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Editorial

How do we go about changing systems for the better?

One way is to provide payoff points for processes or behaviors that benefit the system. A brand new provision for such new payoff points is one of the most exciting aspects of the new "Director's Awards" for science and for management. (See back cover.)

We take it for granted that the National Park Service is in the business (or preferably in the profession) of promoting excellence throughout the National Park System. What we sometimes fail to realize is that the National Park Service is also, *itself*, a system. The things we do for the resources of which we are the designated stewards – things calculated to improve, enhance, upgrade, preserve, perpetuate, whatever – can be of great benefit in maintaining a high level of performance in the Service as well as maintaining a high level of excellence in the System.

Natural systems such as those that can be found within the National Park System presumably work "unconsciously." Nobody has to tell a turtle or a leaf where to go or how to function. They just do it, "naturally." Their "rewards" are built in to the systems in which they live and function.

In the National Park Service system, we like to think that we function at the conscious level. Every manager knows that there are people in his/her service who – unfortunately – need plenty of clues as to where and how to function. And sometimes just telling them isn't incentive enough. Rewards are necessary as strong motivators, even at the exalted level of "consciousness" at which we all work.

So a new "pathway" in the systems functioning of the National Park Service has now been added. The two initial recipients, Chuck Stone and Jeri Hall, obviously didn't need these incentives. Their dedication to excellence clearly was enough to motivate these outstanding two. But from here on, there will always be that little extra incentive hovering over the NPS system, recognition of performances that stand out from the crowd – signals that tell career personnel that excellence in scientific research and resource management is a rewarding rung on the ladder of upward mobility.

Cover: Look who's part of a National Park? Five of the 500 or so cattle who will continue to be part and parcel of the nation's newest National Park. (See story pp. 4-5. Photo by Mike Nicklas.)

Researchers Study Newest National Park

By M. Lee and E. Starkey

On Oct. 27, 1986 President Reagan signed into existence the nation's newest national park. Great Basin NP was the first national park established in 15 years, the country's 49th, and Nevada's first. Great Basin NP was established as representative of the biological and physical ecosystems characteristic of the Great Basin of the Western United States. The park possesses outstanding and significant geological and scenic values of what may be the least known and most isolated geographic province in the West.

The story goes that during the spring of 1885 a Nevada rancher named Absalom Lehman made an incredible find while chasing cattle in the foothills of Wheeler Peak in Nevada's Snake Range. Coming upon a deep, dark hole in the ground, Lehman left his cattle and returned with a lantern and a rope to explore the cavern. He found magnificent chambers of stalactite and stalagmite forests, formed by calcite-laden drops of water seeping through the ceiling, that grow about an inch every 100 years.

Delicate stone draperies, shields, bacon strips, and gravity-defying helictites adorned the damp chambers that now have names like Crystal Palace, Gothic Palace, and Cypress Swamp. Realizing the significance of his find, Lehman promoted the cave as a local tourist attraction, taking guided parties through the cave until his death in 1891. The caves subsequently were used for square dances, boy scout outings, and picnics, as evidenced by graffiti and soot from campfires on the walls and ceilings in some of the larger chambers. In 1922 the caves were proclaimed a National Monument and came under management of the National Park Service.

The remainder of the Snake Range, including 13,065-foot Wheeler Peak, was managed by the U.S. Forest Service as part of the Humboldt National Forest. Designated a National Scenic Area in the early 1960s, Wheeler Peak possesses several notable features. Near the summit of Wheeler Peak is a small glacier, the southernmost permanent rock glacier in the U.S. Scattered throughout the upper elevations are groves of bristlecone pines, the oldest living things on earth.

After years of opposition from local ranchers and miners who felt their livelihoods might be jeopardized by the park's existence, the 77,092-acre Great Basin NP was established to include 640-acre Lehman Caves National Monument and 76,452 acres of the Humboldt National Forest, including the Wheeler Peak Scenic area. The park is located in east-central Nevada (Fig. 1). Much of the region is sparsely populated with the nearest urban centers, Las Vegas, Nevada and Salt Lake City, Utah more than four hours away by road. The major east-west route to the Park, U.S. Hwy. 50, is aptly named the loneliest road in America.

The final Great Basin bill included a compromise that allows cattle grazing to continue within the park's borders. Although a number of units of the National Park System allow grazing by domestic livestock, in general such use is permitted only to accomplish specific resource management objectives, or it is being phased out. Great Basin NP is unique in that the enabling legislation requires that domestic livestock grazing be continued and at approximately the same level as allowed prior to the establishment of the park.

A key challenge will be to provide simultaneously for livestock grazing and enjoyment by visitors, while pro-

tecting the natural environment. The task has been made even more difficult by historic overgrazing, fire suppression and perhaps even climate changes, which have had significant impacts on the vegetation and soils of the park. Adding to management complexity, most grazing allotments also include adjacent U.S. Forest Service lands and livestock freely move back and forth across park boundaries during some periods of the grazing season.

To provide a good basis for range management, scientists from the Department of Rangeland Resources and the NPS Cooperative Park Studies Unit at Oregon State University (OSU) are currently acquiring resource inventory data and assessing range management alternatives. Innovative management will be required, along with a high level of cooperative planning with ranchers and other public agencies, but a solid foundation of scientific information is being established. An article describing in more detail the range management research at Great Basin will appear in a future issue of *Park Science*.

A second research program underway at Great Basin NP is the 5-year Natural Resource Sociology Program. Designed by scientists at Oregon State and Utah State Universities, the program includes a number of tasks aimed at establishing baseline social and

economic data on the park, its visitors, and the surrounding region.

A key project was the 1988 Great Basin NP visitor use study. Nearly 1200 visitors were interviewed between May and September 1988 at 12 visitor use locations within the park. The goal of the survey was to generate information about park visitors that could help in management planning, and to establish baseline data from which to monitor impacts of the park's creation and subsequent changes in visitation through time. Data were gathered that describe Great Basin visitors, their activities within the park, and the facilities and programs of interest to them. Results of the visitor survey have been published as a statistical abstract available from the OSU/CPSU.

Analysis of the 1988 visitor survey data has continued, focusing on visitor use of alternative recreation opportunity zones within Great Basin NP, timing of use, regional tourism services, and a more in-depth look at visitor expectations for park facilities and interpretive programs. Summary reports for these projects will be available in early 1990.

Other projects proposed for 1990 include a survey of residents in White Pine County to document traditional work and recreation patterns within the Great Basin NP

Continued on next page



Figure 1.

Coordinated Rangeland Resource Management

By Ray Jaindi, Lee Eddleman, William Brock, and Boyd Byelich

Congress created Great Basin National Park (GRBA) in 1986 to preserve a portion of the Great Basin ecosystem for the benefit and inspiration of the people. Like all national parks, Great Basin has a fundamental preservation responsibility. But unlike most national parks, Great Basin is also charged, through its enabling legislation, to provide for continued livestock grazing. Integrating livestock grazing into a preservation management strategy is a complex natural resource management challenge. To meet the challenge, the park has undertaken a research study to evaluate the rangeland resources in GRBA and develop a comprehensive range management pro-

Researchers Study (from page 3)

region and a 1-week visitor "pulse," a short-term intensive survey of Great Basin visitors using survey instruments developed for the 1988 summer visitor survey. The goal is to monitor changes in the activities and preferences of the Great Basin visitor population and will include continued analysis of the 1988 visitor survey data.

Managers and researchers have a unique opportunity at Great Basin NP to study visitation and recreation from the Park's inception. Managing indigenous flora and fauna poses a challenging job for park managers, who must balance increased visitation and development with traditional uses such as grazing and mining. Ecological and social science research currently underway at Great Basin is providing valuable data for planning and management efforts as researchers continue to monitor the evolution of the nation's newest national park.

Starkey is a Wildlife Biologist with the NPS/CPSU at Oregon State University; Lee is a Research Assistant in the OSU College of Forestry, Dept. of Forest Resources.



Oldest living things on earth are the bristlecone pines. This ancient relic still sends out tiny green signs of on-going life.

gram to balance consumptive grazing with natural resource preservation.

The management of any ecosystem is complex. Within natural ecosystems, the dynamics of plant and animal components vary in time and space. Long and short term variations in climate, cycles in animal populations, and changes in species distribution all occurred prior to the arrival in North America of European man and his influences. Superimposed on these natural cycles today, are past and present human impacts.

Equally confounding are the park's political boundaries which have no relationship to natural ecosystem boundaries nor to livestock and wildlife use boundaries. Resource management in the park can affect areas outside the park and management outside the park can substantially affect the resources within.

As if this were not enough, several organizations and individuals are involved in rangeland management issues. Four ranchers, descendants of the original area settlers, and one corporation, are permitted to graze livestock on seven allotments (grazing units) which are at least partially within the park. There are 615 cattle and 3000 sheep grazing in different areas of the park on a rotational basis from mid-June to mid-October each year.

The ranchers are responsible for moving livestock on and off the allotment and within the allotment. Their ranch management operations can greatly influence livestock distribution and use within the park. All allotments are co-managed with the Forest Service (USFS). Boundaries between the park and USFS lands rarely coincide with natural ecosystem boundaries.

Several of the allotments are bounded on the lower edge by land managed by the Bureau of Land Management (BLM). These boundaries again are not natural boundaries of an ecosystem. Mobile species such as deer, bighorn sheep, and mountain lion, which are managed outside of the park by the Nevada Department of Wildlife (NDOW), readily move between these areas. Grazing systems, which transcend agency boundaries, are interdependent using these lower lands for part of the fall and winter forage, and upper mountain lands, such as are found in GRBA, for summer forage.

Because of the interrelationships involved, successful implementation of a rangeland resource management plan requires communication and cooperation between NPS, USFS, BLM, NDOW, and the ranchers as well as the general public.

In addition to the present impacts of man on the resources at GRBA, past impacts continue to influence what is seen today. By the early 1880s livestock grazing in the Great Basin Province occurred year-round on a first-come, first-serve basis. Stockmen relied on the native forage to such an extent that they did not grow supplemental hay for their livestock until after the severe winter of 1889-90 took its toll of their herds. By 1918, there were 1.2 million sheep and 500,000 cattle on Nevada range alone. Compare this to the 1989 use of 87,000 sheep and 490,000 cattle.

Excessive use of resources during the initial period of settlement, combined with fire suppression, created circumstances that paved the way for long term vegetation changes. Pinyon pine has greatly expanded its distribution and densities. Seedlings, which were able to establish during the turn of the century in overused

areas and survive due to subsequent suppression of fire, have now matured and monopolize many rangeland sites. These trees eventually out-compete most understory species. The loss of the understory species results in increased erosion and decreased species diversity.

Such changes affect adjacent plant communities indirectly, because forage used by wildlife and livestock becomes more limited and animals are forced to concentrate on the remaining adjacent plant communities which in many cases are sensitive riparian areas.

Range Management Research

Rangeland management at GRBA is based upon coordinating, cooperating, and communicating with agencies and individuals that are not part of the NPS. It requires proactive management to address resource problems stemming from a sequence of events set in motion over 100 years ago and perpetuated through the artificial suppression of fire. To address these issues GRBA has begun a range management research project through the Rangeland Resource Department at Oregon University.

This project calls for assessing the present plant community structure and dynamics within the park; evaluating the present livestock grazing systems and patterns of use; evaluating the physiological pattern of pinyon growth to assess the ability of pinyon to expand upward into adjacent plant communities; initiating long-term climatic and vegetative studies; and evaluating the history and role of fire in maintaining the present plant communities.

Other aspects which need to be addressed to complete the resource analysis are riparian community structure and dynamics; effects of management alternatives today on vegetation structure, with consideration for perturbations in the system due to man's past activities; and wildlife population response to the creation of the park.

Given the diverse ecology and complex administration of interrelated resources, coordinated planning is a necessity. Coordinated rangeland resource management planning is a process by which concerned parties work together, relying on one another's expertise to develop and implement plans for the management of all major resources and ownerships within the area of concern (Anderson and Baum 1987). As such, it not only becomes the basis for current management but serves to maintain flexibility needed for successful modification in the future.

In the interest of advancing the interactive coopera-

Park Polluters Not Caught

The EPA air pollution control program for parks and wilderness areas "was never designed or envisioned to affect sources which existed prior to 1977 unless or until they undergo major modification ... (and) was structured to focus primarily on major sources," according to William Rosenberg, the EPA's assistant administrator for air and radiation.

The statement came as the EPA official acknowledged that some national parks are experiencing poor air quality because of pollution from nearby urban areas or in some cases pollution that may originate hundreds of miles away.

Five national parks were studied by the GAO. They were found to be affected by 2,330 stationary sources of pollution, but only 27 of these sources were regulated.

— A Necessity for Great Basin National Park

tion needed, GRBA has instigated formal meetings, provided assistance to the permittees during livestock moves, offered assistance to USFS in range evaluation and monitoring for joint allotments, and mixed informally at community functions.

For this effort to work, it has been imperative that communication with individuals and organizations involved be completely open and direct. In GRBA's case the process seems to be working. What we see resulting from his effort is a management system that takes into account the complexity of rangeland management and the differences in the goals and objectives of the individuals and agencies involved. This approach should lead to effective cooperation, coordination, and communication, and facilitate proper range management.

Jaindl is a Research Associate and Eddleman is Associate Professor in Rangeland Resources, Oregon State University; Brock is the Resource Management Specialist and Boyd Byelich is the Range Technician at Great Basin NP.

References

Anderson, E.W. and R.C. Baum. 1987. Coordinated resource management planning: Does it work? *J. Soil and Water Conservation*. May-June:161-166.



Near the summit of 13,065-foot Wheeler Peak (right) is the southernmost permanent rock glacier in the U.S.

mab notes

Mammoth Cave NP is now part of a biosphere reserve. The MAB Bureau in Paris approved this nomination on Feb. 8, 1990 along with eight others from seven countries, including newcomer Madagascar. This brings the total to 283 BRs in 72 countries. The other U.S. nomination – Land Between the Lakes in Kentucky/Tennessee – was favorably reviewed but was deferred pending resolution of a boundary issue.

Bill Gregg, NPS MAB Coordinator and a member of the technical committee that reviews such nominations worldwide, comments that "there is almost a revolution in the quality of material and the coordinating mechanisms set forth in the recent biosphere reserve nominations. I'm impressed with the degree of thought that goes into them and the commitments to research, other biosphere reserve programs, and building a coordinating framework. The U.S. nominations no longer stand out as more competitive than the others."

The NPS is well represented, directly or by association, on the newly established U.S. MAB directorates. James Allen, North Atlantic Regional Office, is on the Marine and Coastal Ecosystems, chaired by James M. Broadus, Woods Hole Oceanographic Institution. Dale Taylor, Alaska Regional Office, is on the High Latitude Ecosystems directorate, chaired by Patrick Webber of Michigan State University. James Gramann, professor at Texas A & M University and Research Sociologist for the Southwest and Western regional offices, is on the Temperate Ecosystems directorate, chaired by Robert J. Naiman, University of Washington. The Tropical Ecosystems directorate, chaired by Ariel Lugo, USDA Forest Service – Puerto Rico, and the Human Dominated Systems directorate, chaired by Roberta B. Miller of the National Science Foundation, have no NPS members, but all directorates include members with Park Service ties.

Institutionalized regional MAB programs, now a major focus of the U.S. MAB program, are in various stages of development around the country. Many NPS biosphere reserves are components of existing or potential regional programs. Great Smoky Mountains NP provides a home

for the executive office of the **Southern Appalachian MAB Cooperative**, now more than a year old.

Organ Pipe Cactus NM is included in an ongoing study to assess the feasibility of a **Sonoran Desert regional program**. The study is being coordinated by Friends of Pro Natura, an Arizona-based conservation organization. Carlos Nagel, president, reports that they are sending a proposal to U.S. MAB for funding of a "town hall" meeting to be held in the region, probably in spring 1991. Both Mexican and U.S. organizations would discuss the geographical extent of a bi-national regional MAB program, what form the coordinating body would take, and how funding to support this body and its programs would be secured. Nagel thinks that by spring 1991 the chances are good that the Pinacate region, just south of the border, will be a biosphere reserve. That proposal now awaits signature by the Mexican Ministries of Agriculture and Urban Development and Ecology.

The University of Puerto Rico has received a grant to collect information and hold discussions as a preliminary step before conducting feasibility studies for regional programs around **Guanica BR in Puerto Rico** and **Virgin Islands BR**. Local people, government agencies, and private organizations must all be involved, and "this is turning out to be a longer process than we expected," says Allen Putney of the Eastern Caribbean Natural Area Management Program, which is assisting with the project.

Dave Foster, Research Hydrologist at Ozark NSR and coordinator of an effort to explore possibilities for an **Ozarks regional MAB program**, reported that a contractor was to be selected on February 22 to conduct a feasibility study. The regional program would focus on the Current and Buffalo river watersheds.

A **central Colorado BR complex and regional program** was discussed in Boulder on Nov. 14, 1989 by representatives of NPS, the USFS, the USGS, the National Center for Atmospheric Research, state, county, and municipal offices, the University of Colorado, and private groups. Such a complex would be built around the

existing biosphere reserves: Rocky Mountain NP, Fraser Experimental Forest, and Niwot Ridge in the Roosevelt NF. The conferees identified acid deposition, air quality, fire in the residential/wildland interface, recreation, and water as key regional issues.

Up Glacier way, Brace Hayden, Ecosystem Coordinator, sees promise for regional cooperation in the **upper Flathead River Basin**. The International Joint Commission, in its report on a proposed coal mine in the basin, recommended that governments consider sustainable management strategies in the basin and referred to an earlier proposal by then-Governor of Montana Schwinden for an International Conservation Reserve (ICR) in the basin. Such a reserve would involve parts of Glacier NP, the Flathead NF, provincial forests and parks, and a small amount of private land along the river. It would bring the land managers together to discuss regional issues such as migratory fisheries, endangered species, other wildlife management programs, timber utilization, and oil and gas.

Dr. Robert Naiman, chairman of the MAB Temperate Ecosystems directorate, was scheduled to lead a group of University of Washington scientists, members of the directorate, and representatives from the Southern Appalachian Biosphere Reserve to the **Olympic Peninsula** March 9-11. Their mission: to begin exploring the potential of the Peninsula for building a regional MAB program and to compare it with the socioeconomic characteristics of the Southern Appalachians, where a cooperative MAB program is underway. Management of old-growth forests, maintenance of biodiversity, and management of migratory fish are among the major regional resource concerns. The Peninsula consists largely of Olympic NP and national forest land, though only the park is presently designated as a biosphere reserve.

Copies of the *Proceedings of the Symposium on Biosphere Reserves*, held at Estes Park, CO in 1987, are still available from: Wildlife and Vegetation Division, National Park Service, P.O. Box 37127, Washington, D.C. 20013-7127. **Napier Shelton**, NPS Washington Office

Humpback Whales of Glacier Bay: An Update*

By Gary Vequist

Editor's Note: This is a condensation of an article that appeared in the Fall 1988 issue of *Whalewatcher* magazine.

When explorer George Vancouver first sailed the waters of southeastern Alaska in 1794, he charted an ice-filled passage bordered to the north by an immense glacier. Less than 100 years later, the naturalist John Muir navigated this same passage to find that the glacier had retreated 48 miles to the north, leaving behind a new marine habitat – Glacier Bay.

During this period of rapid glacial retreat, the Glacier Bay marine ecosystem developed into habitat suitable for feeding humpback whales. The first documentation of whales appeared in field notes of a 1938 U.S. Geological Survey visit. "At least one whale each day and at times as many as four or five would be feeding close inshore, near the reef . . . On more than one occasion they leapt clear of the water."

Systematic studies of the humpback whales in Glacier Bay began in the mid 1970s, when Charles Jurasz realized he could recognize individual whales by the shape of their dorsal fins and the unique patterns of natural coloration on the undersides of their flukes.

Concern about the disturbance of feeding whales, an endangered species, by the increasing numbers of vessels visiting the bay prompted the NPS to consult formally with the National Marine Fisheries Service (NMFS). Following NMFS's recommendations in a 1979 Biological Opinion, the park instituted regulations limiting the number of vessels entering the bay. These regulations proved extremely controversial. The cruise ship industry and tour boat operators challenged reports that vessel traffic disturbed the whales. To help resolve the dispute, NPS initiated a multi-disciplinary study of the behavior, prey availability, and acoustic environment of humpback whales in Glacier Bay and adjacent waters of southeastern Alaska.

Acoustic Environment

Under contract to NPS in 1981 and 1982, Paul Miles and Charles Malme of Bolt Beranek and Newman, Inc. surveyed the acoustic environment of Glacier Bay. Using sound measurement electronics, they collected and compared the radiated noise "signatures" of individual vessels.

Miles and Malme found vessel noises varied considerably both within and between classes. In general, larger ships were noisier than smaller, and the noises of vessels increased with increasing engine speed. Newer diesel-engine-powered cruise ships were almost 10 dB louder than the older steam-turbine-driven ships (since the dB scale is logarithmic, a 10 dB increase is a doubling of acoustic energy). The louder vessels could completely mask whale sounds.

Behavioral Responses

A study of the behavioral responses of humpback whales to vessel traffic was contracted to Lou Herman of the University of Hawaii and C. Scott Baker, then a graduate student at the University. From shore-based stations, teams of researchers tracked the positions of whales and vessels using precision surveyors' theodolites, and recorded the behavior of whales using small portable computers.

Humpback whales exhibited short-term behavioral



Capelin collected during survey of whale prey in Glacier Bay.

changes in response to vessel traffic. These changes were correlated with speeds, sizes, distances, and numbers of vessels. Whales responded to the close proximity of vessels by decreasing blow (breath) intervals, increasing dive times, and by moving away from vessel paths. Researchers noted that whales actively engaged in feeding generally were the most tolerant of vessel traffic and that Park Service guidelines for vessel operations helped reduce the potential for whale disturbance.

Prey Availability

Humpback whale prey studies were conducted by Ken Krieger and Bruce Wing of the Auke Bay Laboratory, NMFS, using quantitative hydroacoustic surveys and net sampling to assess the abundance and species of available prey. Quantitative hydroacoustics refers to the use of computer-integrated fathometers or echosounders to measure densities of biological "targets" in the water column. The computer analyzes the timing and strength of the echo to determine depth, size, and density of the plankton or fish species.

Based on surveys conducted from 1981 to 1984, the distribution and abundance of whales in Glacier Bay showed considerable within- and between-year variation. The local distributions of whales were often associated with high densities of prey and some areas of the bay were used consistently for feeding across years. In Glacier Bay whales fed primarily on schooling fish while whales in most other areas of southeastern Alaska fed mostly on euphausiids, small crustaceans often referred to as krill.

Krieger and Wing's observations of foraging behavior and prey availability in Glacier Bay during the 1980s contrast sharply with those made prior to 1978, when surface swarms of Euphausiids were believed the primary prey of humpback whales. Based on these differences, Krieger and Wing concluded a decrease in Euphausiid densities was the main reason for the change in use of Glacier Bay by humpback whales.

The study of humpback whales, now entering its 16th year, is a rare case of sustained scientific, per-

sonal, and administrative commitment. Long-term monitoring of free-ranging whales can determine population trends. With the exceptions of 1983 and 1985, the numbers of whales entering the bay equaled or exceeded numbers reported during the 1970s. The increases resulted from continued returns by past resident whales and their offspring, and establishment of residency by previously-transient whales.

Habitat Use

The site fidelity of these individuals is one of the most interesting findings of long-term monitoring. Maternally-directed fidelity to a feeding region is indicated by return of animals first identified in Glacier Bay as calves accompanied by their mothers. At least 17 whales sighted in Glacier Bay during the 1970s were resighted in the 1980s. If 30 to 35 years is a reasonable estimate of longevity for humpback whales, some have returned to Glacier Bay for at least half a lifespan.

Records from 41 female humpback whales indicate that on average, mature females give birth only once every 2.7 years to calves that survive their first 6 months and their migratory transit. While not alarmingly low, this calving rate may indicate a slow recovery ahead for the North Pacific population.

Reproductive rates and juvenile mortality are important parameters for judging health and potential recovery of populations. Sighting histories of females in the Glacier Bay area indicate the reproductive rates of these individuals are lower and more variable than whaling records previously suggested for humpback whales.

Footnote: Concern has surfaced over the possible effects of the Exxon Valdez oil spill upon humpback whales. The spill has killed many seabirds and sea otters but it is hoped that significant injury to whale populations will not result.

Between 30 and 40 whales have been identified annually in Prince William Sound in recent years; about 100 individual animals were identified there. Historically, at Kenai Fjords and Katmai NPs few whales have been observed feeding near shore. The NPS does not have marine jurisdiction at those parks, but it has conducted marine bird and sea mammal surveys in the area since the oil spill, as has the USFWS and other federal agencies. Grey whales migrated through the spill area earlier and, although no direct whale mortality was attributed to the spill, concern continues about sublethal effects. Humpback whales traditionally stop and feed there during summer, which could increase their risk of exposure. The NMFS has contracted to increase monitoring of humpback whales in Prince William Sound.

Oil removal efforts will reduce the threat of contamination of whales and whale prey species. Free floating oil is less common; much of the oil remaining is now on intertidal beaches. Whale prey in the spill area already may have been affected, both in quantity and quality. An expanded whale monitoring at Glacier Bay and adjacent waters will serve to evaluate any dispersion of whales from Prince William Sound to that area. Fortunately, Glacier Bay and the rest of Southeast Alaska were not affected by the oil spill, since Southeast Alaska is the summer feeding grounds for over 400 humpback whales.

Vequist is a Resource Management Specialist with the Alaska Region.

*See earlier article in *Park Science*, Vol. 6 No. 3

Abundance of Peregrine Falcons in Grand Canyon National Park Has Implications for Regionwide Recovery

By Bryan T. Brown, Steven W. Carothers, Stephen W. Hoffman, and Richard L. Glinski

Recent studies to determine the status and abundance of nesting peregrine falcons (*Falco peregrinus anatum*) in Grand Canyon NP have documented the largest population of this species on a single land-management unit in the lower 48 states. At least 58 adult pairs of peregrines were discovered in a survey of approximately 25 percent of the park in the 1989 nesting season alone. Throughout the 1988-89 study period, 71 breeding areas have been identified.

The overwhelming extent of large cliff habitat present within Grand Canyon suggests that the park is ideal nesting habitat for peregrine falcons. In addition, the proximity of the Colorado River with its abundance of resident and migrant birdlife provides a large prey base for potential use by peregrines. Preliminary surveys of the park in the early 1980s revealed a half-dozen pairs of peregrines, but a more thorough survey was desirable.

In 1987, the NPS at Grand Canyon contracted with SWCA Environmental Consultants, Inc., of Flagstaff, Ariz., to conduct a 3-year survey of peregrine population status in the park. Resource managers John Ray and Peter Rowlands of Grand Canyon NP were to administer the study. Close cooperation was maintained with the non-game branch of the Arizona Game and Fish Department which was conducting a statewide survey of nesting peregrine falcons, and with the U.S. Fish and Wildlife Service.

The survey's primary purpose was to determine the number of nesting pairs present. Additional objectives were to examine nesting success, compile observations on the impacts of human disturbance on nesting pairs, and to develop a long-term monitoring program for use by NPS personnel.

The immense size, limited access, and remoteness of the Grand Canyon presented logistical obstacles which had to be overcome before any survey work could be accomplished. Areas of the Park that could be reached easily by road, trail, or river were surveyed first to maximize cost-effectiveness. The use of helicopters was almost completely eliminated in order to minimize disturbance and noise impacts to park visitors and wildlife.

Instead, observers reached their study sites on foot, by road, or by boat. Study sites were located from one to three miles apart along the continuous lines of cliffs, which occur in three general tiers, or steps, from the bottom to the top of the Canyon. Up to 10 adjacent study sites a day could be surveyed in this way by using motorized rafts to place observers along the Colorado River.

Once at their study sites, observers would camp there overnight. Survey results from evening and morning observation periods indicated whether or not peregrines were active at the site. By surveying up to 10 contiguous study sites per day, an entire line of cliffs could quickly be "cleared" (no peregrines present), or the activity range of a pair or individual could be defined by simultaneous, overlapping observations. A key assumption of the field technique was that peregrines were absent from the site if no activity was observed during the evening and morning observation periods totalling 10 hours.

1988 and 1989 Results

Twenty-eight pairs of nesting peregrine falcons were identified during the 1988 field season, in an area com-



Hundreds of miles of high-quality peregrine falcon nesting habitat exist along the Colorado River in Grand Canyon NP. Photo by Bryan Brown.

prising approximately 10 percent of the park. Most of those pairs were located along the Colorado River, with some pairs on the north and south rims. Few pairs were located in the inner canyon between the rims and river. Seven successful eyries fledged an average minimum of 1.83 juveniles each.

Extrapolation of the 1988 survey results suggested that 69 pairs of peregrines could potentially occur in those areas of the park exhibiting high-quality nesting habitat: the north rim, south rim, and river corridor. The scope of the 1989 survey work was modified to test the accuracy of this extrapolation by shifting the emphasis of the survey to those three areas.

Field work in 1989 more than doubled the area of the park that was surveyed, so that the entire river corridor and most of the north and south rims were included. The increase in area surveyed in 1989 was cause for the greater number of pairs found. The 58 pairs identified in the 1989 survey included 15 of the pairs previously identified in 1988; 13 pairs located in 1988, however, were not detected during the 1989 survey. A 21-day river survey confirmed that the core of the peregrine population at Grand Canyon occurs along the river, where at least 37 pairs were located.

The more extensive field surveys of 1989 made it possible to better determine average spacing between adult pairs of peregrines. Average distances between pairs on the south rim, north rim, and Colorado River were 3.7 miles, 5.0 miles, and 4.2 miles, respectively. Minimum distances between eyrie cliffs of adjacent pairs were 1.8 and 2.0 miles on the river and the south rim, respectively.

Difficulties with weather and timing on a portion of the Colorado River survey ruled out a direct comparison of 1989 results with the 1988 population estimate of 69 pairs on the rims and river. Nevertheless, the more accurate estimates of spacing between pairs

obtained in 1989 made possible a refined estimate of the actual peregrine population on the rims and river. Extrapolation from the 1989 survey data indicates that approximately 100 pairs of peregrines could occur in those areas of the park.

Preliminary information on the food habits of nesting peregrines along the river, based on observations of prey captures during May, suggested that large numbers of bats and white-throated swifts were being taken as prey. Bats and swifts apparently have increased greatly in numbers along the river since 1963 due to habitat changes (increased riparian habitat and insect populations) brought about by the operation of Glen Canyon Dam, located just 15 miles upstream of the park. The use of these two species as important prey items illustrates a possible relationship between the operation of the dam and the abundance of peregrines along the river – a hypothesis that would require thorough testing to confirm.

Relation to Colorado Plateau Population

The extraordinary number of peregrine falcons in Grand Canyon represents the dense core of a large population of peregrines occurring on the Colorado Plateau of Arizona, Colorado, New Mexico, and Utah. Falcon surveys of Canyonlands NP, Capitol Reef NP, Glen Canyon NRA, and Zion NP (*Park Science* 9(2):3-4) by The Peregrine Fund, Inc., and NPS have demonstrated the large size of the Colorado Plateau population and its contribution to regionwide recovery efforts. Since the majority of this population is on NPS land, management conflicts resulting from peregrine conservation efforts will be minimal.

The presence of a large, possibly interdependent, population of peregrine falcons on NPS lands on the Colorado Plateau suggests a need for greater cooperative efforts between the parks, as well as between NPS Regions. All parks involved in peregrine population monitoring have in common a desire to maintain the long-term health and natural well-being of the population. Ongoing research and monitoring efforts in a number of NPS areas on the Colorado Plateau could be coordinated to provide more useful information than the results from any one park could provide alone. A uniform monitoring protocol, for example, if adopted by several parks, would do much to establish regionwide population trends.

Implications for Recovery

These findings have substantial implications for the recovery of this endangered species in Arizona and the Southwest. Surveys by the Arizona Game and Fish Department in 1989 located over 70 pairs of peregrine falcons across Arizona in areas outside of Grand Canyon NP. The 58 pairs located within the park in 1989, when combined with Arizona Game and Fish Department total, raise the state total to almost 130 pairs. The boundaries and goals of recovery areas for peregrines in the Southwest are still in the process of being established, but the population size in Arizona appears to be near full or partial recovery. A possible result of these findings, made possible in part by the discovery of a large peregrine population in Grand Canyon, would be downlisting of peregrines in the Southwest from endangered to threatened status in the near future.

Brown, Carothers, and Hoffman work with SWCA Environmental Consultants. Glinski is with the Arizona Game and Fish Department.

Plant Diseases in Hawaiian Parks: Prevention or Preservation?

By Donald E. Gardner

Although the science of plant pathology is alive and well in Hawaii, as in other localities, most research emphasis is directed toward economically important diseases of major crops such as sugarcane and pineapple. Diseases occurring in native ecosystems, including those of Hawaii's national parks, have received relatively little attention. Such research is important for several reasons.

Hawaii, as an isolated, self-contained island ecosystem, is well known for its vulnerability to the destructive influences of alien introductions. The effects of alien plants and animals in these systems is increasingly well documented; however, potential influences of pathogenic microorganisms (e.g. fungi, viruses) and invertebrates inadvertently introduced have not been as well investigated. The susceptibility of native flora to attacks by introduced pathogens leading to destruction of epidemic proportion is an ongoing possibility. Such an introduction led to the almost complete decimation of the highly susceptible native American chestnut in eastern forests when the virulent chestnut blight fungus was introduced probably from the Orient in the early 1900s.

On the other hand, certain pathogenic fungi are considered, like their host plants, to be endemic to Hawaii, having evolved from ancestral introductions into unique forms as their hosts themselves have evolved. Such microorganisms, as components of native ecosystems, should be recognized, understood, and afforded the same protection provided the more visible higher plant and animal park resources. Without knowledge of the biology, life cycles, host ranges, nutrient requirements, or even the existence of such organisms, along with a recognition of their symptoms and signs on host vegetation, it is possible neither to manage nor to interpret park resources comprehensively. It is sometimes difficult to determine whether a fungus, with microscopic wind-borne spores, is endemic, indigenous, or was introduced on plant material as a direct result of human activity. Ambiguity in this categorization is therefore more common than are such determinations for higher plants and animals. My, and my coworkers' work on the following three prominent disease conditions illustrates the challenges encountered and the knowledge gained from plant disease research in native systems:

Red Leaf Disease of 'Ohelo

'Ohelo (*Vaccinium reticulatum*) and tree 'ohelo (*V. calycinum*)

are endemic Hawaiian shrubs. 'Ohelo is a major component of upper elevation dryland forests of both Hawaii Volcanoes (HAVO) and Haleakala (HALE) NPs, whereas tree 'ohelo is an important rainforest species. 'Ohelo, like its mainland relatives, cranberry and blueberry, produces succulent, edible fruit and receives considerable attention from park visitors. A disease I have termed the red leaf disease attacks both Hawaiian species (Gardner 1985). It is widespread in 'ohelo stands and is especially prominent along the well-frequented Hosmer Grove nature trail near HALE headquarters. In early stages, disease symptoms include strikingly bright red foliage produced usually on individual branches or twigs, in contrast to the surrounding normal green leaves.

Prior to my investigations the symptoms were generally not recognized as representing a disease condition. Park staff sometimes mistakenly referred the disease to the normal condition of newly-developing 'ohelo leaves, which also tend to be red. However, on close examination, including monitoring the development of tagged symptomatic branches, I noted that leaf drop, followed by twig death occurred rather than normal maturation of new growth. Affected branches also become abnormally thickened, with a proliferation of small twigs resulting in a "witches' broom" (Fig. 1). Such broom formation is a common symptom associated with plant diseases caused by several types of pathogens. Microscopic examination of leaf undersurfaces revealed minute fruiting structures of the fungus *Exobasidium*, a pathogen known to attack crop species of *Vaccinium* in North America and Europe.

I have referred the fungus for the present to *E. vaccinii*, the common species on *Vaccinium* hosts elsewhere, presumably having been introduced to Hawaii on imported azaleas or other ornamentals of the Ericaceae. This scenario, if correct, would suggest the need for management action toward the eradication or control of the alien pathogen from the endemic *Vaccinium* population. However, there is also evidence that the fungus may represent an undescribed endemic species and thus would belong in the 'ohelo population to be preserved and interpreted accordingly. Appropriate management action must await conclusive determination, by specialists in this group of fungi, of the status of red leaf disease in Hawaii.

Koa Rust

The endemic koa tree (*Acacia koa*) occurs throughout the Islands in mid to upper elevation forests and is the second most common overstory species of HAVO. Aside from its obvious importance in native ecosystems, koa is also a valuable timber source in non-



Fig. 1. A partially defoliated "witches' broom" on an 'ohelo shrub affected with red leaf disease in Haleakala National Park. Earlier disease stages are characterized by conspicuous clusters of bright red leaves on infected twigs or branches.

NPS administered forests. Park visitors sometimes mistake koa for eucalyptus because its sickle-shaped phyllodes, which assume the function of true leaves in mature growth, resemble eucalyptus leaves.

Two closely related rust fungi, *Atelocaula* (*Uromyces*) *koae* and *A. digitatus*, cause conspicuous abnormal growth on phyllodes, twigs, and branches (Hodges and Gardner 1984). *Atelocaula koae* is con-



Fig. 2. A witches' broom of abnormally thickened, fleshy phyllodes (substitute leaves) infected with one of the koa rust fungi in Hawaii Volcanoes National Park. The diseased growth is covered with powdery masses of cinnamon-brown spores.

Hawaiian Plant Diseases (Continued from page 8)



Fig. 3. Abnormally proliferated, elongated twigs draping in a dense broom on an a'ali'i (*Dodonaea viscosa*) shrub with an advanced stage of *Dodonaea yellows* disease.

sidered endemic, whereas *A. digitatus* is indigenous, also occurring in Australia on *Acacia* hosts native to that country. However, the life cycle of *A. digitatus* in Hawaii differs from that in Australia, having an extra spore state. As a further complication, we have identified a distinct, microcyclic form of *A. digitatus*, believed to be unique to Hawaii. Microscopic examination of the spores of this group of fungi has shown a highly ornamented type of reticulate surface structure, rare elsewhere among the rusts, which serves as a strong link establishing the affinity of the *Acacia* rusts to one another.

The diseases caused by these fungi produce contortion of new growth, and abnormally much-thickened, fleshy growths on phyllode surfaces or cause finger-

like modifications on the phyllodes themselves to form witches' brooms (Fig. 2). The fleshy growth is covered with powdery cinnamon-brown spore masses, contrasting with the normal green foliage. Systemic infection eventually kills branches, which retain their leaves and become conspicuous. Extensive damage in koa stands is rare, however, since the host-pathogen relationship among these coevolved species is well balanced.

The obvious close affinity of the Hawaiian rusts to those of Australia, as well as that of the *Acacia* hosts themselves between these regions separated by wide expanses of the Pacific Ocean, leads to interesting speculation concerning the ancestral origins both of the endemic fungi and their host in Hawaii. The frequent assumption by visitors that my interest in these fungi is to develop an effective treatment to "cure" the trees sets the stage for a "fungus appreciation" discussion emphasizing the uniqueness of these organisms and their place in native Hawaiian systems.

Dodonaea yellows

Dodonaea viscosa (formerly *D. eriocarpa*), known locally as a'ali'i, is an indigenous shrub or small tree of the soapberry family. It represents the dominant or a codominant woody vegetation type in drier regions of Hawaiian parks. I first observed a disease condition in 1977 on a small number of a'ali'i shrubs in HAVO (see Gardner 1988). Symptom progression relative to that of other diseases is slow. However, affected branches, or entire plants themselves, eventually lose their leaves and die. I have designated this apparently newly discovered disease "*Dodonaea yellows*" because the symptoms strongly suggest a "yellows"-type disease often associated in other plants with a mycoplasma agent (a submicroscopic bacteria-like organism). However, investigations led by University of Hawaii graduate student Wayne Borth have thus far revealed only unidentified virus particles rather than mycoplasmas associated with diseased tissue (Borth, et al. in review). Notwithstanding this association, we cannot yet conclude that the virus is actually causing the disease. Borth is continuing work to clarify the probable cause, means of spread or transmission, and other characteristics of the disease.



Fig. 4. A healthy a'ali'i (left) closely associated with a diseased shrub of the same species (right) in the field in Hawaii Volcanoes National Park. The diseased shrub has yellow foliage and an abnormal growth form.

Since my initial observations, the disease has become more prevalent such that in some stands of a'ali'i in HAVO it is difficult to find many unaffected plants. We have now observed the disease, which appears specific to this host, in HALE as well as HAVO, and in other widespread a'ali'i populations throughout the Hawaiian Islands. Symptoms are particularly conspicuous, with entire plants uniformly affected, or individual, isolated branches or twigs may be symptomatic in contrast to surrounding normal growth. Leaves are stunted, often strikingly yellow, and have wavy margins. Abnormal twig proliferation and elongation causes a dense, draping broom-like growth (Fig. 3). Severely affected plants can be recognized at a distance in the field by their overall abnormal growth form, even giving the appearance of a separate, unrelated plant species (Fig. 4).

At present, nothing is known of the origin of the disease, whether arising as a new condition in Hawaii or introduced from elsewhere. Likewise, nothing is known of the means of spread or transmission and whether possible arthropod vectors are native or introduced, or what the potential long-range effect on a'ali'i populations may be. I have corresponded with plant scientists and foresters in other regions of the Pacific where *Dodonaea* spp. occur but have thus far found no other record of a disease resembling *Dodonaea yellows*. A mycoplasma disease of *Dodonaea* has been reported from India, however. Any connection between the Indian disease and the condition in Hawaii remains to be determined.

Management action, whether directed at disease control through removal of affected plants or control of possible vectors, or, on the other hand, toward preservation of the disease as a natural phenomenon, must await research answers to the many questions posed by *Dodonaea yellows*. We hope that the pieces of the *Dodonaea yellows* puzzle eventually can be assembled to allow resource management to approach this problem in a way consistent with NPS objectives.

Agriculturists, gardeners, homeowners, and the public in general are often conditioned to regard all plant diseases and their causative agents as undesirable entities to be gotten rid of by "spraying them with something." Such action may be warranted where park resources are clearly under serious attack by alien invaders. However, as protectors of our native environments, park managers should be cautious vis-à-vis the "spray everything" mind-set. Much can be learned and appreciated by our taking time to become acquainted with the smaller, lesser known components of the resources for which we also have responsibility.

Gardner is a research scientist (plant pathologist) at the University of Hawaii NPS/CPSU.

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Pollen Analysis in Historic Landscape Studies At Fort Necessity National Battlefield

By G.K. Kelso, R. Stone and J.F. Karish

Cultural Resources Management Guidelines (NPS-28) establishes two kinds of historic landscape studies: the Cultural Landscape Report and the Standards for Managing Historical Rural Landscapes. These are conducted by historians and historical landscape architects assisted by cultural geographers, cultural anthropologists and archeologists. Documentary sources and general field survey methods are emphasized.

Archeological pollen studies indicate that Euroamerican land use has changed continuously and that vegetation has constantly changed in sensitive response to cultural change (Kelso et al. 1989). No groundcover on any cultural landscape has remained perfectly stable, and (barring occasional specimens of long-lived taxa) there is no such thing as a historic vegetation. The documentary/archeological approach to historic landscape is, therefore, inadequate for sites without extensive literary and photographic records. These include most pre-20th-century NPS properties, sites occupied by humble folk and small plots within larger land-use units.

We will demonstrate with the following data from Fort Necessity National Battlefield that a cross-disciplinary approach incorporating paleobotanical studies works better. Pollen, seed and phytolith (biological silica) data may be used, but pollen is emphasized in this study because trends show up better than among seeds, and taxa are easier to recognize than among phytoliths.

The Fort Necessity earthwork and stockade (Fig. 1) were hastily constructed on the orders of Lt. Col. George Washington in an opening in the forest called "Great Meadows" during his 1754 road building expedition to the forks of the Ohio. It was surrendered to the French and destroyed in July 1754 after a brief siege that is now considered to be the opening battle of the French and Indian War. The forest surrounding Fort Necessity provided cover to the attacking French and Indian force. Its historic spacing and relationship to the meadow is critical to visitor interpretation. The meadow was drained and the surrounding forest was cleared by a family of farmers and stock growers named Fazenbaker sometime between 1856 and 1880 (Torres-Reyes 1970:12).

The current bare hillsides around the fort present visitors with an inaccurate view of the 1754 tactical situation. The Fort Necessity GMP calls for restoration of the forest to its 18th century boundaries by the 300th anniversary of the battle (A.D. 2054). Historic descriptions of the site indicate deciduous trees, with clumps of pine, on the hillsides and bushes and grass in the meadow. In 1816 some clumps of alders were observed along the stream, but a hardwood forest is assumed to have begun at the edge of the meadow in 1754 (Harrington 1957:10,22; Torres-Reyes 1970:9-10). NPS managers recognize that some of the treeline plantings already undertaken are erroneous (Harrington 1957:19), and want more precise data before proceeding with reforestation. Paleobotanical methods should provide this. The following preliminary pollen report constitutes an Eastern Parks and Monuments Association supported feasibility study for such research.

This feasibility study is really a test of two hypoth-

eses. Pollen is washed downwards in soils and is destroyed through time by oxidization and aerobic fungi (Dimbleby 1985: 5,59). Soils have been eroding and deflating rather than accumulating during the historic period, and old groundcover data would be lost unless it was carried down into the profile by percolating rainwater.

The first hypothesis is that leaching has been preserved a palynological record of the native forest and meadow under the farming and NPS period spectra in the Fort Necessity soil profiles. Our second hypothesis is that the pollen spectra should reflect different vegetation composition in contrasting edaphic situations on the site.

To test these hypotheses a series of cores was taken from west to east down a hillside and across the meadow toward the fort. Four have been analyzed to date (Fig. 2, bottom right). The hillside core 3 should register the former forest. Core 2, at the base of the hill should have fallen within the 1754 ecotone and should incorporate pollen from hawthorns and shrubby forest edge taxa, including other members of the rose family. Cores 1 and 4 are located on what was considered to have been battle era meadow and should be dominated by grass and sedges.

The results of the analysis of core 3 are presented at the top of Figure 2. Pre-clearance forest is registered in the prominent oak counts near the bottom of the profile, confirming our hypothesis that leaching would preserve pre-clearance groundcover data. Dimbleby (1985:3,59) estimated a pollen leaching rate of 10 cm per 300 years under English forest planted on former plowland and pasture. If the deforestation recorded at 12 cm below the surface in Fort Necessity Core 3 took place around 1880 the leaching rate at Fort Necessity is ca. 10 cm per 90 years. If deforestation took place closer to 1856 the leaching rate approximates 10 cm per 110 years. These average out 3 times as fast as Dimbleby's (1985:3,59) projected rate. Leaching is faster under cleared soil than under forest. Actual leaching rates may be somewhat faster, because friction between the coring tube wall and the sediment compressed the profile about 20 percent. Our initial Fort Necessity cores apparently did not reach the 1754 pollen spectra. Countable pollen remains at the bottom of profile, and our next core can go deeper.

A post-clearance groundcover and land-use succession is also recorded in Fort Necessity core 3. Local tradition holds that the hillside was cleared for pasture.

The pollen spectra tend to support this interpretation. The trees are followed by the ragweeds predictable on disturbed soils and then by the grass which should dominate a pasture. Pollen from grass planted on former farmland under the Boott Mill Boardinghouse backlot at Lowell, Mass. leached down into the underlying glacial sands as an abrupt block of high frequencies (Kelso, et al. 1989: Fig. 9-9). The Fort Necessity grass spectrum, in contrast, developed slowly. The hillside appears to have been cleared and let go naturally to grass.

Cereal pollen other than rye does not blow. It is spread by cultural rather than natural mechanisms (Vuroela 1973:12). Cereal pollen in Fort Necessity core 3 appears as the ragweed frequencies peak, and the type is most prominent in the upper 4 cm where grass counts are highest. It is probably derived from cattle feed, deposited via manure, and most probably reflects active grazing. The Fazenbakers apparently were willing to put cattle on the hillside before the grass population was fully developed. This would be unlikely if they had actively cultivated the grass. The chestnut data also suggest little effort was expended on soil preparation. Chestnut pollen increases as oak pollen declines. This must indicate stump sprouting. Chestnut pollen, in turn, declines as the manure borne cereal pollen increases. The stumps on the hillside were neither grubbed out nor burned at clearance, and the chestnut stump sprouts were left, eventually to be exterminated by browsing.

The critical pollen spectra of the core series down the hill and out onto the meadow are presented in topographic order below core 3 in Figure 2. The forest clearance and pasture development reflected in the oak/ragweed/grass and European cereal/chestnut sequences of core 3 are repeated in cores 2 and 1. The patterns become less clear with progress out into the meadow, and sedges indicating wet ground appear in core 1. The distribution of historic groundcovers does not, however, appear to have been as we hypothesized. Hawthorn and other shrubby members of the rose family are not recorded in core 2 at the postulated ecotone. Neither these types nor really large quantities of sedge pollen appear until core 4, closer to the more solid ground around the fort on the other side of the meadow.

The most obvious change in the pollen spectra with topography is a steady increase in alder pollen from core 3 through core 1. Percentages decrease again in core 4 and it is unlikely that this alder pollen either



Fig. 1. NPS reconstruction of Fort Necessity based on archeology and documentary sources.

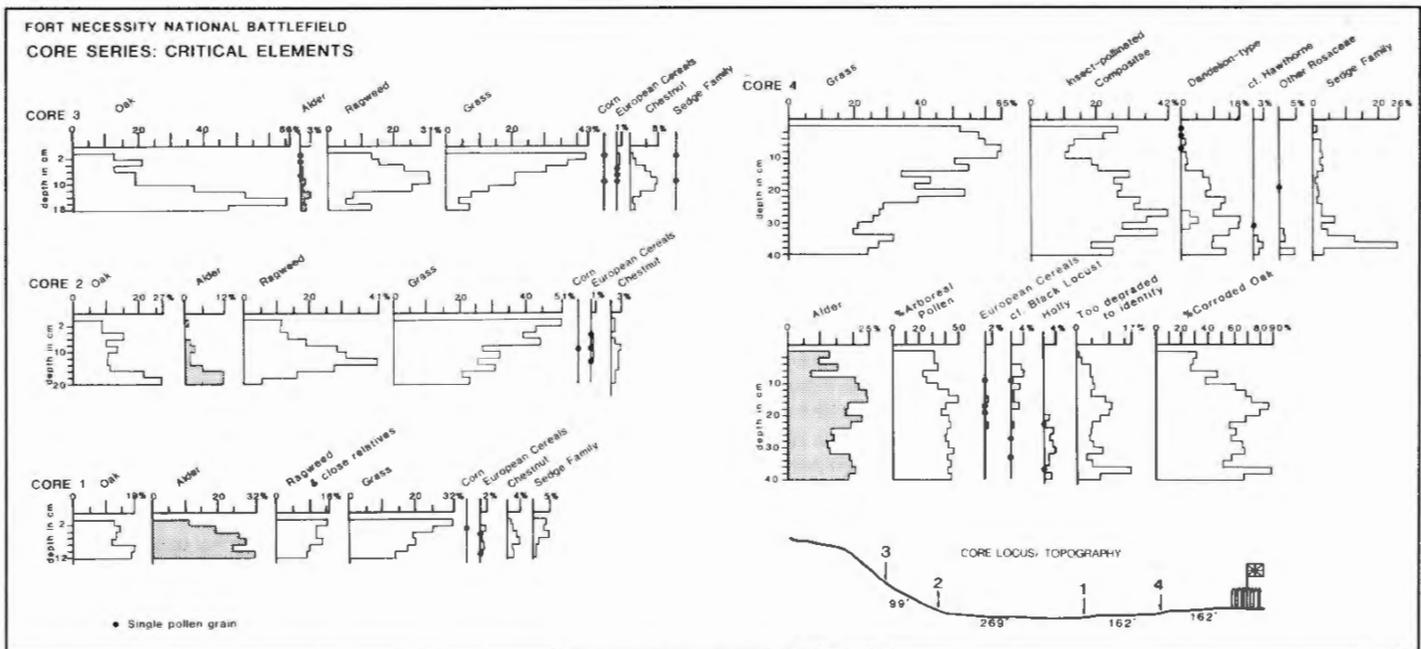


Fig. 2. Pollen percentages critical types in Fort Necessity cores in topographic order down hill and onto meadow.

reflects wet-land drainage or the clumps of alders observed along the creek in 1816 (Torres-Reyes 1970:9). It appears probably that an extensive, previously unrecorded population of alders existed between the oak dominated forest and the open meadow at the core transect.

A post-battle land-use record is also registered in core 4 from the meadow (Fig. 2, right). Fazenbaker drainage improvements are evident in the decline of sedge pollen at about 32 cm, and brush removal is recorded in the disappearance of hawthorn and other members of the rose family in the 30 cm 28 cm zone. The numbers of plants related to the dandelions and asters initially increased on this dryer, less shady soil but were suppressed by an expanding grass population above ca. 26 cm.

The introduction of cattle is indicated by the appearance of European cereal pollen at 24 cm, and both the "too degraded to identify" and "corroded oak" measures of pollen corrosion increases in those samples in which cereal pollen is best represented. This indicates that the soil is being churned and aerated by

the hooves of the cattle. Cattle also appear to have browsed the local holly population out of existence above 20 cm. Black locust frequently invades exhausted pastures and overgrazing may be responsible for the expansion of that pollen type above 18 cm.

Vegetation change through time and across space at Fort Necessity is clearly recorded among the pollen cores. Our next step is to establish the pollen and phytolith signatures of all plant populations and the leaching rates for all types of matrices. We will then be able to map the battle era vegetation by analyzing only the pre-clearance spectra. Not all historic era changes in the Fort Necessity flora are applicable to our research problem but all are attributable to particular human activities. Pollen analysis should serve landscape historians investigating other questions equally well at other sites.

Kelso is a supervisory archeologist at the Cultural Resource Center, North Atlantic NPS Region; Stone, formerly of Fort Necessity, is an interpreter at Hopewell Furnace, PA; Karish is Mid-Atlantic NPS Regional Chief Scientist.

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computer corner

RADCALC: DBase III Tracks Radon Exposure

Mammoth Cave NP began monitoring radon in park caves in 1976. Since then, NPS policy requirements, cave tours and park staff have increased to the point that the park now must deal annually with an enormous volume of radon data. To comply with NPS Cave Radiation Safety and Occupational Health Guidelines (NPS-14) over 17,000 data records are generated annually at the park. About 12 percent of these are actual measurements of radon levels in the cave. The remaining 88 percent are records of employees' exposure to radon. Hundreds of thousands of calculations must be carried out to convert this raw data to the required output.

The park began an effort to automate this data man-

agement task in 1987 by using a Lotus 1-2-3 spreadsheet program to supplement manual calculations. However, the data manipulation process was still very manpower intensive. When the radon monitoring activities were incorporated with the park's air resources management program in 1989, a new effort was made to streamline the radon data management process. An odd assortment of personnel from the Southeast Archeological Center, the park's science and resource management staff and the park's GIS/computer specialist worked together to create a prototype radon data management program in DBase III+. Through most of 1989, data were "crunched" through both this new program and the previously used manual/Lotus system. Through this process, data accuracy (of both systems) was checked and the new program was debugged and refined.

While the current version of the program (called RADCALC) is still somewhat crude, it is quite user friendly and produces the final reports needed to track employee exposure and to comply with NPS-14. Additionally, it creates a digital database that may easily be used for medical research or other purposes in the future. It is estimated that the conversion reduced the park's data management workload by almost one FTE, created a much more flexible data management environment, and significantly reduced the potential for data errors.

The most current version of the program is available through the Office of Science and Resource Management, Mammoth Cave NP by sending a blank, formatted 5¼ or 3½ inch diskette.

Chaney is Chief, Office of Science and Resource Management, at Mammoth Cave NP.

regional highlights

National Capital Region

The NCR's Center for Urban Ecology (CUE) has established several cooperative arrangements to assist in meeting some of region's identified research objectives. The Pest Management Program of CUE, under James L. Sherald has established an Inter-agency Agreement with the USDA Systemic Botany and Mycology Laboratory, Beltsville, MD, to study the basic mycology of the dogwood anthracnose pathogen *Discula* sp.

A Cooperative Agreement has been established with the Forestry Department/Pesticide Research Center, MI/State U to develop a screening and identification procedure for detecting elm cell lines that are resistant to Dutch elm disease. Sherald is the project leader, Mariam Sticklen, MSU the principal investigator.

John Hadidian, Wildlife Biologist, is the CUE coordinator of a Cooperative Agreement between NCR and the NPS CPSU at U/GA. These projects involve white-tailed deer studies and the evaluation of deer impacts on vegetative communities. A comprehensive bibliographic search is currently being conducted. Plans are underway to establish vegetation sampling plots in several NCR parks and to evaluate sampling methodologies simplifying and standardizing data collection. Susan Bratton, CPS Unit Leader at the University, is participating and providing guidance.

The CUE's Pest Management Program will be assisting the USFS in contracting and coordinating gypsy moth suppression for five federal agencies, the District of Columbia, NPS sites at Fredricksburg, VA, and NCR. Approximately 12,000 acres are scheduled for treatment. The bacterially derived pesticide *Bt* will be used on most of the 12,000 acres: nucleopolyhedrosis virus, a gypsy moth-specific virus formulated as Gypchek and supplied by the Forest Service, will be applied to 100 acres in Prince William Forest Park. Christine Haggerty, Forest Pest Management Specialist at the CUE, is contact for the program.

Water resource management in the NCR is challenged by two reclamation projects: Minnehaha stream as it passes through Glen Echo Park and wetland management in Washington, DC. The original ravine of Minnehaha stream valley had been filled to become a parking lot. A flood following a storm in May of 1989 blew out all the fill, the parking lot collapsed and more than a dozen cars were lost, some of them washed through a culvert beneath the C & O Canal into the Potomac River. Restoration of the stream valley will follow a hydrologic model being developed by Bill Reed of the NPS, Water Resources Division, Fort Collins, that will handle increments up to the 100 year flow.

Dick Hammerschlag, CUE Chief and regional water resource program coordinator, is assisting the resource management staff of National Capital Parks-East on a program to enhance and reclaim wetlands along the Anacostia River. The NPS is a cooperator with the Washington, DC Council of Governments in an EPA-sponsored program to improve all waters entering the Chesapeake Bay. Kenilworth Marsh, a 44 acre remnant of emergent wetland, adjoins Kenilworth Aquatic Gardens, a NPS site in the Nation's Capital.

Managing soil and edaphic factors upon which vegetation depends continues to be a challenge at all sites of the Nation's Capital. Jim Patterson, Research Agronomist, cooperates in the National Turfgrass Evaluation Program by providing and maintaining field test plots on the Mall and grounds of the Washington Monument where diverse turfgrass genotypes of Kentucky bluegrass, perennial ryegrass, tall fescue, fine leaf fescue and other turfgrass varieties are subjected to the impacts of heavy visitation. These evaluations have resulted in improved turfgrass selections for NCR as well as for NPS sites in other regions.

Patterson is using a micromorphologic technique to observe petrographic thin sections of compacted soils. The sections will be analyzed microscopically to determine particle orientation under compacted soil conditions, the void:solid ratio, presence or absence of soil crusting and the effects of aeration techniques on compacted soil.

John Short, soil scientist, has begun a study of the physical and chemical characteristics of the highly man-influenced soils of the Washington Monument grounds. These soils have properties unlike those of nearby natural soils because of the disturbance associated with their formation and their continual manipulation through management. The goal of the study is to improve our understanding of "urban" soils, and to classify them, using criteria developed to highlight their unique properties.

Another soil research project has been initiated to characterize atmosphere of Washington Monument grounds soils. The compacted nature of these soils alters the atmosphere and adversely affects plant root growth. The goal of the project is to determine the extent of changes to soil atmosphere caused by compaction, and the efficacy of methods used to alleviate soil compaction.

Rocky Mountain Region

A work group with representation from six parks and the regional office met at Rapid City, SD, on Dec. 7 and 8, 1989 to develop a regional policy for disposal of surplus wildlife. The policy will be an interim one, pending completion of an "insular population" research project scheduled for FY's 1991 and 1992. Parks in the work group are Badlands, Grand Teton, Rocky Mountain, Theodore Roosevelt, Wind Cave, and Yellowstone.

The surplus wildlife addressed by this group are the large ungulates, with emphasis on bison and elk. In order to get at the disposal issue, the group threw a wider loop and addressed operational, research, and regulatory and legislative problems as well. The group plans to issue a report that will review these three problem areas and make appropriate recommendations. The report will be submitted for consideration to a panel being convened to plan the "insular population" research.

Utah's Division of Wildlife Resources has issued a draft proposal to introduce the non-native rainbow smelt (*Osmerus mordax*) into Lake Powell to provide additional forage, ostensibly for all game fish, but primarily for striped bass (*Morone saxatilis*), a non-native species introduced much earlier. The original range of

the adaptable rainbow smelt appears to have been the Atlantic coast between Labrador and New Jersey. It has been introduced into the Great Lakes and the Mississippi River Basin.

Glen Canyon NRA and the NPS are gravely concerned and strongly oppose the proposal. The USFWS also opposes the proposal.

Resource management specialists from Colorado Plateau parks and personnel from RMRO met in Moab, UT, Jan. 27-Feb. 1 for the annual Colorado Plateau Workshop. Upcoming initiatives will include an inventory and monitoring proposal for the entire plateau as well as a feasibility study of the plateau as a Regional Biosphere Reserve.

Plans are underway for the second year of a major initiative to survey and monitor peregrine falcons throughout the region. Mike Britten, presently at Gates of the Arctic will soon be reporting to ROMO to assist in the program for the next few years. NPS personnel will coordinate with USFWS in FY90 in a major peregrine prey pesticide contaminant study.

A 5-year GIS plan, started in FY90 for the entire Rocky Mountain Region, will include an inventory of existing digitized data, an inventory and evaluation of available mapped information, and an evaluation of GIS equipment and data needs over the next 5 years. Completion of the plan is expected by summer.

The large-scale and spatial distribution in the Greater Yellowstone Area raises a multitude of questions about fire's impact and what the long-term response of the ecosystem will be. Questions such as how will the spatial distribution of the fires change or alter long-term forest successional patterns or community composition and distribution; how will the pattern of the burns influence the rate of nutrient cycling or energy flow through the ecosystem; how will the patchy distribution of vegetation, resulting from heterogeneous burn patterns, influence the population dynamics and habitat use of large ungulates, will be considered in a research project funded jointly by NPS and USFS and administered by the U/WY NPS Research Center. This project, to begin in May 1990, will explore the importance of scale in the landscape ecology of the Greater Yellowstone Ecosystem. This study will use a combination of mathematical modeling and field studies to examine short-term ecosystem changes arising from the fires and to also predict long-term ecosystem patterns that may result. The resulting models will provide park managers a mechanism for evaluating potential effects of future fire management plans.

North Atlantic

The North Atlantic Region has hired, as director for the University of Rhode Island CPSU in Narragansett, RI, Dr. Charles T. Roman, a wetlands ecologist. Dr. Roman will begin in mid-March to develop a program of coastal research for both the North Atlantic and Mid-Atlantic Region's seashore parks. Formerly a research scientist at the Center for Coastal and Environmental Studies at Rutgers University and closely associated with the NPS/CPSU, Roman has been working with the Narragansett Bay Estuary Project. Other North Atlan-

regional highlights

tic Region science staff that will be joining the unit include Dr. Paul Buckley, ornithologist, Dr. James R. Allen, coastal geomorphologist, and an invertebrate ecologist position which is currently vacant but should be filled by press time.

In addition, the North Atlantic Region has hired a wildlife biologist, H. Brian Underwood. Brian is completing a doctorate degree in wildlife biology at SUNY, Syracuse, focusing on the management of white-tailed deer. He will be working for both the North Atlantic and Mid-Atlantic Regions, principally on the problem of white-tailed deer management, but also will be looking at other large mammal management problems such as Acadia coyotes and the Assateague ponies.

Mid Atlantic

The first hack site for introduction of peregrine falcon into Shenandoah NP was operated on the summit of Hawksbill mountain. (A move is afoot now to rename the peak Falconsbill.) It's not a misprint when you read that "8 of the 7 birds were successfully introduced to the wilds." It seems that a young falcon from a hack site 50 km away in the George Washington NF came to visit and decided to stay. (Showing good taste, we think.)

Plans are underway to expand the program to three hack sites, in a three year effort with the Peregrine Fund to establish breeding populations within the birds' previous range in the Appalachians.

An interagency workshop was held February 6 at Shenandoah NP to discuss protection of the Shenandoah salamander – an endangered species facing threats from alien gypsy moth infestations. An article on this will be forthcoming.

On May 10 and 11, Shenandoah NP will hold its 13th biannual research and resource management symposium. Theme of this year's event is Partners in Preservation, reflecting the park's emphasis on cooperative land use planning and resource protection efforts with the private sector. Elizabeth Haskell, Virginia's secretary for natural resources, will be banquet speaker; 12 papers will describe research and monitoring projects completed in the last two years.



Stephen W. Hiner, (left) lab specialist, and **J. Reese Voshell Jr.**, associate professor with Virginia Tech's entomology department, hold the awards presented them recently by **David A. Haskell**, chief of Shenandoah NP's division of natural resources and science. The two, honored for "outstanding service in protecting the resources of the park," developed a monitoring system for park streams.

Western Region

Channel Islands NP, with help from the Denver Service Center and the Western Regional Office, is preparing a Development Concept Plan to support ecological restoration resource management and research programs on 22,000-ha Santa Rosa Island. For the next 22 years, ranching and hunting operations will constrain visitor access and use on the island. Removal of feral pigs begins this year. The Plan integrates logistical support for visitor services with the resource management program, and insures that short-term development of utility systems coincides with long-term goals.

Two new technical reports (Nos. 36 and 37) have been published by the NPS CPSU at U/Cal/Davis. They are "Visitor Perception of NPS Fire Management in Sequoia and Kings Canyon NPs: Results of a Survey Conducted Summer 1987" by Joyce A. Quinn (#36), and "Endangered and Rare Plants of Santa Barbara Island, Channel Islands NP," (#37), by Ronilee A. Clark and William L. Halvorson.

Pacific Northwest

Fuel and Fire Behavior Predictions in Subalpine Forests of Pacific Northwest NPs (CPSU/UW 89-4) is the first in a series of U/WA CPSU publications on subalpine fire dynamics of PNW Region NPs. Co-authors James K. Agee and Mark Huff, assisted by Michael Gracz and Mark Finney, report on research conducted in the "rainshadow" behind mountains at Crater Lake, Olympic, Mount Rainier, and North Cascades NPs.

Gary Larson, research aquatic ecologist with the Oregon State University CPSU, briefed staff at Mount Rainier NP Feb. 27 on the findings of recent research on water quality of glacial and non glacial streams in the park. The project was started in 1985 by Cat Hawkins (now at Olympic NP) as her Natural Resource Management course project. Since then, sampling has continued and recommendations for management and continued monitoring have grown out of the research. Water quality was found to be influenced by distance downstream from glacial headwaters, geology, time of day, season, elevation, and mineral springs.

Stay Tuned!

Doug Houston, research scientist with the PNR Region, stationed at Olympic NP, reports that as of press time (March 20) the Interagency Scientific Committee to Address the Conservation of Northern Spotted Owl is "diligently striving" to produce a scientifically credible conservation plan for the owl.

The six-person committee, with representatives from DA's Forest Service and DI's Bureau of Land Management, NPS, and USFWS, had a March 30 deadline for submitting such a plan. Houston is one of the members of the advisory support group.

The Crater Lake Interim Report, dealing with studies and investigations into the status and trends of changing water quality at Crater Lake, was signed in Novem-

ber 1989 and submitted to Congress. Research data dealing with relationships between suspected thermal features, the lake's limnology, and the lake's clarity will continue to be analyzed. A draft final report is due to NPS in September 1990.

In 1989, 65 lakes in North Cascades NP were sampled for water quality, algae, zooplankton, and bottom fauna to determine the status of lake communities in naturally fishless lakes. A number of lakes in the park have been stocked with rainbow trout, and researchers now propose to do intensive studies of "paired lakes" – one without fish and one stocked with trout – to determine the effects of fish stocking on natural lake communities. A peer review of this proposal will be held in May, according to Gary Larson, project co-leader. The proposal is for two years of paired lake studies, in 1990 and 1991.

Midwest Region

A workshop on rare plant species inventory, research, and monitoring needs in Midwest Region parks, held Feb. 2-3 at the U/WI Madison Arboretum, provided an overview of endangered species programs in the region, prepared a priority list of inventory and research proposals for rare plants in parks, and discussed approaches to monitoring these species. Participants representing a mix of NPS personnel and regional academicians, were asked to comment on a draft list of rare plant inventory/monitoring projects. A draft 3-year plan is being developed and will be presented to the parks.

Supt. Jerry Banta and Ecologist Bob Brander of Apostle Islands NL, have formed a Western Lake Superior Natural Resource Cooperative to address eco-region level natural resource issues. Seven cooperating federal and state agencies and higher education institutions will address the following areas over the next 3 to 5 years: biological diversity, resource supply/recreation demand, and Lake Superior quality. The Midwest Regional Office is issuing a challenge grant to participating groups to study toxics in Lake Superior.

Scientists monitoring the wolf population at Isle Royale NP counted 15 animals during the annual winter monitoring – an increase over the 11 counted last year, according to Rolf Peterson of Mich/Tech U, who conducted the count. Resource Management Specialist Robert Krumenaker reported three new pups with an adult pair at the east end of the wilderness island; another wolf, which may be a pup, was reported with a wolf pair at the west end of the island. The population now consists of three groups that could produce offspring this year, and four "loners."

Water Resources Division

The WRD has published a report, "Outstanding National Resource Waters: A Resource Management Tool," by Barbara West, outlining the general provisions of the EPA's antidegradation policy, with special attention to Outstanding National Resources Waters (ONRW), a program designed to protect high quality and other special or unique waters. The report is

Continued on page 14

Regional Highlights (Continued from page 13)

directed toward park superintendents and resource managers and explains how state ONRW designations can be used to complement NPS resource management strategies. Because all NPS units are subject to state water pollution control laws and regulations, the report highlights how NPS can use state processes to protect NPS water and water-dependent resources.

Since each state approaches antidegradation in a different way, the report provides a state-by-state listing of the regulatory agency and a discussion of each state's ONRW program general provisions.

* * *

A hydrologic report, "Initial Calibration and Ratings for Parshall Flumes 1 and 3 at Rattlesnake Springs, Carlsbad Caverns NP, was prepared by Gary Rosenlieb, Water Operations Branch. Rick Inglis of the same branch prepared "Preliminary Hydrologic Measurements: Taft Creek Groundwater Study, Olympic NP." Both reports are available from the WRD.

RMR Launches New CPSU Plan

The Rocky Mountain Region is undertaking a new Regional CPSU program calling for a network of CPSUs in all RMR states, utilizing university staff as unit leaders on a less-than-full-time basis. These units would be the focus for research within the respective states.

Some 18 research scientists duty-stationed at Rocky Mountain, Grand Teton, Yellowstone, and Glacier NPs will be transformed into "park-based CPSU staff," in cooperation with four regional universities. Implementation is subject to negotiation, but it is expected that the Rocky Mountain NP unit will be aligned with CO/State/U, the Grand Teton NP with U/WY, the Yellowstone NP unit with both U/WY and U/MT, and the Glacier NP unit with U/MT and Mt/State/U.

John Varley of Yellowstone and Cliff Martinka of Glacier will serve as unit leaders for their respective parks. Grand Teton will recruit for its unit leader. The Rocky Mountain unit will be led temporarily by a university staff member to be selected while park Chief Scientist Dave Stevens pursues his PhD degree.

A competitive contracted research program currently operated cooperatively with U/WY will continue under a one year extension. It is hoped that NPS research authority legislation will be passed in the next year and that the cooperative competitive program may be advertised for open competition among universities for future involvement. The competitive program features a nationally circulated Request for Proposals and over a million dollars in current research contracts for the Region. It is administered by Prof. Mark Boyce of U/WY NPS Research Center and Bob Schiller, RMR Science Branch Chief.

The completed network would feature (1) part-time academic involvement for all NPS researchers to foster professional growth; (2) true peer review of annual work plans and accomplishments; (3) Regional oversight to "standardize" project documentation and improve coordination; and (4) a "balanced" program that protects the needs of small parks.

WRD Chief Stan Ponce delivered the keynote address, "Management of Large Reservoirs within NPS Units: Issues and Concerns," to the annual meeting of the North American Lake Management Society in Austin, TX, Nov. 7, 1989.

Nancy Driver of the Water Operations Branch made an invited presentation in November to the USGS National Symposium on Water Quality in Orlando, FL. Her published abstract, "NPS Water Quality Program," is available from WRD.

* * *

The National Park Service is currently working on a Watershed Management Plan to address the periodic flooding of Divide Creek at the St. Mary developed area in Glacier NP. The study will be conducted in four phases. The Water Resource Division will conduct the first phase which consists of an analysis of the geophysical conditions. Concurrently, the park staff will perform the second phase which includes planning considerations of mitigative alternatives. The remaining study phases will utilize input from the first two studies to address engineering designs and specifications for implementation of flood mitigation. An inter-

agency work group has been formed consisting of various subject matter experts needed to assess the natural characteristics of the watershed and to make recommendations on actions needed to protect life and property in the developed area.

The St. Mary developed area is located on an alluvial fan formed by constant channel deposition and related meandering of Divide Creek. There have been at least six floods in this area during the past 50 years. Two of these floods inundated the developed area and caused considerable damage to property. One person was killed near the highway that accesses this area.

In recent years, the park has been forced to remove channel debris and deposition in order to prevent flood events from impacting the developed area. These necessary actions have sometimes caused the park to be out of compliance with requirements of Section 404 of the Clean Water Act. The Corps of Engineers and the state of Montana have requested that a Watershed Management Plan be developed prior to issuing new permits in this area.

The study results should serve as a guide for the management of this complex and dynamic system.

Wetland Compliance Manual For Mid-Atlantic Region

By Joel Wagner, Hydrologist
Water Resources Division

The term "wetland" encompasses a broad array of aquatic systems, many of which are represented within NPS-managed areas. In recent years, recognition of the continuing degradation and outright loss of these valuable resources across the U.S. has led to increased wetland research and the institution of protective measures at all levels of government. Through this process, a number of aquatic habitats not commonly thought of as "wetlands" are now often classified as such. For example, streambeds, mudflats, tidal pools, and portions of riparian areas now join the more commonly recognized wetland types (swamps, bogs, salt- and fresh-water marshes, seasonally-flooded meadows, and so on) as resources singled out for special protection by a number of relatively new laws, regulations, Executive Orders, and NPS policies.

Since its creation, the NPS has been involved in preserving wetlands through the mandates outlined in the NPS Organic Act. More recently, the National Environmental Policy Act, the Clean Water Act (especially Section 404), Executive Order 11990 (Protection of Wetlands), the NPS Floodplain Management and Wetlands Protection Guidelines (hereafter referred to as "NPS Wetland Guidelines"), and other wetlands protection measures have been instituted. Under these and other requirements, NPS managers must protect wetlands from the adverse impacts of both *external actions* (e.g., lowered water tables, upstream diversions or releases, degraded water quality, and introduction of exotic plant or animal species) and *internal actions* (e.g., construction of a park's infrastructure, maintenance operations, resource management operations, and activities associated with inholders or permitted uses).

As a consequence of the changing definitions and classifications of aquatic resources and the complex, interrelated provisions of wetland regulatory requirements, there is considerable confusion amongst NPS planners, resource managers, and other personnel regarding what constitutes a wetland, how they can be recognized, what laws, regulations, and guidelines apply to them, and what tools are available to aid in their identification and

protection. To facilitate wetlands management and compliance in the NPS Mid-Atlantic Region, Chief Scientist John Karish requested that the Water Resources Division (WRD) develop a document that would clarify these issues for field personnel. In response, the WRD has recently published a manual entitled **Wetland Regulatory Compliance: A Guidance Manual for the National Park Service Mid-Atlantic Region**.

The manual is designed to summarize, in a single document, the NPS requirements for complying with Executive Order 11990, the NPS Wetland Guidelines, Section 404 of the Clean Water Act, and other Federal, state or local laws and regulations protecting wetlands. Flow diagrams are used to guide the user through a sequence of steps that facilitates compliance with wetland planning and compliance requirements and consistency with state or local laws. These diagrams refer the user to sections of the text that explain the specific procedures in greater detail. The flow diagrams and text include abbreviated processes applicable under emergency conditions (e.g., situations where rapid action is necessary to protect human life, health, or property).

The final chapter of the manual provides guidance for conducting wetland inventories in NPS units (required by the NPS Wetland Guidelines) and for conducting preliminary wetland evaluations in the field. Field indicators for the soil, hydrology, and vegetation characteristics of wetlands are provided, and information about more definitive wetland delineation is presented. A copy of the NPS Wetland Guidelines and a case study where a completed Clean Water Act Section 404 permit and an Executive Order 11990 "Statement of Findings" were prepared for the Black Bay Development, Voyageurs National Park are presented as appendices.

Although the manual was prepared specifically for the Mid-Atlantic Region, the bulk of the information presented is applicable Servicewide. Copies of the manual can be obtained by contacting the Water Resources Division, 301 South Howes St. - Room 353, Fort Collins, Colorado 80521 or by phone (303-221-8311). Questions regarding the content of the manual should be directed to Joel Wagner (FTS 327-2955 or 303-969-2955).

Excerpts from an essay by Wendell Berry, "Taking Nature's Measure," appear in *Harper's*, March 1990, under "Readings." Berry suggests that our dealings with nature should be in the form of a dialogue rather than the monologue we have conducted for the most part. We would ask what nature would be doing if we weren't there, what nature will permit, without harm to the place and its natural and human neighbors, and what nature would help us do there.

The essay is from a collection titled *What Are People For?* to be published in April by North Point Press, Berkeley, CA.

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The use of live organisms to track complex pollutants is discussed in *Texas Water Resources*, (15:3). Author Ric Jensen concedes that although the term "biomonitoring" may be fairly new, the practice is at least centuries old. As evidence, he cites the use by medieval kings of "food tasters" to determine whether rivals were poisoning the evening meal. That danger-fraught job might have carried a higher civil service rating had it been listed as Biomonitoring Specialist.

**

A serious article on biomonitoring and what it can accomplish in the area of pollution control appears in *Bioscience* (40:2, 83-86). Michael Root takes a look at the wide variety of organisms that may be useful in detecting environmental hazards invertebrates such as fly larvae, worms, and bees; fish, birds, and mammals. Constant monitoring is often logistically difficult and economically unfeasible, but hazardous chemicals entering the environment and taken up by indigenous organisms over time will show up. Sublethal levels accumulated within their tissues can give scientists a measure of pollution integrated over time.

**

A discussion of scientific creativity, by Craig Loehle, is carried under "Roundtable" in *Bioscience* (40:2-Feb.90). The three major headings are Choosing the Problem, Releasing Creativity, and Work Habits, but subheads, e.g. "picking fights," "where there's smoke," "inverse procrastination," "surfing," "let's get bored," and "be unrealistic," reflect the mix of wisdom and humor with which the subject is treated.

Loehle cites Robert H. MacArthur, a promising ecologist active in the '60s and '70s who died young but before he became known for an unerring instinct for "discovering interesting problems that were solvable and for extracting the essence of complex problems so that they became solvable." Even when such people are wrong, Loehle writes, "they are wrong in interesting ways and on interesting topics."

Two "proposals" are shown in Fig. 2 of Loehle's article. C. Darwin's is "for the P.I., a geologist by training, to solve the problem of speciation. Method: Collect every possible fact and formulate in all-inclusive theory. Duration: 20 years." A. Einstein's is "for the study of the nature of space and time. Method: Conduct thought experiments in armchair, supported by abstract mathematics. Duration: 1 lifetime."

The Fig. 2 caption reads: "What would have happened if Darwin and Einstein as young men had needed to apply for government support? Their probability of getting past the grant reviewers would be similar to a snowball surviving in Hell."

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Amphibian decline

A panel of experts has confirmed what biologists have been warning for some time: There is convincing evidence that frogs, toads and salamanders are rapidly declining around the world.

But the panel, convened by the national Research Council, a non-profit group that advises the government on scientific matters, said there was no evidence the declines are caused by a single factor such as acid rain or increased ultraviolet light. Rather, the animals are disappearing because of wide-spread destruction of habitat.

The research council called on the 22 scientists to assess the question of amphibians' decline in the wake of numerous anecdotal reports, and among the conclusions was that many species in western North America are on the wane, even in nature preserves where there is no apparent human intrusion.

The panel issued a world-wide emergency warning and called for short-term studies to assess the problem before convening a larger meeting of scientists from around the world.

Compiled from staff and wire reports for *The Oregonian*, Feb. 22, 1990.

The National Park Service Annual Science Report, *1988 Inventory of Research Activities in the National Parks*, published in November 1989 and edited by Anne Frondorf, is available from the NPS Publications Coordinator, c/o Air Quality Division, P.O. Box 80225-0287, Denver, CO 80225-8027; (303) 969-2156.

**

Last summer, Norwegian researchers identified unexpectedly high numbers of viruses in both marine and freshwater environments, confirming the growing suspicion among scientists that viruses play a much more important role in marine ecology than previously believed. The find is reported in the Jan. 5, 1990 issue of *Science News*, which describes a "painstaking new study in which researchers sliced through thousands of ocean-dwelling bacteria and photographed the cross-sections." Indications from this research are that a large percentage of the microscopic cells harbor viral infections, and that viruses may cause much of the bacterial death in these waters. Until recently, researchers had assumed that most aquatic bacteria succumbed to "grazing" by protozoans.

**

The NPS-produced videotape on acid rain-related research in the parks, "For the Long Run," has been approved by the Dept. of the Interior for public distribution. The tape, which until now had been approved only for internal NPS distribution, may now be marketed and sold as well as used by parks and Regions for interpretation and education programs. The tape has won a prestigious international film award and will be shown internationally by the U.S. Information Agency.

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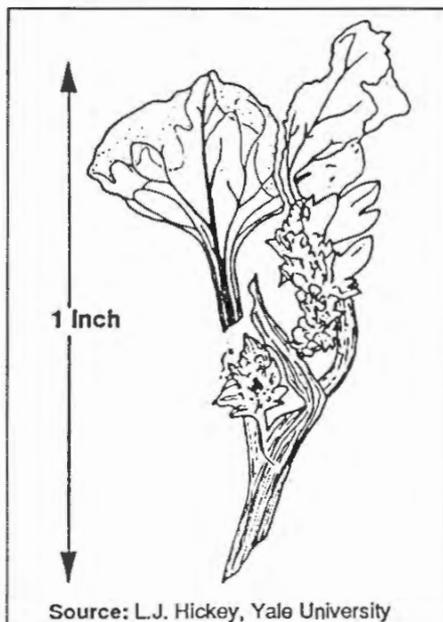
Researchers at U/WI-Madison have discovered a compound similar to lignin – an important structural element of wood and of cell walls in vascular plants – in algae. Algae are considered the best model organism for a land-plant ancestor, and this research has resulted in what may be a new piece of the plant-ancestry puzzle: how plants evolved from their green algal ancestors.

The problem, according to an article in the July 29, 1989 issue of *Science News*, is that primitive plants, lacking hard parts, made poor fossils. The recent finding provides a "chemical missing link" between land plants and the group of green algae that scientists believe gave rise to them about 400 million years ago, says Cornell University plant scientist Karl J. Niklas. The group's work, which was first reported in the July 28 *Science*, found new evidence that lignin's initial function was not structural (since algae need not stand up in water) but probably as an antimicrobial agent, which only later took on a mechanical role.

**

The oldest fossil flower yet found – barely one inch tall and resembling today's black pepper plant – has been found by Dr. Leo J. Hickey, Yale University paleobiologist, and Dr. David W. Taylor, Yale botanist. Their discovery, reported in the Feb. 9, 1990 issue of *Science*, lived 120 million years ago, 5 million years older than any such plant previously discovered. Because it bears characteristics of the two major branches of modern flowering plants scientists said the plant could be their common ancestor. Nearly all the world's plants that bear seed (about half a million species) would thus be descendants of this tiny plant.

Scientists now estimate that the earliest flowering plants may date back to 130 or 140 million years ago. Some fossil pollen from that period came from flowering plants, but the full plants and flowers of anything that old have yet to be identified.



Source: L.J. Hickey, Yale University

An artist's rendering shows the fossil of the oldest known flower, called the Koonwarra plant. (*New York Times News Service*.)

For readers interested in the whole question of climate change and greenhouse effects and who are overwhelmed by the enormity of the research involved and the conflicting predictions stemming from that research, Reid Allen Bryson offers a measured word of caution, based on his own personal reservations.

Writing as a guest commentator in *Environmental Conservation*, (16:2, 97-99), Bryson applauds the modeling approach to increased carbon dioxide in the atmosphere but cautions against accepting the results as providing "answers," rather than steps toward answers.

Bryson is emeritus professor of meteorology, geography, and environmental studies at UAWI Center for Climatic Research. He notes that "teachers and real scientists try to avoid 'only,' 'all,' 'never,' and 'always.' Having studied climate for half a century, I am very skeptical of a model of future climates which is based on only one variable, and when that variable is one which has not been shown to be dominant in the base of past climatic variations!"

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Former NPS Director George B. Hartzog's address to the October 1989 Ranger Rendezvous XIII in Hot Springs, Ark., is covered in the ranger association's journal, *Ranger*, (6:1, 10-16). The following excerpts provide the flavor:

"The National Park Service was anesthetized in 1973. While in this deep and dreamless sleep, its once great Office of Archeology and Historic Preservation was dismantled; its scientists were intimidated and dispersed; the Land and Water Conservation Fund was 'gutted,' and the National Park Service was rendered lifeless by pyramiding layers of bureaucracy stuffed with unknowing partisan political 'must hires.' Shamefully, only about five percent of the employees in the Washington office of the National Park Service today have ever pulled a day's duty in a national park...

"Your director is a qualified park professional, a graduate of the University of Indiana's School of Park and Recreation Management, which his uncle, Dr. Eppy, now in his nineties, built into one of the premier schools in America. Moreover, as a friend and ally of the vice president, Jim's political credentials are impeccable. With that connection he should have the clout to get the job done."

At the same meeting, Director Ridenour (as quoted in the same issue of *Ranger*), told the assemblage:

"I've been traveling about 50 percent of the time.... I know that the real action is out there in the field and that it's very difficult to understand conditions in the field unless you've been out there.... When you look at maps back in the office, it's never the same as when you stand out there and look around."

**

More good news for Integrated Pest Management! Owners of a 3,600 acre pecan ranch in Las Cruces, NM had spent \$700,000 on chemicals to try to rid their trees of yellow and black aphids, all to no avail. The insects thumbed their noses at all nine chemical poisons and continued to chew the trees to death. In desperation, the owners quit spraying and instead dropped 72 million ladybugs and green lacewings from an airplane onto their trees. They described the results after two years as "very very very effective." Not only did the reintroduced predators control the aphids (who could develop resistance to chemical sprays, but not to

being eaten), but after two years of treating the orchard with purchased ladybugs, the ladybug species *natural* to the Las Cruces area returned to the orchards. They had disappeared previously as a result of the chemical spraying.

The story was written for the *Oregonian* (2/15/90) by J.E. Ferrell.

An article by Gary E. Davis, research marine biologist at Channel Islands NP in *Natural Areas Journal*, (9:2, 80-89), describes the design of a long-term ecological monitoring program for Channel Islands NP, California. The design was described by Davis and Bill Halvorson in the Spring '89 issue of *Park Science*, (9:3, 16-17).

**

The trees "died happy" some three centuries ago on the southern Washington coast. This is the verdict of a chain-saw wielding scientist from UCO's Institute of Arctic and Alpine Research in Boulder, where scientists read tree ring growths as though they were grocery bar codes. David Yamaguchi of the Institute presented his theory of an enormous earthquake some 300 years ago to the December 1989 meeting of the American Geophysical Union's fall meeting.

Earthquake forecasting is based heavily on both the time elapsed since the last event and its magnitude," he said. "Calendar dates obtained from tree rings could set the clock ticking and help geologists forecast future seismic activity."

In the past five years, researchers have found buried marshes along the Pacific Northwest coasts, showing that the ground abruptly crashed downward on several occasions, drowning the marshes in seawater. Radiocarbon dating of organic material in the buried marshes put the last even about 300 years ago. Healthy, vigorous western red cedars have been found to have met abrupt, untimely death at that time - apparently earthquake victims.

**

Native Plants For Parks is the title of a brochure describing a cooperative program between the NPS and the Agriculture Department's Soil Conservation Service. The program provides cost-effective methods for use by resource managers in working with native plant revegetation, historical plants, and threatened or endangered species. The brochure details the SCS technical assistance available and tells how to request assistance and from whom. Contacts are: NPS Technical Advisor, Denver Service Center, FTS 327-2310; SCS National Plant Materials Specialist, Washington, DC FTS 447-5667; SCS Technical Advisor, Denver, CO, (303) 236-2913.

At present five NPS/SCS cooperative agreements are producing seed or transplants for specific park road program funded projects; 12 such projects have been scheduled for FY 1990.

**

The Biological Diversity of Food Plants: Some Interpretive Thoughts is the title of a 52-page xerox article by Western Region's chief of interpretation, Dick Cunningham. The paper contains information on the origins and historical usages of food plants, stresses the need to preserve genetic food resources, and suggests interpretive/educational techniques for using the information. Cunningham works out of the NPS Western Regional office in San Francisco.

**

The Student Conservation Assn. Work Skills Program for 1990 will begin its professional training courses with a Site Revegetation Workshop in California April 6-8. Nine subsequent workshops will be held, in Virginia, Washington, New Mexico, Idaho, Wyoming, and Oregon, at various times through September 28. For more information write to SCA Work Skills Program, PO Box 31989, Seattle, WA 98103; (206) 547-7380.

Several recent publications by David N. Cole and others from the Forest Service, Intermountain Research Station's Wilderness Management Research Unit, deal with uses of wilderness and their affects on various kinds of wilderness communities. They are available, on request, from Wilderness Management Research Unit, Forestry Sciences Laboratory, PO Box 8089, Missoula, MT 59807.

**

Problems in federal government computer software development and regulation, investigated by a subcommittee of the U.S. House Committee on Science, Space, and Technology (report available from the Government Printing Office in D.C., Sept. 1989) places most of the blame on the federal procurement system, according to M. Mitchell Waldrop in the Nov. 10, 1989 issue of *Science*. Subcommittee staffer James Paul, who spent two years working on the report, told *Science*: "The federal procurement system is like a software system with bugs. Every time it's broken down, somebody has patched it. But keeping it together is getting harder and harder and costing more money." The government, he said, requires "a legally binding contract specifying in excruciating detail exactly how the system will look at delivery some years hence." The whole procurement culture, he concludes, is now at the point where an experienced software engineer would simply throw up his hands and say "Hey: Let's toss this out and start over."

gis corner

The Western and Southeast Regions recently held GIS workshops. The Western Region workshop, held in Tucson last August, looked at the practice and prospects of GIS implementation in Arizona parks. Subsequently, the Arizona parks GIS steering committee met in Flagstaff in January to discuss the workshop's findings and make recommendations to management for implementing GIS technology in Arizona (and neighboring) parks. Principal recommendations were (1) to examine mechanisms for providing technical GIS support to Arizona parks; (2) to investigate the possibility of procuring UNIX workstations through a consolidated procurement action; (3) to explore the possibility of standardizing the classification of all GIS themes; (4) to examine DOS-based GIS alternatives (for use by smaller parks); and (5) for GISD to take a stronger role in setting standards, guidelines, and policy.

The Atlanta workshop looked at GIS implementation throughout the Southeast Region. As in the Tucson workshop, Park Service and other-agency GIS implementations were explored, including a demonstration of GRASS. Recommendations on the Region's strat-

Continued on page 17

GWS Conference Calls for Papers

Grosvenor To Keynote

Three main conference objectives will shape the 1990 Science in the Parks conference, sponsored by the George Wright Society and set for Nov. 12-17, 1990, at the Westin Paso del Norte Hotel in El Paso, TX:

(1) To develop a Society platform or set of working priorities for 1990-1999, listing the five most critical and/or urgent threats to both cultural and natural resources as labeled by the Society forum;

(2) To develop a forum position related to the cause and effect of each threat; and

(3) To develop a 10-year (or less) strategy by which the Society can actively contribute to the mitigation of identified threats.

Oral and poster presentations should illustrate a

threat or a recurring problem that threatens the preservation of cultural or natural resources in the areas of management, research, or agency communications; organization/relationships/funding.

Threats can be of national or worldwide scope. Authors will serve as committee members assigned to each concurrent session, and these sessions will be organized according to common themes among poster/paper submittals. Committees will synthesize the findings of each concurrent session into a defined threat, each to be prioritized by the forum for platform consideration.

Prospective presenters should submit in duplicate by Feb. 15, a proposed title, with a summary of 100 words or less to Conference Co-chairman Tom Gavin at the following address: 1990 George Wright Society Conference, National Park Service, 450 Golden Gate Ave., Box 36063, San Francisco, CA 94102; FAX (415) 556-2793, Attn: Tom Gavin.

Gilbert Grosvenor, president of the National Geographic Society, will keynote the Natural Areas/ Yosemite Centennial Symposium planned for Oct. 13-19, 1990, at the park and in the San Francisco Bay Area.

With support from The Yosemite Fund, the conference will be a joint effort with the park and the Natural Areas Assoc., under the theme, "Natural Areas and Yosemite: Prospects for the Future."

Grosvenor's presentation is sponsored by the Commonwealth Club of California and will be broadcast nationwide on National Public Radio from San Francisco. Participants will visit key areas to review educational and research projects, hear from NPS personnel about current management and research efforts in the park, and enjoy one-day field trips to natural areas, preserves, and parks in the Bay Area.

The tentative deadline for conference paper submissions is April 15.

GIS Corner (Continued from page 16)

egy and approach to GIS included: (1) strengthening coordination, goal-setting, and policy; (2) recognizing the need for both an agency-wide and Regionwide "corporate" data base; (3) recognizing the need for centralized support for the use of GIS technology, including both policy and technical matters; (4) establishing a major role for technical GIS support in the Southeast Regional Office; (5) establishing a uniform classification for vegetation mapping throughout the NPS; (6) recognizing that larger parks can assist smaller parks in using GIS technology; (7) demonstrating the utility of the technology to upper management by showing its long-term cost effectiveness and positive contribution to decision-making; (8) strengthening GISD's role in setting standards for data, classification, hardware, and software; and (9) publishing a Service-wide GIS newsletter.

February 6-8 the GIS Division gave its first training course on *GIS for Managers*. About two dozen NPS managers and superintendents attended. The course covered the nature and use of GIS technology, staffing, hardware, software, funding, uses, and institutional considerations for implementation within NPS. Lively discussion covered barriers to implementation. Attendees went away with an understanding of the technology, the realities of implementation, and steps they might pursue to institutionalize its use within the Service.

Resource Technology 90 (RT 90): I am putting together about four sessions (of eight papers each) dealing with GIS (and related) technology in parks and protected areas. A number of international parks are represented. **The conference has been officially authorized as an NPS training opportunity.** Accordingly, you may attend as a course trainee, rather than as a meeting attendee. A formal training announcement will be issued this spring.

Gary Waggoner of our office points out that GIS people around the Service have begun to publish and present professional papers about their park GIS applications and experiences... a sure sign that GIS in the Service is growing up - that it is beginning to be perceived as a routine management tool. In the interest of improved communications, Gary encourages everyone preparing such papers to send a copy to us, so it can be mentioned in this column.

Harvey Fleet

Geographic Information Systems Division

meetings of interest

1990

April 19-20, WILDERNESS AREAS: THEIR IMPACT, a 2-day symposium at Utah State Univ., sponsored by the College of Natural Resources and UT/State/U Extension Service; no fee registration; contact Dean's Office, College of Natural Resources, Logan, UT 84322-5200 or (801) 750-2445.

April 29-May 3, SOCIETY FOR ECOLOGICAL RESTORATION, 2nd annual conference, at the Sheraton International Hotel, Chicago's O'Hare airport. Program will explore the state of the restoration art as it applies to key environmental issues and will include special events to facilitate communication among restorationists, decision makers, and the general public. Contact: Dave Egan, U/WI Arboretum, 1207 Seminole Hwy, Madison, WI 53711; (608) 262-9547.

May 8-16, THE BERGEN CONFERENCE; ACTION FOR A COMMON FUTURE, in Bergen, Norway. Contact: Ministry of Environment, 1990 Conference Secretariat, PO Box 8013 Dep., 0030 Oslo 1, Norway.

May 16-19, THIRD SYMPOSIUM ON SOCIAL SCIENCE IN RESOURCE MANAGEMENT, at Texas A&M University. 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; FAX: (808) 955-6950.

Oct. 3-5, ECOLOGY AND PLANNING: THE LANDSCAPE DIMENSION, at the Red Lion Inn, Sacramento, CA (second of a series - see p. ??). Sponsored by U/Cal/Davis Extension, featuring fundamentals and techniques of landscape ecology and case study applications to specific land use problems. Contact: Dana Abell, Univ. Extension, U/Cal Davis, 95616.

Oct. 13-19, NATURAL AREAS/YOSEMITE CENTENNIAL SYMPOSIUM, at Yosemite NP and the San Francisco Bay area; jointly sponsored by the Park and the Natural Areas Assn., "Natural Areas and Yosemite: Prospects for the Future;" contact: Coordinator, Natural Areas/Yosemite Symposium, GGNRA, Fort Mason Bldg., #201, San Francisco, CA 94123; (415) 556-1009; FAX (415) 556-1399.

Nov. 12-17, SIXTH CONFERENCE ON RESEARCH IN THE NATIONAL PARKS AND EQUIVALENT RESERVES, at the Westin Paso del Norte Hotel, El Paso, TX; Contact: Conference Committee at (415) 556-1866.

1991

Nov. 4-8, THIRD GLOBAL CONGRESS OF HERITAGE INTERPRETATION INTERNATIONAL, in Honolulu, to explore how effective interpretation can help protect natural and cultural heritage while providing meaningful and memorable experiences for residents and visitors. Contact: Gabriel Cherem, EMU Geography & Biology, Ypsilanti, MI 48197; (313) 487-0218, or Ray Tabata, UH Sea Grant, (808) 948-3191.

Endangered Species Survey Covers Midwest Region Parks

By Gary D. Willson

In August 1983, the National Park Service (NPS) and the U.S. Fish and Wildlife Service (USFWS), Wyoming Cooperative Fish and Wildlife Research Unit, entered into an agreement to provide comprehensive information on the status and distribution of plant and animal species listed as rare by federal and/or state agencies in parks within the Midwest Region.

The need for rare species investigations was clear. The highly populated Midwest Region contains some of the most impacted ecosystems on the North American continent. Consequently, the number of rare species potentially occurring in parks is very large (table 1).

Table 1. Approximate number of rare plant and animal species on federal and state natural resource agency lists for the Midwest Region. National Park Service.^a

State	No. of Species	State	No. of Species
IL	350	MO	650
IN	620	NE	15
IA	250	OH	910
KA	25	WI	150
MI	540	Federal	255 ^b
MN	300		

^aNumbers determined from state lists current through October 1985 and Federal lists current through February 1986.

^bIncludes listed and candidate species.

The NPS is mandated by the federal Endangered Species Act to protect and conserve endangered and threatened species on its lands. Also, NPS policy requires parks to comply with state legislation designed to protect rare species.

The project's objectives were to determine which rare species can be expected to occur in parks and provide recommendations to enable the NPS to conserve the terrestrial and aquatic habitat necessary for maintaining and/or enhancing their populations. Achieving these objectives involved (1) consulting rare/nongame species specialists and pertinent literature to determine which rare species are *known* to occur in parks and identify those with *potential* to occur in parks; (2) conducting field surveys for rare species within selected parks; and (3) compiling and summarizing literature to identify management and research requirements for individual species. The project encompassed 19 parks within the Midwest Region.

Field surveys were conducted in 16 parks for a variety of rare species. These included rare plant surveys at Isle Royale NP, Pictured Rocks National Lakeshore (NL), Saint Croix and Ozark National Scenic Riverways (NSR), Effigy Mounds National Monument (NM), and Cuyahoga Valley National Recreation Area (NRA); herpetological surveys at Indiana Dunes NL and Pipestone NM; a rare turtle survey at Saint Croix NSR; rare raptor surveys at Agate Fossil Beds and Scotts Bluff NMs; Ozark and Saint Croix NSRs, and Apostle Islands NL; a rare snail survey at Effigy Mounds NM; and a survey of museum records of rare lichens for parks in Minnesota. These surveys provided park

records for over 100 species of rare flora and approximately 20 species of rare fauna.

In addition, computerized data files of state conservation agencies, state heritage programs, nongame species specialists, and literature records were consulted to determine if other rare species were known to occur or have potential to occur in parks. Forty-six federal species and more than 380 state-listed rare species were found to occur in parks, and another 1,012 species were believed to have potential to occur in parks (table 2).

The project's final report contains species abstracts for rare state and federal species known to occur within parks. Each abstract presents information on taxonomic characteristics, habitat affinities, and listing status for state-listed species plus cause of decline, current population status, current, historic, and park distributions, and literature lists for federal species.

The final report emphasizes several important considerations for rare species management. Of foremost

Table 2. Number of rare species occurring or potentially occurring on NPS lands. Midwest Region.

Category	Number of Species
Federal plants on parks	19
Federal plants potentially on parks	53
Federal animals on parks	27
Federal animals potentially on parks	73
State plants on parks	263
State plants potentially on parks	683
State animals on parks	118
State animals potentially on parks	203

concern is loss of habitat. NPS lands are particularly valuable as refugia for rare species. However, the NPS in the past has often emphasized policies that favor climax vegetation, resulting in a decrease in young successional stages and the diversity of plant communities. The ecosystems of the Midwest clearly evolved with fire, however, this perturbation is now largely absent. The report recommends that NPS investigate appropriate opportunities to reinstate fire as a successional force.

Continued on page 19

Table 3. Priority list of rare plant research and resource management needs.

Plant	Federal Listing Status	Park	Management Recommendations
<i>Lesquerella filiformis</i>	E	WICR	Establish population size; map individuals; record phenology and plant vigor; determine effects of insects, visitors, and plant succession; determine fire effects.
<i>Cirsium pitcheri</i>	T	INDU PIRO SLBE	Monitor to assess stability of populations; counts of both juvenile and adult plants; determine effects of dune trampling; consider pollinators.
<i>Platantha praecleara</i>	T	PIPE	Survey PIPE to locate population.
<i>Mimulus glabratus</i> var. <i>michiganensis</i>	PE	SLBE	Determine variety of <i>Mimulus</i> collected; survey population.
<i>Arabis missouriensis</i> var. <i>deamii</i>	C2-	SACN	Possible use of prescribed burning and overstory clearing; search areas adjacent to SACN site; resurvey INDU and OZAR.
<i>Aster turcatus</i>	C2	OZAR	Life cycle information/propagation techniques; periodic survey at OZAR; effects of plant succession.
<i>Besseyia bullii</i>	C2	SACN	Life history information; removal of woody plants(?); fire effects; additional survey at SACN; monitor at SACN; threats mitigation at SACN; recovery actions for prairie/savannah habitats at SACN.
<i>Calamagrostis inperata</i>	C2	OZAR	Survey upper Jack's Fork.
<i>Plantago cordata</i>	C2	OZAR	Maintain stream water quality.
<i>Phus trilobata</i> var. <i>arenaria</i>	C2	INDU	Protect dune habitat; further taxonomic research; assess flowering time; transplant experiment.
<i>Silene regia</i>	C2	GWCA OZAR WICR	Habitat protection; need for burning/woody plant removal; expose soil for seed germination; monitor populations at GWCA, OZAR, and WICR.
<i>Sullivantia renifolia</i>	C2	EFMO	Research general life history and ecological requirements; search OZAR.
<i>Talinum rugospermum</i>	C2	INDU SACN	Determine ecological requirements; further surveys at OZAR.
<i>Viola novae-angliae</i>	C2	GRPO VOYA	Determine phenology; monitor populations at GRPO and VOYA.
<i>Woodsia oregana</i> var. <i>cathcartiana</i>	C2	PIPE VOYA	Monitor population at PIPE; survey VOYA.

Electric Fence Enclosure Fails to Confine Feral Goats

By Dan Taylor

Feral goats (*Capra hircus*) were introduced to Hawaiian and most other Pacific islands by mariners during the late 18th and early 19th centuries. They severely degraded the integrity of native ecosystems. During the 1970s and '80s goats were eradicated from most of Hawaii Volcanoes NP (92,676 ha). Installation of wire mesh boundary fences were the cornerstone of the park's goat removal strategy. Within the fences goats nearly were eliminated by systematic drives, hunting, and aerial shooting. Remaining animals were eliminated using radio-collared Judas goats (Taylor and Katahira, 1988). However, 30 to 50 goats still frequent an unfenced area of approximately 2,400 ha in the park. Our considerable success with wire mesh fences notwithstanding, a cheaper and more aesthetic alternative to wire mesh fencing was desired to control these animals.

Electric wire fences are commonly used to enclose livestock, including cattle, horses, goats, sheep, and other animals (Smith, et al., 1986). However, the literature is silent regarding the efficacy of using electric wire fences to control movements of feral goats. A neighboring rancher has successfully enclosed domesticated goats using a simple 2-strand electric wire fence. He and some of his associates convinced us to test electric fence wires on feral goats.

Our ultimate objective is to eradicate feral goats from a remote, sparsely vegetated, and rugged section of the park at elevations 2,000 to 3,500 m on the south

slope of Mauna Loa. The animals here are seldom hunted or harrassed, nor constrained by fences. Workers constructed a spacious experimental electric fence enclosure, then captured 4 goats from a feral Mauna Loa group and put them into the enclosure. We evaluated the effectiveness of the fence and construction costs.

Methods

Park resource management workers enclosed 7 ha using a high quality, 12 V DC, electric fencing package obtainable in the U.S. market (Common Sense Fence, Inc., Chatfield, MN). A 12 V, 55 amp-hr marine battery energized the circuit, which was recharged by a 28 cm x 36 cm solar collector. Workers installed 6 strands of #12.5 gauge galvanized wire, under 150 pounds tension, supported by 25 mm-dia fiberglass posts. The bottom, third, and fifth wires were charged with 5,500 V, delivered for 1/10,000 sec at 45-55 pulses per minute. Alternate wires were grounded. The system was grounded with a buried 2 cm dia, 2 m long solid copper rod. The bottom wire was 5 to 20 cm above ground level and succeeding intervals were 15, 20, 20, 25, and 25 cm. The top wire was therefore 110 to 125 cm above ground level.

The rectangular enclosure was 1375 linear meters circumference. Thus there were 8,250 m of wire, 4 braced corner posts, and one gate. We made the enclosure as spacious as we could configure it, between a secondary road and a 12-16 m high escarpment, yet entirely visible from atop the escarpment. Distances from escarpment viewpoints to the fence ranged from 18-328 m. It was not feasible to construct an enclosure the size of a theoretical home range.

Vegetation within the enclosure covered approximately 15 percent of the area. The dominant grass was non-native *Andropogon glomeratus*; dominant shrubs were native *Styphelia tamaemae* (pukiawe), *Dodonaea sp* (a'ali'i), *Dubautia sp*; dominant trees were native *Metrosideros polymorpha* (ohi'a) and non-native *Myrica faya* (firetree). Fifty-five clumps of the rare native shrub, *Scaevola kilaeae*, were protected from goats with special wire canopies. *Myrica faya* individuals which obscured views of the fences were cut down. Vegetation clumps and several rock outcrops and earth cracks provided numerous refugia for goats.

Technicians captured 1 juvenile (female) and 3 mature (2 male, 1 female) goats from one of the remote Mauna Loa groups and then sedated them with injections of Rompun and Ketamine. They immediately fitted each animal with a color-coded collar bearing a radio transmitter to facilitate observation during the test and to locate escapees. Then they delivered the goats, still under sedation, by helicopter to the enclosure, which was 19 km from the capture site and 821 m lower in elevation. The animals awoke and began walking about the enclosure 1:51 to 3:46 hours after they arrived. Observers discreetly monitored the goats from the escarpment and recorded behavior before and during encounters with the fence wires.

Results and Discussion

Within 24 hours, all 4 goats penetrated the electric wires and escaped. The 2 adult males escaped together, at mid-day, 57 and 20 min., respectively, after arousal from sedation. One of the males was recaptured and returned to the enclosure 72 min. after his



Billy hits the wires and gets hung up by his horns (proving it doesn't take two to tangle).

escape. He escaped again 75 min. later. The 2 females escaped together shortly after dawn on the second day, after spending the night in the enclosure. They had been active for 22:01 and 23:05 hours, respectively. The electric wires were fully charged throughout the test, as indicated by a signal strobe and by a clip-on volt meter that indicated a charge of 5,500 V on the fence before and after the test. Three of the goats were in contact with wires long enough during their passage through the fence to have received 3 to 5 shocks during their passage through the wires.

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Endangered Species

(Continued from page 18)

The report also recommends establishing a rare species management program for the Midwest Region. In response to these recommendations, the Region produced priority lists of rare plant and animal research and resource management projects. The list for rare plants is shown in table 3. Considering the large number of known and potential species, the initial priority lists included only federally listed and candidate species.

Research projects involving high priority rare plants include a life history study of *Lesquerella filiformis* at Wilson's Creek and distribution surveys and community ecology of *Cirsium pitcheri* at Indiana Dunes, Sleeping Bear Dunes, and Pictured Rocks. Priority animal research includes a study to determine possible causes of decline in the grey wolf at Isle Royale; an evaluation of piping plover habitat at Indiana Dunes, Sleeping Bear Dunes, Pictured Rocks, and Apostle Islands; a study of feeding and breeding behavior of the bald eagle at Apostle Islands; and a survey for rare mussels at Saint Croix. As a resource management project, the endangered peregrine falcon was reintroduced to Isle Royale and Pictured Rocks.

Park resource managers now have in hand essential baseline information to minimize habitat disturbance and direct impacts to rare species. The report was instrumental in the development of a Regional rare species research program and in the establishment of long-term species management goals, and it enabled the Region to develop conservation effort priorities.

Wilson is an NPS Ecologist with the Midwest Region.



Solar charge unit is attended to by Phillipa Lin, a VIP (volunteer in the Park).

Electric Fence (Continued from page 19)

The test fence enclosed subject animals in new territory, and therefore it could be argued this created an immeasurably different circumstance than a barrier across accustomed travel routes. Critics credibly insist a *bonafide* electric fence barrier in the Mauna Loa control unit still hasn't been tested. My curiosity about this question remains unsatisfied. However, if the enclosed goats hadn't escaped so easily we could justifiably have repeated the test or even installed a test fence on Mauna Loa.

All of the escapees dispersed less than 2 km from the enclosure. The females stayed together, and the males dispersed separately. They were monitored for 4 to 6 weeks, using the radio transmitters. Finally they were shot.

Materials cost \$5,085 (U.S.), including solar electricity panel and fence chargers, and excluding shipping costs. Crews of 4 to 8 workers took 293 hours to construct the enclosure. Because most of the posts had to be set in drilled holes, and because the workers were not accustomed to installing electric fences, I estimate the time required to complete this project was about 30 percent longer than normal. Costs for comparable Type III galvanized, 130 cm-high wire mesh fence with tee-type steel galvanized posts would be \$6,200. Experienced park crews could install such a wire mesh enclosure in 240 hours. Therefore material and construction costs of electric fencing do not offer outstanding advantages in our circumstances.

In National Parks, however, aesthetic qualities of fences must be considered. The required fence would be located along a distant but highly visible park boundary, which crosses open lava fields in a frequently viewed and photographed section of the Mauna Loa volcano. A wire mesh fence would present an obvious linear and textural intrusion on an otherwise pristine vista, unless the gray galvanized wires were tinted brown or black. An electric fence would be invisible at a distance greater than 1 km if the white posts could be colored.

Park managers have a low tolerance for goats, because of the detrimental impact they have on the fragile subalpine ecosystem of the Mauna Loa section of the park. We intend to eradicate them. Since we still are not certain the free-roaming goats of Mauna Loa will accept electric wires as barriers, we will install traditional wire mesh fences, despite cost and aesthetic disadvantages. Wire mesh fences are certain to be effective and will continue to be used until a better alternative is available.

Acknowledgements. I thank A. Kikuta, H. Hoshide, L. Katahira, and other wildlife management staff of Hawaii Volcanoes National Park for fence construction and animal handling support. I also thank C. Stone, D. Okita, B. Marlin, and T. Gavin for their support.

Taylor is a Resource Management Specialist at Hawaii Volcanoes NP.

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Marine Debris Monitoring

Editor's Note: This is the first of several articles on the marine debris monitoring program. The next will summarize the results of the first year of study.

By Nicholas J. Chura

Of growing national concern is the increased abundance of marine debris, particularly plastic debris, being found at sea and littering beaches. When discarded at sea, various forms of plastic can not only entangle and kill marine life, but also disable ships and degrade beaches.

The National Marine Fisheries Service (NMFS) has conducted a long term study on Alaska beaches since 1972, primarily to monitor derelict fishing gear and entangling debris. Elsewhere along our nation's shorelines, where data on the types and volumes of debris are generated largely from voluntary beach cleanup efforts, beach litter has been perceived as more of an aesthetic and/or health problem. While useful for media and public education purposes, the data collected during these cleanups are, for the most part inadequate for scientifically assessing the overall problem or for developing solutions. Proper quantitative data are needed for this purpose, ideally from each region of the country, to take into account various sources and effects of debris, which differ from area to area.

Survey One Year Old

In this regard, as fiscal year 1989 came to a close last September, so did the first year of the National Marine Debris Survey and Monitoring Program. This is a major five year effort to learn more about the amounts and kinds of materials littering our nation's beaches and to evaluate the long term trend in ocean pollution. It is being conducted under an interagency agreement, signed in August 1988, between the NPS and NMFS.

The agreement obligates NMFS to provide (1) on-site training in survey methods, (2) funds not to exceed a specified amount each year to cover expenditures incurred by the NPS to complete identified tasks, and (3) review and approval for release of NPS annual reports on the results and findings of the surveys conducted each year.

NPS in turn will (1) provide coastal study sites with a minimum of 5 kilometers of accessible shoreline not subject to cleaning; (2) assign permanent employees to be responsible for the surveys at each location; (3) have these employees attend on-site training on methodology prior to beginning the required quarterly surveys; and (4) compile, analyze, and report survey results in an approved format, for each site within four months of the end of each fiscal year.

Jim Coe is designated the Contracting Officer's technical representative for NMFS; Scott Johnson is his alternate. Al Greene and Nick Chura are the NPS Project Officers. The agreement expires Jan. 1, 1994 unless amended or renewed.

Two parks in each of four geographical regions designated by NMFS were chosen as study sites. These are Olympic and Channel Islands NPs (West Coast), Padre Island and Gulf Islands NSs (Gulf Coast), Canaveral and Cape Hatteras NSs (South Atlantic Coast), and Assateague Island and Cape Cod NSs (North Atlantic Coast.)

Training Sessions Held

Scott Johnson, headquartered at Auke Bay, AK, conducted training sessions for personnel at various

coastal parks in the program, focusing on the survey methods to be used. The methods are the same for all beaches. A minimum of five 1-km sections of accessible shoreline are utilized. These sections are not subject to cleaning, have minimal visitor impact, contain representative oceanic debris, have uniform substrate and topography. The designated survey area is from the water's edge to the seaward extent of vegetation. Debris visible from walking height is counted, and when possible, debris is removed from the beach or marked at the end of each survey.

The first two quarterly surveys served as a shake-down period, whereby survey personnel became acquainted with sampling procedures and learned of possible problems. In general, the surveys appeared to be more time consuming and required more manpower than anticipated. Also, costs for conducting the surveys, processing the data, etc., seemed to run higher than what was being made available by NMFS.

A noteworthy early problem occurred at Padre Island, where the amount of debris deposited on beaches far exceeds that of any of the other parks in the study. Here, it was quickly determined that surveying marine debris deposition along the entire length of each of the five 1-km transects was simply not feasible. Because of this, the transects have to be surveyed on the basis of statistically representative subsamples (100 meters in length).

Pre-Survey Workshop Held

Other questions raised as a result of these first surveys concerned modification of the NMFS data collection form; data processing, tabulation, and analysis; reporting requirements, and related subjects. These were recognized as needing resolution in a group setting. As a result, a workshop was held in Washington, DC in June 1989, attended by representatives of the eight parks, a rep from NPFs, and two Washington Office (WASO) people.

The first day of the workshop featured presentation of a summary report on program activities to date by each park rep, allowing the reps to gain familiarity with one another's work and to identify unique and common problems. The next two days were spent developing protocols needed to foster standardization of procedures for all eight parks. Small (2-3 member) committees (1) drafted material on assigned subjects, (2) presented their material to the other workshop participants for discussion and assistance, (3) made changes in or additions to the draft material based on comments received, and (4) arrived at group concurrence on the developed material.

Then guidelines for handling, analyzing, and presenting data were prepared by Andy Cole (CAHA), David Manski (CACO), and Tim Morgan (CANA), instructions on the format and content of the annual park report and the annual NPS report to NMFS were prepared by Gail Bishop (GUIS), Jennifer Bjork (PAIS), and Dan Richards (CHIS), and modified data collection forms with a set of definitions of terms were developed by Chuck Janda (OLYM), and Jack Kumer (ASSA).

Ted Merrell, although retired, represented NMFS at the workshop and shared his knowledge and experience. Ted is credited with initiating the marine debris surveys of beaches in Alaska and has several scientific papers published on the subject. Through his efforts others came to realize the extent of the marine debris problem, and it is upon his work that our marine debris survey and monitoring methodology is based.

Continued on page 21

Ecology and Planning: The New Perspectives

By Jean Matthews

"Integrate the processes involved in landscapes, describe it in terms that planners and developers can understand, and then put it all to use."

They were all there to hear the challenge: a mix of more than 200 planners and developers, consultants and builders, lawyers and resource managers, information specialists and scientific academicians, meeting in Sacramento, CA, on Feb. 8-9, for a conference on Ecology and Planning: The New Perspectives.

The speaker was Paul Risser, author of *The True Prairie Ecosystem*, vice-president of research at U/NM, Albuquerque, and a founder of the US Section of the International Society for Landscape Ecology. He was part of a conference put together by Dana Abell, consulting ecologist with U/Cal Davis, out of recognition of "the whole new fields" arising from the last decade of professional ecology. These new fields, whose presentations were made by people who had a large part in defining them, "have altered many of the perspectives that have influenced management decisions for nearly a century," Abell explained, and upon this thesis the conference was built.

Anne Whiston Spurr, successor to Ian McHarg as chair of the U/PA department of landscape architecture and regional planning, addressed the opening

Marine Debris (Cont. from page 20) Official Approval Given

Ted hand-carried a copy of the modified NMFS data collection form back to Alaska, where it was officially approved by NMFS officials, clearing the way for a final format to be put to immediate use in the parks. (The original NMFS form was based on the kinds of debris found on Alaskan beaches and was not fully applicable to the kinds of debris found elsewhere along the U.S. coastline.) The definitions developed for the modified form help clarify the meaning of the items listed and prevent their misinterpretation.

Thanks to the efforts of Andy Cole, all the data generated by the surveys can be stored and processed at North Carolina State University, where the Department of Recreation Resources Administration in the College of Forest Resources has agreed to serve as central storage and retrieval location. For a nominal fee the University will accept, enter, and store the data collected quarterly from the eight parks and produce the tabulations, analyses, and graphs/charts required for the annual reports.

Instructions drafted on the form and substance of the annual park reports and the annual NPS report to NMFS will help insure that information from the various parks is presented in a similar and compatible manner. With all the annual park reports in hand at the end of the calendar year, a mini-workshop was held to help prepare the NPS annual report to NMFS, due Feb. 1, 1990.

Getting everyone on the same wave length, so to speak, was accomplished primarily through the workshop. If turnover of park personnel is not too great, if the parks continue to commit resources to the program, and if WASO helps to ease the financial burden on the parks, then the remaining four years of work should go smoothly. The obvious dedication of field personnel involved has carried the program through a successful first gear of a long term program of national significance.

Chura is a biologist with the NPS Wildlife and Vegetation Division, WASO.

Tim Allen, in his attempt to impress the conferees with the importance of "how you look at things," resorted to the eyelash mite that lives on human eyelids. His context was a discussion of the decision that planners must make as to whether something is an organization, a population, a community, a landscape, an ecosystem, a biome, or a biosphere.

In the case of the eyelash mite, he said, "you have us, and you have the mites. We're big; gravity matters to us. The mites are tiny; surface tension matters to them. So what do we, with our comparative bulk and long lives, represent to the mites? A reliable resource!"

Question: At what hierarchical level does that put us? And the mites?

"There is the real world out there," Allen said, "that doesn't care what we call it."

evening session on "deep structure in the urban landscape." Spurr is currently putting into practice in a major design and planning project for West Philadelphia the concepts of her book, *The Granite Garden: Urban Nature and Human Design*. She dealt with the tendency nature displays for reasserting its own inherent patterns (such as stream channels and their floodplains) on the cultural landscape of cities, suburbs, and other developed lands.

The full-day session opened with Bruce Wilcox describing a newly redefined field, conservation biology, in whose redefinition he has been energetically involved. Wilcox was co-editor of *Conservation Biology - An Evolutionary and Ecological Perspective*, and was a founder and early director of the Conservation Biology Center at Stanford. He now is president of the new Institute for Sustainable Development at Menlo Park, CA. He touched on the organization of biological diversity at the functional level (molecular, populational, species, and ecosystem), and their components (genes, populations, species, and communities), and gave examples of each before proceeding to the various theories (island biogeography, equilibrium, etc). He wound up with examples of "the theory-management connection." These examples (such as management strategies for raptors) amount to proof, he said, "that conservation biology is not just a bunch of theories. It can be, and has been, used to insure population viability and to better design nature reserves."

"Restoration is the acid test for ecology" - Edith Allen borrowed her opening statement from William Jordan, editor of *Restoration and Management Notes*. Allen, a faculty member in San Diego State University's biology department and editor of *The Reconstruction of Disturbed Arid Lands*, described the unseen world involved in true restoration (versus "reclamation") and observed that "nothing succeeds like succession."

In line with that thought, she described much of restoration work as involving preparation of the soil and then helping it build itself toward climax instead of trying to establish immediately what it took nature tedious time to bring about. She even had a kind word to say for alien (exotic) species that may be better adapted to fast establishment and thus able to save the topsoil "until someone can figure out how to re-establish native grasses."

Risser followed Allen, with a resume of the scales of visible landscapes - plant, field, farm, watershed,

biome, and globe, and continued with a description of "the science of patches" that deals with the patterning of the land. He dwelt on how this comes about in nature, how man participates in its change, what maintains it under varying degrees of human control, and how patterns influence the processes that affect whole expanses of land.

Stephen Gliessman, director of the agroecology program and faculty member for environmental studies at U/Cal Santa Cruz, and author of *Agroecology; Researching the Ecological Basis for Sustainability*, presented the ecological perspective to all phases of the planting/harvesting/husbanding cycle. In the process he managed to make fresh sense out of things that shrewd farmers have known for centuries. Among his slides was one of the city of Shanghai, within the boundaries of which 12 million people are totally self-sufficient for fruits and vegetables, employing the city's human excrement in production of the food from which it sprang (and will continue to spring).

Robert Colwell, professor emeritus in the school of forestry and resource management at U/Cal Berkeley, and author of *A Manual of Remote Sensing*, described the evolution of remote sensing (of which he was a pioneer) in the inventorying of natural resources.

"Mozart time" - the grand blending of all the themes - was provided by Timothy F.H. Allen as he wound up the conference with his systems view, linking much that had been presented. Professor of botany at U/WI Madison, Allen was led by his work on algae communities into systems analyses of disturbed ecosystems. He is writing a book, *Toward a Unified Theory of Ecology*, that will be ready in mid-1990.

Allen admonished the conferees to "define the system you are attempting to work with, and then take responsibility for your definition."

"I'm going to present the hierarchical theory," he said, "and remind you that if you look at the world in different scales, it will look different." Deep structure he defined as the larger scale, surface structure as the finer scale. "If you don't have a handle on the scale at which you're looking and working, you can get lost," he said. He took exception to the talk about "levels of organization," and preferred the idea of "scale of the system." In scaling, he said, you determine your limits (the biggest scale you will consider and beyond which all else is excluded) and your resolution (the smallest scale with which you will concern yourself).

"You simply cannot cram everything into a data compressor and come out with an integrated ecosystem - not one you can poke and push and upgrade every five minutes or so." The trouble, he said, is that some very small things turn out to be terribly important, and they often don't show up for years. "What our early efforts at total ecosystem modeling told us," he said, "was that if you don't scale your system properly, when you run your data you could die in the 'rounding out'."

Ecology, Allen concluded, is a "soft science" that demands we look at it in the right way - which includes a way that is politically workable.

Abell, who designed and coordinated the conference, noted that a good beginning in that direction had been made. The conference was planned as an in-depth introduction to larger-scale conferences being planned on all the subject areas for later dates and aimed at the widest possible mix of those involved with landscape planning and development. See the *Park Science* calendar page for information.

Joint Soviet-American Research In the Oka Biosphere Reserve

By David M. Graber and Raymond Herrmann

There are many tales of glasnost. This is one: The short, hopeful story of how the opening of Soviet society and the intensifying concern of ecologists in the United States, in the U.S.S.R., and just about everywhere else led four American and seventeen Soviet scientists into three weeks of old-fashioned fieldwork in the Russian backwoods. It's a story featuring mud and mosquitoes; the marriage of a Soviet diesel generator and a Japanese laptop computer; the clash of American versus European ecological thinking; and the gratifying discovery that the joy of working with nature and a passion for saving it from humankind's toxic foolhardiness are a cultural common ground perhaps more potent than nationality.

This was "U.S./U.S.S.R. Bilateral Exchange, 14 August - 9 September 1989, Project 02.05-41: Biosphere Reserves." For fifteen years, the governments of the two countries have been signatories to an agreement promoting the mutual development of environmental monitoring and protection schemes in their respective nature preserves. Like many - maybe most - such international agreements, "progress" had been marked by alternate visits of officials highlighted by tours, toasts, and occasionally productive conversation. The fortunes of the working scientists on both sides rose and fell with the international political climate. These days that climate, like the meteorological one, is warming precipitously.

Last May, meeting first in Idaho Falls and continuing in the Wind River mountains of Wyoming and in the middle of the River of No Return Wilderness, we finally achieved the political and scientific common ground to work together. There would be joint work on environmental monitoring - specifically to track and measure pollutants in air and water. That is a relatively straightforward business where Americans have held the high ground for years through our global superiority in science and technology. And we would seek to find standards for describing and monitoring "biological diversity." This 1980s talisman for slowing the extinction of species and the loss of whole ecosystems goes to the heart of the science of ecology. It is an arena in which European - and Russian - ecologists have marched to a different drummer than the Americans . . . and one in which the Russians are far better apprised of our work than we of theirs.

But before we embark on our scientific expedition to the Oka Biosphere Reserve, a digression: For two decades, UNESCO's Man and the Biosphere (MAB) program has attempted to foster more harmonious relations between people and the natural world. Its International Biosphere Reserve designation seeks to link fully protected "core" areas with adjacent lands where agriculture, forestry, or other human endeavors may be taking place. The selection of biosphere reserves was intended to cover the spectrum of ecosystems planetwide, from tundra to tropical rainforest - although politics has had a certain moderating effect on the character of the network. The ecological lessons learned in the core areas are to be applied to improve management in the occupied lands, as well as to provide a protective buffer for the natural areas. Typically, some of the finest natural preserves the world has to offer have been designated Biosphere Reserves. Understandably, a great deal of global effort

toward nature conservation has taken place in and on behalf of this network of biosphere reserves.

In America, many of the dedicated biosphere reserves have been national parks. But for a few notable exceptions - southern Appalachia is one - little effort has been made thus far to reach beyond the core parks to surrounding buffer areas. And only quite recently has the biosphere designation produced much more in the national parks than a brass plaque. The national parks have become increasingly critical as fully-protected nature reserves, yet the agency that manages them must devote much of its energy to satisfying the recreational needs of park visitors.

The Soviet Union has largely avoided this problem. "Parks" in the Soviet Union are designed principally for recreation, although this typically is accomplished in rustic surroundings. A special nature reserve designation, "zapovednik," was established more than 50 years ago; these are entirely closed and protected except for non-manipulative scientific investigation. Most Biosphere Reserves in the U.S.S.R. are zapovedniks. In America the reserve designation has most often been bestowed upon the relatively unmodified wilderness parks that form the "crown jewels" of our system, where we have been able to imagine that "wild nature" still functions. In the Soviet Union, as in Eurasia in general, nearly all landscapes have been occupied, modified, and re-modified by human beings for centuries - "wilderness" is a peculiarly American abstraction. And occupation patterns in Europe are such that establishing an inclusive reserve of 50-100 square miles is a substantial challenge.

For the August joint scientific expedition our Russian hosts selected the Oka Biosphere Reserve, just a few hundred kilometers south of Moscow. The Oka Reserve consists of 22,846 ha of floodplain, bogs, and alternating sand ridges between the Oka and Pra rivers. This complex landscape has resulted from the reworking of fine sand-sized glacial outwash deposits by eolian and hydrologic processes. Once farmed, once logged, it is now densely forested with birch, pine, and oak. Every spring, the rivers Pra and Oka swell and - blocked by ice downstream - flood the reserve. By late summer, only the boggy ground betrays the Oka's seasonally underwater existence. Although a biological island surrounded by farms, the Oka supports moose, wolves, beaver, and a rare giant aquatic insectivore, the desman, *Desmana moschata*. This zapovednik, closed to tourism, is linked to a surrounding agricultural buffer zone used for forestry, farming, cattle grazing, and some hunting; much of its dedi-

cated research and monitoring is intended to improve stewardship of the entire region.

The 4 American scientists participating in the joint field program were Robert Pierce of the Forest Service (Hubbard Brook), Lindsay Boring of the University of Georgia, and David Graber and Ray Herrmann of NPS. The sociology of our Russian colleagues bore some curious parallels to our own experiences as park versus university or institute scientist. The lead Soviet scientists work for the Institute of Evolutionary Morphology and Animal Ecology, a division of the Soviet Academy of Science in Moscow - city folks. Joining us at Oka were some of the Reserve's biologists - country folks. One group had the connections, the other the study site. They worked well together, but I was reminded of similar competition at home. After introductions to the little village, Brikin Bor, that serves as reserve headquarters, a lovely place delightfully named in honor of an ancient highwayman who robbed travellers from Moscow, we set up camp in the interior of the reserve.

Participants agreed to use an established ecological transect of 116 25 m segments as the basis for their investigations. This transect extends from the Pra River to Svjatoe Lake. It crosses high and low floodplain of the Pra, a sand ridge, the edge of a large swamp, two more ridges, and a moist birch forest near the lake. The transect intersects oak, birch, pine, aspen, and alder forests, both old growth and stands of moderate age. The range of elevation is 6.9 m, and within short distances (e.g. 25 m), microtopographical differences of 0.5 to 2 m are correlated with radical changes in vegetation.

We soon settled into a pattern of work. During the day we collected field data on the species present in different plant communities, on forest structure, on soil and moisture characteristics. In the evening we confronted our profound differences in scientific education and perspective. Just what are the important ecological parameters that can be measured and compared in Oka, in the Smoky Mountains, the rainforest, the taiga? Just what is "biological diversity," anyhow? The Russians - senior scientists and graduate students alike - read and understand some English. We Americans were hopeless in Russian. Translating abstruse points of ecological theory back and forth is time consuming and wearying, particularly after a full day. Sometimes we all got frustrated and testy. American scientists are accustomed to spirited questioning. Russians are not. We occasionally detected a look somewhere between shock and illicit glee in the eyes of the young Russian biologists when we scrimmaged with their elders. But an overriding concern that we must succeed, that our two nations cannot afford to remain isolated in their pressing environmental problems, drove us to learn from one another and to adopt the best points of both perspectives. And we did.

The Soviets had energetically mined information theory and biogeographical theory of the 1960s and 1970s to develop indices of biological diversity based on the relative number of individuals of each species present within and between sites (alpha and beta diversity). They were particularly interested in using these measures to distinguish "equilibrium" from "dis-

Glen Mittelhauser, co-author of the article "Monitoring Harlequin Ducks at Acadia" (*Park Science*, 10:1, p. 18), writes that "since the article was submitted, hunting regulations were changed for the 1989-90 hunting season. The current regulations completely protect the Harlequin in Maine."

Pat Corr of the Maine Department of Inland Fisheries and Wildlife also wrote *Park Science* calling attention to the change in regulations.

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Joint Soviet-American Research of Oka BR (Continued from page 22)

equilibrium" systems. The Americans were anxious to include biotic structural and temporal diversity dimensions. Where the Soviets saw distinct communities composed of species with a common ecological history, we saw environmental gradients producing a continually changing array of species over space and time. We were particularly impressed by one site along the transect where a tornado had ripped out the old stand of oaks, providing an important gap for the invasion of other species; and another site where beaver cutting and flooding had converted an aspen forest to birch and pine. All along the transect, minor differences in relief and underlying near-surface groundwater produced dramatic and sudden transitions in vegetation. We gradually concluded that both approaches are complementary, and together yield important parameters of biological diversity.

Of course, although we were truly in the boondocks, the sensation of a Soviet society in abrupt transition, a revolution, was pervasive. Our hosts were candid in their discussions of Soviet politics and social problems. No one cared what we looked at or photographed, or said. Our conversations took on an added significance since we all knew a social revolution was occurring all around us. One memorable evening an intense argument occurred among the Russians over whether the awful condition of Russian highways was a consequence of the Communist government or intrinsic to the Russian character. The terrible bind of a highly sophisticated culture with a non-functioning economy – where there simply is no money for scientific tools or for social amenities – is intensely frustrating.

It is most important that those managing and conserving nature reserves around the world find common currencies for comparison. "Biological diversity," although an abstraction, can be defined quantitatively within a watershed context and along a variety of axes. The work at Oka, and future such joint ventures, will help us select which parameters are most useful for conservation.

Graber is a Research Scientist at Sequoia-Kings Canyon NP; Herrmann is a Research Scientist with the NPS Water Resources Division in Denver, CO.

The Bergen Conference

In April 1988, the member governments of the Economic Community for Europe (ECE) welcomed the initiative of the government of Norway to organize a Regional Conference for Europe and North America in cooperation with ECE and in consultation with the United Nations Environmental Programme (UNEP), involving labor, industry, youth, the scientific community, and other nongovernmental and intergovernmental organizations.

The result was "The Bergen Conference: Action for a Common Future," to be held in Bergen, Norway, May 8-16, 1990.

Associated with this conference will be an international meeting of scientists, an international youth conference, and a trade and technology fair featuring environmentally sound technology, concerts, exhibitions, and other events that together will form "a free-ranging environmental festival."

See Calendar for contact.

Visitor Perceptions of Yellowstone National Park After the '88 Fires

By David J. Snepenger

During the summer of 1988 Yellowstone National Park (YNP) and surrounding areas experienced fires at a level that normally occurs every 200 to 300 years. The research reported here examines perceptions of recent visitors and nonvisitors to YNP and their future visitation plans.

The data for the study were acquired using on-site and telephone surveys. The surveys elicited information on past and future visitation, media habits concerning the fires, perceptions of the park after the fires, and visitor group information. The on-site surveys commenced shortly after the fires. The first sampling occurred in the fall of 1988, followed by samplings during winter, spring and summer of 1989. Each on-site data collection effort gathered information from more than 200 visitor groups at Old Faithful Geyser. To garner information from people who had not been to the park since the fires, a telephone survey contacted 100 households in Boise, Denver, Lincoln, and Salt Lake. In total 1,315 surveys were collected.

Findings

One of the major issues addressed by the study was who would be likely to visit YNP after the fires. Towards this end, the survey compiled considerable information from those groups visiting the park in the year after the fires. Listed below is the visitor profile:

1. Most visitors stay one (48%), two (24%) or three (15%) days in the park.
2. About 55 percent of all visitors traveled less than 500 miles to get to the park.
3. Most people came to the park in groups ranging from 2 to 5 and with about equal numbers of males and females in the groups.
4. Most of the groups (78%) consisted of family members, family and friends, or couples. The other groups (22%) were made up of tour groups, school classes, or single individuals.
5. Almost 80 percent of all visitor groups had one or more persons with at least some college education.
6. Fifty-four percent of all visitor parties had incomes in excess of \$40,000.
7. The most popular leisure activities in the park were geyser viewing, viewing wildlife, sightseeing, photography, and viewing the fire burn.

The second major issue addressed in the study was future visitation levels to the park. The majority of respondents thought that visitation to YNP would increase in 1989. The actual 1989 visitor data revealed an increase in visitation due to curiosity about the fires. With respect to projecting long-run future visitation, the data showed that visitation over the next 10 years is likely to increase.

In an effort to gain additional insights into future visitation, survey participants were asked to identify their motives for visiting the park. The primary motive was vacationing, followed by viewing nature, and then curiosity about the fires. The most frequent visitors were the most likely to mention curiosity about the fires.

The third topic addressed the issue of what perceptions people hold of Yellowstone due to 1) their own visit to the park and 2) the media coverage of the forest fires. Perception information was collected in two ways. One set of questions asked respondents whether Yellowstone was burned severely, moderately, or lightly. The other set asked respondents to provide three adjectives to describe the park.

The majority of respondents thought that the park was severely or moderately burnt. However, those that have been to YNP since the fires thought that it was not as burnt as those who have not been to the park.

The most mentioned descriptors of the park by visitors and nonvisitors dealt with topics other than the fires. The park's image is dominated by its beauty, nature, and size. These images persist even though most of the survey respondents watched television, listened to radio, or read articles about the fires.

Conclusions

The 1988 fires in YNP have not and will not greatly affect short and long-run visitation. Even though the media coverage was extensive it did not appear to adversely impact the perceptions people hold of the park. Visitors and nonvisitors to YNP appear to be interested in viewing and understanding the consequences of the fires in natural ecosystems.

Snepenger is Assoc. Prof., Coll. of Business, U/MT, Bozeman, MT 59717-0007.

Ridenour Orders Review of NPS Science & Research

NPS Director James Ridenour has ordered a sweeping review of NPS science and research programs to ensure that they are responsive to natural resource management needs now and in the future. He identified scientific research as a major NPS initiative in the 1990s and announced that the review would be carried out by the National Research Council, the principal operating agency of the National Academy of Sciences.

The study, which will take approximately 18 months to complete, will examine the current programs and make recommendations in four areas:

(1) A strategy for identifying and verifying suspected dangers to park natural resources;

(2) A balance in the types of research programs needed across disciplines and between those directed at immediate vs. long-range goals;

(3) An administrative framework that would effectively implement the research programs at national, regional, and park levels, and

(4) A mechanism for implementing results through an effective relationship between NPS science programs and resource management planning and decision-making.

In the Next Issue:

"What is Science," by Stephen D. Veirs, Jr.; "Purple Loostrife Control in Voyageurs National Park," by Jim Benedict; "Microphytic Soil Crusts Link Ancient Past to Present," by Jane Belnap; "Vegetation Restoration at Lincoln Boyhood Home," by Noel B. Pavlovic; and Western Regional Highlights from Dennis Fenn (which got lost in the typesetting shuffle but resurfaced before press time).

A Plea from the Editor

Park Science is valiantly striving to include all the items it receives for dissemination to the field. Recently, the information load is becoming both a news junkie's delight and a conscientious editor's nightmare. Please, **please**, when you prepare your input to these pages, do your BEST to pare it to the bone. The editor, constrained to 24 pages per quarter, dies (with you) each time a piece has to be cut or dropped. We want to serve all sections and all areas of interest, so try to remember that brevity is the soul not just of wit, but of your chances to appear herein.

Excellence Recognized



NPS Director James Ridenour presented the 1989 Director's Award for excellence in Science to Dr. Charles Stone, research scientist at Hawaii Volcanoes NP at the January 1990 Regional Directors' meeting in San Antonio, TX. The same award, but for excellence in Natural Resource Management, went to Jeri Hall of George Washington Memorial Parkway. Stone was nominated by the Western Region for his work in alien and endangered species research and his application of science in becoming a significant figure in Hawaiian natural resource conservation and education. Hall, the National Capital Region's nominee, was recognized for her establishment of a GIS capability at the Parkway.

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