director, and he has prepared a work plan and budget for FY 1989 and FY 1990. Great Smoky Mountains NP is providing office space and secretarial help for the SAMAB Coordinating Office. A nonprofit foundation is being established and, if things go as planned, will fund SAMAB projects beginning in FY 1991. Until then, all funding will come from member agencies.

Cooperative MAB activities with the Soviet Union continue, with a general goal of developing methods for comparing environmental/ecological conditions in the two countries and for other research and education of mutual interest. Ray Herrmann of the WASO Water Resources Division and Dave Graber from Sequoia-Kings Canyon NPs were part of a U.S. group that met with Soviet scientists May 26-June 1 in Idaho and Wyoming. The objectives were to exchange chemical standards, to exchange air samples for equipment calibration, and to agree to a methodological approach for field work to be cooperatively conducted in the U.S.S.R.'s Okskiy State Reserve in August and September. The discussions also touched on cooperative work planned for 1990 in Alaska's Noatak BR, where the emphasis is expected to be on monitoring related to global warming effects. Herrmann and Graber also participated in the Okskiy Reserve trip, Aug. 15-Sept. 15, where methods for evaluating biodiversity were discussed and tested.

In July the U.S. MAB National Committee allocated a total of \$414,000 to 11 **research and education projects**. The emphasis in this year's grants was decidedly international: 10 of the projects dealt with resource issues in other countries. Subjects ranged from agriculture in the central Andes, grazing in western Tibet, and restoration of pine forests in subtropical China to training, conservation, and management of tropical biosphere reserves, circumpolar study of global change, and global environmental education initiatives. The annual call for proposals for next year went out in August. Bill Gregg, NPS MAB Coordinator, says **better proposals are needed from U.S. biosphere reserves**. This year's were not competitive.

Michael Ruggiero, Chief of the WASO Wildlife and Vegetation Division, represented the U.S. MAB Committee at the **Second European Conference of MAB National Committees** at Trebon, Czechoslovakia May 22-27. Representatives of 20 countries attended, including 10 Eastern bloc countries. Workshops were conducted on biosphere reserves, ecotones, forest ecosystems, and landscape change. Roundtable discussions focused on urban ecosystems and environmental education. Mike reports that there was a real spirit of cooperation between East and West. The environment now has become the major issue in Europe and ways are being sought to harmonize efforts among countries. The attendees were particularly interested in U.S. programs relating to geographic information systems and long-term monitoring.

Napier Shelton
NPS Washington Office

Virginia NPS Sites Surveyed For Rarest Plants, Animals

In 1988, the Mid-Atlantic Region entered into a major Cooperative Agreement with the Virginia Natural Heritage Program to survey portions of the Commonwealth of Virginia containing Mid-Atlantic Region NPS lands to ascertain the presence and current status of rare or endangered plant and animal species as well as significant and exemplary natural communities. These lands include Shenandoah NP, occupying the Northern Blue Ridge in Virginia; George Washington Birthplace and Booker T. Washington National Monuments; Colonial and Appomattox Courthouse National Historic Parks; and Petersburg, Richmond, and Fredericksburg/Spotsylvania National Battlefield Parks.

The inventory will aid the NPS in decisions concerning land use, maintenance activities, public access, citing of recreational facilities, and management of areas containing rare elements of natural diversity. All information gathered in this study will be supplied to the NPS and also incorporated in the Natural Heritage Program Biological and Conservation Data System.

Established in 1986 with the Virginia Department of Conservation and Historic Resources, the program is responsible for collecting data regarding the state's rarest plants, animals, natural communities and other special features as a permanent, dynamic library containing the rare elements of natural diversity, continually updated and maintained by the Natural Heritage Program.

Since many rare and endangered species in Virginia are located in private lands and are subject to intense development pressures and extensive habitat destruction, the preservation of rare species must be considered as a primary criteria in the development of future NP management plans. Rare species and significant natural communities documented in reports from past studies performed within the park land boundaries are usually presented in a general geographic area with few site specific locations noted. As plans for these NPS lands are formalized and carried out, site specific locations for rare species will be an asset.

The rarity status of species found in the inventory will be determined. Records of each rare species' distribution in Virginia will be reviewed by the Natural Heritage Program; moreover, the status of each species on a global scale, utilizing the National Natural Heritage Network will be determined. A rarity hierarchy formulated from this combined information will be invaluable in determining which species and natural communities should receive immediate attention and which are potentially less vulnerable.

The information gathered in the inventory will be valuable to the Virginia Department of Conservation and Historic Resources and the NPS in their respective missions of preserving natural biological diversity in the Commonwealth and will promote a continuing partnership in sharing and updating information in the future.

The major objectives of the inventory are to:

1. Identify records, occurrences and status of plant and animal species and vegetative communities within, adjacent to, or potentially occurring in Virginia NPS sites of the Mid-Atlantic Region, listed as rare, threatened or endangered by state and federal agencies;

2. Field survey and verify locations or recorded occurrences;

3. Field survey potential habitat locations for new occurrences of rare species or communities likely to be present;

4. Document existing conditions of element occurrences and recommend management requirements; and

5. Record and map all historical, previously recorded and extant rare species and community locations according to standard Heritage Program methods and procedures.

In cooperation with the Mid-Atlantic Region and individual parks, up-to-date boundaries of authorized and federally owned lands for the parks of interest have been obtained and transferred to Virginia Heritage Program USGS 7½' topographic maps. Land ownership information has been recorded in the Heritage managed area and element occurrence databases for any element occurrence located within these boundaries that had not been previously identified as on NPS lands. Appropriate herbaria and museums are being searched for existing records of occurrences of the rare species and communities of interest within or adjacent to the Virginia NPS areas. All collected information is being entered on relevant Heritage Program forms, databases and maps. A literature review is underway as well.

Based on updated information on the rare plant, animal and community occurrences, and in cooperation with the NPS, a work plan of site and species priorities for field survey in the 1990 and 1991 field seasons will be developed. Priorities will include previously recorded occurrences and new sites that have a high potential for containing species or communities of interest according to their habitat requirements. According to the approved work plan, extant sites or occurrences will be inventoried and mapped; information on site location, population numbers and condition, habitat and site requirements, degree of site endangerment and known or suspected threats, management recommendations and other items will be recorded on standard Heritage Program forms, maps and databases.

Any rare species located during the field surveys will be photographed and colored slides will be provided

for use by the appropriate Park Resource Management and Interpretive Programs. Collection of plant material will be kept to a minimum and those specimens collected will be prepared and deposited according to NPS standards.

John Karish, Mid-Atl. Reg. Chief Sci.
Jeff Marion, Regional Research Sci.

Three BRs Meet To Examine Roles

Three Biosphere Reserves in the northern Rocky Mountains – Glacier NP and the Coram NF in the U.S., and Waterton Lakes NP in Canada – sponsored an August 1989 seminar entitled "Crown of the Continent into the 21st Century: A Perspective Under the MAB Program." The seminar was held to introduce the Man and the Biosphere program to land managers, visitors, the general public, and employees of the three BR areas involved. Biologists, historians, and tourism and development representatives from Canada and the U.S. also attended.

The first day focused on the MAB program and current land management trends in the region. Key-note speaker Bjorn Dahl told how the MAB program works in the Southern Appalachians. Dahl emphasized that key players in the program need to include the states and public as well as federal agencies. Noting that the northern Rocky Mountains has not experienced the serious human pressures the Southern Appalachians has, Dahl expressed his opinion that the 'Crown of the Continent' could be an exemplary MAB area. With the vast relatively undisturbed resources there is an opportunity for research, education, conservation, and sustainable use.

The second day emphasis was on developing understanding of the cultural and biological history and diversity of the area. Curly Bear Wagner, a member of the Blackfoot Tribe, discussed Blackfoot history and culture, and the Indians' philosophies regarding the land. There was also a presentation on man's influence in Glacier NP. Speakers highlighted the biology and management of wolves, grizzly bears, bald eagles, and peregrine falcons, four threatened or endangered species selected because their vast ranges expand beyond the northern Rocky Mountain region. Dick Hutto, a University of Montana professor, addressed biological diversity, ecosystem management, and concerns regarding single species management.

Current trends in resource utilization was the focus of the final day: Trends, and current and future needs for development and tourism in the Flathead Valley.

A common thread in each speaker's talk was that the resources and their utilization must be managed cooperatively in this region. The desire is to maintain biological diversity and integrity in areas such as Glacier and Waterton Lakes NPs and the Bob Marshall Wilderness while we explore resource utilization in adjacent lands. These activities must be coordinated so that man and the natural resources can coexist in the Crown of the Continent.

This seminar serves as the catalyst for future MAB discussions in this area. A meeting of the local land managers is tentatively scheduled for late October or November to develop strategy for arousing interest and support for the MAB program in this area.

Laurie Kurth, Ecologist
Rocky Mountain NP

NOTICE

To be placed on the *Natural Resources CompuServe network*, call your Regional Information Management Coordinator (the ADP Division Chief). He/she will call Carl Zaner, NPS CompuServe System Manager, in the WASO Information Systems Division. If your IM Coordinator is unable to help you, you can call Abby Miller, NR Program Coordinator (FTS 343-4650/commercial (202) 343-4650). She can then provide a list to Carl. You will need to know your CompuServe "address" (available in "NPS Basic Guide to CompuServe/InfoPlex Electronic Mail"). If you do not have an address, your IM Coordinator can also help you obtain one through Carl.

Endangered Species Restoration At Gulf Islands Seashore

Several projects underway at Gulf Islands National Seashore are aimed at restoring endangered species to portions of their former range. These include efforts to reestablish populations of bald eagles, brown pelicans, and beach mice in the park, and cooperation with the USFWS to propagate endangered red wolves, a species that has been extinct in the wild for several decades.

A hacking program on Horn Island, a wilderness barrier island in Mississippi Sound, has resulted in release of 19 young eagles in the park over the past three years. It is anticipated that these birds will return to breed when they mature at five to six years of age. Two birds already have returned – a second year bird in March 1988 and another immature bird in October 1988.

The project is part of a program aimed at restoring southern bald eagles across their former range in the Southeastern United States. Eggs collected from wild nests in Florida are hatched and hand raised at the Sutton Avian Research Center in Oklahoma. At eight weeks of age young eagles are distributed to release sites around the Southeast. The program moved from a research to a management phase last winter under the direction of park research personnel. The first of a series of large scale releases in the Southeast will take place this winter when 42 eagles will be loosed in coastal Mississippi.

Beach Mice Get New Lease

By 1986 the endangered Perdido Key beach mouse had been reduced to a population of fewer than 30 animals at one location on Perdido Key, making it one of North America's rarest mammals. A cooperative program involving NPS, the State of Florida, USFWS, and Auburn University was begun that year to reestablish the mice at Gulf Islands on portions of their former range. Thirty mice have been reintroduced to the Seashore over the past two years and a captive breeding program has begun. The mice appear to be thriving and a breeding population seems to have been established over the entire 7 miles of the park's Perdido Key Unit. This marks one of the first successful reestablishment of an endangered mammal population.

Brown Pelican populations have been increasing steadily along the Gulf Coast after being virtually wiped out by pesticides in the early 1960s. Populations in Alabama and Louisiana are expanding, and it is hoped that these endangered birds will return to coastal Mississippi. As part of an experimental project to attract pelicans to protected predator-free nesting areas in the Seashore, pelican decoys, nesting material, and nesting platforms have been provided for the birds on an isolated island in Mississippi Sound. No nesting has yet been observed, but up to 150 juvenile birds have used the island as a roost site.

Red Wolf Program Underway

The red wolf, a shy, solitary species of wolf that once ranged throughout the Southeast, has been extinct in the wild for almost 20 years. Last year the USFWS launched an exciting and innovative program aimed at

reestablishing the species on Alligator River National Wildlife Refuge in North Carolina. Unfortunately the only red wolves remaining have been in captivity all their lives, and it is feared that their survival rate in the wild may be low. One solution may lie in the propagation of wild wolves in a controlled but wild setting. The Seashore's Horn Island, a wilderness area 10 miles off the Mississippi coast, is ideal for such a program. Horn Island, which lies at the heart of the wolf's former range, contains ideal habitat for red wolves, and an excellent food source in the form of introduced rabbits and nutria, both of which are considered pests on the island.

A pair of adult wolves was transported to Horn Island in January 1989 as part of a five year research and propagation project. Research will document the biology of these poorly known animals and assess their effects on exotic and native prey populations. In addition, any offspring produced will be removed once they are independent of their parents, and released into the wild at Alligator River. It is hoped that the survival instincts developed by these animals on Horn Island will ensure their success in the wild.

Ted Simons, Research Biologist
Gulf Islands National Seashore

Pacific NW Native Plants Meeting

"Designing, Maintaining, and Restoring the Native Landscape" is the title of a conference held Sept. 29-30, 1989, at Portland (Oregon) Community College, sponsored by Cascadia Native Landscape Center. Woods, wetlands, and meadows – their ecology, design criteria, plant procurement and installation, and maintenance and management – comprised the agenda.

Cascadia Native Landscape Center aims at promoting research of Pacific Northwest native plants and plant communities and greater utilization of PNW native plants in the urban and suburban landscape. For information on the sessions – freshwater wetlands, Douglas fir and Garry Oak woodlands, and Meadows, hedgerows and roadsides – contact Mark G. Wilson, 980 S.W. Broadway Dr., Portland, OR 97201; (503) 222-0134.

Natural Areas Conference Topics

Conference topics for the 16th Annual Natural Areas Conference Oct. 17-20 in Knoxville, Tenn., will range over the following areas:

Managing exotic species in natural areas; characteristics, management, and restoration of old-growth temperate forest ecosystems; protection of riverine ecosystems as natural areas; global climate change and the implications for natural areas managers; the ethics of natural area preservation, and managing and protecting caves and cave faunas.

meetings of interest

1989

Oct. 17-20, 16TH ANNUAL NATURAL AREAS CONFERENCE and ELEVENTH ANNUAL MEETING OF THE NATURAL AREA ASSOCIATION, Hyatt Regency Knoxville, Knoxville, TN; hosted by Wildlife and Natural Heritage Resources and Tennessee Valley Authority. Contact: J. Ralph Jordan, 228 Natural Resources Bldg., TVA, Norris, TN 37828.

1990

March 20-24, FIRE AND THE ENVIRONMENT: ECOLOGICAL AND CULTURAL PERSPECTIVES, an international symposium to be held in Knoxville, TN, multi-sponsored including NPS, U/TN, USFS, and the Society of American Foresters. Contact: Fire Ecology Symposium, Dept. of FW&F, U/TN, Knoxville, TN 37901-1071, (615) 974-7984.

May 16-19, THIRD SYMPOSIUM ON SOCIAL SCIENCE IN RESOURCE MANAGEMENT, at Texas A&M University. Abstracts for papers and posters due Dec. 15, 1989. Contact: James Gramann, Dept. of Recreation and Parks, Texas A&M, College Station, TX 77843; (409) 845-4920.

May 23-29, CONGRESS ON MARINE TOURISM, a symposium and workshop on balancing conservation and economic development, sponsored by Sea Grant College Program, East-West Center, and the Pacific Basin Development Council. Contact: Dr. Jan Auyong, Marine Tourism Congress, Sea Grant Extension Service, U/HI at Manoa, Honolulu, HI 96822; (808) 948-8191.

Resource Management Specialists to Meet

A workshop for Regional Chiefs of Natural Resource Management has been scheduled for late October or early November in Denver, Colo. A call to the meeting from NPS Associate Director Eugene Hester asked that each of the 10 NPS Regions be represented by 2 or 3 staffers who have primary responsibility for natural resource management.

Suggested topics include the NPCA's *National Park*

System Plan, implementation of research results in resource management and decision-making, conservation of biodiversity, management of endangered species and of over-abundant species in incomplete ecosystems, public information programs as ways to communicate critical resource issues, funding to implement research results, wilderness and fire management policies, and how consumptive uses in parks are affecting resources.

Counting Grizzly Bears in Northwest Alaska

By Kathryn Roney, Lee Anne Ayres
and Warren Ballard

Will a world-class lead/zinc mine being developed between Noatak National Preserve and Cape Krusenstern National Monument adversely affect their grizzly bear populations? That is the question faced by the Northwest Alaska Areas and the Alaska Department of Fish & Game. Grizzly bears in northwest Alaska are harvested by both sport and subsistence hunters. This, in addition to the impending development of the mine, called Red Dog, highlighted the need to obtain better population data on bears.

Historically, managers in Alaska have relied primarily on gross analysis of harvest data and miscellaneous observations to assess bear population trends. However, the use of harvest statistics for monitoring population status is not well documented and appears to be imprecise and questionable. More importantly, the information collected cannot be reliably compared to later observations.

Mark and Recapture

Our objectives were to obtain information on bear density, population structure, movements, and reproductive parameters by using a combination of conventional radio telemetry, satellite telemetry, and density estimates acquired with "mark/recapture" techniques.

The mark/recapture method of estimating wildlife numbers has been widely used for a variety of animals. The basic technique is to capture, mark, and release a known number of animals within a population. Later, you recapture animals from that population. In our case the marked animals, those with radio collars, were recaptured visually rather than physically. The proportion of the visually located animals which are marked as compared to the total number captured should correspond to the total marked animals as a proportion of the entire population. The full equation is:

$$\frac{\text{Number of captured animals which are marked (m)}}{\text{Number of animals captured (n)}} = \frac{\text{Total number marked animals in population (M)}}{\text{Estimated total population (N)}}$$

In addition to the population estimate, confidence intervals (CI) can be calculated. The CIs indicate the probability that the true population size falls within the bounds of the interval. This estimate of "confidence" in a population estimate is important when, in the future, we attempt to determine whether a change has occurred in the population.

Catching Grizzlies

The helicopter maneuvered into position and Warren Ballard, project leader, darted the female grizzly bear with immobilizing drugs, *tiletamine hydrochloride* and *zolazepam hydrochloride*. The amount of drug delivered was based on a visual estimate of her weight. It took approximately 10 minutes for the bear to go down.

The capture team's work had just begun. Sow 51 had two "cubs of the year." These cubs needed to be sedated to insure the family group remained together. The cubs were to be captured by hand. While a spotting plane kept an eye on the cubs, the helicopter placed team members in strategic locations. Then the foot race began. The speed, strength, and endurance of 25 pound grizzly bear cubs is incredible, as exhausted team members will verify!

Once both cubs were captured, they were trans-

The Northwest Alaska Areas includes three units of the National Park system; Noatak National Preserve (6,600,000 acres), Cape Krusenstern NM (660,000 acres), and Kobuk Valley NP (1,750,000 acres).

The Red Dog Mine is currently under construction on private land between the Noatak and Cape Krusenstern. Approximately one-half of the 54 mile road which connects the mine to the coast runs through Cape Krusenstern. The mine site is located 7 miles from the western boundary of the Noatak National Preserve.

The mine is expected to begin operation in 1990, primarily for lead and zinc. The project will include tailing ponds, a mill, power plant, worker housing, a saltwater port, water reservoir, the road, and several gravel borrow sites. The facilities will occupy at least 22,200 acres. The project is expected to operate a minimum of 40 years and much longer if additional nearby mining claims are developed.

ported back to their mother. The radio collar Sow 51 had been wearing for two years was now replaced, ear tags and tattoos checked, antibiotics administered, and physical measurements taken. She had been wearing a conventional radio collar. Her new collar had both conventional and satellite transmitters. Six grizzlies with home ranges that include the Red Dog mine were fitted with the satellite collars. These collars transmit daily movement data and provide much more detailed information.

Counting Grizzlies

The census was done using several fixed-wing aircraft and a helicopter. Each day the census area was thoroughly searched for "marked" bears. Marked bears were those with functioning radio collars. Once a bear was spotted by a search plane, all active radio collar frequencies were scanned on a receiver. If no frequency was picked up from the bear, it was categorized as unmarked. Generally the helicopter was called in to place a radio collar on unmarked bears. In this way the number of bears within the population which were marked (M) increased each day. The census lasted 7 days.

Sow 51 was one of 12 radio-collared grizzlies that had been captured and radio-collared in previous years and was available as a marked bear at the beginning of the census. By the last day of the census, there were 37 radio-collared bears in the area.

Assumptions of the Mark/Recapture Technique

Mark/recapture has a number of assumptions which must be met to be valid. The one most frequently violated is that of "population closure." We needed to determine how many of the collared bears remained in the census area and were available for recapture. This was done by deploying a radio-tracking plane, which searched for and located all collared bears each day. Each bear was identified as being in or out of the census area for that day.

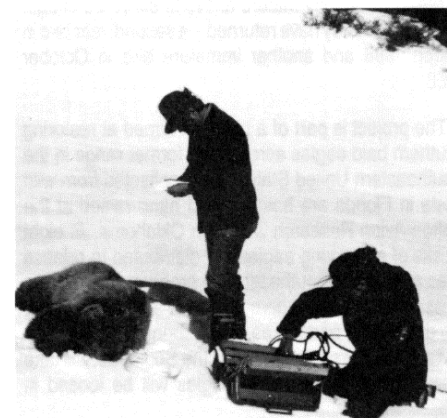
Another key assumption in mark/recapture estimates is that all individuals have an equal chance of being captured (sighted in our case). We are in the process of determining whether this assumption was met. There seems to be a reduced sightability for sows

with cubs. Our data are being combined with data from similar Alaskan studies. With larger sample sizes, we anticipate that statistically significant differences among sex, age, and family groups can be properly tested.

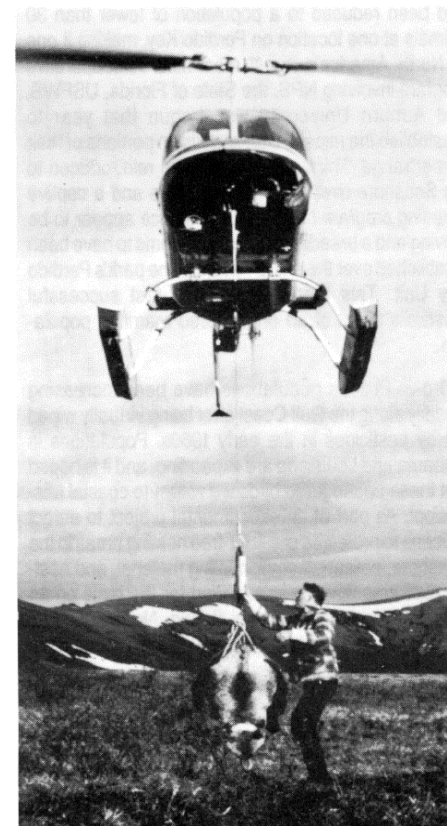
Results

The intensive capture efforts allowed us to estimate the current sex and age structure of the bear population in the study area. Yearlings and cubs comprised 31 percent of the population. Ratio of adult (greater than five years of age) males to females was 61/100.

Two additional groups of populations estimates were developed: (1) numbers of adult bears greater than three years of age and (2) total numbers of bears



Warren Ballard and Kate Roney marking, collaring, and collecting data on a grizzly bear. 5/27/89. (Photo by Ayres).



Here's how you weigh a bear. (Photo by Ayres).

Adult Bear Population Estimate (N)

and 95% Confidence Interval

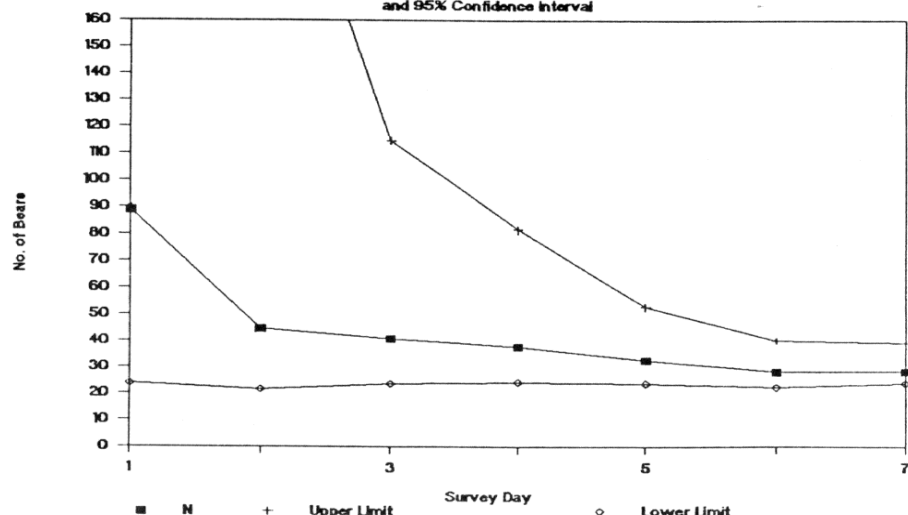


Figure 1



Radio collars and a drugged grizzly bear. A conventional radio collar is on the right. A collar with both conventional and satellite transmitters is on the left.

including young. The most statistically valid estimate was the former because it violated fewer crucial assumptions (primarily the assumption that all captures are independent of one another).

The adult population estimate within the census area was 28 bears (95% CI of 24 - 39) and the total population estimate was 37 bears (95% CI of 31 - 46). The population estimate did not change greatly as the survey progressed (Figure 1). What did change was the size of the CIs; they narrowed as the survey progressed. Population estimates and associated CIs leveled off by day 6. We surveyed one additional day to confirm that result and terminated the census after day 7. The primary benefit to marking additional bears during the census was to decrease the CIs.

Our reported total density estimate was 1 adult bear per 25 square miles. This falls near the midpoint of published density estimates for arctic study areas in

North America.

The grizzly bear in northwest Alaska is near the limits of its range. Its reproductive rate is low. Bear 51 bred for the first time at 4 years of age. She probably will live for 15 to 20 years and produce a litter every 3 years.

Because of their low reproductive rate, management of grizzly bears needs to be very conservative. Historically, populations of grizzlies have responded slowly, or not at all, following a reduction in numbers due to some impact or habitat loss. Typically, by the time a change in status of a bear population is identified, needed remedial actions are severe and often futile.

The Future

The status and health of the northwest Alaska bear population will be assessed at a later date by repeating the study using identical methods. The advantage of the mark/recapture technique over more common

8th International Bear Conference

"Future for Bears" was the theme of the 8th International Conference on Bear Research and Management, sponsored by the International Association for Bear Research and Management (IBA) and held in Victoria, B.C., Feb. 20-25, 1989. Over 200 people from 10 countries attended. The fact that it was held outside the U.S. made it difficult for NPS personnel to attend.

Of the 76 papers, evening workshops, and poster sessions, much of the focus was on the black and brown bears of North America. Research covered in the accompanying article "Counting Grizzly Bears in Northwest Alaska" was presented at the conference.

One paper briefly covered all species of bears. Chris Servheen of USFWS presented *The Status and Conservation of the Bears of the World*. North American problems in bear conservation seemed small compared to those of the rest of the world. Of the eight bear species worldwide, only the black bear and polar bear are stable in most areas. For several species (the Asiatic black bear, sloth bear, sun bear, and spectacled bear) species biology and even basic distributional data are lacking. Servheen noted that these species (as well as the giant panda and the brown bear outside of North America) will require international cooperation to survive.

The IBA has been selected by the International Union for the Conservation of Nature (IUCN) to be the parent organization for the "Bear Specialist" group for non-polar bears of the world. An appeal was made for bear researchers to share information and to contribute to research on bears at the international level.

Conferences of the IBA are held every three years; the next will be held in Montana in 1992. The proceedings for the 8th Conference should be available within one to two years. Proceedings of past conferences are available from: Michael R. Pelton, Department of Forestry, Wildlife & Fisheries, U/Tenn., Knoxville, TN 37901.

Conference #	Date	Cost
1st	1968	\$5.00
2nd	1970	Out of print
3rd	1974	Out of print
4th	1977	\$5.00 (Bargain)
5th	1980	\$28.00
6th	1983	\$30 (\$28 for members)
7th	1986	\$35 (\$32 for members)

Individuals interested in IBA membership should send a check for \$7.00 to Dr. Sterling Miller, Sec.-Tres., c/o Alaska Dept. of Fish and Game, 333 Raspberry Road, Anchorage, AK 99518-1599. Members receive a quarterly newsletter, *Bear News*. Checks for membership or past proceedings should be made payable to "IBA."

methods is that the population estimates have known precision and can be statistically compared to later estimates. The causes of any changes are more difficult to decipher. The movement, productivity, and harvest data should help us understand reasons for changes.

Alaska contains approximately 65 percent of the North American population of grizzly bears. However, we cannot take for granted the current healthy populations of bears here. The precarious situation for grizzlies in the remainder of the United States, highlights the fact that bear populations can be greatly reduced by habitat loss and other human impacts. A well-

(Concluded on back cover)



Lee Anne Ayres with a captured grizzly bear cub. The cubs weigh approximately 20 lbs. in late May. They can easily outrun people.

designed and scientifically valid study is an important first step. We plan to repeat the population count. This will allow us to compare density data and movement patterns. We also will be able to more accurately evaluate, and perhaps mitigate, any impacts of the Red Dog mine, or other developments, on grizzly bears.

Roney is Resource Management Specialist and Lee Anne Ayres is Wildlife Biologist for the Northwest Alaska Areas. Warren Ballard is a Research Biologist for the Alaska Department of Fish and Game.

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In the Next Issue:

"Landscape Ecology – A Concept for Protecting Park Resources" by Craig Allen, John Lissoway, and Keith Yarborough; "Kemp Ridley Project at Padre Island Enters a New Phase" by Donna L. Shaver, and "Monitoring Harlequin Ducks at Acadia" by Glenn Mittlehauser and Judy Hagen.