

PARK SCIENCE

A RESOURCE MANAGEMENT BULLETIN

NATIONAL PARK SERVICE
U.S. DEPARTMENT OF THE INTERIOR



VOLUME 7 - NUMBER 4

SUMMER 1987



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Cover: Author Ken King, foreground, checks machine that registers ground transmission and attenuation of energy inputs typifying conditions at Chaco Culture National Historical Park. Story begins on page 3.

Editorial

The extremely untimely death of Thomas Lucke on February 28th of this year left the *Park Science* editorial board with a gaping hole. Tom had been a volunteer – offering to share the fruits of his careful reading of law journals as they apply to park matters. He read these journals voraciously; he extracted their Parks-related meat; he translated it into words we all could understand.

Your editor chose not to rush out and attempt to fill the board's vacancy. She has always found that volunteers tend to work harder and to add a personal cachet that gives a little different spin to the whole operation.

Sure enough. The lilies-of-the-field syndrome proved itself again. Within two weeks the phone rang and it was Harvey Fleet, Chief, Digital Cartography Branch, GIS Division at the NPS Denver Service Center, asking if he might have a little corner of *Park Science* with its own standing head for dealing with Geographic Information Systems (GIS) matters. (The response to his article in the Spring 1987 issue had encouraged him to make his bid.)

Not wishing to offend the gods by looking a gift lily in the mouth, we accepted forthwith. So Harvey Fleet is our new board member, and he welcomes both questions and information in his area of expertise.

WILLIAM PENN MOTT, JR., Director
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ISSN-0735-9462

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Seismic Research Protects Significant Ruins At Chaco Culture National Historical Park

By Ken King and Keith A. Yarborough

Boom! Crunch! Rumble! Thump!

These comic strip expletives are also apt expressions of energy inputs that can shake your house down – whether produced by real earthquakes or by human activities. Whatever the source, such perturbations are of great concern to cultural and natural resource managers throughout the National Park System. In the Southwest Region these energy inputs pose a major threat to the ruined remains of the magnificent Anazazi constructions which are preserved at Chaco Culture National Historical Park in northwestern New Mexico. These delicate treasures are the cultural remnants of the "City of Towns," which flourished in this arid area from the 10th through the 13th centuries, C.E.

This unique and significant part of the nation's cultural heritage is threatened by a number of activities in and around the park. Externally, coal strip mining is imminent to the north and northeast of the park, entailing extensive, continual blasting with large quantities of high explosives. Add to this a coal-hauling railroad, to be constructed only two miles north of the park, and then throw in oil and natural gas development, which surrounds the park. Internally, the park's road system loop, which carries visitors among the ruins, has been "upgraded" and paved. All of these activities go "boom," "crunch," "rumble," and "thump."

To protect the ruins from further damage, the Division of Natural Resources Management in the Southwest Region initiated an investigation by the USGS Seismic Risk Assessment Branch located at the Colorado School of Mines. This research quantified the two main factors of seismic damage to structures, in general: (1) energy input(s) causing vibrations and (2) responses of the receivers, the ruins at Chaco.

The objective of this work was to develop risk zone maps showing the zones around the ruins within which certain activities involving seismic perturbations and structural responses could be permitted and outside of which they must be precluded. The importance of the Chacoan ruin demands the safest, most conservative protection from **any** damage.

Energy inputs can be expressed in terms of ground shaking motions – as accelerations or as velocities. The safe upper limit of particle velocity in the ground

for industrial blasting, which will protect structures, is 50.8 mm/sec (2 in./sec.). This standard is used by many states and results in only minor cosmetic damage. A more conservative, safe level for dwellings is 2.0 to 3.8 mm/sec. European maximum allowable induced ground motion levels for residential sites are equally conservative:

- 1) 10 mm/sec. from commercial explosives in Czechoslovakia.
- 2) 10 mm/sec. at frequencies greater than 12 Hz and 12 mm/sec. at frequencies less than 12 Hz in Great Britain.
- 3) 4 mm/sec. or greater not permitted at German building sites.
- 4) 12 mm/sec. at 10 Hz and 6 mm/sec. at 5 Hz in Australia.
- 5) For historic buildings and sites in Germany, Great Britain, and Sweden: 2 mm/sec., 2.5 mm/sec., 2 mm/sec., respectively.

Note that **both** ground motions, representing energy inputs **and** frequencies of the ground motion, to which the fundamental or higher harmonic response frequencies of the structures may be "tuned," are important.

In considering energy inputs, one must ask: (1) What is the energy input of the source type, as to both frequencies of vibration and magnitude and (2) How does it attenuate (dissipate) while being transmitted through the ground (surface/sub-surface media) to the structure (receiver)?

This requires direct measurement of real ground motions and energy attenuations at the site(s) to determine if a damage problem will result. An attenuation equation was developed for each individual ruin. The fundamental frequency and higher harmonics must be determined, as well. The three energy source types which most threaten the Chacoan ruins were evaluated:

1. The Railroad and strip mining activity, exclusive of explosives;
2. The high explosives used in the strip mining; and
3. The energy inputs from traffic and road construction equipment (eg., motorized BOMAG compaction rollers, compaction "wackers," heavy trucks).

Surprisingly, the railroad and strip mining activity attenuates quickly, and is **not** a concern for ruins damage. However, the high explosives and road construction equipment are "heavy hitters." Figure 2 shows that the traffic and some of the construction equipment lie within and above the safe limits for historic structures and ruins.

Three points about energy inputs are important:

1. Energy does **not** attenuate the same for the various frequencies of transmission through the ground. Each attenuates differently.
2. Both the response frequency periods **and** the magnitude of energy inputs as expressed by ground motions must be measured empirically, especially to obtain the higher harmonics.
3. The response frequencies of vibration in the structures will tell whether damage will occur.

Therefore, the different modes of wall vibrations, as well as the fundamental period and higher harmonics and wall damping were measured by placing a seismometer at the top and bottom of selected test walls



Seismometer mounted on a typical Chaco wall is employed to determine the wall's vibrational response to energy inputs.



Propping and bracing of a wall at Casa Chiquita alter the wall's response to energy inputs. Ken King checks the new readings.

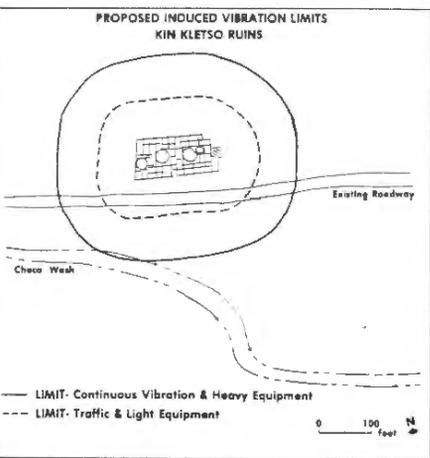


Figure 1 – Recommended minimum distances for road building equipment and traffic.

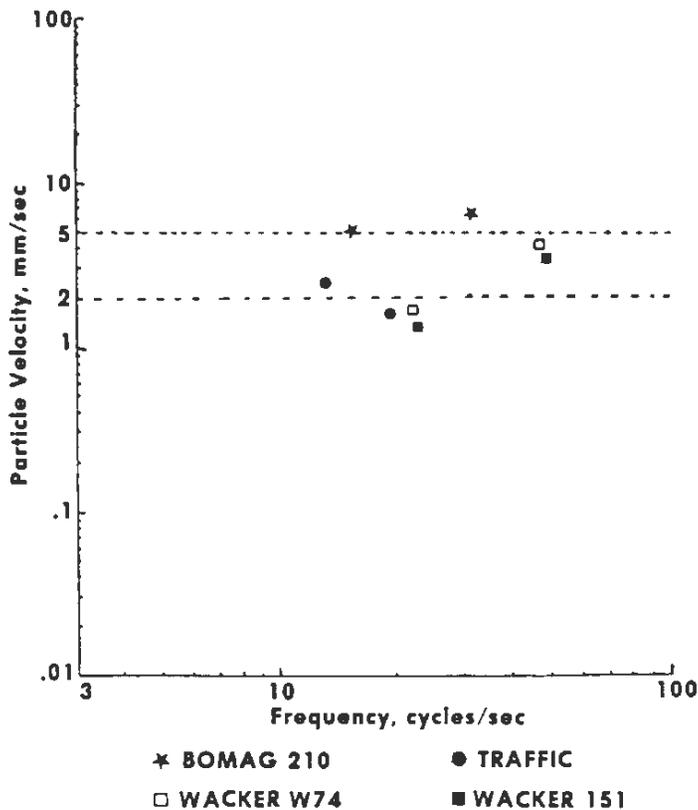


Figure 2 - Peak horizontal ground velocities at a distance of 10 m from four different types of road building equipment.

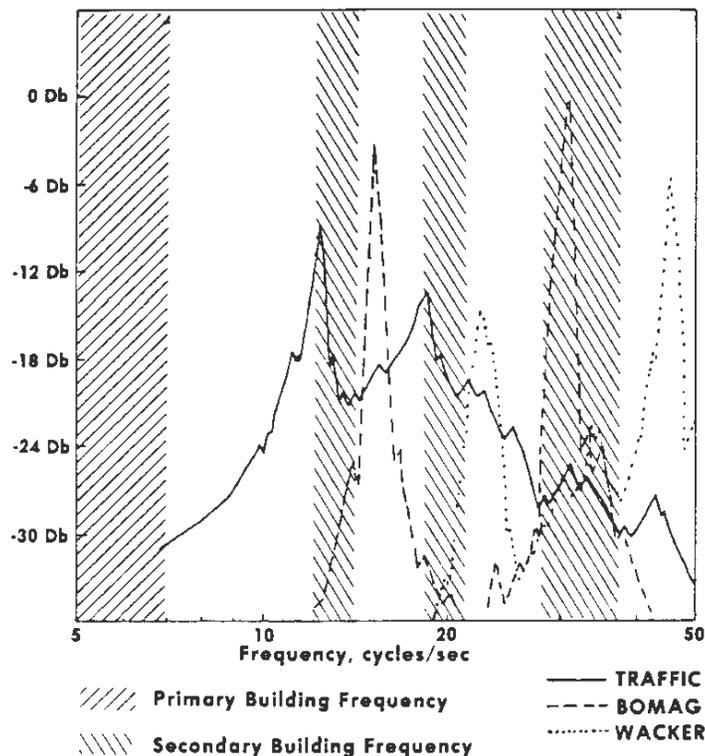


Figure 3 - Spectra of average induced horizontal ground motion from traffic and road building equipment at 10 m and the primary and secondary natural frequencies of the walls.

at Chaco to observe how they shake, as a function of wall height, for a standard energy input. The three modes of wall vibration observed were:

1. longitudinal: a side-to-side motion;
2. torsional: a rippling down the wall's height and length;
3. diaphragming: a successively reversing bulging.

The results showed that the **stable** ancient ruin walls behave just as any structure, in general. Unexpectedly, they respond very much like contemporary steel framework buildings. However, a few walls were found which did not respond in this predictable fashion. These were deemed to be unstable, due to crumbling doorways, lack of inerties with cross-walls, poor rubble fill inside the dressed wall surfaces, etc. Short walls can be just as vulnerable to damage from energy inputs as tall walls, depending on their frequencies and modes of vibration.

The predictability which was found permits measurements of a few representative walls to provide height vs. fundamental frequency of vibration determinations. Also determined were the important engineering parameters of natural frequencies and rates of damping or amplification at certain "tuning" frequencies, due to internal wall stiffness. Both the frequencies and the damping analysis involve transforming an energy vs. time plot by Fourier spectral and transfer function techniques. It was noted that excessive or insufficient damping can produce damage, depending on the wall's height, modes of vibration, and frequencies of vibration in "tune" with the frequencies of ground motion induced by energy inputs.

When the frequencies of the energy input vibrations resulting from various sources such as traffic, road construction equipment, high explosive blasting, etc., are superimposed upon the fundamental and higher frequencies of wall response vibrations, as shown in Figure 3, it was possible to predict which walls would

be damaged by some of these various activities. The fundamental frequencies of the walls are not "tuned" to the frequencies of the ground motions; i.e., they do not have the same natural frequencies as the vibrations produced by traffic or road building equipment. However, many of the other higher harmonics of vi-

bration in the walls are in "tune" with the frequencies of the induced ground motions. Figure 4 shows the situation for Kin Kletso ruin. The transfer function analysis showed that the walls at Kin Kletso can magnify the induced ground motion at their base to their top by three to eight times. Furthermore, it was possi-

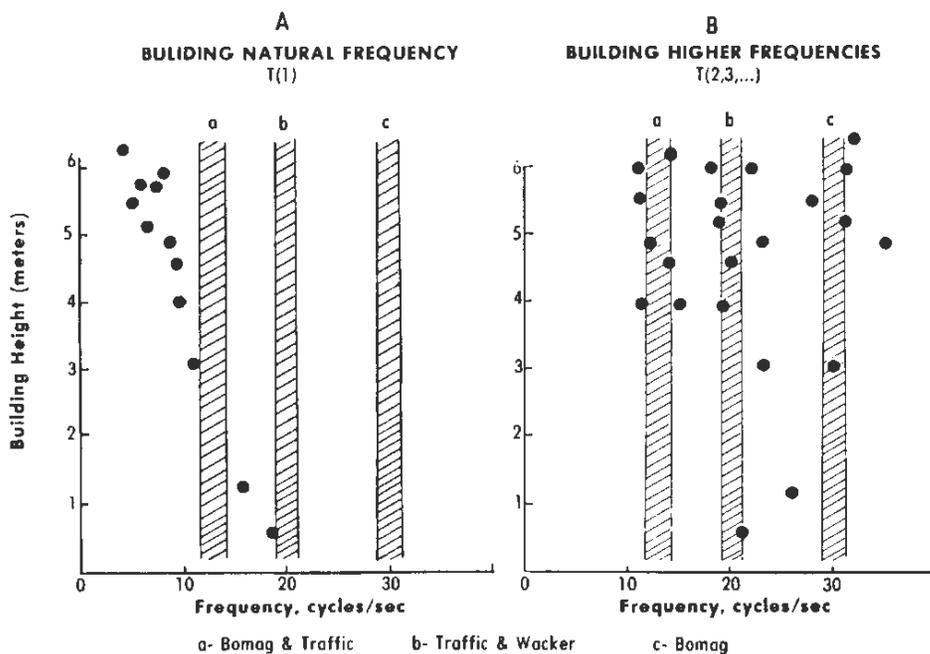


Figure 4 - (A) Comparison of frequency of induced ground motion with fundamental (first) frequency of vibration of the buildings (solid circles). (B) Comparison of frequency of induced ground motion with higher frequencies of vibration of the buildings (solid circles).

Isle Royale Moose Thrive As Wolf Population Declines

ble to predict the respective distances from the source of energy inputs of various magnitudes to the receiver walls to provide adequate protection. For certain traffic types, and wall response characteristics, some distances as small as 10 meters put some of the ruins' walls in jeopardy from the road construction. Figures 2-4 show the data.

A synthesis of all of these findings produced the risk zone maps for the canyon's most imperilled major ruins. Figure 1 shows proposed vibration limits for the protection of Kin Kletso from traffic, and light and heavy construction equipment. Similar maps drawn to expanded scales, delineate the risk zones for the ruins from the high explosive blasting by the coal strip mining operations. These zones differentiated among three magnitudes of explosives used: 1000 lbs., 5000 lbs., and 10,000 lbs., and show the respective distances that such blasts must be kept away from the ruins to prevent any damage.

Mitigation procedures to protect the ruins are of two main means:

1. Reduce the magnitude of energy input(s) at the source, and/or

2. Change the vibrational characteristics of the receiver (fundamental period and higher harmonics).

Accordingly, certain of the ruins' walls were braced and supported during the road construction. This was done to alter their frequencies of response vibration – i.e., to “detune” them with respect to the ground motion vibrational frequencies – and **not** to support them. However, this has to be done carefully so that the **altered** response frequencies of the bracing and of the wall are not “tuned” to some other input source. This would be an “out of the frying pan, into the fire” change. For example, the back wall of Pueblo Bonito has been braced for many years. The large main brace has a natural frequency of 13.8 Hz, and a damping value of 6.8 percent. The wall itself has a natural frequency of 2.8 Hz, so the two are decoupled as well as being detuned with respect to the various energy source inputs.

Kin Kletso was built partly on a large rock which conducts more energy. Therefore, because heavily loaded trucks carrying fill material passed very close to this ruin, the roadway was built up with cushioning sand, smoothed, and paved. Furthermore, the drivers were admonished **not** to accelerate or to decelerate in the vicinity of this ruin.

This type of research can produce findings that managers of all historic and prehistoric structures will find valuable in protecting these cultural resources from a wide variety of energy sources. Had this research not been ongoing at Chaco fortuitously at the same time as the road construction, Kin Kletso and Casa Chiquita, along with portions of Pueblo Bonito and Pueblo del Arroyo, would have been reduced to heaps of building stones.

The bottom line for “Boom! Crunch! Rumble! Thump!” is Beware!

King is with the USGS Seismic Risk Assessment Branch in Golden, CO; Yarborough is a Physical Scientist with the NPS Southwest Region.

Reference:

Seismic and Vibration Hazard Investigations of Chaco Culture National Historical Park,” King, K.W., St. Algermissen and P.J. McDermott, USGS/Denver, Colorado, Open-File Report 85-529, 58 pages.

Moose are thriving on Lake Superior's Isle Royale NP, but the island's wolf population continues to decline and a park researcher says food supplies may be the key factor in both cases.

“A combination of adequate food supply and low wolf numbers has allowed a maximum rate of increase for Isle Royale's moose,” says Rolf Peterson, wildlife biologist at Michigan Technological University and director of the NPS-sponsored wolf-moose research project.

“There is enough balsam fir on the island to support the park's moose herd during the crucial winter months, and most of the animals are young, healthy, and in prime breeding condition,” says Peterson. “We expect these conditions to continue until the early 1990s, when overbrowsing by the growing moose herd should begin to limit food supplies and result in lower moose survival rates, especially for calves.”

Peterson says he and fellow researchers counted 1,380 moose on the island this year, 355 more than a year ago. “That's about seven per square mile, a phenomenal density compared to mainland moose populations,” he says. “This is three times higher than the average density of other moose populations in North America.” Peterson expects the Isle Royale moose to reach a peak of about 2,000 animals sometime during the next decade.

But while moose enjoyed another successful year, the island's wolf population suffered a setback.

“Wolf numbers are down to 15 from 20 last year,” Peterson reported. “We saw one wolf being attacked and killed by other wolves while we were on the island this winter, but we don't know for sure what caused the other deaths. Food stress may have played a role, since healthy moose are hard for wolves to kill.”

Peterson says three wolf packs inhabited the island at the start of this year's winter survey: the West Pack and East Pack, whose territories included the west and east ends of the island respectively, and the Harvey Lake Pack, which occupied the territory between the other two. This year's study showed the West Pack was down from 11 to 8 members, the East Pack had declined from 5 to 4, the Harvey Lake Pack started out at 3 members, and one wolf roamed the island alone.

“Then one day while we were conducting our aerial survey, we witnessed a territorial confrontation between the Harvey Lake and East packs that changed the situation,” says Peterson. “We saw the Harvey Lake Pack bedded down around a moose they had killed in the East Pack's territory. A few miles away we saw the East Pack coming through the forest. They had picked up the trail of the Harvey Lake group and were headed toward the kill site.

“The East Pack came over a ridge, saw the Harvey Lake wolves, and made straight for the dominant (alpha) male of the Harvey Lake group. Unfortunately, the Harvey Lake male had just eaten and couldn't move quickly enough to get away with the other members of his pack. He put up a furious fight against the three wolves of the East Pack (the fourth East Pack wolf was not present), but after 25 minutes the attackers succeeded in killing him. When we recovered the carcass two days later, the dead wolf weighed 94 pounds and had 12 pounds of meat in his stomach. He was the biggest wolf I've ever seen on Isle Royale.”

As a result of this battle, the two surviving members of the Harvey Lake Pack have dispersed and no longer function as a pack, and the East and West packs have divided the island equally between them, according to Peterson.

The MTU researcher expects the wolves to maintain their numbers at roughly 15-20 through the end of this decade.

“Three breeding females are left on the island, the Alpha female in each pack, but the one from Harvey Lake Pack doesn't have a mate as far as we know,” he says.

Peterson believes conditions will improve for the wolves only when the island's moose have grown older and weaker, and more susceptible to malnutrition because of lack of food due to overbrowsing. When that happens, the wolves will find their larger adversaries easier to catch and kill, and researchers expect the wolf population will gradually grow. The number of wolves on Isle Royale reached a high of 50 in 1980, then crashed to an all-time low of 14 after two consecutive years of severe losses.

During 1987 research on the island's wolves and moose was supported financially by the National Park Service, Charles Ulrick and Josephine Bay Foundation, and Campfire Conservation Fund, plus numerous small donations.

This article was written at the news bureau of Michigan Tech University in Houghton, MI.

Manor To Coordinate Acid Rain Program

From Bill Gregg, Man and the Biosphere Coordinator in the NPS Washington office, comes word of a new staff member – Kathleen Manor – who will act as coordinator for the acid rain program. Manor has an undergraduate degree in biology/environmental sciences from Rollins College and a graduate degree in environmental management from the Department of Environmental Sciences and Engineering at the University of North Carolina, Chapel Hill.

In 1981, Manor joined the National Acid Precipitation Assessment Program as technical assistant to the executive director at EPA, advanced to the deputy position, and wound up as advisor to EPA's acting assistant administrator for air and radiation. Most recently, from 1985 to 1987, Manor managed the air and water programs in the environmental division of the Chemical Manufacturers Assn.

Her major responsibilities in the NPS Washington office will be to coordinate formulation of policy and programs relating to acidic deposition research and the integration of the NPS acidic deposition program with related NPS scientific, educational, and natural resource programs. In addition, she will coordinate NPS participation in NAPAP and in the National Atmospheric Deposition Program.

Abandoned Well Plugging Protects Parks' Resources

By Leslie Vaculik

Natural gas wells blowing out, winter winds whipping rig workers, quick conferences with state oil and gas inspectors – are these scenes from the television show *Dallas*? No, these incidents are taking place in Mammoth Cave National Park and Cuyahoga Valley National Recreation Area. Mammoth Cave and Cuyahoga have established ongoing programs to plug and properly abandon old oil and gas wells that exist within the parks. The procedures being followed are applicable for any park with unplugged wells.

The plugging is done to prevent damage to natural resources and to remove safety hazards. Several of the wells found in Mammoth Cave are close enough to the mapped cave systems that the potential existed for natural gas to escape from the wellbores into the caves. Though no natural gas was detected during testing of some passages, trapped methane is a potential fire, explosion, and asphyxiation hazard. In addition to the potential for gas migration, the wellbores could allow brine and contaminated water from deeper formations to mix with fresh waters of the cave. Pollution of the underground rivers could seriously damage the fragile ecosystems that exist in the darkness of the caves. Cave dwellers, including the endangered cave shrimp, then would be threatened.

At Cuyahoga park visitors have easy access to many wells where deserted pumping units and tanks pose a safety hazard. Other wells, at both Mammoth and Cuyahoga, are in the floodplain of rivers where oil or brine water leaking from the wells could degrade water quality.

The wells exist unplugged in the parks because both parks are in areas of proven petroleum with shallow producing formations, easy drilling and clean gas. Also, when the wells were drilled there were few laws or regulations requiring plugging. Tracts were purchased by the NPS often without the realization that an unplugged well was on the property. One of the first wells plugged in Mammoth Cave supplied gas to a hotel that was demolished when its site was acquired in the 1920s. The well was simply shut off with a surface valve and subsequently forgotten.

Both parks are approaching the unplugged well problem with similar techniques which consist of the following steps:

Identifying the wells – Either the well site and equipment or old records such as deeds, survey plats or state records are found that indicate a well exists. In addition to state records, well information was acquired on visits with the old timers living around the park. Locating some well sites was not always an easy task, especially when 50 years worth of vines and shrubs have covered a 3 foot high gas wellhead.

Planning the Plugging – The collected data are reviewed by the NPS Energy, Mining and Mineral Division and the state's Oil and Gas Divisions to establish the depth of the old wells, the possible equipment downhole, and potential problems that may occur during the plugging work. In Mammoth Cave one problem with cementing that was identified in the early planning stage was the wells' inability to hold cement through the zone of cave development. Any cement pumped into that zone could have leaked into caves. So the interval had to be left void.

The parks are using higher standards for plugging procedures than are required by Ohio or Kentucky state regulations. Both parks planned to plug the wells from bottom to top with cement, except for the cave interval. The continuous cement plug will prevent migration of gas, oil or brine water into fresh water zones or to the surface.

Another aspect of the planning considered the clearing of the old access routes and well pads so that the plugging work could be accomplished. Finally, plans are made to remove any remaining surface equipment and recontour the pad and road to blend with the natural terrain and to reclaim the site. The reclamation standards used by the parks also are higher than is typically required by state regulations.

Contracting – The actual work to plug the wells was contracted out. Cuyahoga Valley let one contract which included the plugging of 12 wells, the grading of an access route, and the follow-up reclamation. Mammoth Cave let separate contracts for the well



Plastic lined pit in foreground catches excess cement or groundwater.

plugging and access and site preparation. In most cases, Mammoth Cave accomplished clearing and reclamation using service personnel and equipment, thereby reducing costs.

Despite the preplanning, actual work to plug the wells rarely went smoothly. One of the wells in Mammoth Cave blew out while the contractor was trying to pull an old packer and string of tubing. The decision was made to allow the well to blow itself down since the gas was methane, which is lighter than air and would disperse. The flow of gas from the well forced the contractor to wait three days while the gas pressure died down enough to continue work on the well. While the well was blowing, a ranger was stationed near the well site 24 hours a day to ensure no park visitors came near the wellhead.

At Cuyahoga the contractor on the first well plugged decided to try to use the old tubing in the well to pump cement to the bottom of the well instead of a newer pressure tested string of work tubing. The old tubing popped a hole and was cemented in place. Fortunately, the tubing was off center in the wellbore, and the contractor was able to subsequently run a 1-inch diameter string of tubing past the blocked area and fill the well and the old tubing string with cement from the bottom up.

Further information on the plugging projects or assistance on similar projects may be had from the author, from Phillip Veluzat at Mammoth Cave, or from Garree Williamson at Cuyahoga Valley.

Vaculik is a Petroleum Engineer with NPS Energy Mining and Minerals Branch, P.O. Box 25287, Denver Colorado 80225, (303) 236-8784.



Mammoth Cave Ranger Henry Holman pulls sample of cement used to set surface marker.

Visitor Surveys Aid Mount Rainier In Handling Management Problems

By Peter Thompson, Darryll R. Johnson, and Thomas C. Swearingen

A five-part social science research project, two years in the making, is bridging the gap between science and management at Mount Rainier NP. The quality and managerial relevance of the five reports (see box) reflect nearly continuous interaction during that two-year period between the park and the personnel of the University of Washington's NPS Cooperative Park Studies Unit.

A number of persistent resource management problems (which were the genesis of the research project) had troubled park managers for decades. Of particular concern were the proliferation of unmaintained (social) trails in heavily used subalpine meadows and the maintenance of a clean, healthful environment for the large number of climbers on heavily used routes in the park where management of human waste by traditional means is increasingly difficult. Over the years, a number of different management strategies have been attempted to alleviate these problems – but with limited success.

A series of meetings, held in the summer of 1984, examined research possibilities addressing these problems. Attending these meetings were members of the Mount Rainier resources management staff, the Pacific Northwest Regional Chief Scientist, and the Research Sociologist from the University of Washington, CPSU.

Three general research objectives were:

1. Measurement of the attitudes of alpine zone users toward human waste management problems and policies;
2. Assessment of user and potential user acceptance of an experimental minimum impact camping platform at Indian Henry's Meadow (a popular backcountry subalpine meadow used by dayhikers and backpackers);
3. Evaluation of the effectiveness of passive communications to encourage day users to follow minimum impact procedures in the Paradise Meadows.

The delineation of these objectives led to a Cooperative Agreement between NPS and the University of Washington CPSU. Darryll Johnson of the CPSU was Project Leader, and Peter Thompson from Mount Rainier Resource Management staff was the park liaison. Tommy Swearingen and William Salvi, CPSU research associates, were assigned important responsibilities.

During the winter of 1984-85, specific work objectives were developed. The schedule called for completion of the research design by March 30, 1985, data collection during the summer of 1985, coding and data processing in the fall, and final report by April, 1986. The first product of the project was a bibliography released in January, 1985 – *Recreational Impacts on Soils and Vegetation: Park and Alpine Studies* by Tommy Swearingen.

At a meeting in January, 1985, there began a process which became the project's hallmark and set this research apart. It was the considerable amount of interaction between investigators, park management, and operational personnel of the park. Detailed, site specific discussions continued into the spring, with park personnel directly involved in providing feedback on all questionnaire items and sign texts for the

Paradise trailside sign text quasi-experiment. Field personnel provided the researchers with valuable insight into the management problems.

Simultaneously, a general visitor survey was added to the project to update park demographic and economic data on the park visitors. The survey consisted of three questionnaires gathering information on a wide variety of topics including visitor characteristics, recreation activities, use of facilities and services, use of park information sources, organized group membership, psychological motivation for park visitation, and travel cost data.

The visitor contact procedures were designed to have minimal intrusion upon visitors' experiences. Refusals to participate were almost nonexistent. Response rates to the mailed questionnaires associated with all project components were high (73 to 84 percent). The data bases represent a valuable information tool that can be used to provide insight into a number of areas of managerial relevance now and in the future.

Because of the amount of interaction between the scientists and the park staff during project planning and applicable findings, park staff showed considerable interest in the final reports. The information is relevant to the development of strategies for continuing education of backcountry users, for formulation of policy considerations related to waste management in the alpine zone, and for facility planning and other managerial strategies connected with the general visitor population. Selected statistical highlights from these projects are listed below.

General Visitor Survey. These data provided a descriptive profile of the visitor and the typical park visit. For example, it was found that of those over the age of 18, one-half had completed college degrees and 20 percent were 60 years of age and older. Twenty-three percent of the surveyed visitors stayed overnight in the park. The general visitor survey also contained a travel cost survey providing estimates of the economic impact of park visitation in the state of Washington. In the course of traveling to and from Mount Rainier, it was estimated that visitors spent approximately 38 million dollars in the state of Washington and 13 million in a four county area around the park.

Paradise Meadow Visitor Survey. Twelve percent of all Paradise Meadows visitors felt that human impact was not a problem in the area; 25 percent did not know if there was human impact or had no opinion about it. Twenty-eight percent of the surveyed Paradise Meadows visitors said they had not been exposed to information relating to human impact in the park. There was a strong relationship between exposure to low impact information and the perception that there was a human impact problem in the Paradise Meadow area. Seventy-five percent of the respondents who were exposed to such information perceived some degree of problem compared to 36 percent of the respondents who were not exposed to such information.

Park visitors not exposed to low impact information may be different in other ways that contribute to their perception that impact either is not a problem or does not exist. These data strongly suggest park communi-

cation efforts do have an impact upon the perceptions of park visitors, and that efforts should be expanded to reach those people not being contacted.

Day-Hiker Off-Trail Hiking in Response to Alternate Sign Texts. Although the data are preliminary and additional research is planned during the summer of 1987, some interesting results emerged. The presence of trailside signs generally affected off-trail hiking, and visitor response varied significantly by sign type. At one site, off-trail hiking rates were 15.5 percent when no signs were present compared to 9.6 percent with the standard park sign ("Meadow Repairs, No Hiking"). Interestingly, both of these rates were substantially higher than those resultant from a non-verbal sign depicting a boot sole in a circle with a crosshatch (2.8 percent), and a sign stating a negative sanction (Off-Trail Hikers May be Fined) (1.7 percent).

Camp Muir Climbers' Survey. Nine percent of the surveyed climbers perceived a substantial human waste management problem on the Camp Muir route. Forty-seven percent of the climbers felt there was a slight to moderate human waste problem; 44 percent felt there was no problem or had no opinion. Some degree of a human waste problem was perceived by 66 percent of campers in private parties compared to 40 percent in commercially guided parties.

Seventy-two percent of all climbers felt there was a need for better public waste management information; 74 percent supported requiring all climbers to use the carryout bag waste system. Thirty-five percent of the private climbers who are supposed to receive the waste carryout bags reported they had not received them. Ninety percent of the climbers favored continued use of the Muir solar assisted toilet.

The researchers feel that these findings, and the manner in which they were derived, assure a continuing high level of interest in research in the behavioral sciences at Mount Rainier NP.

Thompson is now Chief Ranger at Crater Lake NP; Johnson is Project Leader for Social Science in the Pacific Northwest Region; Swearingen is a Research Assistant at the U of WA NPS/CPSU.

The Study's Five Reports

Swearingen, Thomas C. and Johnson, Darryll R. *Mount Rainier National Park Paradise Meadow Visitor Survey.*

Johnson, Darryll R. and Swearingen, Thomas C. *A Preliminary Analysis of Day Hiker Off-Trail Hiking in Response to Alternate Sign Texts at Selected Sites in the Paradise Meadows Area, Mount Rainier National Park.*

Swearingen, Thomas C. and Johnson, Darryll R. *Mount Rainier National Park Camp Muir Climber Survey.*

Salvi, William and Johnson, Darryll R. *The Indian Henry's Meadow Visitor Survey.*

Salvi, William and Johnson, Darryll R. *The 1985 Mount Rainier General Visitor Survey: Statistical Abstract.*

All five studies are published by the Cooperative Park Studies Unit, College of Forest Resources, University of Washington, Seattle, Washington, 1986.

Padre Island Kemp's Ridley Sea Turtle Project Update

By Donna Shaver

Park-wide involvement, cooperation and enthusiasm in a single natural resources project is rare – but it happened at Padre Island in 1986. For the ninth year, Padre Island National Seashore (PAIS) participated in the international program to expand the population of the endangered Kemp's ridley sea turtle (*Lepidochelys kempi*). It was a year characterized by project expansion and advancement. As in the past, Kemp's ridley eggs were incubated and imprinted at Padre Island NS. However, this year, park personnel were also heavily involved in efforts to educate the public about the Kemp's ridley project, beach patrols to look for nesting turtles, and biological studies designed to gather further information needed to direct procedures and future actions.

In 1978 the Kemp's Ridley Sea Turtle Restoration and Enhancement Project was undertaken by the Instituto Nacional de Pesca of Mexico, U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), National Park Service (NPS) and Texas Parks and Wildlife Department in accordance with Section II of the Endangered Species Act. One of the goals of the project was to establish a secondary breeding population of this species at Padre Island. Padre Island NS was chosen because the species had been known to nest there historically and because the NPS would be able to provide some protection in the event that a new breeding population became established.

Nesting

The Kemp's ridley is the most endangered and restricted sea turtle species. Virtually the entire population nests on a single 14 mile stretch of beach near the village of Rancho Nuevo, Tamaulipas, Mexico. Only sporadic nesting has been reported in other areas, ranging from Padre Island, Texas in the north to Veracruz, Mexico in the south.

The Kemp's ridley population has undergone one of the most dramatic declines ever experienced by any endangered species. It is estimated that 40,000 females nested in a daytime aggregation (arribada) filmed in 1947. By 1966, when biologists finally learned the location of the nesting beach and began protection, only 3,000 to 5,000 females nested in the largest arribadas. Despite conservation efforts, the adult population now is thought to consist of only 1,000 to 2,000 individuals. Causes for this sharp decline include the harvest of adults for meat and leather and of eggs for use as a supposed aphrodisiac. Incidental capture of these turtles in fishing and shrimping trawls is also thought to have reduced their numbers.

L. kempi is the only sea turtle species in which the adults nest during the day. Females require approximately 45 minutes to complete the terrestrial nesting process. They emerge from the sea, lumber up the beach, excavate a nest cavity about 1.5 feet deep, deposit about 100 eggs (one clutch), cover the nest and return to the sea. Eggs incubating in an undisturbed, natural nest are heated only by the warmth of the surrounding sand and the metabolic heat generated by their own embryonic development.

Hatching and Imprinting

About 20 clutches of Kemp's ridley eggs are collected in Rancho Nuevo and shipped to Padre Island each year. The eggs are caught in plastic bags as the female lays them and hence they never touch Rancho



YCC workers assist with catching the hatchlings released in the surf at Padre Island.



Hatchling Kemp's Ridley turtles are released mid-beach at Padre Island. As sun warms the turtles they become active and rush to the surf.

Nuevo sand. They are then packed into styrofoam boxes containing Padre Island sand and are transported via aircraft to the national seashore. The styrofoam boxes are placed in an outdoor predator-proof, screen enclosed incubation shed. Incubation temperatures of the eggs are recorded hourly with a recording thermograph.

After the eggs hatch the hatchlings are released on a beach area closed to vehicular traffic. They are allowed to enter the water and swim about 10 yards and are then recaptured using aquarium dip nets. It is thought that this exposure of eggs and hatchlings to Padre Island sand and of hatchlings to Padre Island sea water may act to "imprint" them, much the way a salmon is imprinted to its natal stream.

The recaptured hatchlings are transported to the

NMFS laboratory in Galveston, Texas, where they are held in captivity for about one year of "head starting." This allows them to grow to a size large enough to avoid most predators and to be tagged for future recognition. The yearling turtles are released offshore from Padre Island.

Two thousand and eleven Kemp's ridley eggs were transported to PAIS from Rancho Nuevo on June 12, 1986. A total of 1,776 of the eggs hatched. The overall hatching rate of 88.3 percent was the second highest achieved during the nine project years (Table 1). Only one hatchling died in its incubation box prior to beach release and hence the 1986 year-class had the highest survival rate at Padre Island to date. Rough and murky water conditions made hatchling recapture difficult during several morning releases and a total of

16 hatchlings were lost in the surf. The remaining 1,759 hatchlings were recaptured and transported to the NMFS laboratory for head starting.

Sex Determination

The importance of the temperature of sea turtle eggs while they incubate was not known when the Kemp's ridley project began in 1978. It has recently been found that four other species, including the olive ridley (*L. olivacea*), possess temperature dependent sex determination; that is, the temperature at which the eggs incubate determines the sex of the embryos. In these species, lower egg temperatures during the middle third of incubation produce primarily males and higher temperatures produce primarily females. Unfortunately, the extremely low numbers of Kemp's ridleys remaining in the population has prohibited embryo and hatchling sacrificing necessary to systematically study this question in this species. However, it is likely that incubation temperatures do, indeed, influence gender in *L. kempi*.

The implications of such a phenomenon are profound in a project designed to increase the numbers of an endangered species. Although natural sex ratios for this species are unknown, the Kemp's ridley recovery team believes that our conservation efforts for this endangered species should favor a production of a 1:1 sex ratio or slightly more females. Our practice of incubating Kemp's ridley eggs in styrofoam boxes is a technique used in many other sea turtle recovery projects. However, this technique has been found to subject incubating eggs to cooler than normal temperatures and hence results in an over-production of males.

In 1984 a study was undertaken to determine the sex ratio of *L. kempi* transported to, and incubated at Padre Island NS. Gonads were dissected from several year-classes of dead hatchlings and late-staged embryos for histological sex determination by Dr. David Owens (Texas A&M University). Owens found a preponderance of males, indicating that temperatures in the incubation shed were slightly too low. As a result, it was decided to increase 1985 and 1986 incubation temperatures. Gonads were removed from dead 1985 and 1986 year-class embryos and hatchlings. Subsequent histological analysis of the gonads revealed almost equal proportions of males and females in the 1985 year-class and 75 percent females in the 1986 year-class. This indicated that the elevated temperatures were successful in producing more females and provided the first evidence that *L. kempi* possesses temperature dependent sex determination. The matching of clutch incubation temperatures and sex ratios for several year-classes of eggs has allowed us to further define the incubation temperatures at which the eggs should be maintained in order to produce a 1:1 sex ratio or slightly more females.

Adult Sightings

The age at which Kemp's ridleys mature is unknown but estimates range from 8 to 15 years. Since females from the early project years may begin returning to Padre Island to nest, systematic beach patrols for nesting turtles were initiated this year. Many park staff members were issued permits and trained to detect and respond to turtle sightings and all were watchful while on the beach. Various members of the Resource Management, Interpretation, and Maintenance and Ranger Divisions conducted the turtle patrols and thus, the effort was park-wide. Although one adult female and one false crawl (an abandoned nesting attempt) were sighted during the patrols and one nesting adult and one false crawl were reported by visitors,

Table 1. General results of 1978-1986 Kemp's ridley incubation and imprinting at Padre Island National Seashore.

Year	Number eggs from Rancho Nuevo	Number (percent) eggs hatched	Number hatchlings died at Padre Island	Number hatchlings lost during release	Number hatchlings to Galveston
1978	2,191	1,931 (88.1)	64	19	1,848
1979	2,053	1,769 (85.7)	15	93	1,661
1980	2,976	2,502 (84.1)	14	65 ^a	1,611
1981	2,279	1,898 (83.3)	11	19	1,868
1982	2,017	1,563 (77.6)	5	34	1,524
1983	2,006	242 (12.1)	10	2	230
1984	1,976	1,792 (90.7)	239	9	1,544
1985	1,978	1,664 (84.1)	14	25	1,623 ^b
1986	2,011	1,776 (88.3)	1	16	1,759
Total	19,487	15,137 (77.7)	373	282	13,668

^aCalculated excluding 810 hatchlings from 11 clutches intentionally released into the Gulf of Mexico.

^bCalculated excluding 69 hatchlings from a Padre Island natural nest head started at the Galveston NMFS Laboratory.

no Kemp's ridley nests were found.

Since the national seashore is 68 miles long and extensive areas are often devoid of NPS personnel, it is imperative that park visitors assist with turtle detection and reporting. Increased efforts were made to educate the public about the Kemp's ridley project and urge visitors to report turtle sightings immediately. Interpretive programs were given at several hatchling releases and new handouts, posters and displays describing the project were made. Television and newspaper interest and coverage remained high, as in past years.

Beach Temperature Profiles

A beach temperature profile study was undertaken to determine temperatures at which Kemp's ridley eggs would incubate if laid in Padre Island sand. The study was conducted at three sites on Padre Island by contractor Dr. Allan Chaney (Texas A&I University) in conjunction with a simultaneous study at Rancho Nuevo. The results of these two studies were compared. It was found that Rancho Nuevo and Padre Island sand temperatures were comparable during the

summer months of heaviest nesting activity and egg incubation and that Padre Island sand temperatures should be warm enough to produce females.

Future Program Efforts

Padre Island NS has received 19,487 Kemp's ridley eggs and sent 13,668 hatchlings to Galveston for head starting during the nine years of the restoration and enhancement program. The Kemp's ridley recovery group members recently decided to extend the program through the summer of 1992. Important biological information on this poorly known endangered species has been gathered each year. Much of this information will have future implications and applications at Padre Island and Rancho Nuevo. Although no confirmed nestings of our Padre Island imprinted turtles have occurred, national seashore staff members and visitors will continue to look for returning females and be optimistic that such returns will occur and that a secondary breeding population of the Kemp's ridley will become established at PAIS.

Donna Shaver is a Natural Resource Management Trainee at Padre Island National Seashore.

Resource Management History Traced by Ranger's Thesis

From R. Gerald Wright at the NPS/CPSU at University of Idaho, Moscow, comes word of a thesis by Gordon C. Olsen of Slippery Rock University, entitled "A history of natural resources management within the National Park Service." Olsen is a Ranger at Antietam National Battlefield and limited copies of his M.S. thesis are available through Barry MacIntosh, NPS historian in Washington, DC. Wright's review follows:

The thesis is chronologically organized and traces the history of resource management activities, personnel and offices from the start of the NPS to present. It is a lengthy document, well researched in terms of its use of archival records, unpublished NPS memos, and Annual Reports of the Director, Chief Scientist, etc. The thesis is an excellent reference document for those who are interested in knowing more about the roots of the NPS in terms of personalities and offices involved in natural science and resource management. A major part of this discussion deals with the Washington Office. Producing an ordered chronology of the activities of this office is no small task.

The thesis is less strong in its discussion of actual

resource management activities. However, it must be realized that considering the breadth of NPS activities, writing such a history is far from easy. In part, the chronological thread which adds organization to the administrative history, makes the discussion of resource management activities disjointed. Overall some activities are treated better than others. The history of fire management is excellent, discussions of wildlife management had less detail than I would like to have seen.

Somewhat distracting was what I consider excessive use of lengthy direct quotes. I also feel there was a tendency for the author to except some historical accounts at face value. This results in NPS activities being portrayed in a consistently positive light even when this may not be warranted. A greater reliance on the discussion of NPS resource management activities available in refereed publications may have helped correct this situation. It is my perception that these materials often provide a more objective viewpoint.

Fragile Dune Environments: Managing for Human Impacts

By Wendy Z. Hultsman

Human impact on fragile dune environments is a management concern at Indiana Dunes National Lakeshore. As the available space on beaches becomes limited, due to rising water levels on Lake Michigan, visitors to many of the Lakeshore parks are moving into the foredune and backdune areas. After years of such unstructured use, the dunes are showing the effects. Vegetation that once held shifting sand in place has been trampled and replaced by blowouts and barren footpaths.

In 1984 the National Park Service made its first assessment of visitor impact on three dune environments: Indiana Dunes National Lakeshore (IDNL), Pictured Rocks National Lakeshore, and Sleeping Bear Dunes, all along Lake Michigan. A hierarchy of mitigation measures was identified, based on levels of control. They consisted of:

- educational efforts — using interpretive signing to describe the effects of human impact on the environment;
- directional signing — indicating areas along roadways and trails where use of the dunes is permissible;
- improved trails — providing well-defined pathways, including boardwalks;
- exclusion — designating certain areas as “out of bounds” to visitor use through signing and physical barriers;
- prohibition — disallowing trespassing of any kind through designated park areas surrounding sites which can be harmed significantly by human impact; and
- sanction — issuing warnings and fines to those who trespass through prohibited park areas.

The first three measures, (positive, less authoritative techniques), were formulated into strategies to modify visitor behavior. The 1984 study indicated visitor use focused on sunbathing and dune climbing, and that knowledge of dune environments was low. A proposal aimed at altering the previously unrestricted use of the dunes took into account that any single element of the hierarchy would not likely provide adequate mitigation without simultaneous use of other measures. This article focuses on Indiana Dunes NL, where the following measures were instituted in the summer of 1986:

1. Implementation of an educational program about



The specified Dune Climb Area was easily accessible, provided excellent vistas, and was broad enough to allow use by several visitors at once.

the fragile nature of dunes and the effects of human impacts;

2. Development of boardwalks through the most heavily used portion of the dunes, with observation and sitting areas, and;
3. Installation of signs encouraging use of designated trails in heavily used dune areas and posting of “no hiking” signs where use was prohibited.

The 1984 study also recommended increased enforcement and/or physical barriers to stop traffic into the foredunes surrounding heavy use zones, such as near the bathhouse.

To assess the effectiveness of these measures, a replication study was conducted at IDNL in 1986 at West Beach, the most heavily used. Both formal interviews and unobtrusive observations were used; the study ran from late May through early September.

VISITOR RESPONSE TO MITIGATING TECHNIQUES

Education

Large, professionally designed interpretive signs were placed along the 1/4 mile entrance walkway and on wooden decks by the bathhouse. Messages described the dunes and resource protection and a small interpretive area was set up inside the bathhouse.

Field observations found that few people read the interpretive signs, and visitor awareness of resource concerns did not appear to increase. However, visitors indicated they favored an increase in educational programs.

Formal Trail System

A one-mile boardwalk was constructed through a fragile portion of the dunes, providing a means of reaching scenic vistas and serving as a self-guided interpretive trail. Reaction was favorable and use was evident throughout the summer. Most popular uses were privacy-seeking young couples escaping the crowded beach environment, older adults observing birds and boats through binoculars, and young children using the boardwalk as a play environment.

The boardwalk escaped vandalism during the summer, but after Labor Day, when patrolling decreased, signs of vandalism appeared, particularly as graffiti and damage to railings along remote sections.

Signing

In an attempt to modify negative use of the dunes, signing and fencing were employed. Small “Trail Closed” signs were installed at the head of volunteer footpaths and synthetic mesh fencing impeded access to protected areas. On the boardwalk “Protect the Dunes” and “Stay on the Boardwalk” signs were erected where users might be tempted to leave.

Response to the signing varied. Small signs prohibiting access were not effective. However, size of the signs may have caused them to be overlooked. Similarly, the boardwalk messages did not stop all visitors from leaving the formal trail system. However, some vegetative revitalization was evident by summer's end, indicating that impact on fragile environments was lowered.

Additional Mitigating Measures

Small gauge wire mesh fencing was attached below the boardwalk and anchored in the sand in an attempt to thwart visitor movement from the crowded beach



Since boardwalk users must choose their own route back to the parking lot, several footpaths exist when one could serve the purpose.

into the foredunes. However, wind patterns caused the sand to shift, exposing the bottom of the fencing and allowing easy access to the foredunes. The principle was sound, but environmental conditions limited effectiveness.

A final mitigating measure designated one of the foredunes as a specific Dune Climb Area. The area was easily accessible, provided excellent vistas, and was broad enough to allow use by several visitors at once. Observation indicated the area was well used and kept fairly free of debris.

MANAGEMENT IMPLICATIONS

Results of the 1986 study suggested several factors occurring at West Beach have implications for management. These included:

1. The size of the beach is decreasing due to rising water levels and visitor movement into the foredunes may increase. Designating certain areas as permissible for use or enforcing a no-use policy are options.
2. Dune use continued heaviest around the bathhouse, but with addition of the boardwalk, vegetation was beginning to reappear.
3. Visitor knowledge of human impacts and the fragile nature of the dune environment remained low although most beach users desired an area that is natural in appearance.
4. Most visitors followed boardwalk routes rather than volunteer trails. Where boardwalks are not financially feasible, marked trails may be effective in funneling visitor traffic.
5. More abusive use of the dunes appeared after the season ended and close patrolling ended. The small percentage of users (5%) that did wander through the dunes during the summer was enough to maintain the network of volunteer trails. Use of these trails would need to be eliminated completely for total revegetation to occur.

RECOMMENDATIONS

Several recommendations appear warranted, based on the effectiveness of existing measures coupled with the likely effectiveness of new techniques found successful in similar environments.

Boardwalk and Trails

Continue maintaining the boardwalk, possibly extending it to the paved parking lot. Currently, the southernmost segment of the boardwalk ends on the summit of a backdune. Boardwalk users must then choose their own route to the nearby parking lot. As a result, several footpaths exist when one could serve the pur-

pose. If the boardwalk were extended to the parking lot, it would provide a hard-surfaced trail loop.

Signing

Reword the boardwalk signing to provide a more personalized message, such as "Dunes are fragile areas; protect your dunes; please stay on the boardwalk" or "Dunes are fragile areas; protect your dunes; use the dune climb area in front of the bathhouse."

These messages would stress the visitor's connection with the natural resource area. Similar signing should be located along the entrance route to the park and in the parking lots, informing about the fragile environment before they enter it.

Alternate Activity Options

Some negative dune use may occur out of boredom. Recreation for group use should be provided on the beach; e.g. portable volleyball standards with nets at the far ends of the beach zone providing activity alternatives and helping reduce congestion in the central beach areas.

Controlling Dune Use

Media coverage and on-site information about responsible use of the resources would help. Since a majority of the visitors live within a one hour drive of the park, the need for environmental protection can be carried in articles and public service announcements in local and regional news media.

From the viewpoint of matching management and visitor perspectives, the most favorable approach appears to be continue maintaining and extend the boardwalk; maintain mesh fencing used to channel visitors through those areas where there is no boardwalk; modify the signing along the boardwalk to include a more personalized approach to keeping visitors off the dunes, and retain the existing level of interpretive educational signing. In an environment primarily recreation activity-oriented, the most effective measures probably will be those that modify visitor behavior through physical changes in the environment rather than through educational messages. However, efforts to educate visitors before they reach the park also may prove effective.

Hultsman is an Assistant Professor of Forest Recreation at Purdue University, West Lafayette, IN 47907.

Grizzly Compendium Available

The Interagency Grizzly Bear Committee (IGBC) has published its 540-page Compendium, developed to assemble all available information on the biology and management of the grizzly bear in North America, according to Christopher Servehen, Grizzly Bear Recovery Coordinator, U.S. Fish and Wildlife Service, Missoula, MT.

Designed as a source document for grizzly bear managers, researchers and students, the Compendium has a format designed to facilitate review of all known information on any subject area of interest regarding grizzlies. It contains both published and unpublished information from all North American sources, plus a complete reference list and a detailed narrative summary by topic.

Also of interest in the same subject area is a 21-page "Report to the IGBC on the Availability of Foods for Grizzly Bears in the Yellowstone Ecosystem," published December 1986 and prepared by Servehen, Richard Knight, David Mattson, Steven Mealey, Dale Strickland, John Varley and John Weaver.

NPS Science Support Staff Announces IPM Training Videotapes

By Donna Vermeire

The NPS Science Support Staff in Washington, D.C. (WASO) recently completed, through an Interagency Agreement with The Environmental Protection Agency, four training videotapes that will introduce the concepts of integrated pest management (IPM) to maintenance and resource management personnel, as well as meet the goals of training for pesticide applicators. Designed to be used in formal IPM training courses, the videotapes also can be presented at staff meetings and park safety training events. It's an easy-to-learn-from method in the growing library of the Science Support Staff's educational materials on IPM.

In the late 1960s and 1970s, accumulating evidence of environmental hazards, health risks, and rising costs associated with indiscriminate use of pesticides sparked policies and programs designed to curb the more harmful practices. These programs now include regulatory actions, training and certification programs to improve application safety, and research and demonstration projects in integrated pest management. In 1980, the NPS initiated its Servicewide IPM program; its goal was to minimize risks and costs while maximizing effectiveness. To implement IPM strategies in the National Parks, the Science Support staff began the videotape project.

Gary Johnston, IPM Coordinator and project officer, identified four subject areas for videotape treatment - pesticide applicator safety, the detection of wood-inhabiting insects by structural inspection, subterranean termite biology, and crack and crevice treatment for cockroach management. Technical experts included William E. Currie of EPA and Dr. Harry B. Moore of North Carolina State University.

The scripts were written and produced by the author and videotaped by EPA's Audio-Visual/Television crew in the summer and fall of 1986. Three tapes were mastered on high quality 3/4 inch industrial format; the Crack and Crevice tape was done on broadcast-quality Super 1/2 inch betacam. They were shot on location at National Mall, Rock Creek Park, Great Falls Park, Fire Island NS, Morristown NHP, Hampton NHS, Big Cypress National Preserve, Grand Canyon NP, and the buildings and maintenance yard of the National Capital Region. The Employee Development Division coordinated the videotape programs.

Pesticides, by design, are biologically active and toxic, and pose potential risks to human beings. Those who handle pesticides are the primary group at risk. However, pesticide residues in food and drinking water can be transferred to human tissues, where the chemicals may accumulate, so misuse or indiscriminate use can affect park visitors and users as well. Furthermore, longterm effect on "non-target populations" is also a serious possibility; pesticides can reach unintended victims. Therefore, the first videotape was *Pesticide Applicator Safety*. The IPM strategies include reducing the amount of pesticide per application, reducing the number of applications, using protective clothing and equipment, and training users in safe handling and application. It stresses substituting less toxic chemicals or non-chemical techniques, acute and chronic poisonings, accurate reading of the pesticide label and material safety data sheets, and pro-

ductive clothing and equipment.

Many NPS historic wooden structures are vulnerable to insect attack and bio-deterioration, yet their historic fabric cannot always be treated with chemicals. Preservation depends on prevention, replacement, and repair of damaged wood. Therefore our second videotape developed *Structural Inspections - A Way of Managing Wood-Inhabiting Insects* to educate all who play an inspector's role on how to prevent deterioration of wood. The program follows Dr. Harry Moore of N.C. State University, an entomologist and author of "Wood-Inhabiting Insects in Houses," in an inspection of an NPS wooden structure. At the Ford Mansion in Morristown, N.J., we focused on individual insect problems by cutting away to examples of wood deterioration at other National Parks. The tape deals with learning how to identify different types of insect damage to wood, sources of infestation, insects that do the most damage to wooden structures - the subterranean and drywood termites, wood-boring beetles, carpenter ants, and carpenter bees, and the importance of integrating IPM techniques that render a structure less susceptible to insect attack.

Intelligent prevention and control of any insect pest is based on an understanding of its biology and habits. Thus, in our third videotape *Subterranean Termite Biology*, we establish the relationship of prevention and control procedures to termite biology and habits. This tape uses edited footage of insect photography from two previously produced tapes, Dr. F. E. Wood's "Subterranean Termites" and Shell International Chemical's "Thief in the Dark."

The final videotape to be released this year will be *Crack and Crevice Treatment for Cockroach Management*. It follows a pesticide applicator and trainee as they treat an NPS food-handling operation and an office for cockroaches, focusing on the IPM techniques of sanitation, caulking as a mechanical control, site monitoring, and a low toxic pesticide treatment with a boric acid dust.

These four new videotapes and the previously produced *IPM in the Parks*, bring to five the number of video programs being used by the Science Support staff in its education and training efforts. "IPM in the Parks," developed in 1985, embodies the Park Service's IPM philosophy. Its enthusiastic reception in the field made possible the development of the other four programs.

These tapes were intended for internal distribution and training. However, they may have an impact on the pesticide industry, if numerous phone calls and requests from a wide and diverse audience is any indication. At a recent EPA/USDA National Workshop on Pesticide Applicator Certification and Training, the videotapes were screened nightly for Government, industry and environmental audiences. A large number of requests followed these showings. We are in the process of finding a mechanism for distributing the programs externally. However, copies of the tapes are available on 1/2 inch VHS for NPS users. Contact the regional training offices, WASO Science Support Staff, and Regional IPM Coordinators.

Vermeire is an NPS Training Specialist in the Washington Office.

regional highlights

North Atlantic

The North Atlantic Region held its First Triennial Conference on Science and Resource Management in Northeast National Parks on the University of Massachusetts-Amherst campus March 30-31, 1987. See picture on opposite page. More than 100 NPS park managers, scientists, resource managers, interpreters, and contract scientists met to discuss resource problems, research results and their application to resource protection.

We were welcomed by the University Provost, Dr. Richard O'Brien, who discussed the University's commitment to quality research in the public interest and by Dr. Eugene Hester, new NPS Associate Director for Natural Resources. The new Regional Chief of Interpretation, Cindy Kryston, spoke of new efforts to utilize science in interpretation. Mid-Atlantic scientists as well as Southeast Region and Washington Office representatives also attended.

The papers and posters presented reflect resource problems and research needs unique to the North Atlantic Region. The topics ranged from river otter, bald eagles, peregrine falcons and piping plovers to PCBs, DDT, lyme disease, sick marshes, dead fish and missing benthos. The problems addressed also reflect the resource concerns common to all NPS areas, including visitor use impacts on trail systems, baseline information requirements, environmental monitoring and geographic information systems. Other issues addressed include air and water pollution in Northeast National Parks, wildlife management issues, shoreline and bluff erosion, the role of fire management in fire management planning and resource management amidst conflicting jurisdictions.

Program abstracts from the meeting are available from Office of Scientific Studies, National Park Service, 15 State Street, Boston, MA 02109.

Mid Atlantic Region

Regional Chief Scientist John Karish reports availability of three new Regional Research Program reports. "The Experiential Aspects of Recreation - A Review of Relevant Literature and Suggestions for Future Research" by Joyce Berger and Richard Schreyer involves extensive literature search and a series of in-depth interviews with noted researchers in the area of leisure studies and related fields. Other reports include "Rare Plants and Natural Communities of the New York side of the Upper Delaware Scenic and Recreational River Corridor" by Lauren Lyons-Swift and "Gypsy Moth Risk Assessment for Shenandoah NP" by Durland Shumway and Todd Bowersox.

Regional Scientist Jeff Marion sends news of two new publications. "Methods for Estimating Recreational Use: A Bibliography" includes references arranged by the following visitor use estimation methods: visitor observation and counts, trail counters, road traffic counters, interviews and questionnaires, photography (several types), self registration, and permits. "Ecological Impacts on Recreational Sites at New River Gorge National River, West Virginia" by Marion and Dave Coie describes impacts on well-established sites along the New River and evaluates the differences in impacts on sites used primarily by two distinct clienteles - local fishermen and commercial rafters. Copies are available from Jeff Marion, Star Route 38, Milford, PA 18337.

Continued on page 14

Western Region

Research Scientists from the Western Region attended a conference on Botanical Research and Management held on the Galapagos Island April 12-19, 1987. Lloyd Loop (Research Scientist, Haleakala), Charles Stone (Research Scientist, Hawaii Volcanoes) and Clifford Smith (Unit Leader, CPSU/University of Hawaii) provided an overview of conservation biology in the Hawaiian Islands and stressed its applicability to resource management problems in the Galapagos. Ninety-five registrants - two-thirds from Ecuador, one fifth from the United States, and the remainder from Europe and New Zealand - attended. Loope presented a paper on "Management and Research Efforts to Protect Vulnerable Endemic Plant Species of Haleakala National Park, Maui, Hawaii"; Stone's paper was "Managing the Invasion of Alien Ungulates and Plants in Hawaii's Natural Areas"; and Smith gave a paper on "Weed Management in Hawaii's National Parks."

* * *

Sequoia, Kings Canyon and Yosemite NPs will implement an expanded policy of protecting giant sequoia from black charring by fires when the program of prescribed burning resumes this summer. This decision followed recommendations in a 45-page report by a 7-member Technical Review Committee chaired by Dr. Norman L. Christensen of Duke's Botany Department. The review committee endorsed the NPS policy of using prescribed burns to restore natural ecosystems in the giant sequoia forests of the three parks, recommended that burn plans be formulated with participation of a person trained in landscape architecture, and that greater emphasis be given to long-term monitoring of fire effects, and emphasized that "ecological values are paramount and are not to be compromised for purely aesthetic reasons."

* * *

The Third California Islands Symposium, sponsored by Southern California Academy of Sciences, Santa Barbara Museum of Natural History, and Santa Barbara Botanical Garden, was held on March 2-6, 1987. Papers on the history, geology, archeology and biology of the Channel Islands and other off-shore islands of California and Baja California were presented to approximately 600 attendees. Proceedings will be published later this year.

* * *

Twenty research scientists and park managers from the Western Region participated in a research and resource management workshop at Channel Islands NP on May 11-15, 1987.

Workshop participants identified, prioritized and prepared proposals for research and resource management activities for Santa Rosa Island, a 54,000-acre area acquired for \$30 million on December 29, 1986.

* * *

Thomas J. Stohlgren, Ecologist at Sequoia and Kings Canyon NPs and Dr. Philip W. Rundel (UCLA) published a paper in *Ecological Modeling* (34:245-257) titled "A Population Model for a Long-lived, Resprouting Chaparral Shrub: *Adenostoma fasciculatum*." Chamise, the most common shrub in

California, may be able to survive more than 23 fires (30-80 years apart). The model also evaluates potential changes in population age structure given different fire-caused mortality rates.

Annual Report No. 10, covering calendar year 1986 activities of the NPS Cooperative Park Studies Unit at University of California, Davis, is now available from the Region, covering NPS contracts and NPS activities in the field of scientific research.

* * *

"Breeding Ecology of the Hawaii Common Amakihi" is the title of a paper by Charles van Riper III in *The Condor* (89:85-102), journal of the Cooper Ornithological Society 1987. The paper cover 11 years of research (1970 through 1981) into the ecology and breeding biology of the Common Amakihi on Mauna Kea, Hawaii. Van Riper is head of the NPS/CPSU at U/Cal, Davis.

Alaska Region

Bear-People Conflicts, a symposium on management strategies was held in Yellowknife, North West Territories, Canada in April. Managers and scientists from Canada, the U.S., and Europe attended. "Successful Bear-People Conflict Management in Denali National Park, Alaska" by John Dalle-Molle and Joseph Van Horn and "Seasonal Camping Closures of Important Bear Foraging Sites to Reduce Human/Bear Conflicts" by Gary W. Vequist were among the papers given. Proceedings will be published within a year. For a copy of abstracts and notes on the papers and workshops, contact John Dalle-Molle, Box 9, Denali Park, Alaska 99755.

* * *

A recent publication by James M. Peek, Dale G. Miquelle, and R. Gerald Wright entitled "Are Bison Exotic in the Wrangell-St. Elias National Park and Preserve" appeared in *Environmental Management* 11(2).

* * *

Dr. Dale L. Taylor was selected to fill the region's vacant wildlife research biologist position. Dale began his career with the National Park Service as a seasonal employee in 1973 at Grand Teton NP and became a permanent employee there in 1977. From 1977 to 1981 he served as a fire ecologist at the South Florida Research Center. In 1981 he accepted a similar position with the Bureau of Land Management in Anchorage, Alaska. He transferred to the Anchorage office of the U.S. Fish and Wildlife Service in 1984 as their marine mammal coordinator.

* * *

Al Lovaas served on a panel at the Northern Section of the Wildlife Society annual meeting held in Juneau March 31 through April 2, 1987. Al presented a paper in response to the question "How does your agency treat economic values of wildlife and fisheries and of what importance are those values in decision-making?"

* * *

Gary Vequist gave a paper on April 3, 1987 in Juneau at the Fourth Northern Furbearer Conference entitled "Sea Otter Recolonization of Ancestral Range in Glacier Bay National Park."



Regional Highlights

Continued from page 12

Southwest Region

Natural and Cultural Resources Management on April 6-10 held a workshop for resources management personnel who represented different disciplines and parks in the Southwest region. Objectives of the workshop were to explore similar problems, discuss alternatives, common solutions, and future directions for both natural and cultural resources management. The workshop was well attended, by nearly 40 field personnel including interpreters, maintenance personnel, managers, and an excellent mix of disciplines. In addition, there were representatives from the Denver and Fort Collins offices of Water and Air Resources as well as numerous regional staff. A poster session was held on Wednesday evening and over 100 persons were in attendance to view and discuss various on-going resources management projects in the region.

Primary concerns of the field personnel were identification and documentation of the resources and acquisition of basic inventory information. Current and future ADP use was also a concern.

Comar, Inc., the contractor who has been developing the bat counting system for the Southwest Division of Natural Resources Management, has delivered the system hardware and provided training for NPS employees. The system, designed to count as many as 16 million objects photographed in a two hour period, is able to analyze VHS video tapes and has potential for counting a variety of wildlife species. The Southwest Region will be reporting population figures for various bat caves in the Southwest including Carlsbad Caverns NP. The system has potential for counting other wildlife; anything that can be photographed as moving horizontally across the screen can be counted. Inquiries can be directed to Dr. Milford Fletcher, Chief Scientist, Southwest Regional Office, FTS 476-6412.

Pacific Northwest

The Student Conservation Assn., Inc. (SCA) is conducting its 3rd annual training series at National Parks and Forests throughout the nation. Instruction is provided by highly qualified personnel whose credentials and collective experience encompasses service with such agencies as USFS, NPS, BLM, SCA, YCC and YACC, the Appalachian Mountain Club and the Appalachian Trail Conference. Curriculum involves students in comprehensive field work projects, from rock structures and trail engineering and design to chainsaw use and maintenance and revegetation and site restoration.

The program, which began in April (at Kings Canyon NP, Calif.) will run through September (at Mount Rogers NRA, VA). For information, contact SCA, P.O. Box 31989, Seattle, WA 98103; (206) 547-7380.

R. Gerald Wright of the NPS/CPSU, University of Idaho, sends word of a recently published article by himself and C. Pedevillano, "The influence of visitors on mountain goat activities in Glacier National Park, Montana," appearing in *Biological Conservation*, 39:1-11.

Rocky Mountain

Some recent papers describing natural resource research progress and findings within the Yellowstone ecosystem include a second year progress report on "Yellowstone Lake: Tributary Study" by Daniel P. Reinhart and David J. Mattson, "Grizzly Bear, Red Squirrels, and Whitebark Pine: A Third Year Progress Report" by Mattson and Reinhart, and "Habitat Dynamics and Their Relationship to Biological Parameters, 1977-83" by Mattson. All three are products of the Interagency Grizzly Bear Study Team.

Yellowstone NP has issued a listing of 40 elk and vegetation research projects underway on Yellowstone's northern range and being conducted by resident NPS scientists. The project list rises to 60 when university and outside contract researchers are included. Research categories are winter range analysis (overgrazing issue); summer range analysis (overgrazing/competition issue); fire, riparian vegetation, and aspen topics; rangeland restoration and exotic (alien) plant work; historical conditions: ecological, geological, archeological; life history and ecology of six principal ungulate species; condition and health of principal ungulate species; interspecific competition between wildlife species; effects of human disturbance on elk; predator-prey relationships; and erosion, sedimentation and turbidity. For information on this, contact Norm Bishop, FTS 585-0200, or (307) 344-7381, ext. 2200.

Dr. Joel Berger of the University of Nevada-Reno will complete field work this summer in Badlands NP on bison reproductive ecology. His four-year research has applications both to management of the park's bison herd and to maintenance of large ungulate populations in other parks and wildlife reserves around the world.

"Black-tailed Prairie Dogs: Good or Bad?" was just one of several papers presented at the eighth Great Plains Wildlife Damage Control Workshop in Rapid City, SD. Additional presentations on topics studied at Badlands and Wind Cave National Parks were: "Sociobiology and population dynamics of prairie dogs"; "Control of ecosystem processes by prairie dogs and other grassland herbivores"; "Arthropod consumption by small mammals on prairie dog colonies and adjacent mixed grass prairie in western South Dakota"; "Prairie dog overpopulation: Value judgment or ecological reality?"; "Management of prairie dogs at Wind Cave NP"; and "Small mammals: Pests or vital components of the ecosystem?"

The 2-day meeting closed with a panel discussion on prairie dog management and control and its effects on the livestock industry and black-footed ferret recovery plans. Proceedings will be published this fall.

Water Resources Division

The Applied Research Branch is cooperating with the USFWS, Virginia Polytechnic Institute, University of Virginia and other agencies and with park personnel in developing a longterm monitoring program for tracking the effects of acid rain at Shenandoah NP. Of special concern are water quality and potentially sensitive biological organisms.

7-Year Study of Falcons Provides Clues To Origins

Padre Island, Texas, is a major staging area for migrating peregrine falcons. During the 1986 Spring and Fall migrations on North and South Padre Island, 318 Arctic peregrine falcons were banded. An ongoing study (since 1979) by Dr. Don Morizot, University of Texas Science Park, monitors the status of this threatened species. His study compiles records of band returns and analyzes small amounts of blood withdrawn from each trapped falcon. By using electrophoretic analysis of blood enzymes, it has been possible in some cases to identify natural origin.

The falcons migrating along the Gulf coast, nest in Arctic Alaska, Canada and Greenland and spend the winter in South America. Thus, Padre Island provides critical habitat for large numbers of peregrines for as much as one-third of the year. Some interesting results so far indicate possible higher mortality of Alaskan birds during winter as opposed to the Greenland population. This suggests two different wintering locales, one being less favorable. Prospects for the peregrine falcon look good with higher numbers observed during each migration and from reports by biologists in the Arctic.

Jennifer Bjork
Padre Island National Seashore

Specimen Collection Guidance Takes Time

The NPS Natural History Collections Committee is responsible for writing guidance to the field on interpretation of 36 CFR 2.5 (see NHCC Action Plan, 9/20/85). This is a complex issue at this time, and guidance won't be completed for about a year. In the interim, however, we can do work with park superintendents on a case-by-case basis. This can be brought about by inserting the following paragraph in all work assignments requiring the collection of biological specimens:

"Any collections of biological material from a national park unit resulting from this work assignment shall be subject to the current rules governing collections promulgated by the NPS in conformity with 36 CFR 2.5 and found in the NPS Museum Handbook, Part II, pages 4-12 to 4-14. At the time of this writing, such rules are being interpreted on a case-by-case basis by the park superintendent and will be applied as conditions to granting the park collecting permit. The NPS Natural History Collections Committee is currently preparing guidance on interpreting these rules. The chairman of this committee and the NPS Chief Curator may be consulted in the interim if necessary."

James P. Bennett, Chairman
NPS Natural History Specimens

New Recreation Textbook

Wildland Recreation: Ecology and Management, a textbook dealing with wildland resource problems arising as a result of recreational use, has just been published by John Wiley & Sons, Inc., 605 Third Ave., New York, NY 10158. Authors are William E. Hammit of the University of Tennessee and David N. Cole of Systems for Environmental Management. The chapter on monitoring techniques will be of particular interest to NPS resource managers.

information crossfile

The Spring 1987 issue of *Landscape Journal* contains a call for papers for a special issue – on Nature, Form and Meaning – to be published in Fall 1988. Anne Whiston Spirn is guest editor of the edition and may be addressed at the Dept. of Landscape Architecture and Regional Planning, Graduate School of Fine Arts, University of Pennsylvania, Meyerson Hall 119, Philadelphia, PA 19104-6311. Submitted papers should interpret the subject broadly, within the framework of landscape design theory. Papers and accompanying illustrations are due July 15, 1987. This special double issue, with some color, is being funded in part by a grant from the National Endowment for the Arts.

**

William R. Jordan, III, editor of *Restoration and Management Notes*, editorializes in the Winter 1986 issue (Vol. 4, No. 2) on two approaches to the human/nature situation. One approach is the *Newsweek* cover of July 28, 1986, with the words "Can we save our parks" emblazoned across a grizzly bear photo and subtitled "The struggle between man and beast." The other is the image of volunteers working around a recently constructed desilting pond at the edge of the Wisconsin University Arboretum, pulling weeds in a three-year-old restored prairie – a mass of yellow cornflowers intermixed with spikes of young blazing stars.

Instead of the image of "a horde of people using nature up, wearing it out, 'loving it to death,'" Jordan asks, couldn't we think of people engaged in a relationship with nature that is active, participatory – and beneficial? "This, it seems to me," writes Jordan, "is more than just scientific or ecologically sophisticated gardening . . . it is nothing less than a ritual . . . of reentry and reconciliation with nature. And that might have important implications for the dilemma about the human use of nature in our parks and preserves."

**

From Jim Wood, technical writer-editor for NPS publications, comes word that William H. Moir's *The Forests of Mount Rainier National Park*, written for the general public, is within about two months of publication by GPO. Scientific Monographs in the works include *Visual Preferences of Travelers Along the Blue Ridge Parkway*, by Francis P. Noe and William H. Hammitt, and *Population Characteristics, Distribution, and Habitat Relationships of Six Ungulate Species on Winter Range at Yellowstone National Park* by William J. Barmore. Farther back in the SM series process is Jerry Franklin's *Forest Ecosystems of Mount Rainier National Park* – written expressly for a scientific audience.

**

An Occasional Paper (No. 7) entitled "An Identification of Prairie in National Park Units in the Great Plains," by James Stubbendieck and Gary Willson is now available from Jim Wood, writer-editor in charge of NPS publications in the Southeast Regional Office, Atlanta, GA. The 307-page book is a careful prairie study of all pertinent parks in the NPS Midwest, Rocky Mountain, and Southwest Regions. The 32 parks in-

meetings of interest

1987

August 9-14, ANNUAL MEETING OF THE ECOLOGICAL SOCIETY OF AMERICA, at Ohio State University, Columbus, OH. On Aug. 13, Bob Stottlemeyer will chair the Symposium on the significance of longterm research in preserving National Parks. Discussants are Rolf Peterson, Lloyd Loope, William Halvorson, Gary Davis, Jim Kushlan and Bob Dolan. Jerry Franklin of the USFS and the University of Washington will review the symposium for publication in the *Ecological Society's Bulletin*.

August 18-Sept. 11, 21st INTERNATIONAL SEMINAR ON NATIONAL PARKS AND OTHER PROTECTED AREAS, beginning in Calgary, Alberta, Canada, and moving to appropriate field locations that will include a variety of ecosystems – tundra, montane forests, rain forests, grasslands, arid lands, coastal and marine areas, concluding in San Jose, Costa Rica. A technical and professional course to examine policies, administration, planning and other aspects of national parks and other protected areas; sponsored by the National Park Service and the University of Michigan School of Natural Resources. Contact: Hugh Bell Muller, Director; International Seminars on NPs, U/Mich School of Natural Resources, Ann Arbor, MI 48109; (313) 763-4029.

September 11-18, FOURTH WORLD WILDERNESS CONGRESS will meet in Estes Park, Colo., to address "Worldwide Conservation: A Call for a New Initiative." Contact: 4th World Wilderness Congress, International Leadership Foundation, Colorado State University, Fort Collins, CO 80523. (303) 491-5804.

November 1-5, NATIONAL INTERPRETERS WORKSHOP, including an Interpretive Research Symposium and an Interpretive Management Institute, sponsored by the Association of Interpretive Naturalists and the Western Interpreters Association, in St. Louis, Missouri. Contact: Lisa Brochu, 1987 National Interpreters Workshop, 504 Falls Ave., Lodi, CA 95240; (209) 334-4390.

1989

April 20-23 INTERNATIONAL SYMPOSIUM ON VANDALISM: RESEARCH, PREVENTION AND SOCIAL POLICY. Sponsored by USDA Forest Service and the University of Washington Institute for Environmental Studies. Call for abstracts of papers, presentations and posters issued in March 1987, with a June 1, 1987 deadline. Contacts: Dr. Chris Christensen, USFS, Pacific Northwest Research Station, 4043 Roosevelt Way, N.E., Seattle, WA 98105, (206) 442-7846; and Polly Dyer, Institute of Environmental Studies, U of WA, Seattle, WA 98195.

involved have prairie totalling about 117,000 hectares. Ten of the parks have restored prairie. For each of the 32 parks surveyed, information is presented on current vegetation, past management, and adjacent land use. An annotated bibliography of research conducted in each park also is herein assembled.

Willson is with the NPS Midwest Regional Office in Omaha, NE; Stubbendieck is with the Department of Agronomy, University of Nebraska-Lincoln, Lincoln, NE.

**

Birds of South Florida is a 150-page interpretive guide to the birds of Everglades NP, Biscayne NP, and Fort Jefferson NM. Connie Toops and Willard E. Dilley, the authors, are former NPS employees. Dilley was the first naturalist at Everglades NP and Toops worked there as a seasonal interpreter for six years. Published by River Road Press, P.O. Box 1130, Conway, AR 72032, the book contains 53 color photos, maps, an index, and notes on history and habitats. Price is \$9.95.

**

A paper in the *Canada Journal of Forest Resources* (Vol. 16, 1986, pp. 1214-16), co-authored by Jim Bennett of the NPS Air Quality Division in Denver, describes two years of research on populations of aspen (*Populus tremuloides*) in five national parks of differing air quality, and suggests that natural selection for tolerance of ozone may have occurred in some areas

of eastern United States. Eleven to 15 clones from each population were greenhouse grown and fumigated twice during the two year screening process, each time with 180 ppb ozone for 6 h. Average injury for clones was significantly less for the most polluted park than for the least polluted park, and there was a high negative association between average injury and ambient ozone levels. Differences in ozone sensitivity among clones *within* populations were highly significant and larger than differences *among* populations.

The article is titled "Natural selection for ozone tolerance in *Populus tremuloides*" and other authors are P. Berrang and D.F. Karnosky of Michigan Tech in Houghton and R.A. Mickler of Northrop Services, Inc., Research Triangle Park, NC.

**

The Report of the President's Commission on American Outdoors (PCAO) cleared its last publication hurdle on April 1, 1987, when a U.S. District Court in Seattle dismissed a procedural lawsuit by the Center for the Defense of Free Enterprise, to block publication. Copies of the Report will be available until June 30 for \$19.95 from Island Press, American Outdoors, P.O. Box 53406, Washington, DC 20009, and for \$24.50 thereafter. Shipping and handling charges are \$2.75 for the first book and \$1 for each additional book. The Department of the Interior's version will be available through the Government Printing Office by June, at a yet undetermined price, and will also be carried in the 1100 Federal Depository Libraries throughout the U.S.

Resource Data Management System Launched in Pacific Northwest Region

Editor's Note: Rich Winters, PNR's Associate Regional Director for Recreation Resources and Professional Services, has announced a comprehensive regional project to develop microcomputer data bases incorporating the natural resource data in each of the PNR parks. The project, developed by Gerald Wright of the University of Idaho NPS/CPSU, will be guided by a six-member advisory committee made up of park and regional office staff members, will start this spring, and will be tested first at North Cascades NP. The project, described below, is seen by Winters as having "clear management applications." Said Winters: "It will provide a link between resource management plan elements and specific data sets in a park. It will enable a manager to quickly find what data are available in any of the parks to help resolve a particular management issue such as an oil spill, erosion problem, insect infestation, etc. It will provide a lever for use in obtaining important sets of data from non-NPS sponsored research projects that are not in park files. It also will provide an opportunity to make duplicates of rare or one-of-a-kind data sets, thus aiding in their use."

By R. Gerald Wright

The proper management of the natural resources of parks is directly related to an ability to find and use information appropriate for the task. Unfortunately, recent surveys conducted in the Pacific Northwest Region have shown that most parks know little about what resource data are available, where they are stored, who collected them, and how good they are. Most parks lack the personnel needed to deal with this problem and are frustrated by a lack of knowledge of proper techniques to organize and code data, and by a lack of understanding of the types of computer hardware and software useful in managing data. The broad aim of this project is to attempt to provide solutions to some of these problems.

Data management implies the capability to uniformly store and use information in a systematic manner. Data may be stored on a computer disk, in file cabinets, or on microfilm and may be used in a variety of ways. A collection of data of a similar type gathered for a specific purpose is called a data set. A data management system makes it possible to:

1. retrieve all or portions of a given data set;
2. update, change, or delete all or portions of a given data set;
3. combine different parts of one data set or the data in several sets;
4. search and locate specific data elements; and
5. do routine arithmetic analyses on a given data set.

The objectives of this proposal are to:

1. Systematically locate and inventory the natural resource data of all parks in the Pacific Northwest Region; and then organize and summarize the characteristics of this information in tabular form in what will be called a data directory;
2. To evaluate the significance of each alphanumeric data set identified in the directory of the respective parks, and use project personnel to enter all data considered to be important to park management into a computerized data management system;
3. Using previously processed data, data to be processed by this project and data to be processed by GISFU, develop a prototype GIS of at least two parks

Table 1. Example of the structure of the data directory for a given park, and key elements in the data directory. (Keywords will be used where possible.)

Resource Category:

1. Study Number	Park unique numerical identifier for the study
2. Description of the Data	Brief description of the data set
3. Species	Major species measured (if applicable)
4. Type of Study	Indicate if it is a research, monitoring, inventory, or other type of study
5. Date(s)	Dates and seasons of data collection
6. Location(s)	Specific location(s) in the park of the study
7. Data Availability	Indicate where the data are stored, give addresses and phone numbers if available
8. Data Type	Whether data are numerical, mapped, alphabetic
9. Data Relevance	What the uses are or have been for the data
10. File Length	The number of records, elements, maps, etc. in the file
11. Reference(s)	Who collected the data, citations of any publications using the data
12. Cross-reference(s)	Indicate the numerical identification of any related studies in the park
13. Data importance	Indicate the results of an evaluation of the significance of the data
14. If and how computerized	Indicate if the data are computerized, the software used, and the format they are stored in
15. Related resource mgmt. plan elements	Indicate which elements in the resource plan the data set can be applied to

in the region.

This proposal views the establishment of a data management system as best accomplished in a decentralized manner which therefore makes each park ultimately responsible for managing its own data. It also takes an incremental approach starting at a basic level by doing an inventory and making a catalog of the data resources and then systematically building in complexity towards the development of a computerized data management system. This approach provides ample opportunity to evaluate progress at discrete time intervals and to make adjustments in procedures where necessary.

Throughout its course, this project will be guided by an advisory committee made up of selected park and Regional Office personnel who will assist in refining study methods, in evaluating the products at each step in the process, and in recommending alternative approaches where appropriate.

Objective 1. An inventory of all natural resource and visitor use data will be undertaken for each park in the region. Included will be mapped data such as

vegetation maps and trail locations; numeric data such as censuses and transect readings; alphanumeric data such as species lists, and collections such as photographs and museum catalog records. The characteristics of each of these types of data sets will then be organized and summarized in a data directory. Proposed elements of this directory along with a key to their meaning is shown in Table 1. A list of the type of data sets that would be included in the directory are shown in Table 2.

It is recognized that finding and interpreting some data sets will be time consuming and difficult. The task will require the cooperation of appropriate personnel at each of the respective parks. The inventory will be done by a team of one or more research technicians, temporarily stationed at the respective parks.

When the directory for a given park is completed, it will be published and made available throughout the region. More importantly, it will be placed in a computerized information management system. This will allow each of the fields to be searched separately, information to be combined, and appropriate sum-

Table 2. Resource categories proposed for the data directory

Categories	Example Data Sets
Atmospheric Data	Air quality, acid rain, climatic data, air pollution data
Fish and Aquatic Organisms	Food habits data, habitat use data, counts, classifications, impact studies, population data, distribution information, endangered species
Geologic Data	Paleontology, structure and stratigraphy, glacier data, lava data, cave data, mineral deposits and claims
Hydrologic Data	Water quality, snow surveys, pollution data, acidification, limnology
Soils Data	Descriptions and classifications, erosion and capability data
Terrestrial Vertebrates and Invertebrates	Distribution, food habits, counts, harvest and use, population data, classifications, endangered species
Vegetation Data	Descriptions and distributions, disease and infestations, grazing use, endangered species, frequency and cover data
Visitor Use Data	Visitation statistics demographic and behavior data, impact data

NY Conference Focuses on Long-term Research

By David Parsons

A group of about 40 distinguished scientists met from May 10-14 at the New York Botanical Garden's Institute for Ecosystem Studies (IES) in Millbrook, NY to discuss ways of improving support for long-term ecological research and monitoring. Organized by IES Director Gene Likens, the 1987 Cary Conference on Long-Term Studies in Ecology: Approaches and Alternatives, analyzed the importance of long-term data sets in understanding natural ecosystem processes,

discussed alternative approaches to carrying out long term research and explored ways of improving communication regarding the importance and utility of long-term data sets in natural resource decision making.

The meeting consisted primarily of small group discussions structured around six keynote addresses. Jerry Franklin (U WA and USFS) presented an overview of the importance of long-term ecological

search for identifying and understanding long-term trends, cyclic, and episodic processes, and for generating and testing ecological theory. He emphasized the need for a more systematic approach to long term studies in order to address major regional and global environmental issues.

L. Roy Taylor (Harpden, England) spoke on the Rothamsted experience of over 100 years of collecting data on plant and insect communities. Margaret Davis (U. Minnesota and president of the Ecological Society of America) reviewed the use of retrospective studies (including sediments and tree rings) for reconstructing baseline data on environmental change and certain ecological processes. While such studies are primarily of value on a regional scale they can provide valuable insight to long-term studies.

Ways in which microcosms and simulation models can augment long-term ecological studies were discussed by Herman Shugart (U. Virginia). He gave special attention to the use of models in developing theory and testing protocols. Steward Pickett (IES) addressed the benefits and shortcomings of substituting space for time as an alternative to long-term studies. The common practice of inferring a temporal trend from the study of different aged sites makes critical assumptions that spatial and temporal variation are equivalent and should be used only with this in mind. Finally, David Tilman (U Minn.) discussed the value of experiments in ecological research but cautioned against basing conclusions on short-term data. He warned that the immediate response to an experiment may not be indicative of the eventual effect of the manipulation.

The discussion groups addressed such questions as identification of the key phenomena or questions that require long-term study, how best to integrate various approaches and techniques, the adequacy of available statistical methods to analyze long-term data sets (they concluded techniques are adequate although they are generally not taught in graduate biometry classes), the trade-offs between the immediacy of management needs and the longer process of scientific discovery and how to improve the image of long-term studies (how to convince peers, legislators, funding bodies, resource managers and the public that they consist of more than purposeless monitoring).

In summarizing the discussion groups Bill Reiners (Wyoming) emphasized the importance of well thought out questions or hypotheses as the basis for all long-term studies and the importance of fully considering temporal and spatial scales.

In the concluding session Gene Likens proposed a resolution as drafted by the discussion group under Lee Talbot's (World Resources Institute) direction, calling for a new commitment for the scientific community to work more closely with resource managers in assuring maximum application of research findings. A final version of this resolution, along with conference papers and discussion group highlights will be published by the Institute for Ecosystem Studies.

David Parsons, the NPS representative at the Conference, was encouraged by the groups' interest in the value of National Parks and other protected areas as sites for carrying out and implementing the findings of long-term research and monitoring. There was considerable interest in developing such a statement to be issued, perhaps, by the ESA. Such support could prove extremely valuable to current efforts to develop an inventory and monitoring program within the NPS.

Parsons is Research Scientist at Sequoia/Kings Canyon NPS.

Table 3. Estimated time in months including travel time required to complete Objective 1.

Time for each park	Parks*	Total Time
.75	EBLA, FOCL, FOVA, ORCA	3
1.7	NEPE, SAJU, WHMI	5
2.3	CODA, CRMO, JODA	7
5	CRLA	5
6.5	MORA, NOCA	13
7	OLYM	7
	Total	40 months

*NPS abbreviations for PNR parks

mary reports to be produced. The estimated time required to complete the first objective is given in Table 3.

Products of this objective will include:

1. A published data directory for each park with copies distributed to all other parks.

2. A computer file on a common data management system containing the information for each data directory.

Objective 2. Each numeric data set in the directory for a given park will be evaluated by the research team along with knowledgeable park and regional office personnel as to its relevance to park management. Those sets considered to be most significant will be organized in a uniform format and placed into micro-computer files using a standard data management system such as dBASE III. In most parks, some data already are stored on computer files. Where necessary these data will be converted to the chosen data management system or, if they are already in that form, they will be incorporated directly into the park's data management system. Actual data entry and verification will be carried out by CPSU personnel at the University of Idaho. This task will involve about 11 months total effort.

The principal investigator will carefully research the format used for the various data files. The intent is to make them as compatible as possible with systems used by other regions. Contacts will be made with parks, national forests, and others involved with resource data base design and implementation.

Products of this portion of the study will include:

1. The establishment of a common data management system for the region and a report discussing its use.

2. A set of floppy disks (or equivalent) for each park containing all numeric data considered to be useful to management along with a report describing the contents of each disk.

3. A duplicate set of all data for all parks to be supplied to the Regional Office or other suitable repository.

Objective 3. The final objective is intended to be

a prototype effort and the techniques learned will be used to develop GIS for other parks. In part this objective is contingent on technologies that are only now being developed. For example, recent hardware acquisitions by the NPS Geographic Information Systems Field Unit (GISFU) should allow parks more easily and cost effectively to use this facility for remote processing of geographic data. Concurrently, technological developments also are making it possible to run NPS GIS software such as SAGIS on specially equipped 32 bit microprocessors. The budget calls for the acquisition of such a machine and associated peripherals to explore this possibility.

A combination of such approaches should ultimately permit parks to more easily develop and use their own GIS. Some parks in the region already have geographic data that have been processed by GISFU that can be incorporated into such a GIS. Part of the funds allocated for this project will be used to help GISFU to acquire, digitize and process additional geographic data for selected parks. The choice of the test areas to be included in this effort will be made with the guidance of the advisory committee. It is estimated that this task will involve 15 months effort.

Products will include:

1. Development of a functional GIS for at least two parks.

2. A report evaluating the feasibility of the techniques and hardware used in this project along with recommendations for future action.

The success of this project will depend in large measure on the cooperation of the personnel, particularly in resource management and science, in the respective parks. Assistance will be needed for example to help locate and interpret the various data sets. A commitment to the project goals from those individuals serving on the advisory committee will also be necessary for the project to succeed. Work space will be required in each of the parks for CPSU personnel for periods of from one to seven months.

Wright is a Research Scientist with the NPS/CPSU at the University of Idaho.

VIRMC Makes Intensive Data Collection Effort

By Caroline S. Rogers

In an earlier *Park Science* issue (Summer, 1985), we discussed the Virgin Islands Resource Management Cooperative (VIRMC) research projects and activities for 1984-1985 (Phase I) and 1985-1986 (Phase II). The Phase I final reports were printed in October 1986, with printing of Phase II reports expected in the spring of this year.

Following is an update on VIRMC activities and a brief description of 1986-87 projects. Island Resources Foundation is the fiscal agent and main contractor for all VIRMC projects subcontracted to other VIRMC members. The VIRMC studies represent probably the most intensive data collection effort ever carried out in a protected area in the eastern Caribbean.

International Workshop

In July 1986, Allen Putney from the Eastern Caribbean Natural Area Management Program, and Dr. Walter Knausenberger, University of the Virgin Islands, conducted a workshop on Coastal Protected Areas in the Lesser Antilles. The workshop was sponsored by the Commonwealth Science Council, Eastern Caribbean Center (Univ. of the Virgin Islands), and VIRMC. Results of VIRMC projects and several case studies from around the region were presented to resource managers and scientists from the U.S. Virgin Islands, French Antilles, the Netherlands Antilles, Puerto Rico, Belize, and Costa Rica. About 75 people attended the sessions.

Synthesis/summary report

Research Biologist Caroline Rogers is responsible for coordination and preparation of a synthesis and summary of research and resource management information with relevance to terrestrial and marine resources in Virgin Islands National Park and Biosphere Reserve. Robert Teytaud has prepared the terrestrial sections. The objectives of the report are to present the extent of our knowledge of natural resources in the park; to synthesize information which has implications for resource management within St. John and the wider Caribbean; to identify future research needs; and to recommend management alternatives and options for ecosystems within the park and biosphere reserve. The report is intended for scientists and protected-area managers in the Caribbean.

Recreational Uses of Marine Resources

Dr. Rogers is also the principal investigator of a study of boating and other recreational uses of marine resources within the park. Park Resources Management Specialist John Miller, park Biological Technician Larry McLain, former park Biological Technician Vonnie Zullo, and several volunteers have assisted in the field. A dramatic increase in the number of boats visiting the park has resulted in severe, localized damage to several coral reefs, both from careless anchoring and from boats striking the reefs. Inexperienced snorkelers also break off fragile coral branches. The reefs are among the park's greatest assets. Coral breaks on selected, particularly vulnerable reefs are recorded monthly.

Following installation of marker buoys near one reef in May (with help from Ralf Boulon, Virgin Islands Government Division of Fish and Wildlife), damage decreased markedly. Monitoring of the damage to coral communities and seagrass beds from boats an-

choring in popular north shore bays continues. Captains of various small cruiseships now visiting St. John have been contacted and are cooperating by anchoring in sandy areas rather than on seagrass or coral communities.

Seagrass Communities

Dr. Susan Williams, from West Indies Laboratory, and graduate student Dan Cooke have completed the field work for a study of seagrass beds and green sea turtles in Francis and Maho Bays on the north side of St. John. Comparison of their recent maps with earlier aerial photographs and a map prepared in 1959 suggest a marked decline in the extent of the healthy grass beds in both bays. The plants they have examined in stressed areas have lower growth rates.

Small turtle enclosures were set up in stressed areas to determine if elimination of turtle grazing would increase grass productivity. Seagrass protection zones, where anchoring is prohibited, have been established in small portions of each bay. Research/Resource Management staff plan to monitor seagrass recovery within these zones in the future.

Buck Island Fisheries

NPS is working with William Tobias from the local Division of Fish and Wildlife and Dr. John Ogden from the West Indies Laboratory in a study of the fish and shellfish populations at Buck Island Reef National Monument off St. Croix. One objective of the project is to determine the effectiveness of protective legislation in sustaining or increasing these populations. Census data (from visual surveys and fish trap counts) are being compared to data from previous studies funded by NPS and carried out by West Indies Laboratory.

St. John's Forests

Work continues this year on a long-term vegetation monitoring project started in 1985. Principal Investigators are John Earhart, World Wildlife Fund, and John Matuszak, University of the Virgin Islands. Anne Reilly and Matt Davis, Yale School of Forestry, are recording standard forestry measurements within three permanent plots in Fish, Hawksnest, and Reef Bay watersheds.

Geochemistry

Cindy Ginez and Carlos Ramos from the Center of Energy and Environment Research in Puerto Rico are

examining the impact of heavy metals in intermittent streams within guts on St. John and on the marine ecosystems which receive runoff from these guts. They are collecting biological specimens to sample chemicals and minerals entering St. John's waters.

Database Management

Dr. Edward Towle and Bruce Potter from Island Resources Foundation are examining different approaches to handling of data collected during all VIRMC projects. They are evaluating different Geographic Information Systems (GIS) and database management systems appropriate to existing and projected research and resource mapping and long-term monitoring activities focussing on biosphere reserve areas.

Some experimental computer-delivered graphics and spatial display strategies are also being developed, and recommendations for a user-friendly VIRMC, GIS and database management system will be made. A test project with computer graphic display of historic watershed land use data is anticipated.

St. John Salt Ponds

Dr. Maynard Nichols of the Virginia Institute of Marine Science has completed the field work on a pilot core-analysis study of selected salt ponds to assess the sedimentation effects of previous land-use practices and to determine the status of present-day input levels to natural impacts over a 500-year period.

The study will provide geochronology of selected cores and reveal likely historical records of changes in vegetation cover, sedimentation and soil chemistry that can affect coastal systems. The results will provide a possible new research strategy for island resource management and technical recommendations for managing watersheds within the Virgin Islands Biosphere Reserve.

Virgin Islands Biosphere Reserve Center

The NPS has made a strong, highly visible commitment to the biosphere reserve program by supporting the research of the Virgin Islands Resource Management Cooperative and through construction of the Virgin Islands Biosphere Reserve Center on St. John. Completed in January 1987, the Center has four buildings which include offices for Research/Resources Management Staff; housing for visiting scientists, students, and volunteers; a small laboratory, a collections area, and a conference room.

The Center, which was formally dedicated on March 25, is a potential focal point for research, training, education, and cooperative activities in the eastern Caribbean.



Virgin Island Biosphere Reserve Center.

computer corner

The Threatened, Endangered, and Exotic (TEX) module on COMMON described in the *Park Science* Computer Corner, Fall 1986 issue, will include all federally classified species, plus all important exotic (alien) species for which active park management programs exist. This data base was designed specifically for exchange of basic TEX species information between regional offices and parks on a Servicewide basis.

At a recent meeting in Washington, organized by Nick Chura of the NPS Washington office (WASO) and Trish Patterson of the Southeast Regional office, it was decided that parks could benefit from development of a data base (in dBASE III) that individual parks could run on microcomputers. Information on federal- and state-listed or other species of concern could be entered and summarized and parks could expand the database to accommodate park-specific data elements and TEX monitoring information.

Information and Data Systems (WASO) agreed to develop and distribute the data base, which will include all data elements currently in the TEX module of COMMON and additional elements such as state status, species location information, and habitat.

Bill Gill described for the meeting the USFWS En-

dangered Species Information System (ESIS) – a database being developed for improving the storage, retrieval, and dissemination of information on nationally listed species. With 177 species records already in the data base, information is being collected on 422 species. All species listed through January 1987 should be loaded by the end of the year. The base contains 66 fields of information, including detailed narratives and standardized keyword fields for information searches. Species information is available through USFWS Regional offices, and information on the ESIS data base can be had from Bill Gill or Mike Hein (702 235-2760) or by writing to ESIS Project Leader, U.S. Fish and Wildlife Service, Office of Endangered Species, Broyhill Bldg., Suite 500, Washington, DC 20240.

The Nature Conservancy (TNC) staff reported that since 1974 TNC had been working in partnership with state governments to create centralized, biological inventories. A network of permanent information gathering institutions, called Natural Heritage Programs, has been established in nearly every state. TNC data bases currently contain records for about 36,000 species, with separate ranks for global, national, and state status. TNC data base also includes information

regarding taxonomy and synonyms, distribution, general biology, and habitat. Information on these species is available through the National Heritage Program state offices. Information on their data base is available from the National Heritage Task Force office, 1800 N. Kent St., Suite 800, Arlington, VA 22207; (703 841-5300).

Jeff Marion, Research Scientist
Mid Atlantic Region

Field Courses Announced

Two field courses in mosses, liverworts, and vascular plant flora will take place in the Juneau area of Southeastern Alaska in June. Dr. Joannes A. Janssens of the University of Minnesota and Dr. Steven J. Wolf of the University of Colorado at Boulder will cover ecology, taxonomy, structure, collecting, herbarium techniques, and field identification.

Other field courses slated for June included one in wilderness resource management (June 8-20) in the Colorado Rockies and Yellowstone – an introduction to ecologic, economic, and recreation issues and led by Dr. Kenneth A. Barrick of the University of Alaska.

For information about this and other field courses, contact Mountain Research Station, University of Colorado, Nederland, CO 80466 (303) 492-8841.

Biology Conservationists Meet

The first annual meeting of the Society for Conservation Biology was being held at Montana State University in Bozeman on June 23-26, approximately the time *Park Science* should be arriving in the hands of subscribers. The meeting is being held to overlap partially with the joint meeting of the Society for the Study of Evolution and the American Society of Naturalists at MSU on June 21-24. The SCB meeting is covering the role of disease in population regulation and conservation, edge effects and conservation, conservation genetics of fish, and the training of conservation biologists. For further information on the Society, the meeting, or the *Journal of Conservation Biology* (in which selected papers from the meeting will be printed), contact Peter F. Brussard, Biology Department, Montana State University, Bozeman, MT 59717.

Interpreters, Managers Discuss Mutual Concerns

The "First Annual Yosemite – Sequoia/Kings Canyon Interpretation, Research, and Resources Management Workshop" was held at Fresno, Calif., May 13, 1987. Park scientists, resources management specialists, and interpreters from the three parks discussed issues of mutual concern, such as prescribed fire and bear management. The current status of research and resources management and how interpretation is being used to address these disciplines was a primary focus of the meeting.

A similar workshop on our Pacific Island national parks is planned for November 1987 at Hawaii Volcanoes National Park. These "mini-workshops" are a direct result of the three Interregional Resources Management/Interpretation Workshops that have been sponsored and conducted by Western Region.

Dick Cunningham
Chief, Interpretation, Western Region

An NPS Caribbean Resource Protection Strategy

The Caribbean Strategy is a comprehensive planning effort designed to provide for long-term protection and perpetuation of U.S. National Park Service (NPS) natural and cultural resources in the Virgin Islands and Puerto Rico. It is a process designed to build support for appropriate stewardship of the Caribbean resources. Although the extent of NPS Caribbean properties is minor compared with that of the Virgin Islands and Puerto Rico governments' and private holdings, NPS visibility and influence in protecting key natural and cultural resources are significant and vital.

The Caribbean Strategy idea evolved from the realization that many of the resource values within the various Caribbean parks and adjacent areas have declined in recent years. NPS holdings in the Caribbean include Virgin Islands NP at St. John and Hassel Island at St. Thomas, Buck Island Reef NM and Christiansted NHS at St. Croix, and San Juan NHS on Puerto Rico. It was determined that those resources require greater attention and protection from a variety of threats if they are to continue to be the principal examples of natural and cultural resources in the Caribbean. The best approach to protect those resources is through a comprehensive and systematic process in which everyone that benefits from the resources can participate in their protection.

To develop that process, the NPS assigned Ro Wauer to the Caribbean for a three-year assignment. Ro is a career NPS employee with extensive experience in resource management as a field ranger, interpreter and superintendent, Regional Chief Scientist and Resource Manager, and was the Washington Office Chief of NPS Natural Resources for five years. Ro has settled on St. Croix with an office at the Cooperative Extension Service, University of the Vir-

gin Islands.

The process began with the identification of seven broad areas of concern, the establishment of a coordinating committee, and the formulation of seven resource groups. Resource group participants will develop a series of concise action plans to address specific concerns within the seven categories. These action plans later will be presented at public forums where concerned individuals will have an opportunity to participate.

Afterwards, the revised and completed action plans will be presented to an assemblage of key Congressmen, conservationists, and other pertinent peoples who will be asked to endorse the actions called for and to support followup management activities, including the acquisition of new and necessary funds.

The timeframe for the fully implemented Caribbean Strategy process may take years, but the initial steps that lead to a "constituency" conference should be completed by early 1988. In the meantime, all feasible short-term actions required to correct resource problems in the parks will continue; all of the ongoing and new actions will be written into the broader range action plans.

In summary, the Caribbean Strategy process includes the: (a) documenting of all the pertinent resource concerns and activities completed and ongoing, (b) incorporating all prevention and mitigation activities needed for short-, mid- and long-term resource protection, (c) utilizing all pertinent organizations and individuals in the process, and (d) building a constituency through which all the necessary support and resources can be obtained.

Ro Wauer

superintendent's corner



By Robert W. McIntosh, Jr.

Superintendent, Gateway National Recreation Area

The loss of grassland habitat in the New York metropolitan region is a well documented phenomenon, exemplified dramatically by the rapid disappearance of the Hempstead Plains on Long Island. Grassland acreage continues to decline due to both urban encroachment and the absence of natural factors that influence successional changes. And because of habitat loss, grassland-dependent fauna are declining. Several grassland birds are now on the Endangered, Threatened, and Special Concern lists for most states in the U.S. Northeast.

Gateway's Floyd Bennett Field, a former municipal airport for New York City and later a military airfield, has a history of supporting populations of grassland birds; current surveys have recorded over 150 species. In the past decade northern harrier, American kestrel, upland sandpiper, barn owl, shorteared owl, horned lark, eastern meadowlark, and grasshopper sparrow have all frequented the prairie-like grasslands which have developed on the dredge spoil used in the 1920s and 30s to transform the salt marshes of Barren Island into airport. Most of these species utilize the grasslands for both nesting and feeding. The barn owl and kestrel are cavity nesters, and depend on the grasslands for feeding habitat. This impressive list of grassland-dependent nesting species is augmented by migrant and wintering birds, most dramatic of which are roughlegged hawks and other raptors.

In 1979, the first formal suggestion of grassland management at Floyd Bennett Field was made. This came in a parkwide survey of avifauna done by New York City naturalist, Dr. Peter Post. The proposal recognized the threat that successional changes posed to the continued existence of this regionally unique habitat. The subsequent Gateway General Management Plan, Natural Resource Management Plan and the Floyd Bennett Field Development Concept Plan reiterated these concerns and suggestions, based not only on wildlife, but also on the need to retain the flat, open landscape of Floyd Bennett Field's historic civil aviation period. By 1984, through the encouragement of Al Appelton, New York City Chapter of the Audubon Society, Gateway National Recreation Area (NRA) and other conservation organizations had assembled to form the Grassland Restoration and Management Project Committee; G.R.A.M.P.'s for short.

Composed of staff from Gateway, representatives

of New York City Audubon Society, the Seatuck Research Program of Cornell Laboratory of Ornithology, and scientists from local universities, the G.R.A.M.P. Committee has directed a program of management oriented research into bird/habitat relationships at Floyd Bennett Field. Cooperatively funded research conducted by Seatuck biologists began in 1984 and will continue through the 1987 field season, thanks to a recent Herbert E. Kahler Research Fellowship from the Eastern National Parks and Monument Association. With Gateway's budget priorities, these "outside" funds were instrumental in completion of necessary field work for the final year's investigation.

This research has produced a number of products both immediately applicable to habitat management at Floyd Bennett Field, and useful as baselines for future comparisons. A covertype map and survey of breeding birds, important in their own right, formed the basis of a multivariate analysis. Cluster analysis of these data revealed four species associations; habitat generalists, shrubland species, grassland species, and development species. Based on these associations, the outcome of various habitat management scenarios was projected and has formed a partial basis for Gateway grassland and visitor-use management decisions.

While such latitude in habitat management is uncharacteristic of most National Parks, Floyd Bennett Field is unique, in that, its landform is primarily human created. The General Management Plan called for a "new, natural landscape . . . created on the underlying impacted land." The Floyd Bennett Field Development Concept Plan also endorsed the idea of restoring the landscape to a condition more in harmony with surrounding natural areas, and called for retaining the existing grasslands. Finally, the concepts of habitat and species diversity, on both a site-specific and regional level had to be considered.

As open grasslands disappear, so too would all the grassland-dependant bird species. Considering the regional rarity of these species, loss of these populations would be significant. Based on a concept of increased diversity, and using maps of habitat interspersion and juxtaposition, the Seatuck reports recommended consolidating some of the existing, fragmented grasslands by removing encroaching shrub patches. Subsequent reconnaissance has found that of over 1,400 acres at Floyd Bennett Field, approximately 120 acres can be managed to provide a large continuous grassland. With this approach, Gateway will retain its population of grassland birds; it will also be managing for unimpeded succession, which will continue on roughly 760 additional acres of Floyd Bennett Field. Thus, both grassland and woodland wildlife can be managed for, with the commensurate benefits of wildlife observations, series of walking trails, wildlife and species diversity, camping skills, and other non-resource consumptive recreation activities.

Implementation of active management began in the winter of 1985-86 as "roughneck" crews from New York City Audubon Society began clearing patches of bayberry and black cherry from a 25 acre parcel. As called for in a Floyd Bennett Field Grassland Management Action Plan, this process of initial clearing will continue until 1988. Following this phase in each area, a period of intense cutting of resprouting growth is envisioned, ultimately settling into a routine of mowing half the entire grassland area each year.

As management proceeds, so too will scientific and resource management monitoring activities. Breeding birds will continue to be mapped throughout the grasslands, and changes in bird species composition in the

managed area will be noted. Photo monitoring stations and line transects will be used to document changes in the physical structure and species composition of vegetation in the managed area, as well as to compare with changes in similar but unmanaged areas.

The anticipated outcome is that by the mid-1990s, Floyd Bennett Field could become a national focal point for grassland wildlife management and a working model of how these diminishing grassland species can be managed. The cooperative nature of this project is rewarding; each party is able to offer a service or ability that complements the others and has enabled the project to progress so far. The activity however, is "biological" in nature thus long-term. Only the targeted bird species can "tell" us the success of this project, with their changing numbers over the years.

This is an exciting activity that has fostered all the necessary ingredients for expressing the traditions of National Park Service science, resource management, and cooperative activities. The project is creating biologically productive, diversified, and educational urban wildlands within the nation's largest metropolitan area. It is an attempt to show that we can, if we try, live in harmony with our environment.

Any questions or requests for copies of the documentation to date on this project should be addressed to John T. Tanacredi, Chief, Officer of Resource Management and Compliance, Gateway National Recreation Area, Floyd Bennett Field, Brooklyn, New York 11234.

Wolf Recovery Plan Draft Moving Through Interior

An agency draft of the Northern Rocky Mountain Wolf Recovery Plan for Yellowstone NP is in the process of approval within the Department of the Interior, according to Norm Bishop, NPS interpreter at Yellowstone. The wolf's ecological niche at Yellowstone has been vacant since 1927, when national policy was to exterminate wolves on all public lands.

An international wolf symposium was held in Washington, DC at the National Geographic Society building on May 22 in conjunction with the opening there of the "Wolves and Humans" exhibit, produced by the Science Museum of Minnesota. The symposium was sponsored by Defenders of Wildlife, supported by the National Geographic Society.

Erosion Techniques Course Set

An international technical course that will teach how to retain earth masses and how to prevent soil losses from slopes and stream banks and how vegetation, structures, and geosynthetics can be used together in attractive, environmentally compatible and cost effective ways will take place July 15-17, 1987, at the University of British Columbia in the Walter Gage Complex, Vancouver, B.C., Canada. For information on the course, "Biotechnical Slope Protection and Erosion Control," write Don Theobald or Sue Boyd, Dept. of Engineering Professional Development, 432 North Lake St., Madison, WI 53706, or phone 608-262-3516.

Prairie Restoration/Management At Homestead: A History

By James Stubbendieck and Gary D. Willson

Homestead National Monument of America (HOME) is located 5 miles west of Beatrice, Neb., on 160 acres first homesteaded by Daniel Freeman in 1862. In 1936, Congress set aside the 100 acres of formerly abused pasture and cropland and 60 acres of woodland as a permanent monument to the homesteading era. Physical features of the site are dominated by Cub Creek, a major tributary to the Big Blue River, and its adjacent bottomlands. The balance of the site is made up of moderately steep glacial till with eroded sandy and gravelly side slopes.

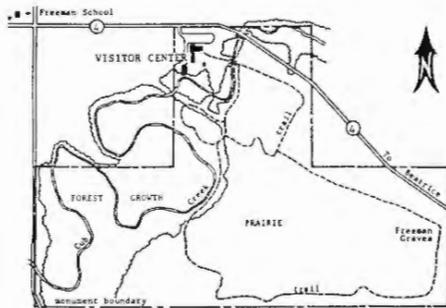
Because of the importance of prairie to the settler, the primary objective of HOME has been restoration of the landscape to approximate the original conditions encountered by Daniel Freeman. This goal has been evident from the first management plan written by Wildlife Technician Adolph Murie circa 1938. Murie described two possible restoration methods; one was transplanting sod from a local prairie, and the second was seeding. He realized the advantages of sodding by stating, "... not only is prairie grass brought into the area, but also native species of prairie herbs." In preparing this first management plan, Murie contacted the eminent prairie ecologist, Dr. J.E. Weaver of the University of Nebraska, who felt that this project, "contained the possibilities of an excellent experiment ..."

When the site was acquired by the National Park Service, severe erosion had occurred on the upland slopes, heavy depositions of silt were on the lower slopes, and the woodlands were cutover and heavily grazed. Management during the early years at HOME

centered around stabilizing the severely abused soil and protecting newly planted native grasses.

At least 40 acres of the site were under cultivation as late as November 1939. Park records indicate that the first seeding took place in 1939 with seed gathered from a prairie located approximately 5 miles to the west. The approximate seed mixture was 45 percent big bluestem; 50 percent little bluestem; and 1 percent each of Kentucky bluegrass, needleandthread, indian-grass, prairie dropseed, and sideoats grama. The first sodding also was carried out in 1939 to control severe sheet, rill, and gully erosion on the coarse-textured south upland slopes. Source of the sod is unknown.

Park map.



Cropped upland and overgrazed woodland at Homestead NM in 1939.



Recent view of restored upland prairie at Homestead NM.

The following is a selected summary from park records of the management history at HOME between 1942-1986.

1942 - Additional seeding and sodding along with the construction of small check dams to slow erosion.

1943 - Weed control; sunflowers were mowed and bindweed was treated with sodium chlorate.

1947 - Sodding in upland gullies; seeding and local prairie hay mulch used in eroding areas.

1948 - Additional spot seeding; sod added to the uplands; selective grazing suggested as a means of reducing fire hazard.

1949 - First use of a herbicide other than sodium chlorate (2,4-D).

1951 - 40 acres moved.

1952 - Upland hayed.

1953 - Bottomland hayed.

1954 - Seeds harvested.

1955 - Smooth brome grass infestation noted.

1963 - 2,4-D used for weed control.

1964 - Lowlands heavily infested with weeds. Dalapon used for smooth brome control and 2,4-D for broadleaf weeds.

1965 - Thatch buildup leads to complete mowing.

1968 - Smooth brome mowed.

1969 - 7-11 acres of lowland seeded.

1970 - First prescribed burn; 2,4-D applied.

1976 - Four acres of lowland reseeded.

1979 - Woody plants sprayed with ammonium sulfamate; routine 2,4-D spraying program stopped.

1980 - 17-acre wildfire occurred.

1982 - Quantitative vegetative sampling begun; prescribed burn in April (8 acres); manual removal of musk thistles and common mullein.

1983 - Entire prairie burned; 4 acres of weedy lowland mowed.

1984 - Weedy lowland mowed; fall burn of small overgrown sumac; herbarium assembled.

1986 - Lowland area sodded and planted with approximately 3,000 greenhouse grown seedlings from locally collected prairie seed.

This chronological summary shows clear changes in management emphasis as prairie restoration at HOME evolved. The first priority of soil stabilization gave way to an interest in more natural management of vegetation. For example, prescribed burning replaced mowing and the general use of herbicides. A logical, progressive understanding that management procedures can be integrated and selected to obtain certain results has occurred. Interest has also moved from native grasses in the early stabilizing years of HOME management in the 1930s and 1940s, to an interest in legumes in the 1950s, and on to a more recent and complex understanding of the role of forbs. Quantitative sampling of the vegetation was initiated in 1982 and a herbarium was assembled in 1983 and 1984. A recent concern has emerged over the use of local gene pool sources for future introduction of plants, which indicates a further evolution of the park's understanding of the prairie ecosystem.

HOME is one of the oldest ongoing prairie restorations on a man-altered landscape. The only other nearly contemporaneous example is restoration of the Curtis Prairie in Madison, Wis., in the 1930s. The Curtis Prairie started with a less disturbed site and benefited from the intensive labor of CCC crews and close association with Dr. John Curtis and University of Wisconsin graduate students.

Stubbendieck is Professor of Range Ecology at University of Nebraska - Lincoln; Willson is Ecologist/Operations for the NPS Midwest Region, Omaha, Neb.

Groundwater Contamination Charted At Big Cypress Well Drilling Site

By Cordell Roy, Mark Flora, and Bruce Freet

Oil well development in the Big Cypress National Preserve (BICY) generates large amounts of "produced water" during the drilling process. These produced waters, contaminated both by high concentrations of dissolved solids (found naturally in the deeper aquifers underlying the preserve) and contaminants associated with drilling fluids and muds, pose a potential water quality problem if not properly managed.

A suspected loss of produced water brines from a temporary surface storage impoundment at the BICY Raccoon Point oil field in 1984 degraded water quality and resulted in damage to vegetation located down-gradient from the impoundment. To evaluate this problem, a cooperative effort among Exxon, U.S.A., the National Park Service, and the Florida Department of Environmental Regulation ensued. A mutually agreed upon study design was adopted, and Exxon, U.S.A. contracted with the consulting firm of Environmental Science and Engineering to carry out the field work.

Focus of the first study was to document 1) the severity of biological and water quality perturbations, and 2) the water quality recovery rate at the suspected spill location (Site 2). Concurrently, a second study was begun at a new drilling location (Site 28) to investigate groundwater contamination that might be occurring from the routine use of mud retention pits. Individuals from each organization met every 3-6 months to evaluate the groundwater monitoring data and reassess the potential for future contamination.

Prior to the leaching incident, produced water, drill cuttings, and drilling fluid residuals were temporarily stored in clay-lined, surface water impoundments known as mud retention pits. When sufficient drill hole depth was reached, the liquid portion of these residues was reinjected into the drill hole to a depth far below the usable groundwater aquifer. The residual solids, consisting primarily of drill cuttings, were then trucked away to a landfill outside the preserve. Eventually, the area disturbed by the impoundment (approximately 0.8 acre) was restored.

Over the six year period that the Raccoon Point oil field was developed, both Exxon, U.S.A. and the National Park Service learned several lessons. First, the mud retention pits require extra space. If procedures could be modified to reduce or eliminate these impoundments, less of the natural system would be disturbed and less area would require future restoration. Secondly, even with careful management, the temporary nature of these impoundments increased the risk of a breach or a spill. Finally, while efforts were made to line the impoundments with impervious bentonite clays, the porous nature of the sand impoundment berms and underlying limestone raised concerns that the impoundments might cause long-term groundwater contamination.

The biological implications of the suspected brine leaching at the Site 2 location were not immediately obvious, since the incident occurred during the dry season after the surrounding pond cypress trees had lost their leaves. When cypress leaf out occurred in March, 1984, a "dead zone" of pond cypress was reported over an area of three acres downgradient of the mud retention pit. A more extensive survey in July, 1984 confirmed this report and further indicated that abnormal basal sprouting was occurring in the surviv-



The upper photo shows the Site 28 oil pad at Raccoon Point. Note the large area utilized by the mud retention pit at the lower right hand corner of the pad. The lower photo illustrates the first well using a containerized system drilled in Big Cypress National Preserve. Note the smaller amount of land required for facilities using this techniques. This well was redrilled on an existing two-well pad.



ing cypress over an area of approximately seven acres downgradient from the pit.

Six monitoring wells were installed at the Site 2 location in October, 1984. Four of these wells were located between 15m and 225m downgradient of the mud retention pit; the other two wells served as controls. "Shallow" wells of 0.4m depth were used to monitor specific conductance, chloride, sodium, pH, and oil and grease in the root zone of the cypress, while "deep" wells of 2.7m documented these water quality parameters in the upper zone of the groundwater aquifer. Chloride concentrations at shallow well 2B, located in the root zone approximately 90m downgradient of the pit, peaked at 1380 mg/l approximately 18 months after the leaching incident (Fig.1). This peak value is significantly higher than chloride concentrations found in the shallow control well (13 mg/l-

42 mg/l) and is within the range of chloride values reported as damaging to cypress trees (500 mg/l - 2000 mg/l). Chloride concentrations decreased dramatically during the following wet season, and by March, 1986, the end of the first phase of this work, they were down to 148 mg/l. Since chloride concentrations in the root zone tend to increase during the dry season and decrease during the wet season, projections made by Environmental Science and Engineering suggest that peak chloride concentrations at this well during the dry season will continue to exceed 500 mg/l for at least 3 years following the spill.

The second study was designed to assess the integrity of the routine use of mud retention pits with respect to groundwater contamination. In this study, monitoring wells (4 "shallow" and 5 "deep") were established both upgradient and from 10m-30m down-

letters

To the Editor:

I have enjoyed reading *Park Science* and have received a lot of useful information over the years. As the Marin Monarch Butterfly Project Coordinator I read with particular interest "Monarchs' Migration Is Concern" (p. 7) in the Winter 1987 issue and I write now to clarify a point: there are two North American monarch butterfly populations, those that overwinter in California do not continue on to Mexico.

The butterflies overwintering in California make up the western North American monarch population. They summer in the Pacific Northwest, southern British Columbia and all the western states to the Rockies. Driven by cooling fall days to take refuge along the moderate California coast, monarchs cluster in 45 known roosting sites. These sites, crucial in the life cycle of the monarch, are currently threatened by housing and commercial construction as well as agricultural development along the spectacular California coastline. The National Park Service coordinates site surveys, tagging efforts and protection projects in Marin County, GGNRA – part of a statewide effort to learn more about the monarch butterfly.

There is also an eastern monarch population. It ranges between New England and parts of Canada, north to the Great Lakes region and they migrate south to overwinter at the famous mountain winter havens in Mexico.

Thank you for your consideration of this clarification.

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To the Editor:

Quinn et al. (*Park Science*, Fall, 1985) are gathering interesting data relating habitat island size to number of species. Subsequent discussion by Bratton (*Park Science*, Winter, 1986), White (*Park Science*, Spring, 1986), and Quinn and van Riper (*Park Science*, Summer, 1986) has emphasized factors in addition to reserve size that are important to design of nature reserve systems. We raise a question about the appropriateness of some of Quinn et al.'s data to their hypothetical choices of reserve system designs, and suggest reserve systems should be designed within a landscape context.

One goal of Quinn et al.'s paper is to provide data bearing on the question of whether "a few large areas . . . (or) a number of smaller tracts, equal in area to the larger ones" (p. 6) (note the narrow range of reserve sizes) will conserve more biological diversity. Yet the natural island, experimental grassland, and marine systems they describe have a wide range of reserve sizes, an important structural difference. Their grassland experiment compares reserves that differ 16-fold in size in *one* reserve system. In this system the large islands (and probably the surrounding landscape – a very large source of organisms) help maintain diversity on small islands since animals and probably plants can move among islands. For example, the larger population sizes on large islands may make them the source for a large proportion of the recent colonists on small islands. Thus the structure (range of island sizes in this case) of the reserve system is probably important to the number of species on islands in each size class.

There is a similar difference in the structure of natural island systems they describe and alternative man-made reserve designs. The authors compare numbers of species on the largest islands (at least in the Galapagos and Hawaiian archipelagos) with those on the other smaller islands. But the species diversity

on the islands in each size class results in part from species interchange in archipelago ecosystems that include a wide range of island sizes. Interchange will be less important in the Hawaiian archipelago since islands are farther apart.

The marine system comprised of "reserves" of hard substrate on a sandy flat also contains a wide range of reserve sizes. The constant influx of propagules of all species from the ocean is another important difference between this system and Quinn et al.'s hypothetical choices of reserve systems.

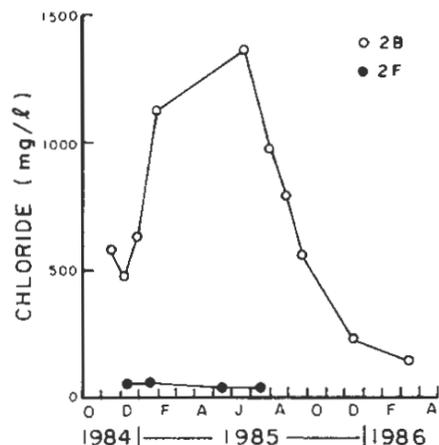
The data discussed by Quinn et al. contribute to this scientific field, but are not directly applicable as a guide to choosing among reserve systems comprised of similar-sized reserves when the goal is to conserve maximum biological diversity. Though data from natural islands suitable for addressing this question are probably quite rare, experiments can be designed that directly address this point.

Our second point is each reserve system is part of an encompassing landscape-level ecosystem with which it has many interactions – no reserve is an isolated island. The previous discussion and a short list of interactions illustrate the point. Some species will use resources outside reserves, transverse boundaries frequently, and some would maintain healthy populations even without reserves. While certain species prefer edges, interior species may need large buffers in order to avoid the modified edge environment (scale of meters to hundreds of meters) or the influx of predators or competitors from the non-reserve landscape. Interchange among reserves can occur if distances and adequate travel corridors (when needed) allow species movement. These interactions will depend on the composition, sizes, and shapes of different units in the landscape pattern, and importantly, will change as the landscape mosaic changes. Reserve systems therefore should be designed to *function* as part of the encompassing landscape ecosystem and to anticipate temporal changes in this landscape.

In the United States many National Parks abut other extensive federal lands. USDA Forest Service managers, for example, typically manipulate relatively large landscapes (relative to National Parks) and control a contiguous pattern of habitat patches and corridors in a dynamic state. They must manage for a wide range of values, including timber, recreation, water, wildlife, range. National Park Service managers on the other hand have different perspectives and options, managing one or two reserves within a landscape over which they have little or no control. Their objectives are admittedly different. Design (and management) of reserve systems and single reserves and management of adjacent lands would benefit from close coordination and long-term commitment among all managers of the landscape.

Studies of population biology and island biogeography to be applied to reserve systems must be put in a landscape context. From this perspective differences in structure (see discussion of grassland and natural island systems above) and context (see discussion of marine system above) become apparent. The emerging field of landscape ecology (see for example *Landscape Ecology* by R. Forman and M. Godron, 1986, Wiley) and tools for analyzing information in a spatial context (such as geographic information systems) promise to be of increasing value in this effort.

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Source: ESE, 1986

Figure 1: Chloride concentration in shallow down-gradient well 2B (90m) and shallow up-gradient well 2F following the suspected brine leaching incident at site 2.

gradient of a new pit (Site 28) prior to oil drilling. No contamination was noted for the first two months following the outset of drilling which began in December, 1984. However, by February, 1985, specific conductance and both sodium and chloride concentrations began to increase in "deep" wells 10m (well 28B) and

30m (well 28D) down-gradient from the pit. Chloride concentrations peaked (1190 mg/l) at well 28B in July, 1985, and at well 28D (690 mg/l) in September, 1985, indicating that clay-lined, mud retention pits are not impermeable and serve as a probable source of groundwater contamination.

Based upon these results, Big Cypress National Preserve and Exxon, U.S.A. agreed that changes in well drilling procedures were warranted. Numerous technical alternatives were considered to implement this change, including modifying existing technique, liner systems, and containerization. Agreement was reached and oil and gas plans of operations were amended to stipulate that drill cuttings be separated from the drilling fluids and produced water, and that the liquids be stored in closed, containerized systems prior to underground disposal. Additionally, the Florida Department of Natural Resources, drawing on the results obtained from this study, now requires that all oil and gas drilling in the Big Cypress Area of Critical State Concern (an area that includes the preserve) use containerized systems. Though more expensive to the operator, these new procedures better protect water quality and disturb a smaller area of land.

Roy was formerly a minerals management specialist with Big Cypress National Preserve and currently is an environmental specialist in the Division of Minerals Management, Alaska Regional Office. Flora is a water quality specialist with the NPS Water Resources Division in Fort Collins, Co. Freet is a Resource Management Specialist, Big Cypress National Preserve.

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In the Next Issue:

"Uniform Appearance? Yes, Uniform Terms? Not Yet" by Larry L. Norris; "Biological Diversity FY 1989 Initiative for Interpretation" by Richard Cunningham; "Risk Recreation Poses New Management Problems" by Alan Ewert; "Research at Wind Cave: Big News from a Little Park" by Kirsten Krueger.

book review

Wildlife in Transition: Man and Nature on Yellowstone's Northern Range by Don Despain, Douglas Houston, Mary Meagher, and Paul Schullery. 1987. Roberts Rinehart, Boulder, CO. Paperback, 143 pp. (ISBN 1-911797173) \$6.95.

During the last 20 years, management of Yellowstone's northern range has been an extremely controversial issue. The recent publication of Alston Chase's *Playing God In Yellowstone* has further fueled the fires of controversy.

The authors of *Wildlife In Transition* have attempted to present the National Park Service's perspective and incorporate the scientific and philosophical basis for management policies. The intended readership is a well informed park visitor or lay person.

My overall impression of the book is very positive. It is readable, informative, and generally well done. The introductory chapter, "A Wilderness In Transition," includes an excellent discussion of problems faced by park managers and scientists in studying and managing national park ecosystems. I will probably use this material in an upper division class which I teach.

Most importantly, the relationship between research and management is discussed. Despain et al. emphasized that National Park Service research had not been aimed at supporting existing policies and that researchers must never let employers' demands interfere with objective research. Although critics will disagree, the authors contend that management of the northern range has evolved from a growing scientific understanding of plant-herbivore relationships, which include a distinction between "economic" and "ecological" carrying capacities. Furthermore, a "great experiment" is underway, which will result in an improved

understanding of the ecosystem.

Most of the text is contained in two chapters dealing with mammals and vegetation. These chapters include historical perspectives and a number of excellent photographs. An important theme of these chapters is that grazing animals and vegetation have co-existed for a very long time on the northern range, and that any attempt to draw conclusions based on short-term studies or subjective impressions is likely to fail. For example, "overgrazing" by elk has been blamed for increased erosion and siltation into the Yellowstone River, when fluctuations in rainfall are likely to have been the actual cause.

However, cause and effect relationships are difficult to establish because so little research has been peer reviewed and published in scientific journals. Most citations in the bibliography have been published as popular articles or in "fugitive literature" as symposium proceedings or research notes. Clearly there is need for more high quality research.

Although there is a great deal of information in this book, which should help the reader better understand this complex ecosystem, I believe the most important contribution is the delineation of the experimental management approach as implemented on the northern range. The authors admit that management policies may have to be changed as we learn more about the system, but that such changes must be based on sound research findings.

In summary, I liked the book. I especially recommend that it be read in conjunction with any of Alston Chase's work on Yellowstone. Furthermore, the price is right, \$6.95 is a bargain for such a valuable book.

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Divers To Meet in Seattle

The American Academy of Underwater Sciences (A.A.U.S.) is a self-regulating body, organized in 1977, incorporated in 1983, and concerned with diving safety, state-of-the-art diving techniques and methodologies, and research diving and expeditions. Membership is open to any individual or organization committed to the advancement and practice of scientific diving.

From 1981-1985, the annual Scientific "Diving for Science" symposia were held at Scripps Institution of Oceanography; the 1986 "Diving in Overhead Envi-

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ronments" was held at Florida State University, Tallahassee.

"Coldwater Diving for Science," to be hosted by the University of Washington, Seattle, Oct. 29 to Nov. 1, 1987, has been organized to provide diving scientists the opportunity for sharing information on a variety of aspects of underwater science and scientific diving.

For additional information contact: John Eriksen, Workshops Chair, University of Washington, E.H. & S., GS-05, Seattle, WA 98195, (206) 543-0467; or Michael Lang, Symposium Chair, Dept. of Biology, San Diego State University, San Diego, CA 98128, (619) 265-4676.