

# PARK SCIENCE

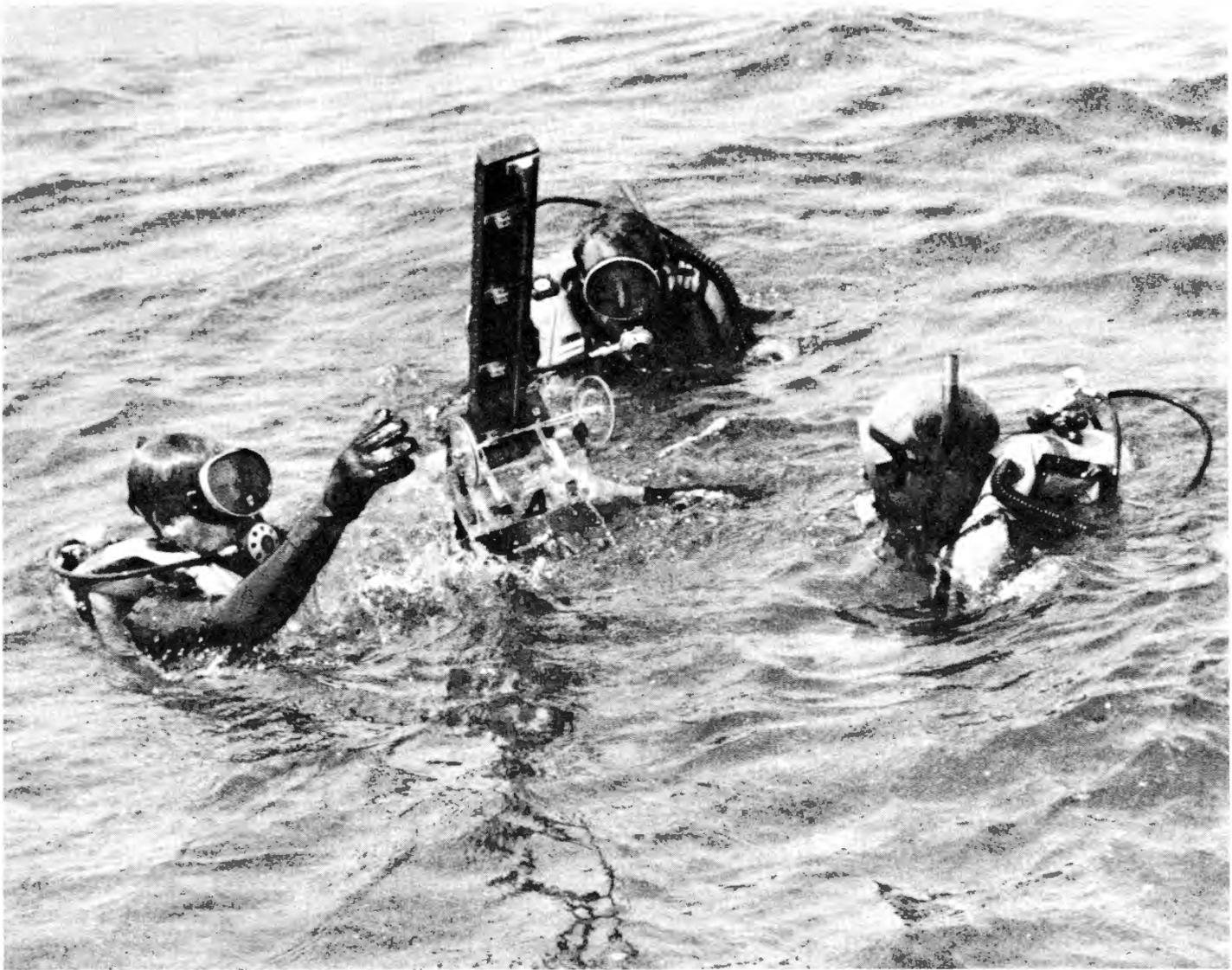
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**Cover:** SCUBA divers from Fire Island NS (Jim Clark, Jim Northrup, Allen O'Connell from left to right) starting to deploy the Kana-type suspended sediment sampler consisting of five collectors (see page 3).

#### Editorial

"Positive directions, new opportunities" is the subtitle of the Final Report from the 1986 Conference on Science in the National Parks – a forecast that reflects the prevailing mood of the 1986 Fort Collins gathering as depicted by Conference Co-chairman and Report author Ray Herrmann.

The Report, a summary of the Proceedings, which is being published and distributed to conferees by the Conference co-sponsor – the George Wright Society, notes that the focus was "deep-seated, mutual concern about the proper relationship of science to the management decision-making process of the National Park Service." The seriousness of the dialogue was "provocative and encouraging," according to the Report, especially since its participants (more than 400) included the NPS directorate, superintendents, researchers from the natural, cultural, and social sciences, resource managers, and interpreters. Representatives from universities, other agency research organizations, and officials from six foreign countries plus the general public lent added dimension to Conference give and take. Excerpts from the Report appear on page 20 of this issue.

At the project information level, another useful publication appeared this summer – *Highlights of Natural Resources Management*, a report on NPS activities in 1986, dedicated to the memory of Thomas W. Lucke, "a vibrant, caring, energetic man whose joy in nature, in life, and in his fellow human beings was so generously shared and so untimely lost." This 30-page report, gathered mainly by word of mouth, is the first attempt at an Annual Report and is part of the NPS Natural Resources Program publication series. Donna O'Leary of the NPS Air Quality Division (P.O. Box 25287, Denver, CO 80223-0297, FTS 776-8784, (303) 236-8784) is editor of this admittedly incomplete compilation of research and technology, actions and initiatives, cooperative activities, and "emerging concerns." This year a formal request for Report material is going out to Regional Directors and through them to the parks, with the idea of compiling a more complete and representative 1987 Annual Report.

And finally, two new *Park Science* features appear in this issue: notes on Historical Research (page 17) and Geographic Information (page 10), bringing more texture and depth to this quarterly reflection of our evolving research and management process.

#### We're Losing Another One – DARN!

About the time this issue arrives in your hands, Bill Lukens, superintendent of Padre Island National Seashore and a much valued member of the editorial board, will be leaving his post. "Some call it retiring," he writes, "but I like to view it as trying something different."

His suggestions for improving have always been thoughtful and on target and we will miss him sorely. Whatever "something different" is, it will be well served when Bill tries it.

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# Nearshore Sediment Transport Studies

By James R. Allen

The beach is the fundamental resource of most of our National Seashores in terms of visitor enjoyment, due importantly to its role as the principal locus of ocean energy dissipation. The beach is a unique but poorly understood habitat in itself, an important media for nutrient exchange between terrestrial and marine ecosystems, and the main driver of onshore ecological zonation.

Improvement of our knowledge of the natural processes driving beach behavior from the outer bar to (and sometime through) the dune, benefits recreation and resource managers as well as interpreters. While many parks have some documentation of past shoreline changes, comprehension of why some areas differ from others is often elusive. In many instances the answers lie offshore in the sediment transport link between bottom topography and wave energy dissipation. Many gaps remain in our understanding of when, where, and why beaches change their form.

Park administrators face additional problems arising from the intervention of society with the natural coastal processes. Coastal environs likely are the most energetic, dynamic, and changeable found on the earth, yet people continue to impose static plans for land use, support structures, and resource management. Many of these actions are external to the parks and are difficult to prevent because often we are unable to conclusively document a causal relationship. Sometimes we are simply overwhelmed by other needs of society.

The impacts upon park resources are extremely costly to mitigate in order to preserve or restore resources and retain visitor access to them. Every Seashore along the Atlantic and Gulf coast suffers from threats due to coastal manipulation in one (usually more) form or another. The specter of accelerated sea level rise also clouds our vision of optimal seaside management.

Two ongoing studies of the nearshore zone with different management goals are: (1) the beach erosion that threatens communities at Fire Island National Seashore (FIIS) to better understand the natural role of nearshore energy dissipation, and (2) investigation of an altered system to mitigate the harm thought to be caused by an external structure at Riis Beach, Gateway NRA.

## Fire Island National Seashore

The shoreline on western FIIS is retreating on bay and ocean sides in response to storms acting on a rapidly rising sea level. This is perceived as extremely hazardous to life and property in the 17 communities intercalated among the park-administered lands. Such powerful forces demand protection.

Recently we discovered that beach and dune erosion during storms is often localized and spatially periodic. Understanding why this occurs is required before we can evaluate protection schemes proposed by others or advise property owners and permitting agencies on permissible actions, and effectively manage our own resources. For one week in each of the past three years, Dr. Norbert Psuty (Rutgers University) and I have been studying a persistent beach re-entrant at Old Inlet. The experiments had extensive support from FIIS personnel. (J. Hauptman, D. Weir,

A. O'Connell, J. Northup, D. Griese, R. Stավdal, S. Singler, M. Tripi, J. Clarke, N. Howell, and B. Fulsom deserve special thanks).

In each field season, several times per day, we simultaneously deploy electromagnetic, bi-directional current meters 0.1m above the bed (on sensor mounts built by Tripi) on the longshore bar by SCUBA divers, with instrumentation on the park's ISLAND QUEEN, and in the inner surf zone, with instrumentation on the beach, to measure aspects of the near-bottom velocity field. The sensors are cabled to the support locations where the 18 minute records of data sampled at 0.2s have been stored on strip-chart analogue recorders for subsequent digitizing. (this year all data will be directly logged in digital form). reduction and analysis. Both bedload and suspended sediment traps were used to measure sediment transport. Beach surveys were extended to depths of 9m, the local limit of sediment exchange, using the QUEEN'S recording echosounder.

Simply put, we measure the processes and responses taking place but the analysis and correlation are most difficult. Obtaining satisfactory results has been tedious because of the need for extensive field training, refinement of techniques and instrument design in the face of highly energetic surf, electronics failures, and scheduling constraints.

Initial results indicate, rather surprisingly, that there is a flushing of very high sediment concentrations in periodic bursts out of the surf zone through the gap in the longshore bar. The inshore and bar stations show a dominance of incident waves (5-10s) with a secondary but quite small subharmonic excitation (usually 12-20s); the hole in the bar is usually dominated by the incident wave oscillations but there is a strong secondary excitation directing the sediment bursts offshore at 50-80s intervals.

These rip current features have not been identified before. Even though the bursts are lower in energy and frequency than the incident waves, the 50-fold increase in sediment concentration results in the phenomenon accounting for more than 50 percent of the total cross-shore sediment movement. Other investigators also are finding that these long period waves (known as infragravity waves to scientists and "surf beat" by surfers) sometimes may contain even more energy than the more visible incident waves.

Our evidence suggests that infragravity waves may control the regular pattern, i.e. the repeated embayments in the shore, often noticed with beach erosion by generating edge waves along the shore.

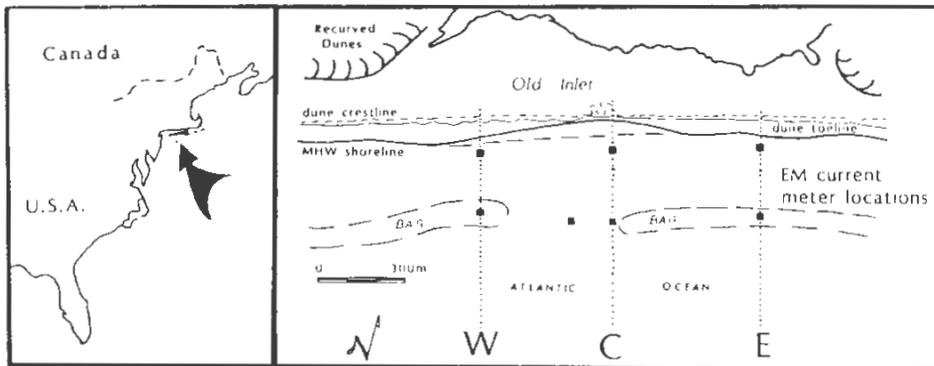
Edge waves are regular undulations of the sea surface formed by the harmonic or subharmonic resonance of reflected energy of incident or infragravity waves. They allow for higher incident wave runup hence greater erosion at the edge wave crest and thus explain why there can be alternating sequences of untouched versus heavily eroded dunes and why the nearshore bar deforms in a similar pattern during storms. Whether the *a priori* bar configuration controls the infragravity forced edge waves or whether the bar is the response to the sea-state process remains unknown at present because we have yet to detect the edge wave. Nevertheless, we do have the appropriate energy source frequency to generate the documented shoreline response if we assume edge wave theory is correct.

Now we think we know how even small storms can cause extreme beach erosion in restricted locales where structures and lives may be threatened. Among the many important implications are that the erosional re-entrants are deterministic – not randomly occurring – and therefore should be predictable; they offer a means by which even small storms can have extreme event impacts in restricted locales; they can penetrate even the widest beaches at Fire Island overnight. Thus wide beaches and artificial dunes are illusory protectors – indeed any small protection scheme is likely to fail in their presence.

These erosion sites can be quite vexing to some parks because ORVs are forced into the dunes to safely pass the unpredictable obstacle. This information is especially advantageous to park management in advisory sessions with communities on the futility of many proposed erosion protection schemes and in designing longer-term solutions such as placing all structures on suitable high pilings. Appropriate acquisition strategies must be developed and implemented when individual properties are lost.

## Riis Park, Breezy Point Unit, Gateway NRA

Erosion at Riis Park threatens the Bathhouse which is on the National Historic Register and houses many support functions including concessions. The narrowed beach also limits the space available to the two million users during the summer months. Again, storms and sea level rise, combined with a sediment supply deficit, are the underlying causes of a shoreline retreat which has been addressed by the construction of an 8-mile long groin field in this century. The erosion rate increased drastically in the last five years, just after a large groin was constructed at the eastern (or



Old Inlet, Fire Island National Seashore study site location and data collection transects. Plan from aerial photo of April 9, 1984.

updrift in terms of the net sediment transport direction) boundary of the park.

Mitigation of any negative impacts of the groin was assured by the Corps of Engineers prior to construction but they now deny any association of the accelerated erosion with their structure. NPS speculation is that the groin deflects a substantial portion of the sand moving alongshore out onto a longshore bar and thence past the Bathhouse locale before returning to the recreational beach, effectively starving the recreational beach of sand. Emergency appropriation of \$1 million was needed in 1986, for NPS inclusion in an adjacent beach nourishment project by the Corps. to provide limited site protection.

A research project to document the pathways of sediment transport around the groin was initiated in the fall of 1986 with the aid of Dr. Karl Nordstrom and graduate students from the Rutgers NPS/CRU, and Drs. Doug Sherman and Bernie Bauer, Univ. of Southern California. For a week in October and another week in November, we conducted beach profiles out to a depth of 25', emplaced an array of 50 depth-of-disturbance rods for SCUBA diver measurements, deployed three current meters and a pressure transducer in various locations. We also released a half ton of fluorescently tagged sand tracer with SCUBA divers recovering core samples in three different experiments covering different tidal and wave energy regimes. Gateway personnel (R. McIntosh, L. May, J. Tanacredi, J. Rosario, and B. Lane) and divers from FIIS (Northrup, O'Connell, and B. Fulsom) provided essential support to the studies. (see cover)

Preliminary results of the tracer study show that

while most of the sediment moves past the groin during low tide, there is substantial redirection during high tide, so much sand does not move onto the adjacent beach. Although the data are still being analyzed, any conclusions will be limited by the fact that the beach nourishment action between the time of study planning and conduction created a planar profile which is abnormal here. A final one-week study repeating the above procedures but with the addition of five sonar instruments for detecting sediment transport is scheduled for the winter of 1987-88 now that the longshore bar profile has returned. We expect the study then will provide conclusive proof that the Corps' structure is responsible for the beach erosion in the park.

Some of the Gateway study was filmed by WNET-TV for use in a program on science and coastal (mis?) management scheduled for nationwide viewing on public stations this fall and winter. Some aspects of the Fire Island study were presented in an international conference and published: Allen, J.R. and N.P. Psuty, 1987, "Morphodynamics of a single-barred beach with rip channel, Fire Island, NY." *Proc. Coastal Sediments '87*, Am. Soc. Civil Eng., New York, pp. 1964-1975 with reprints available from the senior author. Under the umbrella of the interregional barrier island program based at Rutgers NPS/CRU, we are undertaking two similar studies at Gulf Island NS to better understand the potential effects of a planned massive Navy dredging and disposal project and at Canaveral NS to assess the effects of a revetment constructed adjacent to the northern boundary.

Allen is a Coastal Geomorphologist with the NPS North Atlantic Regional Office.

## book review

*Mammals in Hawaii; A Synopsis and Notational Bibliography. Second edition. Bishop Museum special publication 76. Bishop Museum Press, Honolulu. 375 pp. P.Q. Tomich. 1986. \$42.95.*

This welcome revision of the standard reference on mammals in Hawaii comes to us 16 years after the 238-page initial version. The topics remain the same, but with important differences in emphasis. Most notable is the expanded treatment of marine mammals (about 12% vs 5% of the earlier content). The annotated bibliography of 1,500 entries comprises about 43% of the book (vs 36% previously). Species accounts are about the same as in the initial edition (41% vs 43%). The introduction, a checklist, an index, and a section on perspectives in Hawaiian mammalogy, make up the rest of the volume.

The mammals of Hawaii now include 1 volant (the Hawaiian bat), 2 marine littoral species (the northern elephant seal from Midway Islands has been added), 22 pelagic mammals (whales), and 19 terrestrial species, for a total of 44. The 19 terrestrial species were all brought to Hawaii by man; the book treats strongly of things Hawaiian which have been lost because of the introductions. The author's introduction deals passionately with Hawaiian environments today and should be read by legislators, teachers, bureaucrats, developers, conservationists, and all who make decisions by default or ignorance. Elsewhere (p. 190), the view of mankind becomes fatalistic: "It is the nature of man to exploit his surroundings for economic or other gain, to ignore wisdom of the past, and to fail to recognize the extreme vulnerability to disturbance that is characteristic of island biotic communities." I would rather hope that the dedication, scholarship, and efforts by individuals such as Tomich will prove Hawaii an example of how things can be done with future generations in mind.

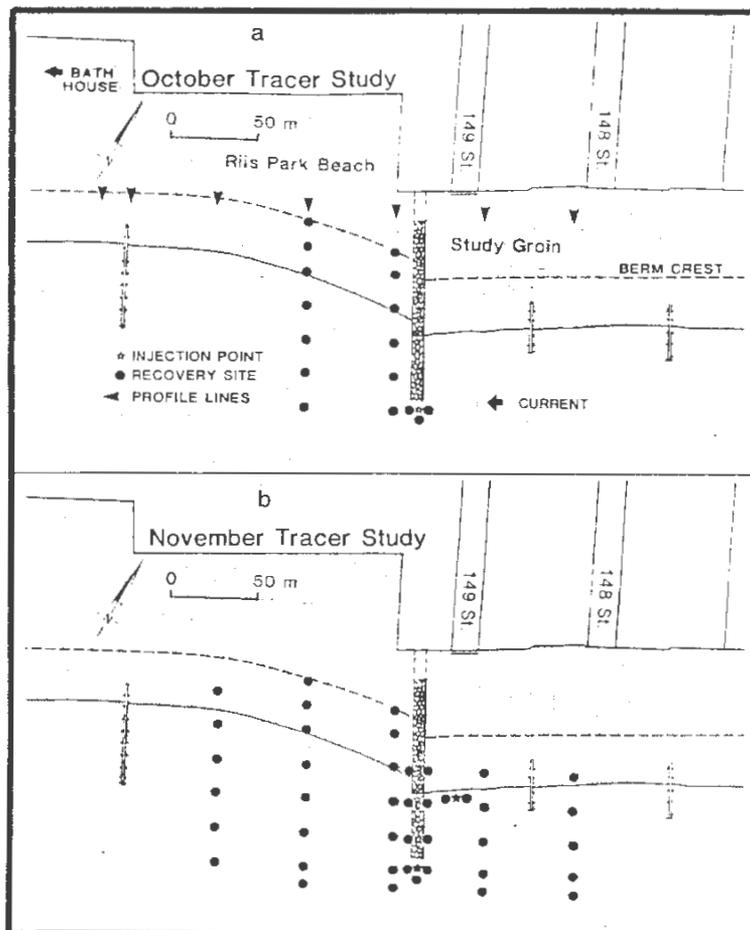
The book contains fair to excellent black and white photographs, a map of the Hawaiian chain, and sketches of whales (with a petroglyph man for scale). I was pleased to see that the author adopted the word "alien" in this edition, rather than "exotic" as in the first edition. It is an appropriately negative term. Further, I wish that the use of Hawaiian names for introduced species (p. 170-171) could be discontinued. Alien species do not belong with things Hawaiian, even words. The detailed treatment of many topics makes it difficult for less interested readers to quickly extract general information. Other sources for this level of knowledge (e.g. van Riper and van Riper 1982), would make a good companion.

Unfortunately, the time involved in the mechanics of publication and the considerable research and management activity in Hawaii at present, have resulted in some species treatments being less up to date than others. The information on pigs, goats, rats, and mongooses does not reflect important recent research. References to efforts by the U.S. Fish and Wildlife Service, the Nature Conservancy, the National Park Service, and the State of Hawaii need more emphasis and provide evidence that progress, although slow, is occurring.

Quentin Tomich's book should stand for years as a definitive reference to mammals in Hawaii and an important source of conservation history for those who wish to learn and to avoid the mistakes of the past.

Charles P. Stone

Research Scientist, Hawaii Volcanoes NP



Riis Park, Gateway NRA study site showing profiling transects and tracer recovery sites.

# Monitoring Spruce Bark Beetles in Katmai National Park and Preserve

By David Manski

Spruce bark beetles (*Dendroctonus rufipennis*) are indigenous to spruce forests at Katmai National Park and Preserve. Since human activities, such as right of way clearance, contributed to significant beetle outbreaks elsewhere, there was concern that maintenance practices in the developed areas of the park might lead to human-induced increases in the local beetle population.

This study was undertaken to provide baseline conditions on the incidence of beetle killed spruce in Brooks Camp, the major developed area in Katmai, and to identify potential human activities that might be enhancing beetle population growth.

## Spruce Beetle Biology

In Alaska and British Columbia, the spruce bark beetle is an important insect in mature spruce forests. For the amount of damage they can cause, spruce bark beetles are surprisingly small; adults are about the size of small grains of steamed rice.

Like other *Dendroctonus* species, small numbers of beetles naturally exist in spruce forests with populations typically controlled by parasites and predators. However, beetle population increases can occur after perturbations to the forest (like blowdown or logging) that result in large accumulations of debris. These materials provide additional breeding habitat for beetles and eventually cause significant population increases. Beetles become a concern if their population outgrows the supply of dead and injured trees and moves into nearby living trees.

Spruce bark beetles may have either one or two year life cycles. Adults become active in spring, with females emerging first to search for new host material. Upon finding a suitable tree, the female drills through the bark and constructs an egg gallery parallel to the wood grain usually above the entrance hole. After mating, 4 to 14 eggs/cm of gallery are laid in clusters, hatching by August into larvae. As the larvae feed in the cambium, they construct their own galleries perpendicular to the egg gallery, overwinter in the infested trees and develop into pupae and adults the following spring.

The spruce bark beetle has a symbiotic relationship with a blue stain fungus. While larvae feed on one vital tissue, the fungus feeds on another and shuts down the tree's water-circulation system. The tree dies of thirst and starvation.

## Monitoring Methodology

To test the hypothesis that the number of beetle-killed trees was not greater closer to Brooks Camp, spruce trees were surveyed at two locations: immediately adjacent to this area of intensive human activity and at an area approximately 5.6 km away. Major developments at Brooks Camp include a 60-guest lodge, employee housing, a visitor center, maintenance and service buildings, a powerhouse and a 28-site campground. Both sites were parts of an approximately 2,500 ha contiguous stand of white spruce.

The Bitterlich variable radius technique was used to sample spruce stand structure and tree mortality at randomly selected points along transects. The diameter at breast height (dbh) and condition (live or dead) of each sample tree were recorded. Dead trees with galleries, numerous entrance holes and/or beetles were considered to be beetle killed. Increment

cores of live and beetle killed spruce were extracted to assess relationships between tree growth and tree mortality.

## Conditions Found at Katmai

Only 6 percent of the 641 trees examined on the two study sites were killed by the spruce bark beetle. Apparently human activities had not influenced the incidence of beetle mortality on spruce. The relative numbers of live and dead spruce and the sizes of trees killed by beetles were statistically similar on survey plots located immediately adjacent to and away from the development. Sampling also indicated that maintenance along a service road at Brooks Camp had not significantly promoted beetle activity; spruce located 15 and 200 m from the road were equally likely to have been killed by beetles.

In and around Brooks Camp, diameters of beetle-killed spruce were smaller than live spruce. In more severe outbreaks in other areas, spruce mortality tends to occur in larger diameter trees. The small proportion of trees killed by beetles in this study contrasts sharply to areas undergoing more extensive infestations. For example, at Glacier Bay NP, where spruce beetles are found in greater densities, spruce mortality due to bark beetles on sample plots reached over 50 percent.

Research elsewhere indicated spruce beetles did not attack hosts solely according to their diameter, but favored trees that had grown slowly in the years before an infestation. This was also found in the Katmai study. Apparently the more vigorous spruce are best able to repel attacking beetles.

## Implications for Management

This study provided baseline data on the current incidence of beetle-killed spruce in and near a de-

veloped area of Katmai NP & P. The information can help evaluate future levels of beetle infestation and/or other disturbances in the spruce forest. Additional surveys should be conducted if casual observations indicate increases in spruce mortality. Quantitative data can be obtained rapidly and effectively by one or two people using the variable radius method.

Planned changes in maintenance practices at Brooks Camp should be evaluated for potential impact on spruce beetles. Beetle outbreaks can begin when dead or dying trees and shrubs accumulate. Activities that may lead to an abundance of suitable breeding habitat for beetles should be avoided. For example, during brush and/or tree clearing along service roads, all vegetation should be removed. Chipping cleared trees and shrubs and using the product in rehabilitating eroded trails and campground sites would be an excellent way to dispose of this material.

Because spruce beetles in this and other studies were shown to attack slow-growing trees, the vigor of high value spruce in Katmai's developed zones could be maintained or enhanced by active management. Manipulations that might decrease susceptibility to attack by beetles include: aeration of the soil around the base of the trees; spacing trees to reduce competition for light and soil moisture; placing wood chips on the ground over tree roots and erecting fences or other barricades around trees to prevent soil compaction.

Away from the developed areas, infestations occurring in response to natural forest perturbations should be monitored, but allowed to run their courses.

Manski is Natural Resource Specialist at Aniakchak National Monument and Preserve.



Spruce bark beetles have ravaged this tree at Katmai NP & P.

# Uniform Appearance? Yes. Uniform Terms? Not Yet.

By Larry L. Norris

The National Park Service promotes a uniform appearance among its rangers throughout the National Park system. There even exists a special catalogue to ensure this uniform appearance among NPS personnel. Uniform means "one image." To stray from this would result in confusion. Would that our use of descriptive terms for the status of certain species were similarly uniform, Servicewide.

This article is an outgrowth of a presentation I gave to the Pacific Mountain Parks Interpretation/Resource Management workshop at Sequoia NP in September, 1986. I had become aware of general confusion over definitions of some often used descriptive terms. Interpreters and park managers need to make clear, first among themselves and then to the public, their definitions of what constitutes a threatened or endangered species, of what denotes rarity in a species, of what is a relict species, of the nature of a sensitive species, and of what qualifies as a native species or an alien species.

Interpretation of these species designations cannot be valid without agreed upon, recognized definitions. The tossing about of vaguely defined terms for species status does not have to be. Published definitions do exist and general use has strongly established others. What I would like to present are those published definitions of terms, along with clarifications and proposals of terms for which we have no written definitions.

## Threatened and Endangered Species:

The NPS should be uniform in the definition and use of the terms *threatened* and *endangered* as they pertain to species status, because we must use those definitions given in the Endangered Species Act. NPS Management Policies direct us to follow the USFWS's lead in this matter. An endangered species is one that is close to extinction throughout all or a significant part of its range. A threatened species is one *likely* to become endangered in the near future. *Never* use *threatened* or *endangered* to describe a species that is not officially listed as such. By not using these terms where they do not apply, we preserve the impact and weight of their true definitions.

## Rare Species:

Rarity is a more difficult concept. What constitutes rarity in a species? Generally, park visitors perceive the word rare to mean "only a few left," but that view is too narrow. Species rarity can be categorized in three different ways:

1. *Numerical rarity* – A numerically rare species may be found over a wide area, but has few individuals in any given population. Examples are rare furbearers such as wolverine and fisher. The California condor was a numerically rare species as well as an endangered species, now presumably totally absent in the wild. Spotted owl and red-cockaded woodpecker also fit into this rarity category. They occupy a wide geographic range, but few individuals exist within that range.

2. *Geographic Rarity* – A geographically rare species may be abundant in a local area, but is not found away from that small geographic area. Park visitors viewing a geographically rare plant, the popu-

lation of which numbers in the thousands, have a difficult time understanding that the plant is rare. In a regional or global sense the species is rare, but it may leave the impression that it is a common plant in its area of local abundance.

The Sequoia Gooseberry, a prostrate plant, forms a fairly continuous ground cover in some of its populations, giving the appearance of a common, successful species: this causes dispute over its rarity. But when one considers that only eight populations of Sequoia Gooseberry are known in the world, seven of which are in the park, then the geographic rarity of the species becomes evident.

3. *Rarity Because of Demand* – This simply means that the species cannot reproduce in the wild fast enough to meet the collection demand placed upon it. In this case, the species need not be numerically or geographically rare. In most park units this kind of rarity does not apply because we regulate collectors through a permitting system, however, theft for commercial market or over collection (demand) can make a species rare.

## Relictual Species:

Webster's Dictionary defines relict as being . . . "A persistent remnant of an otherwise extinct flora or fauna or kind of organism." Relictual species are often rare species, sometimes threatened or endangered, and almost always are of a local geographic occurrence tied to specific, fragile habitat. One example is the hemlock stands in Shenandoah NP, relicts of the last glacial period. Also, rare, endemic Hawaiian tropical rain forest birds can be considered relicts of an otherwise extinct fauna.

## Sensitive Species:

The "catch all" term often used when one is unsure of the status of a species is "sensitive," now used so commonly that it has lost any true definition except in two instances. Staff members of the Air Quality Division in Denver are consistent in their use of sensitive species as being one that shows biological sensitivity to air pollution or acid precipitation. This is the most valid use of the term because it is not dependent on rarity status for further definition.

The second definition of sensitive species comes from the US Forest Service in California, which views any species that cannot withstand more than routine visitor use or management activities as a sensitive species. This definition is too broad for NPS use. I would like to see the term sensitive species reserved and used only in the air pollution/acid precipitation context.

## Native Species:

This term should cause no confusion. To quote from the *Guide for Pesticide Use in the National Park System*, NPS, Biological Resources Division, September 1985, native species are "species which presently occur, or once did occur prior to some human influence, in a given place, area, or region as the result of ecological processes that operate and have operated without significant direct or indirect, deliberate or accidental alteration by humans." Huh? Run that by me at thirty-three and one third.

Simply put, native species are those species that naturally occur in a given area.

## Weed Species:

Weed is a term that belongs in the realm of IPM (Integrated Pest Management) jargon. It is not a species status term in the context of this article because a weed could be native or alien, rare or com-

mon. A weed is unwanted and considered a pest – hence its relegation along with the terms "pest" to the realm of IPM.

## Alien Species:

Alien species is a term that I hope will catch on Servicewide because it clearly states the species status, to park personnel and park visitors alike. The definition of the term has remarkably uniform application to plants, animals, people, or creatures from outer-space. An alien is some organism that is foreign to the local ecosystem of concern, does not fit well into it, and is usually disruptive of the ecosystem until it gets its way by sheer numbers, taking over niches. (It also may die out completely as an unsuccessful introduction.) Alien species only occur in a new area by way of human assistance or feral populations. Examples of alien species in national parks are wild pigs, burros, water hyacinth, and European starlings – all alien species that should be eradicated from park units.

In common usage the terms "exotic" and "introduced" species often are used, especially in the area of Integrated Pest Management. *NPS Common* also uses "exotic" instead of "alien." These terms work well enough for park personnel, but when we refer to them as "exotic," these alien species are not perceived by the visiting public to be the truly disruptive, time-consuming, costly, pestiferous organisms they tend to be.

When I was leading nature walks in Sequoia NP, I would make it a point to use variously the terms "exotic," "introduced," and "alien" for species we encountered along the trail and note the expressions on the visitors' faces at the use of each of the terms. When I said "These wild oats are an introduced species into the area and have substantially altered the foothill woodland ecosystem," very little response was noted. "Introduced" is too kind a word; the people would almost shake hands with the oats. "See that European starling?" I would say. "It is an exotic species in the park and is competing with native bluebirds and woodpeckers for nest sites in the oaks." Their eyes would gaze into the distance, perceiving "exotic" as a good thing – palm trees, white sand beaches, sun and surf, and starlings flitting by . . . another chance lost for interpreting the good fight!

I walked along until the trail narrowed, the brush got thicker, and the canopy closed overhead. Then I used my last and best term. In a loud, surprised voice I gasped out "Alien!" A short period of pandemonium generally ensued. Then I would gather them together if they had not run too far and we would discuss the lowly alien plant. The starling and the wildoats also remembered. Alien species is a clear term that cannot be misconstrued.

## Conclusion:

We are effective at reaching our objectives only to the point at which we are no longer correctly perceived: after that comes misunderstanding. If we could agree on certain definitions for these terms and break our old habits on "exotic" and "introduced," we would better understand ourselves at meetings, conferences, and in our own literature.

And more importantly, we would be able to clearly define what we mean when we use such terms at public meetings, legal hearings, and the like. The NPS is often misunderstood in its attempts to manage wildlife, vegetation, or some other resource. We can alleviate some of the misunderstanding by being consistent in our terminology.

Larry L. Norris is the Natural Resource Management Specialist trainee at Jean Lafitte National Historical Park and Preserve.

# Risk Recreation Poses New Management Problems

By Alan Ewert

A development in the leisure field is the deliberate seeking of risk and danger, often translated into specific recreational activities such as mountaineering, spelunking or white-water rafting. Millions of North Americans have participated in some form of risk recreation, with a number of studies suggesting that this form of leisure activity continues to grow (Darst and Armstrong, 1980; McLellan, 1986; PCAO, 1987).

A variety of terms has been used to categorize and define these types of activities, including natural challenge activities, risk recreation, and high adventure outdoor pursuits. For the purpose of this discussion, these terms are subsumed under the heading of adventure-based recreation, which is defined as the following:

**A broad spectrum of outdoor recreational activities, usually non-consumptive and involving an interaction with the natural environment; containing elements of risk and danger in which the outcome, while uncertain, is influenced by the participant and circumstance.**

This paper will compare and contrast adventure-based recreation with the broader field of outdoor recreation in the context of the participants, characteristics of the activities and implications for management and program design.

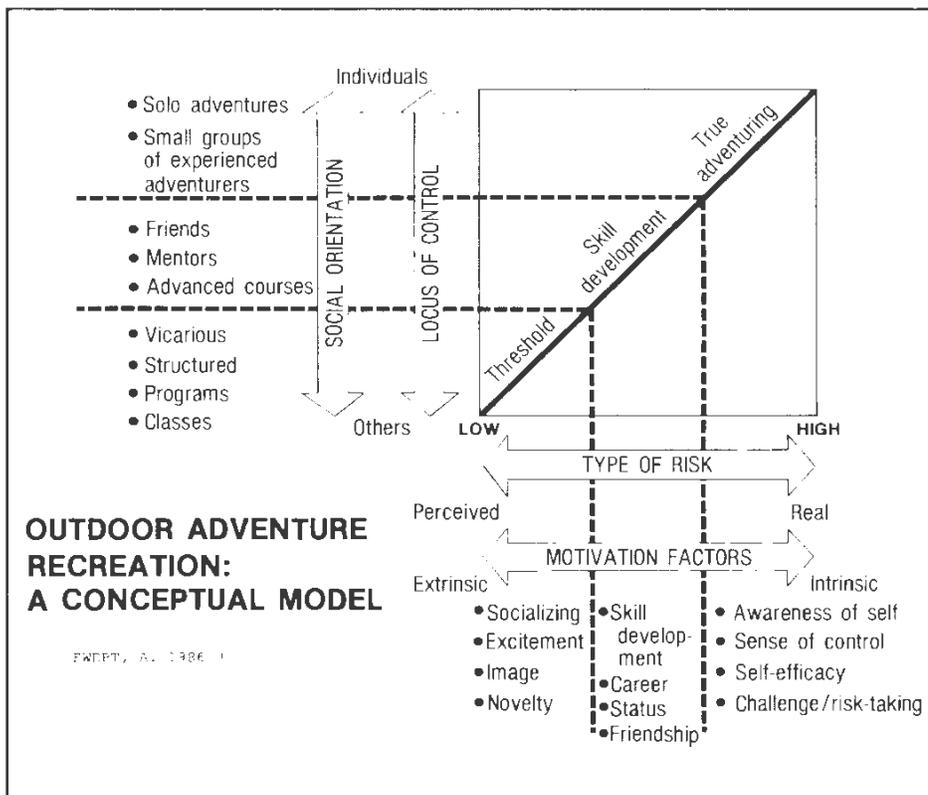
## Comparison and Contrast

Outdoor recreation and adventure-based recreation are similar in several respects. They both fall under the general rubric of recreational activities usually done in an outdoor setting. Moreover, both types of activities are sensitive to management techniques and actions (Hendee, Stankey and Lucas, 1978). While the more traditional activities of outdoor recreation such as fishing, hunting and boating are well-known, more than 20 distinctly different recreational endeavors fall under the adventure-based recreation classification. These activities include:

backpacking	SCUBA
white-water canoeing	spelunking
hot-air ballooning	sky diving
rafting	hang-gliding
ropes courses	mountaineering
backcountry snowshoeing	kayaking
wilderness trekking	rock climbing
bicycle touring	sailing
cross-country skiing	wilderness camping
rappelling	sea kayaking
orienteering	

What distinguishes these activities from those more commonly associated with outdoor recreation is a deliberate seeking of risk and uncertainty of outcome often referred to as adventure. Both forms of recreation involve elements of skill in specific settings, but only in adventure-based recreation is there a deliberate inclusion of activities that contain threats to an individual's health or life. The following model illustrates how a participant in adventure-based recreation moves along a continuum based on developing skill and experience (See Figure 1).

While often similar, outdoor recreation and adventure-based recreation are not synonymous; these activities often serve different participants with different needs, expectations and motivations. Knopf (1983: 208-209) reports that motives for participation may be activity-related. Following this line of reasoning, re-



ported motives for participation in outdoor recreation generally consist of a desire for achievement, affiliation, control, escape and self-awareness (Manning, 1986). In a more conceptual fashion, Iso-Ahola (1980) theorizes that the reasons people engage in outdoor recreation are based on two dimensions: attempts to achieve something and attempts to avoid something. Findings from Davis (1973) and Bowley (1979) support this contention.

In the case of adventure-based recreation, we would extend this conceptualization to include a third dimension, risk-taking. Moreover, this concept of risk-taking is central to the adventure-based recreation concept with an absence of risk resulting in a decrease in satisfaction and desire to participate. In addition, this risk-taking appears to increase in importance as the participant gains experience and skill in the adventure activities (Schreyer and Roggenbuck, 1978; Ewert, 1985). (See Figure 1)

## Management Implications

The above suggestions and findings have implications for both the management of outdoor recreation resources and the provision of outdoor leisure programs. In part, the type of experiences engaged in depends on the opportunities provided. Manning (1986) suggests that when choosing management objectives, the expectations and desires of potential users should be considered. While both classifications involve outdoor activities and settings, the risk-seeking recreationalist will also require opportunities for risk-taking and adventure seeking. Although these factors can be present in the outdoor recreation context, they are usually peripheral to the primary motives for participation.

As suggested by Driver and Brown (1984), people with different motives and expectations for recreation

participation will prefer different environmental settings. It follows that managing resources along strictly outdoor recreational lines invites a displacement and inequity of resource allocation for the adventure recreationalist (Knopf and Schreyer, 1985). Any attempt to reduce or interfere with the challenge and risk-taking potential of an area may severely inhibit the potential for satisfaction for the adventure-based recreation user. Sax (1980) posits that there will be an "erosion" of risk and spontaneity in the outdoor resources that ultimately will attract only users seeking a risk-free environment.

With respect to programming, these differences in the classification of activities also can lead to a bias in the opportunities provided to the user. Assuming that one goal of programming is to provide a sense of satisfaction, the following questions are presented in an effort to create an atmosphere conducive to a wide range of recreational opportunities.

- Identify the essence of the activity; is it a search for adventure and risk-taking or are these factors peripheral to the experience?
- What is the skill and experience level of the participants? Individuals with more skill and experience will usually demand a more self-determined, less leader-led program.
- Will the recreation experience be facilitated or diminished through development on the resource? While site modification and development may facilitate and enhance outdoor recreation use, it may detract from opportunities for adventure recreation. For example, boardwalks and fences can provide a sense of security for the sight-seer but effectively reduce the sense of wilderness and adventure.

Continued next page

## Risk Recreation

Continued from page 7

In summary, outdoor recreation and adventure-based recreational experiences will often require a different approach, both in programming and in the management of resources. Toward this end, effectively meeting the needs of the outdoor recreation seeker will be enhanced by understanding whether the participant is seeking an outdoor recreation or an adventure-based experience. With the increasing popularity of adventure-based recreational activities, merely assuming that most people are interested in traditional activities such as walking, swimming or bicycling might be to overlook the needs of a changing clientele.

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# Spotted Owl Occurrence in Mt. Rainier National Park

By Sonny Paz and Janet Edwards

If you were a resource manager within a national park in the Pacific Northwest's Cascades or Olympic Mountain ranges, you would be faced with the challenge of protecting the northern spotted owl. *Strix occidentalis* is currently on the Washington and Oregon state threatened species lists and a proposal to nominate it for listing as a federally threatened or endangered species, has been received by the U.S. Fish and Wildlife Service.

The primary concern for the decline of the spotted owl in the Pacific Northwest arises from the gradual loss of habitat. Spotted owls are found most frequently within old-growth forests of Douglas-fir, Pacific silver fir, western hemlock and western red cedar below 4,000 feet. A home range often encompasses over 4,000 acres of old-growth forest. Pressures to harvest timber and expand development for urban uses, threatens much of the contiguous old-growth stands. Commercial harvests fragment forests, reducing the amount of preferred spotted owl habitat. These cuts also interfere with juvenile dispersal by leaving large open areas, which juveniles generally avoid.

The U.S. Forest Service, Bureau of Land Management, National Park Service and state wildlife agencies conduct research on the spotted owl to determine habitat requirements, home range size, breeding success and juvenile dispersal. These coordinated inter-agency programs are essential for preservation of the spotted owl since no one agency can maintain enough acres of habitat to support available populations.

Mount Rainier NP employees began studying spotted owls in the summer of 1983; the program has continued each summer through 1986. The study objectives were to:

1. Locate and map spotted owl pairs and their young.
2. Collect information about the behavior and biology of the bird through field observations and pellet analysis.
3. Collect data on barred owls.

### Life History of the Owls

The northern subspecies of the spotted owl, which ranges from southern British Columbia to northern California, is seldom seen or heard. This recluse spends most of its time under the protective canopy of old-growth and mature forests. The spotted owl is well camouflaged; its chocolate brown and white feathering, peppered about the head, back and abdomen, creates an amazing mimic of the bark found on the Douglas-fir and western hemlock trees. These trees are selected for nest sites. The owl's eyes are dark, and the rounded head lacks "horns" or "ear-tufts."

This flying enigma, which measures 16-19 inches long with a three-foot wingspan, is capable of precise and muted flight. Unwary arboreal and semi-arboreal mammals constitute the majority of prey taken. In Washington the flying squirrel accounts for much of the owl's diet.

The female will spend 32 days incubating a clutch of two to three eggs in a secure nest on a platform with overhead cover, while the male provides food for her. The lifetime partnership usually results in April or May hatching of two down-covered owlets every three

years or so. Juveniles, when learning to fly are clumsy, erratic, and frequently fall to the ground. With talons and beak, juveniles climb trees to the lowest branches to rest and avoid predators.

The parents usually feed the young until late September. By October adults discontinue feeding the young, and the hungry, full-grown juveniles leave the parental territory.

By contrast the barred owl, *Strix varia*, which looks strikingly similar to the spotted owl, reproduces more frequently. Since its habitat requirements are not nearly as restrictive, the barred owl has expanded its range into spotted owl habitat zones.

### Research Methodology

Early surveys were conducted entirely along park roads. Because the project was part of the Natural Resource Specialist Trainee Program, the park interior also was surveyed in 1986. Backcountry trails were sampled up to 5,000 foot elevation, 1,000 feet higher than owls normally are found. Although old-growth forests have been labeled as the exclusive domain for the owl, other habitat types, that were commonly bisected by the selected routes, also were surveyed. Surveying younger stands helped to alleviate the bias towards sampling exclusively in old-growth forests. Standard U.S.F.S. survey methods, with improve-



Janet Edwards projects a vocal imitation of a spotted owl location-call at night from a trail in Mount Rainier NP. Working late hours is fatiguing, but an owl response creates a boost of energy and excitement.



*This down-covered juvenile, seen here on July 23 is more than 3 months old. Although it has become an expert flier it still depends on the parents for food.*

ments incorporated from Sonny Paz's seven years of field experience with the owls, were used.

On a typical night, surveys began at a trailhead at dusk, so that "calling" could be conducted during the dark hours when the owl is most active. Negotiating the trail with headlamps, we stopped at quarter-mile intervals and projected a vocal imitation of the spotted owl "location call," "hoo-hoohoo-hoooo," uttered every 60 seconds for 10 minutes. If no response was heard during that time period, we hiked to the next station and repeated the process. It took approximately one hour to cover one mile on the trail. If an owl was heard during the survey, calling continued until the bird's location could be positively identified. The variety of calls, and the behavior of each owl made each experience unique, which compensated for the body fatigue endured from the anomalous working hours.

Whenever possible, the sites of the nighttime responses were revisited during the day to relocate the owl's roost. Because the spotted owl can use up to 10,000 acres of forests, the chance of relocating the birds during the day is marginal. When the birds were located, a technique known as "mousing" was employed. A live rodent was tethered to the ground near the owl. The rodent's activity attracted the owl's attention whereupon the owl dove to capture its prey. This technique resulted in the location of juveniles, be-

cause the adult would then fly off to feed the young owlets. "Mousing" provided opportunities for collection of biological information, photographs, and reproductive censusing.

Conducting spotted owl surveys can be a monumental job for just two park employees. To offset the labor-intensive nature of the task, volunteers were recruited from local universities and conservation groups. We presented both classroom and field training sessions in wildlife ecology and survey methodology and these volunteers contributed over 200 hours of field time. In order to add to the employees' knowledge of resource management programs, we spoke to seasonals during two orientation sessions and one endangered species workshop. As a result, several park employees helped achieve the program goals.

#### Survey Results

Even though home ranges could not specifically be identified without the use of radio telemetry, occupied areas could easily be discerned from the data. Since 1983, owls have been heard and/or seen in 13 different locations in the park, most on repeat surveys. Juveniles were observed in five of the locations. Barred owls were heard in two locations, both in suitable spotted owl habitat. At one of the locations two juvenile barred owls were found. Adult spotted owls in six lo-

cations were heard close enough to the park boundary to establish that habitat protection across agency lines is critical.

At the conclusion of the study, we developed and presented two campfire programs for park visitors and two slide presentations for park staff. The public responded with genuine interest, especially in the close-up wildlife slides, imitations of various owl calls, and information on how to observe this rare bird.

Within the Pacific Northwest, managers have demonstrated a similar interest in increasing knowledge of the spotted owl within the national parks. They recognized the importance of strengthening interagency cooperation when, in 1985, Acting Regional Director Bill Briggie issued a policy directive. It stated that the NPS would cooperate with other government agencies to help ensure the long term preservation of owls in the Pacific Northwest. This team effort involves sharing information, collaborating on surveys and research, reviewing management plans, and participating in local or regional interagency committees.

More attention to spotted owl management concerns will be incorporated into interpretive programs. As funds permit, the four major parks with spotted owl populations (Crater Lake, Mount Rainier, North Cascades, and Olympic) will continue to gather baseline data on spotted owl numbers, distribution, and reproductive success. In response to this initiative, Rainier NP Supt. Neal Guse has earmarked monies from the new fee collection fund, for the continuation of field research within the park. And a regional research program on spotted owls, is among the top ten priorities in the 1987 Natural Resource Assessment and Action Program.

No one knows the future of the northern spotted owl. Is it destined to become extinct through conflicts with human land use practices? Can it adapt to the changing environment in time to retain a viable population? Will the more adaptable barred owl replace the spotted owl in the Pacific Northwest? As resource managers, our task is to work with other agencies to preserve a viable population of spotted owls and to prevent the loss of this unique and spectacular bird of prey.

*Edwards is a Resource Management Specialist currently working out of the PN Regional Office in Seattle, WA; Paz is a forester and biologist employed at Rainier NP through the Environmental Intern Program.)*

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## International Seminar On Park Management Held

Thirty-six park administrators and resource managers from 34 countries took part in the 21st International Park Seminar Aug. 17 to Sept. 11, sponsored jointly by the U.S. National Park Service, the University of Michigan, and Parks Canada.

Hugh Bell Muller, Director of the NPS International Seminars, led the group off in Calgary, Alberta, thence to Yoho NP in British Columbia, Waterton NP and its U.S. sister park, Glacier, on to Saguaro National Monument and the Desert Museum at Tucson, Ariz., and then to Costa Rica, where the seminar ended at San Jose. Field locations covered ecosystems ranging from tundra, montane forests, and rain forests to grasslands, arid lands, coastal and marine areas. Copies of *Park Science* were among materials used to acquaint seminarians with how park managers and researchers interact in U.S. national parks.

## Another View On 35mm Slides For Mapping

The Spring 1987 issue of *Park Science* carried an article by Alison Teetor titled "Using 35mm Color Infrared Slides to Map Vegetation." A rosy picture was painted. However, anyone considering this method should be aware of additional information regarding comparison between 35mm slides and 9x9" photographs.

First, there is a question of scale. Teetor's cost figure for acquiring 3,500 color infrared (CIR) slides is \$87,000. These slides were acquired at a scale of about 1:45,000 and projected, then interpreted, at a scale of 1:12,000. The second estimate of \$23,488 is for 1,404 9x9" photos at a scale of 1:12,000. At this scale, one is paying for better photogrammetric products and much more detailed information.

Comparisons should be made on the basis of acquiring similar data and at corresponding scales. If 9x9" photos were acquired at 1:46,000 scale and the appropriate equipment used for interpreting them at 1:12,000, their cost would be much reduced. An estimate for 9x9" CIR photos for park coverage at a scale of 1:46,000 was given by a private firm as \$3,129. This cost assumed the use of a small plane, which could fly only high enough to use a 3 1/2" lens. A 6" lens is preferable for mapping purposes. Based on estimates of three times the aircraft cost for larger planes (A. Roberts, L. Griswold, 1986), we get \$9,387. This is comparable to the \$8,700 for the 3,500 35mm slides - figures shown in Table 1.

Secondly, cost comparisons should include staff time. Simply examining the numbers of images gives a clue to the mapping time required. To cover the stereoscopic view area of one pair of 9x9" photos requires 150 35mm photos (A. Roberts, L. Griswold, 1986). Thus, where Teetor used 3,500 35mm slides, only about 149 9x9" photos would be required.

Organizing and transferring to a base map 3,500 images is more time consuming. The vegetation mapping time per image could be much less with 35mm slides, but the total mapping time, accounting for edge matching and scale distortion problems, would be considerably more. The Shenandoah project began in 1983 and is slated for completion in May 1987; about half the photointerpreted stands need to be visited on the ground... a staff time commitment.

A third limitation of the 35mm slide method is the difficulty of projecting the slides onto the base map. A 1:46,000 scale 35mm slide image projected onto a 1:12,000 scale map covers an area approximately 5x7". If one uses only the central 65 percent of the slide (to avoid extensive scale distortion), the useful area is about 4x5.5". Within this area one aligns the image with the map, matches the edges of previously interpreted areas with the area to be interpreted from the current slide, and adjusts the scale at which the slides are projected. With large expanses of natural vegetation, topography becomes the primary alignment clue.

Anyone who has done such work realizes that 4x5.5" of a 1:12,000 scale map (originally 1:24,000, but photographically enlarged to 1:12,000), is not much area. In contrast, the central 65 percent of a 9x9" 1:46,000 scale photograph enlarged to 1:12,000 scale covers a 28x28" area.

Also, the use of a projector to enlarge and register a slide to a map prohibits stereo viewing. Use of a

## geographic information

In the Summer '87 issue of *Park Science* your editor announced that, despite my best intentions, I had somehow volunteered my services to the *Park Science* Editorial Board as editor for matters GIS. After the enormity of my blunder had penetrated, I began to reflect how I might make the best of the situation. Here is my first attempt:

Interest in GIS continues to grow throughout the Service, and we in the Geographic Information Systems Division are increasingly hard pressed to keep up with developments. Because we are, fundamentally, a GIS service organization, we feel it is important for us to know what you are doing, GIS-wise, out there. To serve as a stimulus for response I have compiled several lists reflecting my knowledge (and lack thereof) of your GIS activities. Please correct my misunderstanding or ignorance of your GIS situation by responding (calmly) to me or this publication with the correct information.

**List 1. Parks with GIS data bases ready for use:** Acadia, Big South Fork, Big Thicket, Big Bend, Cape Cod, Capitol Reef, Death Valley, Everglades, Glacier, Great Smoky Mountains, Lake Mead, Minute Man, North Cascades, Obed, Olympic, Prince William, Redwood, Santa Monica Mountains, Saratoga, Yellowstone, Yosemite.

**List 2. Parks with GIS data bases under construction:** Antietam, Big Cypress, Denali, Mount Rainier, Shenandoah, Wrangell/St. Elias.

**List 3. Parks and related units with onsite operational GIS capabilities** (i.e., hardware and staff on hand to conduct onsite GIS activities). This list excludes parks with strictly CAD or display capabilities: Biscayne, Obed, Santa Monica Mountains, Yosemite.

**List 4. Parks and related units with onsite equipment not currently GIS-active:** Alaska Regional Office, National Capital Regional Office, Prince William, Redwood.

**List 5. Parks and related units in the process of acquiring operational onsite GIS capabilities:**

Big Cypress, Big South Fork, Bryce Canyon, Capitol Reef, Everglades, George Washington Memorial Parkway, Glen Canyon, Gulf Islands, Indiana Dunes, Mount Rainier, Shenandoah, Southeast Archeological Center.

If you're not on one of these lists - and you feel you should be - or you're not on the right list, or your situation is misrepresented, drop me a note or call (FTS 776-8773, 303-236-8773). We'll get corrections out in the next issue. If you feel like exposing your GIS applications, problems, or other concerns to the world, send them to me and we'll get them in print as soon as possible.

### DOI GIS Peripherals Contract

The Department of the Interior is letting a series of contracts for procurement of GIS peripherals that make it relatively easy to purchase GIS processing equipment. This equipment, which includes color terminals, color screen copiers (for the terminals), digitizing tablets, and pen plotters, is designed principally for use with vector-based geographic information systems, but it can also be used for raster-based data, like those from remote sensing sources.

The contracts will be administered by the BLM, and all you have to do to buy off them is to certify your need for the equipment requested. The contracts will be in place late this fiscal year (1986-87), and will continue for at least five years. The purpose is (1) to streamline and simplify the procurement process for GIS equipment, and (2) to standardize as much as possible the types and kinds of GIS peripherals in use throughout Interior. Because of the large quantities of items involved, I anticipate a significant price break.

If you want to buy off the contracts, let me know (FTS 776-8773, 303-236-8773) and I'll tell you what you need to do.

Harvey Fleet, Chief  
Digital Cartography Branch  
GIS Division  
NPS Denver Service Center

Table 1. Cost comparison for obtaining CIR imagery for Shenandoah National Park, VA.

Imagery format	35mm	9x9 inch	9x9 inch	9x9 inch
Scale	1:46000	1:46000 (3" lens)	1:46000 (6" lens)	1:12000
No. of photos	3500	149	149	1404
No. of flight lines	more than 10	3	3	10
Cost	\$8,700.00	\$3,129.00	\$9,387.00	\$23,488.00

stereo-zoom transfer scope with 9x9" photos allows stereo viewing and greatly enhances the accuracy of image alignment with the topo map.

In summary, when comparing costs of 35mm slide mapping vs. 9x9" photos, one should (1) compare the costs of acquiring imagery at the same scale, (2) weigh the difference in staff time required, and (3) consider differences in accurately interpreting and transferring the information to a base map. A useful rule of thumb might be to use 9x9" photography except when mapping small areas or doing reconnaissance work.

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# Research at Wind Cave: Big News from a Small Park

By Kirsten Krueger

At a time when NPS science is receiving widespread public scrutiny and criticism, the research program at Wind Cave NP, South Dakota, is a notable success story. To those few who have even heard of the park, Wind Cave may not epitomize the image of a research haven. Indeed, some might think of it as "just another hole in the ground." Established in 1903 to protect and preserve the many unique cave formations, the park was soon recognized for the additional significance of surface resources above and around the cave. Today the relatively small 11,335 ha (28,060 acre) park is known for its compact association of rolling mixed-grass prairie – the "sea of grass" – and the Black Hills ponderosa pine dominated forest.

Because of its location and rich flora and fauna (including bison, elk, pronghorn, mule deer, prairie dogs, coyotes, eagles, turkeys, sharp-tailed grouse, bobcat, and mountain lion), Wind Cave has numerous unstudied natural and earth science resources. The potential for both basic and applied research is enormous, and the need for critical baseline and management-oriented data is persistent and growing. Small parks have small operating budgets, but a number of factors have worked simultaneously since about 1970 to support a growing research program at Wind Cave.

Before 1970 the park had no research staff or support funds. Records indicate research efforts that were scattered and periodic. Only three major studies, two on prairie dogs and one on ungulate range carrying capacity, had been completed since park establishment. While a number of cave and surface studies were proposed in the 1960s, none was funded. Those proposals included only basic inventory, survey, and mapping work.

## Enter Al Lovaas

With the arrival of Wind Cave's first research biologist Al Lovaas (now Alaska's Regional Chief Scientist) in 1970, the situation changed. Lovaas encouraged university scientists to work in the park and initiated several projects of his own. Jack O'Brien, chief naturalist at the time, began assisting volunteer cave researchers. When Lovaas left Wind Cave in 1975, cave exploration and mapping projects were well underway and surface research had expanded to include studies of pronghorn behavior; prairie dog town expansion; prairie dog energetics, densities, and diet; elk population dynamics, distribution, herd organization, and range use; and baseline studies of grassland ecology and the use of prescribed fire in grassland management. NPS contract funding was secured for a number of these studies and Lovaas was able to provide limited lab facilities and equipment for park researchers.

Since the arrival of Wind Cave's current research biologist Rick Klukas in 1976, both NPS and independent research activities have continued to grow. As indicated in Figure 1, the NPS studies underway in 1976 (4) have become 15 in 1986. Most NPS studies are directed toward either accumulating baseline data and monitoring, or studying the effects of management activities. Ongoing studies by Klukas include investigations of natural mortality in bison and elk, effects of fire on dog town expansion rates, effectiveness of diethylstilbestrol (DES) as a prairie dog control agent, differences in vegetation within and outside the park's grazing enclosure, predator activities on prairie dog towns, dis-

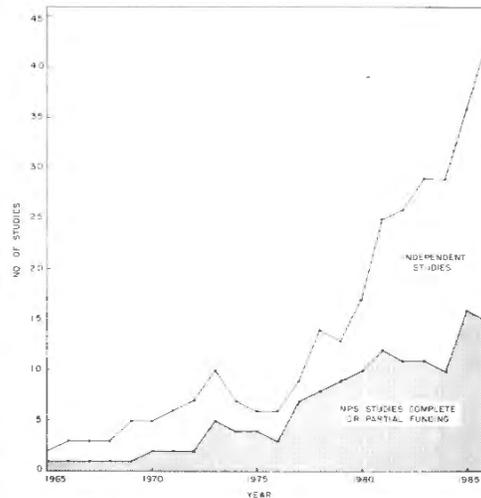


Figure 1. Growth of research at Wind Cave National Park, 1965-1986.

tribution of uncommon woody plants, dynamics of Canada thistle, and expansion of the Wind Cave flora and herbarium collection. Cooperative studies include paleoecology of White River deposits, taxonomy of bison and elk, and an isotopic analysis of  $C_3-C_4$  (major plant photosynthetic groups) use versus availability on major range site types in the park. These studies represent a substantial Wind Cave research effort at low cost to the Park Service.

## Independent Research

Independent researchers have contributed 15 Ph.D. dissertations, 22 Master's theses, and numerous publications. Independent research support has increased to an estimated \$550,000-\$600,000 for the 28 studies ongoing in 1986. Scientists have come to work at Wind Cave from as far as the University of Calgary, City College of the City University of New York, Argentina's Universidad de mar del Plata (CONICET), and many places in between. A few are supported by personal funds; many are university-funded faculty or graduate students, and some are on National Science Foundation (NSF) grants.

Individual researchers have worked in the cave, studying hydrology, climate, paleontology, and continuing exploration and mapping, and on the surface, where studies have ranged from developmental behavior of bison, and prairie dog sociobiology to description of riparian vegetation, and grazing pressures on individual grass species. Research groups from Iowa State, Michigan Tech, South Dakota State, and the University of Colorado, through students, faculty, and funds, have completed studies on bison and elk food habits, prairie dog dispersal, DES as a prairie dog population control agent, and the effects of fire on ponderosa pine regeneration, grassland bird and small mammal populations, and grassland vegetation and soils.

Since the late 1970s, the most substantial independent contribution has been from the Natural Resource Ecology Lab (NREL) at Colorado State University, led by Dr. Jim Detling. With several large NSF grants, NREL has studied plant-animal interactions in the park and intensification of biological activity and control of ecosystem change by grassland herbivores. A dozen graduate students have been involved in projects related to the grant topics. Research subjects include: the effects of grazing by prairie dogs and bison on grasshopper populations, bison grazing patterns and nutrient transport in a mixed-grass prairie system, the effects of bison and prairie dog grazing on vegetation and soils, the

benefits to bison from feeding on prairie dog towns, the role of native herbivores in selection of grazing-adapted plants, the effects of root-feeding nematodes on primary production, the role of herbivores in mediating plant competitive interactions, the ecophysiology of some grass species on an adjacent to prairie dog towns, bison-prairie dog-plant interactions, the effects of fire on bison movements, and the structural stability of grazed versus ungrazed grassland.

## Theories Prove Practical

Unlike NPS-funded research, which is directed toward applied science or management problems, independent studies usually are for contributing to theory or the general body of knowledge. In spite of their theoretical orientation, independent researchers often produce recommendations for park managers that directly address portions of the park's resources management plan. A number of studies have produced results of direct use. With close cooperation between resource managers and the research biologist, these results form a basis for management action and have application in the day-to-day functioning of the park. Examples include the grass and woodland fire studies, which showed a need for certain fire frequencies and intensities in the park and undergird the current Wildland Fire Management Program. Results of 7 elk and bison studies contributed directly to current Bison and Elk Management plans, including population regulation levels, typical versus atypical herd distributions and habitat use levels, and heterozygosity in herd genetics. The park's Prairie Dog Management plan was developed in conjunction with DES population control studies and was heavily influenced by a decade of prairie dog sociobiology research.

Various factors account for the success of research at Wind Cave. Foremost is the simple fact that research results generate interest in additional research. Scientific journalism and word-of-mouth have greatly influenced the growth of interest in Wind Cave in the independent scientific community. Second is a genuine interest among the park staff in research and a willingness to assist researchers. Wind Cave biologists have been persistent and aggressive in initiating and carrying out their own research projects, as well as in promoting and facilitating independent research. The research environment is favorable and attractive; the Maintenance and VP and RM divisions, led by Lowell Butts and Steve Bone, respectively, have consistently provided assistance to past and current research projects, and Supt. Ernest Ortega and Chief Naturalist Bill Swift, recent arrivals at the park, have pledged continued support. Klukas' attitude allows researchers freedom to pursue current ideas, hypotheses, and methods.

Independent scientific interest in the park will doubtless continue and funding sources other than the NPS will contribute to the advancement of chiefly non-applied research at Wind Cave. Demands for NPS-funded research from within the park will rise. Increasingly sophisticated management and management-generated questions will contribute to demand for research that exceeds the current capabilities of personnel and funding. Continued progress in NPS research and closely-related resource management at Wind Cave are thus tied to a commitment by the Service to research support. The need for such a commitment and the urgency of that need grows daily.

Krueger is a graduate research assistant in the Colorado State University Natural Resource Ecology Lab; formerly Seasonal Research Assistant at Wind Cave NP, Hot Springs, SD, and currently a Seasonal Biological Technician at Olympia NP, Port Angeles, WA.

# Mitigating the Effects of Oxygen Depletion On Cape Cod NS Anadromous Fish

By J.W. Portnoy, C. Phipps, and B.A. Samora

Since 1980, scientific staff at Cape Cod National Seashore and the North Atlantic Regional Office have studied biogeochemical disturbances within the Seashore's Herring River estuary (Soukup & Portnoy 1986), diked and drained for mosquito control since 1908 (Fig. 1). Most recent studies have centered on examining the causes of annual summertime oxygen depletion, and its effects on the survival of migratory herring (both *Alosa pseudoharengus* and *A. aestivalis*). This report outlines an interactive and cooperative process involving elements of scientific research, engineering design, environmental compliance, resource monitoring and construction, which resulted in significant mitigation of juvenile herring mortality during the summer of 1986.

## Analysis of the problem

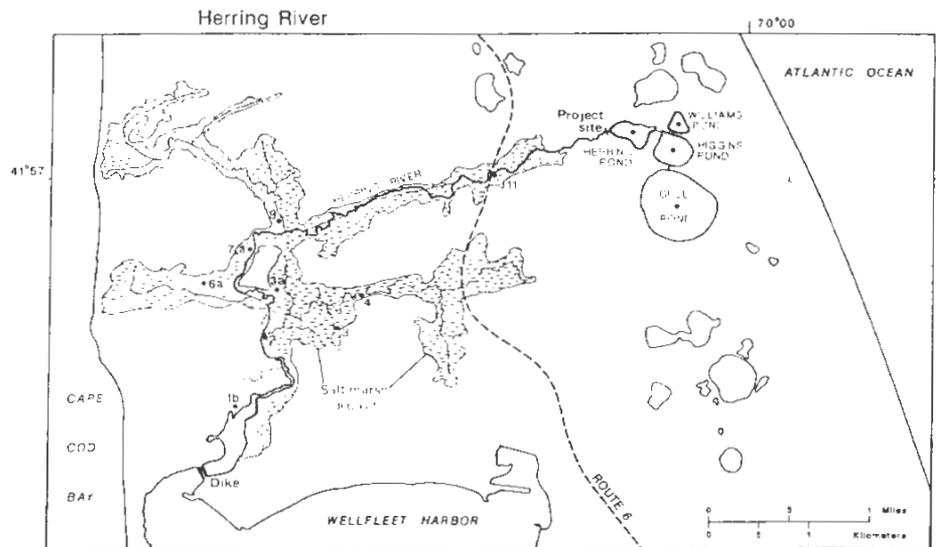
From daily field monitoring of summertime stream conditions (temperature, flow, oxygen demand, dissolved oxygen and carbon dioxide) over several years, we believe anoxia (lack of oxygen) to be caused by the high organic load and low flushing rate of the diked upper estuary. Although seawater flow has been excluded from this system since the turn of the century, organic salt marsh peat, with its high content of reduced iron and sulfur compounds, remains. Warm summer temperatures increase peat decomposition and oxidation of reduced inorganic compounds (e.g. pyrites) and severely tax the stream's oxygen budget. Meanwhile, the dike prevents flushing with tidal salt-water, which is generally saturated with oxygen.

Episodes of total stream anoxia have lasted for up to three weeks and are probably triggered by rainfall and the increased discharge of peat constituents having high oxygen demand. Dissolved oxygen is often undetectable (by Winkler titration) even at midday when photosynthetic oxygen release from aquatic plants is at a maximum; reduction products, such as ammonia gas, are quite evident. Frequently three kilometers of river length are affected, coinciding with the area of diked and drained estuary presently above any tidal reach. Unfortunately, a major component of those juvenile herring hatched in the river's headwater kettle ponds each spring emigrate downstream during midsummer. Migration "pulses" are stimulated by sudden increases in flow following heavy rains. Thus, summer herring migrations tend to coincide with maximum stream organic loads and, often, total stream anoxia. In 1984 and 1985, mortality within the July run was probably complete, affected tens of thousands of fish, and no doubt seriously depressed ultimate recruitment from these year classes.

## A short-term solution

Although a long-term goal is to restore native water quality through the partial or total elimination of existing tidal restrictions, the complex hydrological, ecological and socioeconomic effects of reintroducing seawater into this estuary, diked and drained for nearly 80 years, must be studied first.

In the interim, a process of consultation and planning was begun in the spring of 1986 to find a way to avert disastrous fish migrations concurrent with summertime oxygen depletions. Because of the length



**Figure 1.** The diked Herring River estuary and herring spawning ponds. A removable fish barrier at the Herring Pond outlet has been used to prevent herring migrations when the lower mainstream is anoxic.

(2-3 km) and inaccessibility of affected stream reaches and the high oxygen demand of suspended and dissolved peat constituents, mechanical aeration was ruled out. Meanwhile, Park scientific, resource management, and engineering staff discussed structural options with state anadromous fish experts, knowledgeable in the behavior of juvenile herrings. (The state Division of Marine Fisheries has jurisdiction of anadromous fish runs in Massachusetts but had no funds available to contribute toward any construction.) Through cooperative planning the NPS accepted the lead role in restoration of this herring run.

An idea that emerged early was to simply (it was thought) physically block fish passage at the outlet of the spawning ponds when oxygen downstream within the diked estuary was "contrary to life." However, a basic problem was to maintain normal stream flow, both to sustain those stream biota just below the block and to avoid raising upstream pond levels, without attracting and concentrating migratory fish at the outlet. For example, a filter screen across the outlet - one alternative considered - of sufficient mesh size to avoid fouling would only function as an unintended gill net, trapping juveniles attracted by largely unimpeded direct flow.

State fisheries managers suggested a baffle fish-way at the principal headwater pond (Herring Pond) outlet. This structure would block all flow (and fish passage) through the natural outlet, but at the same time would provide normal flow circumventing the block through a flow diversion pipe. Success of the design was dependent on two attributes of juvenile herring: their attraction to the water surface (positive phototropism) and their attraction for downstream flow (positive rheotropism). To avoid drawing surface schooling fish toward the natural outlet, all flow would be dammed at that point. To avoid attracting fish to the flow diversion pipe intake, the pipe would be extended along the pond bottom to reach an intake depth of five feet. It was theorized that flow into the pipe at this depth would be imperceptible to surface schooling young fish. (Fig. 2).

## Design and construction

Using field measurements of pond outlet and stream bathymetry and estimates of the normal range of flow and hydraulic head, we modified the concrete box baffle design originally suggested by state biologists. To minimize construction impacts on the swampy riparian site, engineering staff designed a light-weight wooden structure (hereafter "fish gate", Fig. 2) which was hand-carried piecemeal along the narrow woodland access path and assembled on site by park rangers. No off-road vehicle use was required.

The structure basically consisted of a removable plywood dam (board) set in slots in vertical members driven into the 10-ft. wide stream bed; a 15-inch diameter flow diversion pipe extending from the pond's five foot contour downstream just through and past the dam; and geotextile stream bed protection both immediately above and below the dam structure. To ensure that all significant flow would travel through the natural stream bed when the dam was open, we added a door to the pipe outlet to stop flow diversion when the lower mainstream contained adequate oxygen. Funding for project materials was provided by Resource Management divisions at both the Park and North Atlantic Region level.

## Environmental compliance

Placement of such a structure in a stream bed obviously requires a multi-stepped process of local, state and federal review for compliance with environmental law. Park staff prepared an Environmental Assessment (EA) to analyze several alternatives proposed as short-term solutions to the fish kill problem. The environmental consequences and associated mitigation also were assessed. The EA was made available for public review and comment for a 30-day period in April and May 1986.

Press releases advertised the project and solicited review and comment on the Assessment. The preferred alternative was the above-described fish gate. Supportive comments were received from individuals and state and local agencies for the preferred alterna-

ive as an appropriate interim solution to prevent herring migration during anoxic periods. However, several agencies urged the NPS to pursue long-term management actions to alleviate the basic biogeochemical problems responsible for observed oxygen deficits.

Because the project would involve some ground disturbance within an area containing several prehistoric archaeological sites not far from the project location, an "XXX Form" (Assessment of Actions Having an Effect on Cultural Resources) was submitted. NPS cultural resource experts approved the project, concluding that any subsurface artifacts would not be affected by the limited ground disturbance.

Under the Massachusetts Wetlands Protection Act, a Notice of Intent was filed with the Massachusetts Department of Environmental Quality Engineering and local Conservation Commissions. Park staff presented the project at local hearings and obtained the necessary permits. The Order of Conditions from the town Conservation Commission required that as much work as possible be conducted from the stream bed and that a filter screen be deployed during construction to trap suspended sediment. (A geotextile type filter fabric was generously loaned to us by a nearby town's natural resource officer.) In accordance with the federal consistency requirements of the Coastal Zone Management Act, NPS sought and obtained a determination from the state CZM director that the project was in the interests of the CZM Act. Park staff identified the bladderwort *Utricularia fibrosa* occurring along the pond shoreline about 200 ft. upstream of the project. This plant is listed as "endangered" by the State of Massachusetts. The State Natural Heritage program concluded, in concurrence with NPS, that no adverse impacts should be expected; however, NPS was asked to carefully monitor *Utricularia* during all phases of construction. Additional consultations with Natural Heritage indicated no further impact on other endangered species.

#### A bit of irony

An Army Corps of Engineers permit was waived because of the small size of the affected stream and because no dredged material would be deposited in the waterway. Interestingly, a Waterways License was required, pursuant to the state Chapter 91, Tidelands Regulations, not because the project site was tidal, but because state funds had been previously spent

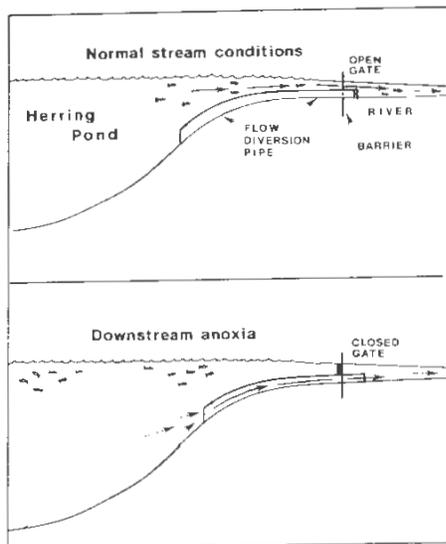


Figure 2. Fish gate operation under normal and anoxic stream conditions.

on "improving" the river. Ironically, the improvement was a 1974 repair of the Herring River tidal dike – the same structure responsible for blocking tidal flushing and depressing stream oxygenation. As expected in this context, both reviewing officials and the public saw the fish gate project as purely mitigative; approval was quickly received.

Importantly, the flow diversion design addressed provisions of Section 2(d) of Executive Order 11988, Flood Plain Management, and in particular, the maintenance of natural stream functions. Even with the barrier in place, the structure would only obstruct fish passage, with normal stream flow bypassing the dam through the flow diversion pipe.

A Record of Decision (ROD), Finding of No Significant Impact (FONSI) was prepared on June 1, 1986, recording the management alternatives selected by the NPS after discussions with the State Division of Marine Fisheries, a 30-day public comment period, and careful consideration of legislative mandates, applicable regulations, the Conservation Commission's Order of Conditions and NPS policies and research findings. All compliance was completed by mid-June 1986. The State Commissioner of the Department of Environmental Quality Engineering issued emergency authorization of the Waterways Permit, allowing us to complete the structure before anticipated oxygen problems in early July.

#### Operation

As midsummer approached, field rangers began daily monitoring of stream dissolved oxygen (DO) conditions (always at midday to control for diel fluctuation). We modified a commercially available portable DO kit to increase precision and accuracy of field measurements and calibrated the field method against laboratory Winkler titrations at least weekly.

The fish gate was completed around July 6, 1986, just as stream DO declined to lethal levels. For this reason, the removable door was immediately dropped in place, blocking downstream fish passage. By July 8, DO was not detectable in the lower Herring River mainstream. Anoxia continued until about July 20.

During this period, no juvenile alewives were seen to exit Herring Pond through the flow diversion pipe, the only egress remaining with the drop gate in place. Also, no juveniles were seen dead or alive in lower stream reaches. We feel it's reasonable to assume that if significant numbers of fish did emigrate, they, or rather their corpses as in previous years, would have been conspicuous in the anoxic lower mainstream. Schools of tens of thousands of 5 - 8 cm alewives continued to circle in the shallows of Herring Pond while the fish gate was closed. But fish were not especially attracted to the outlet, presumably because of the absence of surface flow.

Finally, by July 25, midday DO had increased to 3 ppm; the fish gate was opened, and, stimulated by increased flow with rain on the 27th, juveniles emigrated en masse. No mortality was observed downstream. A second hypoxic episode occurred in August; again the fish gate was closed and mortality was prevented. Alewife passage from herring Pond was blocked in this way for a total of three weeks in 1986.

#### Looking ahead

Obviously, such extreme measures to sustain a particularly vulnerable group of animals, anadromous alosids, do nothing to benefit all other stream organisms dependent upon adequate DO. We hope that our understanding and management of the Herring River ecosystem will continue to improve to a point where severe systemic disturbances, like those re-

## Improving Science's Role In NPS Management

The executive summary of the 1986 Conference on Science in the National Parks, written by Conference Co-chairman Ray Herrmann and cleared through the NPS directorate, describes a three-part process for developing an appropriate, responsive, and well-managed research program:

(1) Deal theoretically with the role that research can and should play in the NPS administrative and management process;

(2) Reiterate the values of quality research, properly organized (vis a vis the physical, biological, social, and cultural sciences) to park management; and

(3) Implement a structure within the NPS management framework that will directly recognize, utilize, and support research.

Four structural issues are identified and discussed in the Report: (1) who is responsible for research; (2) the relationship of research to resource management; (3) the nature and structure of resource management, and (4) the organizational role of research.

The foregoing grew out of the work of two Conference plenary research panels, and invites continuing discussion and work along these lines, Herrmann suggests.

A total of 24 research-related "actions" are identified as growing out of issues identified by the conferees and specifically related to Director Bill Mott's 12-Point Plan. This section comprises the last third of the Report.

In addition, the Report contains pertinent history of science in the parks, a list of "things that research can NOT do," enumeration of significant achievements of the science program, and excerpts from the remarks of the plenary session speakers: Director Mott, George Pring, Boyd Evison, Theodore W. Sudia, W. James Judge, Chuck Odogaard, Tom Lovejoy, Richard Forman, John R. Kelly, Joseph K. Berry, Raymond Dasmann, Jay M. Hughes, and Bob Beeton.

The Summary Report will be carried in full in the next issue of the George Wright Society FORUM, P.O. Box 65, Hancock, MI 49930.

sponsible for total oxygen depletion, can be resolved.

Restored tidal flushing is a primary long-term management goal piloted by ongoing ecological and hydrological studies. However, until a major reintroduction of tidal flow is possible, we can expect periodic oxygen problems. The current program of DO monitoring and "fish gate management" will therefore continue – we hope with the success encountered during the July 1986 run.

#### Acknowledgements

The entire Park staff supported this project; however, specific staff members provided outstanding energy and enthusiasm for the project: Environmental Planner James Killian, Ranger William Brazile, and especially Ranger Dennis St. Aubin, who "made it work" in the field.

The three authors, all Cape Cod NP employees, are Portnoy, research biologist; Samora, resource management specialist; and Phipps, chief of maintenance.

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# Biological Diversity Program Underway 'In Earnest'

*Editor's Note: Bill Gregg was one of six "leading members of the scientific community" (according to the AIBS Forum, Vol. 36, No. 3) who testified at a May hearing of the U.S. House of Representatives Science and Technology Subcommittee on Natural Resources, Agricultural Research and the Environment. The focus on loss of biological diversity "served to educate the Subcommittee members on the decline in biodiversity both nationally and internationally," the AIBS publication stated.*

By Bill Gregg

Loss of the planet's biological heritage as a result of human influences is of mounting national and global concern. Managers of protected areas face new challenges in dealing with changes brought about primarily by loss of natural habitat, introductions of non-native species, and chemical pollutants. Our mission and experience uniquely qualify the NPS to play an important role in reversing the decline.

Last fall, the Director asked a special task force to review the Service's role in conserving biological diversity, and to serve as a forum for ideas on ways to strengthen our capability to meet the challenge. The task force's report, which will be edited for general distribution later this year, will provide a basic reference for developing an NPS plan for preservation of biological diversity. The plan will recommend policies and guidelines, program goals, and a multiyear implementation strategy. The Associate Director, Natural Resources, is establishing a team of NPS scientists and resource managers and planning will begin in earnest this fall.

The Director set aside NRPP funds this spring for projects to familiarize NPS personnel and park visitors with the issue, and to develop methodologies for assessing the status of biological diversity in units of the System. This year's program has four components:

## Development of Public Education Materials

In cooperation with Interpretation and Natural Resources, Mike Whatley, interpretive specialist at Cape Cod NS, was detailed for three months to Natural Resources-WASO to prepare a brochure for park distribution on the ecological, cultural, economic, and ethical dimensions of the biological diversity issue, and the NPS role in "managing a diverse portfolio of biological resources" as a legacy for humanity.

To lay the groundwork for expanding our interpretive programs, Ohio State University is inventorying available materials on biological diversity and evaluating them for use in NPS public communication programs.

The university also is designing a survey questionnaire, which the Director will send to field units early this fall, to characterize our existing interpretive programs, determine the interest of park interpreters in particular topics, and identify priorities for developing media and activities relating to biological diversity. The survey is being modeled upon an earlier OSU project to provide information for developing our "Clearing the Air" program, scheduled to get fully underway next year, and intended to improve our communication on issues relating to air quality, visibility, and acidic deposition in NPS areas.

## Inventory and Conservation of Historic Fruit Trees

Since early Colonial days, dozens of fruit tree cultivars have been planted in the U.S. Some continue to be widely grown; others, no longer cultivated, have been used in developing modern varieties; still others have simply fallen into disuse or been lost. In a recent

NPS training course on integrated pest management for historic orchards, participants identified 20 historic orchards still being maintained in NPS areas, dating from as early as 1752. The actual number of NPS units containing such historic genetic resources is unquestionably greater.

This two-year project, to be carried out by researchers at U/Mass in cooperation with NARO, will develop an automated database based on a Servicewide resource inventory, provide taxonomic identification of the cultivars, evaluate the contemporary commercial importance of the cultivars, assess needs for conservation and propagation, and recommend management alternatives. The project provides for cooperation between natural and cultural resource specialists, and park interpreters, in demonstrating the important role of NPS units in conserving genetic resources.

## Ecosystem Conservation Data Base

Conservation of biological diversity will require cooperation between NPS and other entities responsible for managing areas contiguous with NPS areas as well as noncontiguous areas of similar or complementary habitat. Bioregional cooperation is likely to become the mainstay of successful conservation and management. To help provide basic information on existing and potential contributions of federal, state, and private administrators, the NPS is providing partial support for a MAB project to assess gaps in the representation of ecosystems in the nation's protected areas, as well as to determine the protection status of these ecosystems.

Using digital base maps (1:2 million scale) provided by the U.S.G.S., existing ecological classifications, and maps of protected area systems, researchers at U/Colo and Fla/St/U are developing an information system that will enable users to tailor maps and analyses of protected areas for applications at a wide range of map scales. The first publication from this project, due later this year, will provide a preliminary assessment of the representation of potential natural vegetation types in tracts administered by 11 federal agencies.

Next year's outputs are expected to include a more detailed assessment of gaps in the NP System, as well as the results of a pilot project in Florida based on larger scale resource maps and a statewide survey of the management objectives of the state's protected areas. As more state and regional information is incorporated, the database will become a powerful tool for conservation planning, as well as for coordinating monitoring and research on biological diversity.

## Research on Boundary Influences

The ability of NPS areas to preserve biological diversity is increasingly influenced by changing conditions across park boundaries. Natural ecosystems, continuous over vast areas at the time many parks were established, are being fragmented by complex patterns of human uses and activities. Administrative boundaries once significant only on maps are now significant on the ground in their effects upon patterns of genetic exchange and species distribution between parks and surrounding areas.

This multi-year project will apply concepts of conservation biology and landscape ecology to develop and test a methodology for evaluating changing conditions across park boundaries. The project will rely heavily on remote sensing and geographic information system technologies to describe and quantify these conditions for Western Region parks selected on the

basis of available GIS and inventory data. By integrating ecological, physical, sociological, and landscape variables along park boundaries, it will be possible to test and evaluate hypotheses on how both natural and human-influenced boundaries affect the abundance, productivity, and distribution of particular species and communities.

The concept for the "boundary model" was developed by Christine Schonewald-Cox and her colleagues at our U/Cal-Davis CPSU (see Spring 1987 issue of *Park Science*). Development and testing of the model will involve close collaboration with the NPS Geographic Information Systems Unit, the U/Cal/Berkeley remote sensing group at the University's Space Laboratory, researchers at a number of universities, and participating parks.

Anticipated applications of the boundary model should help parks address a broad range of planning and resource management issues, including:

- identifying priorities for inventory and monitoring of biological diversity
- assessing the changing impact of external land uses, in time and space, on species and communities
- assessing the ecological risk associated with proposed management strategies within and near the park
- determining where rare, threatened, or endangered species are most likely to become isolated or lost
- evaluating the effectiveness of the park's location, size, shape, and habitat patterns in preserving biological diversity
- classifying segments of the park's boundary according to their vulnerability to particular types of human impacts
- developing priorities for land purchases and exchanges
- coordinating the planning of "buffer areas" with adjacent landowners
- planning corridors for wildlife migration
- identifying priorities for mitigating loss or damage to wildlife habitat

This year's work will focus primarily on identifying hypotheses to be tested, selecting parks for pilot studies, obtaining and synthesizing relevant information for the parks and adjacent lands, and developing a detailed research plan. However, a project will be initiated at Organ Pipe Cactus National Monument, where planning for testing the boundary model has been underway for two years with partial support from the U.S. MAB Program. The park offers a field situation for comparing different boundary conditions, because it is bordered on three sides by natural desert scrub subjected to varying disturbance, principally from grazing, and on one side by intensive agriculture. Pressures are increasing outside the park, while, inside the park, natural communities are recovering from the previous impacts of grazing, which was recently terminated.

The research will look at how the composition and distribution of plant communities have changed within two kilometers of the park boundary during the last decade of rapid change in patterns and intensities of human influences, and will establish a baseline for future monitoring. The work is being coordinated by Peter Warren of the Arizona Nature Conservancy, who has 13 years' experience in the analysis of southwest vegetation.

*Gregg is MAB Coordinator for the National Park Service.*

# mab notes

The biosphere reserve concept continues to take deeper root as new reserves are planned and existing ones become more functional. Participants at a major international symposium will assess the concept's progress and recommend new steps to take.

**Reserves on the drawing board.** Of the many potential biosphere reserves under discussion, two merit special note for their magnitude and ground-breaking character. At its second meeting on July 2, 1987, a U.S.-Canadian MAB panel for the Acadian-Boreal Region prepared preliminary proposals for biosphere reserves in the Gulf of Maine and the Acadian Shelf. Both would be binational and contain major marine fisheries. The first would include Acadia NP, many small refuges and sanctuaries in the Maine archipelago, and nearby areas in Canada. The second would include Cape Cod NS, the Monomoy National Wildlife Refuge, and marine areas including Georges Bank. Several areas in the Gulf of St. Lawrence also were considered. Future meetings will identify specific boundaries and zonation and discuss management with area administrators.

A biosphere reserve including the Adirondacks and the lake Champlain Basin looks likely. Meetings have been held in New York and Vermont to discuss the idea, and strong support was voiced in both states, which already had created bi-state organizations for coordinating several types of resource management on Lake Champlain. Designations of core, buffer, and transition zones and mechanisms for biosphere reserve cooperation must be worked out. There is also the possibility of including Mont St. Hilaire, an existing biosphere reserve in Quebec on the river draining Lake Champlain. As the lower part of the Basin, including the lake's outlet, is in Quebec, the biosphere reserve may provide a framework for strengthening binational cooperation in research and management of the lake ecosystem. The Adirondack-Lake Champlain Biosphere Reserve would be the second largest in the world, after the gigantic Northeast Greenland NP.

**Building true biosphere reserves.** A major goal of the international MAB program is development of model biosphere reserves, and the U.S. MAB National Committee has decided to support such a project in the Southern Appalachians, where Great Smoky Mountains NP and the Forest Service's Coweeta Experimental Forest are units of the international network. Steps already taken include selection of Great Smoky Mountains NP as the pilot area for developing a model collections management plan and for evaluation of the Smithsonian/MAB biological diversity protocol. Regional Director Robert Baker has identified five regions in the Southeast where strategies are planned for coordination on cross-cutting regional issues. He has decided that MAB should be the framework for integrating our concerns with those of other institutions in the Southern Appalachians. At the invitation of the U.S. MAB National Committee, state and Federal resource management agencies met at Clemson University in August to identify resource issues and mechanisms for cooperation under the MAB aegis.

The Virgin Island Biosphere Reserve also has made impressive progress toward regional involvement and adequate understanding of resource use problems. Twenty-nine research projects have been carried out through the Virgin Islands Resource Management Cooperative (VIRMC), which includes NPS and 13 other public and private organizations. Virgin Islands is the first U.S. biosphere reserve to establish its own BR

publication series – hopefully a precedent for others to follow. The first 14 reports in the series, which include the results of basic inventories and research on resource conditions and use, were published in October 1986. Eight additional reports dealing with biosphere reserve zoning and management, long-term monitoring programs, and watershed sedimentation studies, are expected by fall 1987; and seven more should be out in December 1987. (See *Park Science*, Summer 1987 for descriptions of research. Write to: Island Resources Foundation, Publications Center, 1718 P Street, NW, Suite T-4, Washington, D.C. 20036 for a list of reports and order form.)

**Trans-border reserves.** At a meeting in June of the Pacific Division of AAAS, Bill Gregg presented a paper on the potential for binational, cross-border biosphere reserves. Worldwide, 15 percent of BR's occur in border areas. In North America, binational reserves are under consideration in the Virgin Islands (with the British), southern California-Baja California, Arizona-Sonora, lower Rio Grande, Maine-New Brunswick, Lake Champlain Basin, and the Boundary Waters region of Minnesota and western Ontario. Such reserves would not only accomplish regional conservation/development objectives but also would foster the international cooperation that is one of MAB's main goals.

**Symposium at World Wilderness Congress.** About the time you receive this issue, an important international symposium on biosphere reserves will be underway at the Fourth World Wilderness Congress in Estes Park, Colo. Speakers from eight countries plus UNESCO and the International Union for Conservation of Nature and Natural Resources (IUCN) will present case histories and review successes, problems, and opportunities. Participants will make recommendations on how best to develop fully functioning biosphere reserves.

**International brochure.** After an agonizingly long gestation period, a full-color brochure on biosphere reserves is expected to go to the printer this fall. Scripted largely by NPS, with design assistance from Meta-Graphics of Berkeley, Calif., and funded through US-MAB and MAB UNESCO, the brochure will fill a long-standing need for printed information on the purpose, organization, and management of biosphere reserves around the world.

**MAB and the IGBP.** In September 1986 the International Council of Scientific Unions (ICSU) approved a report of its ad hoc planning group outlining an International Geosphere-Biosphere Program. The principal objective of the program, expected to begin about 1990 and to be well funded, is "to describe and understand the interactive physical, chemical, and biological processes that regulate the total Earth system." An internationally sponsored Earth-observing system will include remote-sensed observation from satellites and an Earth-based network of biospheric observatories. MAB, with its biosphere reserves, expects to be deeply involved in this program. We will be watching its development closely. Participation of NPS biosphere reserves as "observatories" could greatly improve basic resource information on these parks and their surrounding regions, which would be useful for local management as well as for understanding global systems and problems.

**Napier Shelton**  
NPS Washington Office

## Servicewide Program For I&M Underway

*Editor's Note: From NPS Associate Director Gene Hester comes the following chronology and plan for I&M action.*

A Natural Resources Inventory and Monitoring Initiative report, published in May 1987, addresses the policy, definitions, and rationale of gathering, analyzing, and managing baseline inventory data and long-term monitoring of NPS natural resources, and contains sections on the background, program description, and implementation of the program.

Developed by resource management personnel of the NPS with the help of David Graber, Jerry Franklin, Gary Davis, Ray Herrmann, Carol Aten, Bruce Wilcox, Jim Larson, Bob Stottlemeyer, Maury Nyquist, Peter White, Christine Schonewald-Cox, Al Lovaas, Bob Barbee, Bob Baker, Dick Briceland, Jerry Rogers, and Boyd Evison, the report also has been reviewed by "the field."

The next step in this program, started June 1, 1987, is the drafting of Servicewide standards and guidelines; the task is to be completed by June 1, 1988. A further step will be a survey of the status of Servicewide inventory and monitoring, a task to begin Nov. 2, 1987, and to be completed April 1, 1988. A completed draft of I&M standards and guidelines is to be distributed to the regions and field for review and comments by Dec. 1, 1987.

As a first step toward developing Servicewide I&M guidelines and standards, a meeting was held at Sequoia/Kings Canyon NP with Boyd Evison, Ray Herrmann, Roland Wauer, Gary Davis, David Graber, and Al Greene in attendance. Future meetings will concentrate on various elements of the inventory (e.g., plants, animals, air, GIS, etc.). Al Greene met with the Regional Chief Scientists the first week in August 1987 to give a progress report and to determine the best way to include them in the Servicewide program during its formative stages.

**Marking and Tagging of Aquatic Animals: An Indexed Bibliography** is a 57-page Resource Publication No. 165 of the U.S. Fish and Wildlife Service. It is a compilation of selected references on the marking and tagging of aquatic animals with special reference to information on different kinds of marks or tags that are available, techniques of application, retention or recovery of the marks or tags, and the effects on the organism.

The references are arranged alphabetically by author, consecutively numbered, and indexed by keywords for easy access to references on particular subjects. A list of general references includes detailed, in-depth reviews on particular tagging methods or summarizes many different kinds of tags, marks, or techniques.

Robert McIntosh, superintendent of Gateway NRA, and Chris McNeil, director of the NPS urban grants program, are participants in the Neighborhood Open Space Coalition's one-day conference Sept. 10, 1987, on "New Policy Directions." Values, planning, and partnerships are the three main themes, and Executive Director Tom Fox will close the working conference with a question mark, "Where Do We Go From Here?"

# regional highlights

## North Atlantic

The North Atlantic Region has been active in the international convocation between Canada and the U.S. to select a site for a proposed Acadian and Boreal Coastal Biosphere Reserve. At the initial meeting in NARO in December, 1986, attention was drawn to a series of sites along the Gulf of Maine from Fundy NP in Canada south to Cape Cod NS. Recently, at the second convocation, hosted by Roosevelt-Campobello International Park in June, it became apparent that what really was taking shape was a Gulf of Maine marine Biosphere Reserve interacting with the terrestrial Acadian and Boreal biogeographic area. The focus was on a triangular area from Cape Sable, Nova Scotia to Roosevelt-Campobello and Passamaquoddy Bay then south to Acadia NP and back to Cape Sable, encompassing the center of tidal exchange and principal nutrient front, estuarine inputs, and rocky archipelago systems of international renown. The Sanguenay River entrance into the St. Lawrence is a Canadian proposal; the area is currently under review as a possible Canadian National Marine Park.

Dr. Arthur Hanson of Dalhousie University in Nova Scotia and Dr. James Broadus of Woods Hole Oceanographic Research Institute co-lead the June meetings. Five participants were from NPS (Hauptman, ACAD; Olsen and Portnoy, CACO; Gregg, WASO; Allen, NARO) and four represented Environment Canada-Parks. Despite the overwhelming quantities of lobster consumed, we dealt with such problems as strategic planning, community relations, and long-term monitoring protocols, as well as the more typical aspects of resource protection and management, such as the stresses of visitor use and inholders.

## Mid Atlantic

Regional Chief Scientist John Karish reports availability of four new Regional Research Program reports. "Population and Behavioral Ecology of White-tailed Deer in Shenandoah NP" by J.J. Scanlon, and M.R. Baughan (MAR-22); "Biological Survey of the New River Gorge National River. Summary of Findings" by various investigators from Virginia Polytech Institute (MAR-23); "Analysis of Community Response to Federal Presence in the Upper Delaware River Valley" by M. Carroll, B. Twight, and M. McCabe (MAR-24); and "Analysis of Community Response to Federal Presence in the New River Gorge" by M. Carroll, and B. Twight.

Resource Management Specialist Dave Reynolds, New River Gorge National River, reports completion of a Draft River Management Plan. The Limits of Acceptable Change (LAC) planning process (see *Park Science* article, Fall, 1985) was used to develop the Plan, which involved public meetings and a 45-member Citizens Task Force for development of prescriptive management objectives. Dave also reports the availability of a study that examines different New River flow requirements for recreational and biological resources. Research findings are presented in "New River Gorge Flow Analysis" by Marshall Flug. Copies of the report are available from the author, Water Resources Division, Fort Collins, CO.

Resource Management Specialist Dave Haskell, Shenandoah NP reports that Resource Management and Maintenance staff are working together to diminish impacts to a sensitive mountaintop wetland at Big

Meadows. A water supply well was developed on the edge of the wetland nearly 20 years ago. Recent studies have shown that pumping from the well has been lowering the water table and impacting rare wetland flora. Development of an alternate supply well is in progress.

Resource Management Specialist Bruce Rodgers, Assateague Island NS, reports initiation of a water quality monitoring program for Chincoteague and Sinepuxent Bays. Thirteen water quality parameters are being monitored at each of 9 stations in the bays, which lie between Assateague Island and the mainland. A Hydro-lab Surveyor II is being used for field measurements of 5 parameters including salinity, DO, and pH. Analysis of other parameters is being handled by local laboratories.

Regional Scientist Jeff Marion is coordinating a two-part Regional training course on the development of natural resources monitoring programs and microcomputer data base management. The course will focus on monitoring program efficiency, documentation, measurement consistency, and data base management skills using dBASE III.

## Water Resources Division

Water Resources Reports from the Division, available to NPS personnel and other interested parties as long as supplies last, include the following:

**Giardia in Wildland Waters:** Information for National Park Managers. Water Resources Report No. 86-1.

**Giardia Contamination of Surface Waters:** A Survey of Three Selected Backcountry Streams in Rocky Mountain NP. Water Resources Report No. 86-2.

**Water Quality Monitoring Alternatives** for the Glen Canyon NRA Water Resources Management Plan. Water Resources Report No. 86-3.

**The Response of Experimental Channels** in Everglades NP to Increased Nitrogen and Phosphorous Loading. Data Report: Chemistry and Primary Productivity. Water Resources Report No. 86-6.

**Big South Fork National River and Recreation Area:** Water Quality Report 1982-1984. Water Resources Report No. 86-7.

**A Summary of Water Quality for the Menard Creek Corridor Unit,** Lance Rosier Unit, and Little Pine Island Corridor Unit of Big Thicket National Preserve, Texas (1975-1983). Water Resources Report No. 86-8.

For copies of these reports and/or a complete listing of other reports available from WRD, contact Juliette Wilson, NPS, Water Resources Division, Colorado State University, Fort Collins, CO 80523. (303) 491-5607.

## Western Region

Tamarisk and control activities was the subject of a Sept. 2-3 workshop at the Western Archeological and Conservation Center. Participants included NPS and other federal agency representatives involved with tamarisk control, plus individuals representing herbicide manufacturing companies. Workshop topics covered historic and current control activities, impacts of control strategies on non-target species and habitats, and ecological monitoring techniques related to control activities. A summary report will be prepared and distributed by the CPSU, University of Arizona. Contact R. Roy Johnson, CPSU-UA, for more information.

"Restoring the Earth, 1988" is the title of a national

conference on natural resource restoration and environmental planning scheduled for January 13-16, 1988, at U.Cal/Berkeley, to further exchange of scientific information and to present accomplishments and capabilities of restoration technology in resource management and planning. Topics will include restoration of coastal ecosystems and estuaries; rivers and lakes; forests and wildlife; atmosphere and climate; and control of toxic wastes. Nontechnical sessions will cover policy issues, legislation, litigation, conflict resolution, trends, and accounts of restoration successes. Contact the College of Natural Resources, UCB, for more information.

Research Scientists Charles Stone (Hawaii Volcanoes), Lloyd Loope (Haleakala), and CPSU/Hawaii Unit Leader Cliff Smith represented the Service at an April 12-19, 1987, workshop at the Galapagos Islands. Entitled "Botanical Research and Management in Galapagos," the workshop focused on approaches and techniques for island ecosystem research and management that was particularly applicable to NPS areas in Hawaii.

R. Roy Johnson reports from the CPSU/Arizona that two publications focusing on Arizona parks now are available. One is "External Threats: The Dilemma of Resource Management on the Colorado River in Grand Canyon National Park, USA" (Johnson and Carothers, *Environmental Management*, Jan. 1987); the other is "Flora and Vegetation of the Rincon Mountains, Pima County, Arizona" (Bowers and McLaughlin, *Desert Plants*, 1987).

Charles Douglas reports from the CPSU/Nevada the availability of three new publications: *Food Habits of Burros in Death Valley* (Douglas and Hiatt, CPSU/UNLV Technical Report, 1987); *Management Recommendations for Improving Wildlife Habitat Degraded by Man in the Black Mountains, Death Valley National Monument* (Douglas, CPSU/UNLV Technical Report, 1986); and "Modeling Demographics of Bighorn Sheep: Current Abilities and Missing Links" (Leslie and Douglas, *Transactions of the 51st North American Wildlife and Natural Resources Conference*, 1986).

Thomas Stohlgren, Ecologist, and David Parsons, Research Scientist, at Sequoia and Kings Canyon NPs, recently published a paper titled "Variation of wet deposition chemistry in Sequoia National Park, California" in *Atmospheric Environment* (21:1369-1374). Sequoia NP is indeed receiving acid deposition. In lower volume summer storms, sulfate concentrations are two times higher, and nitrate concentrations are five times higher, than has been measured for rain in remote areas of the world.

Technical Report No. 25, *Impacts of Visitor Use on Backcountry Campsites in Sequoia and Kings Canyon National Parks, California* (Parsons and Stohlgren, 1987), published by the CPSU at U.Cal/Davis, provides the basis for making management decisions on use restrictions and rehabilitation efforts.

## Alaska Region

Radio collars have been installed on 50 reindeer in four separate Native-owned herds at the Bering Land Bridge National Preserve as part of a long-term radio tracking project, designed to provide needed information with regard to herd movements, reindeer interactions with indigenous wildlife, and the herds' use of park grazing lands.

Seven major lakes in Gates of the Arctic National Park and Preserve are being studied by the U.S. Fish and Wildlife Service for baseline fisheries information.

Resource managers at Noatak National Preserve are collecting information on wolves and bears, using radio collars on many of the animals. One of the wolves is equipped with a collar that allows tracking via satellite and computer.

Two teams of archeologists are at work – one at Cape Krusenstern National Monument, the other at Bering Land Bridge National Preserve. The Krusenstern study, led by NPS Regional Archeologist Doug Gibson, began in summer 1987 and will consist of one more year of field work plus a year of analysis. The Bering Land Bridge study, headed by Regional Archeologist Jeanne Schaal, began in 1985 and is winding up its year of analysis.

In late May and June, approximately 42 humpback whales were individually identified in the Glacier Bay-Icy Strait area by Dr. C. Scott Baker, marine biologist for Glacier Bay NP. Of this total, 16 individuals (including one calf) have entered the boundaries of the park. By comparison to most previous years, this is a large number of whales in the area.

Ken Krieger of the Auke Bay Laboratory, National Marine Fisheries Service, reports that the whales are feeding primarily on small schooling fish. Although fish have been the predominant prey of humpback whales in Glacier Bay during the 1980s, feeding on euphausiids or krill was reported to be more common in the 1970s. Many of the whales currently in the bay have summered here during past years and a few individuals have sighting records extending back at least 15 years. According to Resource Management Specialist Gary Vequist, this is one of the longest time-series of data in existence on a population of naturally marked baleen whales.

## Midwest Region

The Annual Report of major research activities in 1986-87 for the NPS Great Lakes Area Resources Studies Unit, headed by Robert Stottlmyer, is now available through the Department of Biological Sciences, Michigan Technological University, Houghton, MI 49931.

## Southeast Region

Two new Research/Resources Management Reports now available from the Southeast Regional Office, 75 Spring St., S.W., Atlanta, GA 30303: R/RM Report SER-83, "The Vegetation of St. John and Hassel Islands, U.S. Virgin Islands" by Roy O. Woodbury and Peter L. Weaver, and R/RM Report SER-84, "Terrestrial Plant Ecology in Great Smoky Mountains National Park Biosphere Reserve. A Fifteen-Year Review and a Program for Future Research" by Peter S. White.

## Southwest Region

The year 1987 was only an average year for hatching and imprinting turtle eggs at Padre Island NS, with 2,001 eggs received from Mexico and 1,288 hatched for a 64.3 percent hatch. Cool wet weather in Mexico is believed to be the cause of the so-so hatching rate. In years past the hatching rate has been in the 80 percent range, but we feel pretty good anyway because the hatch rate in wild populations is probably between 60 and 70 percent. Of the 1,288 hatchling, 5 died, one was lost in the surf while

# historical research

By Edwin C. Bearss

National Park Service historians and scientists don't communicate much – certainly not as much as they should. Although historians (here encompassing all professionals focusing on the human past, including those with other official titles) and scientists represent the basic disciplines underlying the National Park System, how many are aware of what their counterparts are doing? Can historians be more useful to scientists, and vice versa? Can the two disciplines, with better coordination, increase their value to management?

This column, which I hope will become a regular feature in *Park Science*, is intended as one small step toward improving our communication and coordination. It is the brainchild of Alaska's Bill Brown, who hails from the historian ranks (he's pretty historic himself) but who has an affinity for natural concerns heretofore rare among our breed. Bill proposed that I, as chief historian, kick it off and then circulate the byline among our talented cadre of regional historians.

"imprinting" the hatchlings, and 1,282 were sent to the National Marine Service in Galveston, Texas for Head Staring, a program where hatchlings are raised in captivity for 9 months until they are about the size of dinner plates. Although no adult Kemp's Ridley Turtles nested at Padre Island this year, several adults were seen in the surf and hopes are high that nesting will take place next year.

The Regional Office staff, with considerable help from other park staff, private organizations such as the Cave Research Foundation and the Nature Conservancy, completed the on-site evaluations of 26 National Natural Landmarks this year. Three potential National Natural Landmark sites were evaluated as well. We are consistently encouraged by the concern and pride that the owners of Natural Landmark properties take in preserving and protecting these areas.

## Pacific Northwest

Kim Sikoryak, John Day Fossil Beds NM interpreter, is the Pacific Northwest regional winner of the Freeman Tilden award for excellence in interpretation. As such, he has been nominated for the National Tilden Award.

Janet Edwards, a Natural Resource Management Specialist currently working out of the Regional Office, won a special achievement award for her part in preparing the Natural Resource Assessment and Action Program for the Region. Ed Menning, Resource Management Specialist, and Edwards recently worked with San Juan Island NHP Chief Ranger Steve Gobat on fire road access and rabbit population dynamics. They also read four Douglas fir plots to monitor success of various treatments to prevent vole damage.

The 1986 Annual Report of the NPS/CPSU at University of Washington is available now, through James K. Agee, Biology Program leader, and Darryl R. Johnson, Social Sciences Program leader, College of Forest Resources, AR-10, U.W.A. Seattle, WA 98195.

thereby "broadening the appeal of *Park Science* and the horizons of historians as well."

Let me begin, then, by reviewing some recent, current, and planned research ventures in which history and natural science come together most evidently.

Last year, Gordon C. Olson, a ranger at Antietam National Battlefield, completed a 300-page master's thesis titled "A History of Natural Resources Management within the National Park Service." Keyed to the administrations of successive NPS directors, Olsen's thesis traces the place of science and natural resources management in the organization and outlines major trends and developments in these fields.

In 1985 R. Gerald Wright of the University of Idaho's College of Forestry, Wildlife and Range Sciences received a research grant from Eastern National Park and Monument Association for a history of wildlife management in the national parks, intended for book publication. Wright's research is organized into chapters with such headings as "The Introduction of Science into Park Management," "Park Management and the Ecosystem Concept," "Sport Hunting and Poaching Pressures on Parks," and so forth. As of June 1987 the history was about two-thirds complete.

Alston Chase's *Playing God in Yellowstone* has been much criticized for its portrayal of natural resources management in our flagship park. Partially in response, Harry A. Butowsky of the WASO History Division, with support from the Senior Scientist's office, has embarked upon a fresh study of some of the more controversial issues addressed by Chase and others. Butowsky's history will emphasize Yellowstone but will touch upon other such critical parks as Everglades, Great Smoky Mountains, and Yosemite. Completion is scheduled for 1988.

As I write, Associate Director Gene Hester has just approved and funded a North Atlantic Region proposal titled "Inventory and Conservation of Genetic Resources of Historically Significant Fruit Trees in the National Park System," to be carried out during the next two years by the University of Massachusetts. The researchers will produce a computer-based inventory of historic orchards in the System, identify and collect specimens of any unique genetic material found, and recommend management actions to conserve and propagate such material. In recent years we in cultural resources management have become increasingly concerned about the conservation of historic landscapes, so we especially welcome this project and look forward to cooperating on it.

Historians and scientists may use different vocabularies, but most of the time we speak the same language. Let's keep in touch!

## Two More Assessments Of the Alston Chase Book

Two more reviews of Alston Chase's controversial *Playing God in Yellowstone: The Destruction of America's First National Park*, have been called to the attention of *Park Science*. NPS Director William Mott has circulated to the Directorate the Donald C. Baur review in the *Land and Water Law Review* (1987, Vol. XXII, No. 1), calling it "the best review I've seen" and recommending "you read it carefully." Mary Meagher, research biologist at Yellowstone NP, recommends the *Bioscience* (Feb. 1987, Vol. 37, No. 2) review by Duncan T. Patten. Baur is a former General Counsel for the U.S. Marine Mammal Commission in Washington, D.C.; Patten is at the Center for Environmental Studies, Arizona State University at Tempe.

# information crossfile

*Restoration Ecology: A Synthetic Approach to Ecological Research* is the title of a 300-page book due for publication by the Cambridge University Press (32 East 57th St., New York, NY 10022) in October 1987. Editors William R. Jordan III, Michael E. Gilpin, and John D. Aber provide an introduction to "ecological restoration as a technique for basic research." The book explores the ecological concepts and ideas involved in the practice of habitat restoration by taking a theoretical approach suited to ecologists concerned with the structure and dynamics of communities. Large subject areas are "assembling whole systems in the field," "synthetic ecology," and "partial or piecewise restoration in the field." A discount price of \$18 for the paperback may still be available.

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An up-coming issue of the George Wright Society's FORUM will contain a book review by Lloyd L. Loope of *El Nino in the Galapagos Islands: The 1982-1983 Event*, published by the Charles Darwin Foundation for the Galapagos Islands, Quito, Ecuador, 1985. Loope is a Research Scientist at Haleakala NP in Hawaii.

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*Wildlife Recreation: Ecology and Management* is the title of a 341-page book by William E. Hammit and David N. Cole, published by John Wiley and Sons. It will be reviewed in the Winter issue of *Park Science*.

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*Parks*, the IUCN international journal for managers of national parks, historic sites, and other protected areas, has completed its first year of four issues under the editorship of Tony Mence. Vol. 12, No. 1, 1987, features the creation of a system of parks to meet the recreational needs of Hong Kong's huge urban population. A contrasting study in the same issue is the approach used for identifying and effecting the protection of sensitive coastal and marine areas of Oman through existing infrastructures.

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*The Big Cypress National Preserve*, by Michael J. Duever and eight other authors, an in-depth study of the Preserve and a model of what should be done whenever new natural areas are acquired, has been published by the National Audubon Society. The 455-page, illustrated paperback book contains photos, maps, drawings, and a large color folded map in pocket. Contents include geology, hydrology, vegetation, animals, fire, land uses, management units, implications of adjacent land use patterns, and research needs. The book is available for \$30 from National Audubon Society, Research Dept., 115 Indian Mound Trail, Tavernier, FL 33070.

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The summer 1987 issue of *Ranger*, the NP Rangers Association journal, features "Rangers and Resource Management." In addition to a variety of treatments of that topic, the issue contains book reviews of *Grizzly Country*, by Andy Russell, and *Pages of Stone - Vols.*



## computer corner

The NPS Pacific NW Regional Library has made an important advancement into the world of laser technology and at the same time has increased local residents' access to library materials through the region, according to Regional Librarian Ellen Traxel. The library now has a new product called **LaserCat**, which uses optical disks with information on books, magazines and other items held by more than 240 libraries from Alaska to Arizona.

**LaserCat** makes use of a technology known as CD-ROM, which stands for Compact Disc Read-Only Memory. The discs, similar to compact discs now popular for music recordings, represent an advanced computer storage technology that uses laser light to read large amounts of information stored on a small disc. One CD-ROM disc holds 550 million characters of information, equivalent to the information stored on 1,500 computer floppy disks. This is equal to more than 700 issues of a typical daily newspaper.

"This new product gives our library access to one of the most extensive collections of computerized library holdings in the Western United States: The Western Library Network (WLN) database," Traxel said.

WLN, a division of the Washington State Library, provides computer services to libraries. **LaserCat**, which was developed at WLN, features the equivalent of two million catalog cards on CD-ROM. Traxel calls this "inexpensive and easy-to-use tool," a benefit for National park staff wishing to compile bibliographies and catalog park library collections.

A 360K floppy disk that carries seven years of *Park Science* indexing by title, author, subject matter, park, region, and position in *Park Science* is being readied by Pacific Northwest Region Librarian Traxel and Assistant Librarian Richard Arokhaar.

Written in dBase III+, the disks will come with a menu-driven system for accessing the information.

Inquiries about (or suggestions for) this service should be addressed to Ellen Traxel, NPS Pacific Northwest Region, 83 S. King St., Seattle, WA 98104, or phoned to (206) 442-5203 (FTS 399-5203).

2 and 3, covering Sierra Nevada, Cascades and Pacific Coast, and the Desert Southwest, respectively. The latter are by Kalka Chronic, published by The Mountaineers of Seattle. Yet to come in this series is Vol. 4, The Grand Canyon and the Plateau Country.

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Alston Chase rides his Yellowstone opus reputation

once again onto the pages of a national magazine – this time the July 1987 issue of *Atlantic Monthly*. "How to Save Our National Parks" is the title this time. His message is that resource management and research "are, to be sure, starved for funds and have been throughout the history of the agency. But the miser," Chase claims, "is the Park Service itself." In 1963 the National Academy of Sciences urged that around 10 percent of the NPS budget be spent on natural-history research. "Twenty-four years later," writes Chase, "in fiscal 1987 the budget share for such research is less than two percent." Chase's article ends with a 14-step "reform process" for the Park Service.

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Reprints of a 1987 paper on "Changes in Interacting Species with Disturbance" from *Environmental Management*, Vol. 11 (2), by Glen F. Cole, can be had from Voyageurs NP, Box 50, International Falls, MN 56647. The paper illustrates an approach for predicting and subsequently measuring the effects of disturbance or restoration programs on groups of interacting herbivore and carnivore species. The paper has attracted international attention and generated requests for reprints from all over the world according to Cole, who retired from the NPS on June 1, 1987.

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Dr. Harry A. Butowsky of the NPS History Division in the NPS Washington Office is working on a Service-wide administrative history of natural resource management in the NP System and would welcome any questions or suggestions from NPS personnel. He can be reached by phone at 343-8155 or by writing to the History Division, WASO. The study is scheduled for completion Sept. 30, 1987.

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Blackwell Scientific Publications, 52 Beacon St., Boston, MA 02108, announces a new journal – *Conservation Biology*, representing "a confluence of science, pragmatic idealism, and hands-on experience aimed at the invention and implementation of practical conservation and development strategies," a periodical that is included in membership in the Society for Conservation Biology. Michael E. Soule of the University of Michigan is president of the Society; Peter F. Brussard, is secretary-treasurer, and the Board of Governors includes William Conway, Jared Diamond, Paul Ehrlich, E.O. Wilson and Bruce Wilcox.

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Douglas A. Wilcox, Indiana Dunes National Lakeshore, is co-author of "Hydrology, Water Chemistry and Ecological Relations in the Raised Mount of Cowles Bog," which appears in Vol. 74 (1103-1117) of *Journal of Ecology*. Co-authors are Robert J. Sheddlock of the U.S.G.S. and William H. Hendrickson.

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Using a technique referred to as "capture-recapture," a team of 15 biologists and back-up personnel in May and June 1986, conducted a grizzly bear census in a 719-square mile area in the vicinity of the Wulik and Noatak Rivers in Alaska – finding 44 bears of which 30 are adults. The operation, substantially funded by the NPS, is described in the June 24 issue of *Arctic Southerner*, a bi-weekly publication in Kotzebue, AK.

Thirty bears were captured and fitted with transmitting radio collars, each of which was programmed with a distinct frequency, enabling monitors to distinguish each bear and to determine the movements, habitat use, reproductive success, associations, and den sites of each bear.

# Wolf Recovery In Yellowstone

By Norm Bishop

Gray wolves, effective predators on large mammals, were native to Yellowstone. They were extirpated by 1927, when national policy was to exterminate wolves on all public lands. An intensive study from 1975 to 1977 and sporadic sightings (nine possible 1980-1986) suggest that no viable wolf population lives in the park.

The wolf's ecological niche in the park is vacant – a departure from the purpose stated in the park's 1973 master plan to perpetuate the park's natural ecosystem. Management policies for resource management in national parks are to maintain and perpetuate their natural integrity. The policies encourage reintroduction of natural species extirpated by humans, where adequate habitat exists.

The gray wolf is listed as endangered in the contiguous states except Minnesota under the Endangered Species Act of 1973 (ESA). A Northern Rocky Mountain Wolf Recovery Plan was produced by an inter-agency team in 1980. A revised plan is in final review. The plan proposes reintroduction of an *experimental* group of wolves into the Yellowstone area. The 1982 amendments to the ESA allow *experimental* populations of endangered species to be reintroduced with added management flexibility to contain the population and remove problem animals. The plan recognizes that compliance with the National Environmental Policy Act requires an Environmental Impact Statement, with public participation, before any significant recovery action is begun.

Following a management pattern similar to one that has evolved to recover and manage the threatened grizzly bear, three management zones would be set up to facilitate wolf recovery. Management Zone I would be a unit of more than 3,000 square miles containing key all-year habitat to sustain 10 breeding pairs of wolves, with less than 20 percent of the land devoted to livestock grazing. There, the first management priority, along with perpetuation of the natural ecosystem, including other native species, would be wolf recovery.

Management Zone II would be a flexible buffer area where wolves can occupy some key habitat, but where management preference would be given to livestock grazing and other land uses. Problem wolves would be controlled.

Management Zone III is where wolf-human conflicts would be minimized. If wolves pose a problem to humans, they would be controlled. Other established uses take priority over wolf recovery.

When Yellowstone's experimental wolf population has grown to include 10 breeding pairs, probably in 10 packs of 5-16 wolves (50 to 160 total), and those 10 pairs have lived in Yellowstone for 3 consecutive years, they can be reclassified. Delisting wolves will be contingent upon their being protected by states and managed as game animals or furbearers.

The Yellowstone recovery area proposed in the draft Northern Rocky Mountain Wolf Recovery Plan would be set in the center of a vast tract of park and wilderness – the largest intact ecosystem in the temperate zone of the earth – 2.2 million acres in the park, 3.6 million acres of national forest wilderness, and 2.7

million acres of undeveloped wildlands. It already serves as the core of a grizzly bear recovery area, and contains a natural complex of other predators: black bears, mountain lions, bobcats, and coyotes.

L. David Mech, one of the nation's foremost wolf authorities, said of Yellowstone, "This is just magnificent wolf country."

In part because of the proposed Yellowstone recovery area's large size, remoteness, and integrity, there is low likelihood that wolves will prey on the few cattle and sheep that are grazed seasonally on the periphery of the recovery area.

In contrast, on Minnesota wolf range, 1,200 wolves are interspersed with 12,230 farms with 234,000 cattle and 91,000 sheep. From 1977 through 1986, the highest cattle losses reported there were 4.5 per 10,000, and the highest sheep losses claimed were 26.6 per 10,000. As a result, 15 to 59 wolves were trapped per year (38 average) in Minnesota wolf range.

In Yellowstone there are tens of thousands of elk, thousands of deer and bison; hundreds of bighorn sheep, pronghorn antelope, and moose. All these species are natural prey for wolves, and will supply ample food for them. Alternative prey – countless snowshoe hares, twenty species of rodents, abundant waterfowl and grouse – are also available in Yellowstone.

Although grizzly bears, black bears, mountain lions, and coyotes all have demonstrated that they will attack human beings, there are no authenticated cases of healthy wild wolves attacking modern people in North America. Wolves are shy, and avoid people.

The absence of a viable wolf population is the single

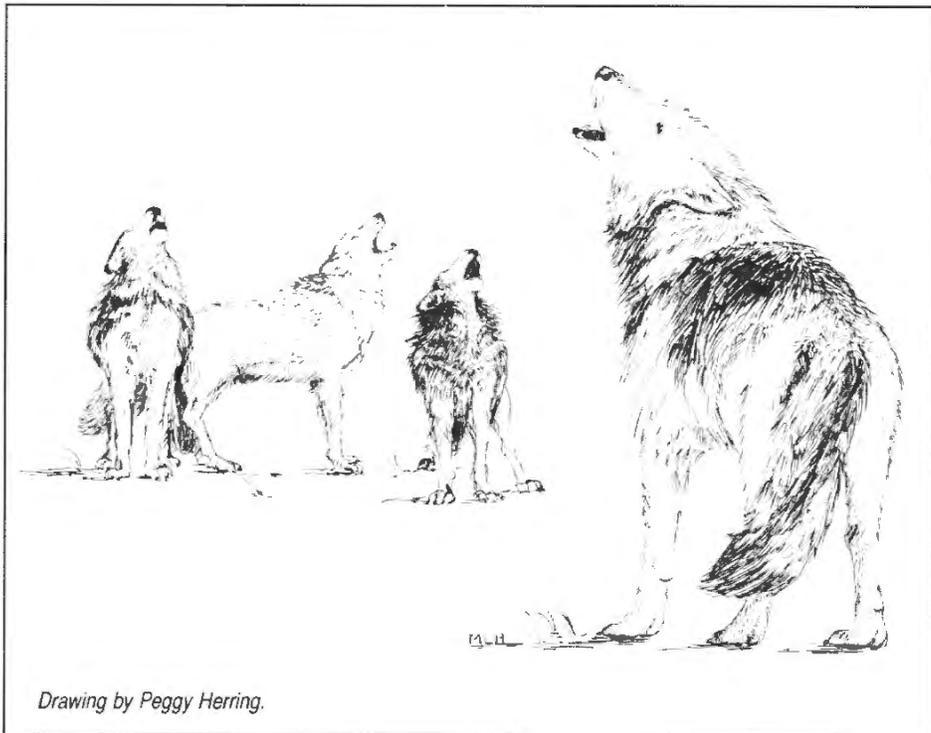
greatest departure from the objective of maintaining a natural ecosystem in Yellowstone. Indeed, wolves are the only one of five threatened or endangered species in the park for which there is no recovery program. The presence of wolves would provide a needed empirical test of their effects on their several species of prey, as well as insight into the interrelationships among wolves and other predators in the park. Detailed studies of those effects must accompany studies of the wolves. From studies elsewhere, it seems likely that wolf kills will offer a more stable spring, summer, and fall source of protein essential to grizzly bears in Yellowstone.

In the draft recovery plan, and in the park's comments on the draft plan, concerns of nearby residents and commercial interests are considered carefully, with proposals to provide public information, means to protect the interests of hunters, outfitters, and commodity interests, to control depredating wolves, or those that may become problems, and to compensate ranchers for stock lost to wolves.

Wolf recovery in Yellowstone need not interfere with public use of the park, or preclude legal use of wilderness for recreation or multiple uses such as grazing, timber harvest, oil and gas extraction, big game hunting, or animal damage control programs. Adjustments have already been made in those activities to accommodate grizzly bear recovery.

Overwhelming support for wolf recovery in Yellowstone was shown in 1985 by a random survey of park visitors (McNaught, U. of Mont.). Yellowstone NP has funded, through the University of Wyoming, a random survey of attitudes of Wyoming citizens toward wolf reintroduction. Preliminary results show very strong support among members of two Wyoming conservation organizations, and opposition among stockgrowers, who fear they might be impacted economically by the presence of wolves in Yellowstone. Support for wolf recovery is widespread in the American conservation community.

*Bishop is Research Interpreter at Yellowstone NP.*



*Drawing by Peggy Herring.*

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# meetings of interest

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1987

**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.

**November 3-6, CONSERVATION EDUCATION WORKSHOP ON ISLAND ECOSYSTEMS**, at Kilauea Military Camp on the Island of Hawaii. Contact: Chuck Stone, Research Scientist, Hawaii Volcanoes NP, Box 52, Hawaii NP, HI 96718.

1988

**January 13-16, RESTORING THE EARTH, 1988**, a national conference on natural resource restoration and environmental planning, at U/Cal/Berkeley. Contact: UCB College of Natural Resources.

**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. 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.

**November, CONFERENCE ON SCIENCE IN THE PARKS**, sponsored by the George Wright Society with the National Park Service and co-chaired by R. Roy Johnson, Leader of the NPS/CPSU at University of Arizona, Tucson, AZ 85721, (602) 762-6501 and James Judge, Director, Fort Burgwin Research Center, P.O. Box 300, Ranchos de Taos, NM 87557, (505) 758-8322. Specific dates and meeting place in Tucson to be announced.

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## Society of Conservation Biology Holds First Annual Meeting

The newly-formed Society for Conservation Biology (SCB) held its first annual meeting June 24-25 in Bozeman, Mont. The Society conducted symposia that addressed such varied topics as parasitology and conservation, the significance of edges in conservation biology, advances in conservation biology of fishes, and prospects and recommendations for undergraduate, graduate education and continuing education for professionals. Keynote speaker Raymond Dasmann opened the meeting that sampled collected research and management efforts presently underway in conservation biology. Other speakers' topics ranged from breeding success of small rhino populations and population viability, to interactions of complex landscapes.

One thing that became evident is the overlap and the need for cross-fertilization between conservation biology, landscape ecology, and the more rudimentary humanitarian and biological disciplines.

The SCB banquet speaker, Norman Myers, urged optimism. He related an ongoing struggle by the Australian national government for establishment of a World Heritage Site in Northern Queensland. This apparently is contrary to the Provincial government's intention to log the remnant forests. Later, Paul Erlich, recipient of one of the society's four conservation awards, turned his attention to the request of the Australian government, asking members to not forget how they, as individuals and as an organization, could

be valuable in this and similar efforts.

Three other awards were: one to the New York Zoological Society for its tradition of leadership in conservation biology; one to Dr. Norman Myers for his unrelenting efforts to keep the world's attention on the ongoing destruction of tropical rain forests; and to Michael Lemartz of the USDA Forest Service for combining field studies, concepts of conservation biology and applied forestry techniques into a management program for maintaining viable populations of red-cockaded woodpeckers.

The meeting, its format and subject coverage, was well-organized. Mike Soulié, the board and other officers including the chairman/organizer, Peter Brussard (MSU), gave us something really worth anticipating in a second meeting of the Society, to be held at the University of California, Davis, Aug. 14-18, 1988. The CSB meeting will be held jointly with AIBS and the Ecological Society. C. Schonewald-Cox will be the campus organizer for the SCB meeting and is happy to answer questions you may have. At the Davis meeting, a number of symposia will cover focal topics in conservation.

Montana offered cooled weather, 65-70 degrees, and its very beautiful Galatin Basin, surrounded by snow-peaked mountains and most of the mega-vertebrate fauna that still roam these northern mountains.

**Christine Schonewald-Cox**  
*NPS Research Biologist, Davis, California*

## Urban Parks' Role In NP System Eyed

By Jean Matthews

Urban parks as places where human survival values can be imparted to visitors was a clear theme at the June 8-12, 1987 Urban Parks Conference in New York City, called and keynoted by NPS Director William Mott. The more than 130 park superintendents, natural resource managers, interpreters, and members of the Washington office NPS directorate in attendance spent five days of intensive interacting and emerged with recommendations in six areas of urban park endeavor. These recommendations are currently being circulated to the superintendents who attended the conference and will be submitted to the Director by October 1.

Of particular interest to *Park Science* readers is Objective #5, which deals with "a comprehensive communication/marketing program that would enable the park manager and staff to better manage and share information requirements, build a stronger base of constituent support, strengthen both internal and external networks, and generate improved awareness and support of the park and the Service within the community." The recommendations spell out the natural resource reasons for "why we need to communicate park ideals."

Denny Galvin, NPS Deputy Director, called urban parks "places where people collide with their planet and their culture, and as such they are very important places. The imprimatur of excellence goes into all NPS sites - not just the great natural parks. When we first came to Gateway, we didn't look for some new urban approach. We said 'Where do we put our nature trails and our interpretive panels?'"

Dr. Jessyna McDonald, a former NPS EE and Recreation Specialist and currently Chairman of Recreation Studies at Purdue University, told the conferees:

"If you can't reach, you can't teach. So the first thing to do is get the urban people to your parks. In the rapidly changing urban picture, value systems are splintering and crashing. The life boats of church and state are disappearing. The National Park Service can function as a support system. Urban parks can operate as extensions of the community, doubling back and affecting the surrounding areas, tending to make whole neighborhoods more parklike, engendering pride and effort."

John Tanacredi, Chief of Professional Services at Gateway NRA, described the Jamaica Bay Refuge within the park boundaries, the greenhouses where natural vegetation is grown for park landscaping, meadow restoration, osprey poles, marsh areas, measures to protect the piping plover (an endangered species), and programs for urban children such as Ecology Village - all opportunities to educate visitors about the ecosystem, its interactions and interdependencies, how their own communities and neighborhoods fit into this scheme, and the values and care involved.

Eugene Hester, NPS Associate Director for Natural Resources, called on urban park personnel to go beyond their own message and mission and function openly as part of the total National Park System. Urban parks, he said, have the responsibility of conveying the important lessons of clean water, clean air, animals, plants, migration, predation, demographics - all the systemic interactions which a U.S. population that was basically rural once understood

"We no longer enjoy this understanding," Hester

said. "We have to let urban people know how water is stored, kept usable, moves through the environment – how air and water serve the wider community, how the ecological health of parks is related to the health of the total environment."

Hester suggested that urban parks should work toward harnessing the energies of their nearby constituents "to help us, as park employees, protect our natural resources." He observed that Director Mott "is strong for biological diversity, for threatened and endangered species," and pinpointed loss of habitat as a prime problem. "Parks are places," he said, "where visitors should be helped to understand the intrinsic value of all animal and plant life – how every organism has some ecological value and many have human benefits yet to be discovered. Parks are opportunities to explain these values – especially urban parks."

The need for social science research, posed by the changing demographics of both visitors and the National Park Service, was recognized by Sociologist William Kornblum of New York University and Don Field, NPS Social Scientist.

George B. Hartzog, Jr., a former NPS Director, challenged the group to consider the problem within NPS ranks. "A burning concern" for the Service itself, he suggested, is to examine its own commitment to the teaching mission. "I perceive," he said, "a lack of consensus within the NPS ranks as to what is our business and should we be in it?"

Dr. Field, who recently completed a survey of NPS personnel with relation to the Service, described the need for sociological research both inside and outside the Service and the imperative to "adjust our traditions to fit the 21st Century if we are to survive into that era."

## If You Don't Mind Missing Christmas At Home . . .

From Joanne Michalovic in the NPS Washington Office of International Affairs comes a call for applications from interested mid-level NPS career employees to attend the **First Asian School on Conservation Biology** to be held Dec. 16-31, 1987, at the Centre for Ecological Sciences, Indian Institute of Science, Bangalore, India. Scientists, students, resource managers, and park managers from many Asian countries will attend, and the organizers have invited and will pay the expenses for one NPS mid-level employee.

Emphasis will be placed on broadening efforts to conserve the entire spectrum of biological diversity and on reconciling the demands of conservation, economic development, and subsistence needs of local people. In addition to course work and lectures on modern developments in the entire field of conservation biology, the school will include a four-day field trip to India's first biosphere reserve in the Nilgiris, South India. Within that reserve are the Bandipur Tiger Reserve, Nagarhole and Silent Valley National Parks, and Mudumali, Wynad, and Upper Nilgiris Wildlife Sanctuaries.

The NPS participant will be expected to deliver one lecture on an appropriate topic pertaining to biological conservation in his/her field of expertise. He/she will also be expected to deliver presentations to NPS staff in the home park or region upon return to the U.S., and prepare a written evaluation of the course and

# Reserve Designs in a Landscape Context: Another Slant in the Continuing Debate

By Joseph E. Means and Sarah E. Greene

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 the data of Quinn et al. to their hypothetical choices of reserve system designs, and suggest that 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 because 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 (here, the range of island sizes) of the reserve system is probably important to the number of species on islands in each size class.

A similar difference exists in the structure of the natural island systems they describe and alternative reserves designed by human beings. 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 because the 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

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experience. All travel, per diem, and course registration fees will be covered. The NPS participant must supply his/her own pocket money for incidentals.

Applications will be accepted from interested mid-level NPS career employees who have responsibility for management of natural resources/biological diversity. This could include but is not limited to resource managers, park managers, park rangers, and researchers.

All applicants must have an International Skills Roster Form and accompanying SF-171 on file with the Branch of Employee Evaluation and Staffing, Rm 2215, ATTN: International Skills Roster, P.O. Box 37127, Washington, D.C. 20013.

Selection will be made using the Skills Form and SF-171. Deadline for application is Oct. 2, 1987.

Previous overseas experience is not mandatory.

Please address any questions to Joanne Michalovic, Office of International Affairs, 202-343-7063.

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 probably are quite rare, experiments can be designed that directly address this point.

Our second point is that each reserve system is part of an encompassing landscape-wide 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, crossing boundaries frequently, and some would maintain healthy populations even without reserves. Although certain species prefer edges, interior species may need large buffers 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. Pest populations, such as defoliating insects, may build up in the surrounding landscape and then enter reserves. These interactions depend on the composition, sizes, and shapes of different units in the landscape pattern, and importantly, they change as the 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 about other extensive federally managed lands. The USDA Forest Service typically manages large landscapes (relative to National Parks) and controls 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, and range. National Park Service managers have different goals and options, usually managing one or two reserves within a larger landscape over which they have little or no control. 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 'Landscape Ecology' by D. Urban et al., 1987, **Bioscience** 37(2): 119-127) and tools for analyzing information in a spatial context (such as geographic information systems) promise to be of increasing value in this effort.

*Means and Greene are Research Foresters with the Pacific Northwest Forest Research Station, USDA Forest Service, 3200 Jefferson Way, Corvallis, OR 97331.*

# Swift Fox Returns To Badlands NP

By Sue Consolo

On June 26, 1987, a family of swift fox (*Vulpes velox*) was reintroduced into Badlands National Park from Shannon County, SD. This culminated six months of searching and planning for the return of a native prairie predator whose decline stemmed from human activity earlier in this century.

Once common throughout the plains states, the swift fox is listed as threatened in South Dakota, and has been proposed for listing under the federal Endangered Species Act. Its decline has been attributed to hunting and trapping as the Great Plains were settled, and to widespread predator and rodent control programs. There were no sightings of swift foxes in South Dakota from 1914 to 1966, but then the species began to reappear in the Dakotas. In the late 1970s, State Department of Game, Fish and Parks researchers located a small population on the Pine Ridge Indian Reservation south of Badlands. However, a large-scale prairie dog control program recently initiated there has raised concern for the swift fox's survival.

The North Unit of Badlands NP contains 64,144 acres of designated Wilderness, with approximately 2,400 acres of uncontrolled prairie dog towns. Prairie dogs are a major prey of the swift fox as well as other predators, several of which are missing from the Badlands. The park's Resource Management Plan called for restoration of the native swift fox, and the Wilderness Area provided an excellent area for reintroduction because of its isolation and the abundance of prey.

In January 1987, after clearing the project with representatives of the state and the Oglala Sioux Tribe, South Unit District Ranger Glen Livermont and I began spotlight surveys on the reservation to see if swift fox remained in the area. As with all wildlife monitoring work, these nightly searches meant long hours of

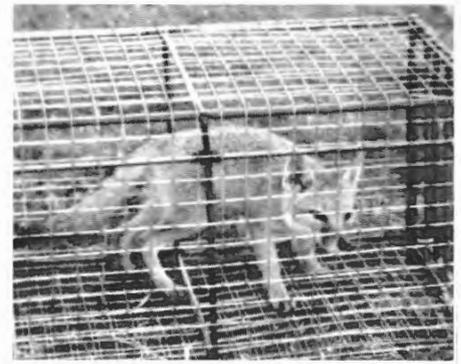
monotony and frustration, punctuated by moments of excitement! We were rewarded on a frosty night in February, when we saw swift foxes for the first time.

The swift fox is a nocturnal hunter relatively tolerant of humans. Among foxes, only the kit fox is smaller and was once thought to be the same species. Adult swift foxes stand about a foot tall and average 5-7 lbs. (2.2-2.5 kg), about the size of a small house cat. They are buff to gray colored, sometimes with a reddish tint. Their black-tipped tails and very pointed ears are diagnostic.

By spring, we had located several pairs and, to our delight, two dens of breeding foxes. Our hope was to locate a family to transplant into the park. Scientists with prior experience relocating foxes in South Dakota and Canada suggested that transplanting a breeding pair or, better yet, a family group offered the best chance for successful establishment.

We selected a reintroduction site in the Wilderness Area close to water and prairie dog towns, and accessible enough for us to build a temporary holding pen. The pen was a 10' x 20' wire enclosure, roofed and floored. Inside the pen we buried a den made of two plywood boxes connected to each other and the surface by PVC pipe. We were advised to fuss over construction of the fox's temporary home, as they are "little Houdinis" in their ability to escape!

Everything seemed on track, but by the first of June, we were getting discouraged; one pair of adults had not been seen for weeks, and another denning pair had relocated during bad weather, causing us to lose track of them. Then, in the early hours of June 16, a spotlight crew suddenly located four playful pups around a fox den not far from the abandoned site. The adult female and a pup were trapped almost immediately but released, as it was apparent that several nights would be needed to "out-fox" and trap the entire



Swift fox pup in holding cage.

family. The mother received a radio-collar to allow us to track her if she moved again. Like other canids, swift foxes often relocate dens several times when pups are young.

Trapping began in earnest the week of June 21. The swift fox was reported to be easy to trap (one adviser told us it would take "all night, but you'll get them all"), so we were a bit surprised that it took all week and a variety of baits and trapping schemes. Using prairie dogs for bait in staked-down traps proved the trick to catching the adults, and by dawn on June 26, we were convinced we had the entire family ready to translocate 80 miles to their new home.

With the help of a YCC crew and other ranger personnel, the swift fox family was measured, ear-tagged, and carried to the release site. The family consisted of a 5 $\frac{3}{4}$ -lb. male, a 4 $\frac{1}{4}$ -lb. female, and four pups, two males and two females weighing from 2.5 to 4 lbs. One by one the fox were handed into the pen and placed down one entrance to the artificial den. Within minutes, they scooted into the den and peered out the other entrance, appearing to find their temporary home acceptable.

During their time in captivity, the foxes received water and food (prairie dogs, mice, birds, and cat food) every three days. The pen was only approached during the day, when the foxes were generally not active above ground. The family was observed from a distance of 30-100 yards at dusk, dawn, and night with spotlights and a night vision scope. There was surprisingly little effort to escape confinement, and the foxes noticeably put on weight, especially the adult female, who was in fairly poor condition at the time of capture.

On July 21, nearly four weeks after being relocated, the pen was opened and the swift foxes were free to go. The artificial den remained, in case they wanted to continue to use it for cover or as their home base. The swift fox is one of several species that rely on their ability to dig burrows for escape from coyotes, eagles, and other dangers on the nearly treeless prairie.

Resource Management Rangers are monitoring the released family of foxes to determine whether they survive and stay in the area. Depending on the success of this transplant, we plan to use similar procedures to trap and release more swift foxes over the next few years. Spotlight surveys in and outside the park will help determine if this threatened species gains a firmer hold in western South Dakota. The swift fox is just one of many native species that have been extirpated from the Great Plains. For Badlands NP, it is exciting to see the return of this rare fox to its natural role as a prairie predator.

Consolo is formerly Resource Management Specialist for Badlands NP, now a Management Biologist at Yellowstone NP.



Sue Consolo prepares reintroduction pen in Sage Creek Wilderness.

# Biological Diversity FY 1989 Initiative For Interpretation

*Editor's Note: Richard Cunningham, Western Region's far-sighted Chief of Interpretation, sent a March 1987 memo to all WR areas and offices, dealing with the interpretive initiative for FY 1989, as announced by NPS Director Mott. (1988 initiative is acid rain/air quality.) Excerpts from Cunningham's memo follow.*

Biological diversity is simply the diversity of life and includes species diversity, genetic diversity, and ecosystem diversity.

The "average" person feels that species disappearance is not very important when compared to the "real problems" of nuclear arms, nuclear power, poverty, arid starving people, overpopulation, the economy, scandal in government, etc. But the problem of disappearing species is one of the great "sleeping" issues of our time. It also presents us, as interpreters, with one of our greatest challenges and opportunities for park interpretation. We have the chance to ring the "wake-up" bell.

On estimate is that at least one million species of plants and animals will become extinct by the end of this century. On a worldwide basis, people are daily consuming more foods and more medicines, and using more industrial products that come from wild species of plants and animals. Over 1,000 species of animals currently are recognized as under threat of extinction. Why should the public be concerned? Why should we save species of animals and plants? To me, there are at least four reasons why: (1) other organisms have a right to existence – compassion calls for their preservation; (2) species should be preserved because of their beauty, their symbolic value (i.e. bald eagle), or their intrinsic interest; (3) species should be preserved for their actual or potential economic uses; other species provide direct benefits to humans; (4) species are living components of the ecosystems in which they live.

For the "general public" though, the need for preservation of species most often comes down to "What's in it for me?" I think the economic or utilitarian reasons for species preservation is the interpretive "hook" by which we can capture the interest of the average person.

**Included here is a selection of references I urge you to use in adding to your personal and park libraries.**

About 80,000 possible edible plants are known to exist. At one time or another man has used at least 3,000 for food, but only about 150 have ever been cultivated on a large scale. Today fewer than 20 different plants produce 90 percent of the world's food. A major disease affecting any one of the four major crops (wheat, rice, corn, potatoes) would have serious implications for many people. Without sufficient stocks of genes from wild strains, modern agriculture is threatened by new diseases and resistant insect pests. Wild plants provide original gene resources for revitalizing and improving the strains of food plants we grow.

Plant and animal species contribute to a wide range of drugs and pharmaceuticals, including antibiotics, analgesic pain-killers, anti-leukemia drugs, anticoagulants, etc. About half of all prescription drugs in the U.S. contain a drug of natural origin. The U.S. is dependent for medicines upon imported plant mate-

rials, especially from tropical forests.

Alkaloids an extremely valuable group of drugs, occur in about 20 percent of all plant species. They include strychnine and narcotics such as morphine, nicotine, and cocaine. Pain-killers, cardiac and respiratory stimulants, blood-pressure boosters, anti-malarials, muscle relaxants and anti-leukemia drugs are all derived from plant alkaloids, yet only about 2 percent of the Earth's 300,000 flowering plants have been tested for alkaloids.

The rosy periwinkle comes originally from Madagascar – an island with an incredibly high rate of extinction. A total of 75 alkaloids have been discovered in the rosy periwinkle, two of which, vincristine and vinblastine, have led to a break through in the fight against cancer, especially Hodgkin's Disease. Vincristine has become a major treatment for children with acute leukemia. How many other "rosy periwinkles" are now verging on extinction – or have already been lost – that might contain a chemical with even more effective anti-cancer properties?

Many animal species also serve our medical needs. The study of elephant physiology may shed light on atherosclerosis. Desert pupfish show remarkable tolerances to extremes of temperature and salinity, a condition that could aid research on human kidney disease. The armadillo may eventually hold the key to a cure for leprosy; it is the only animal other than man to contract the disease. The blue blood of horseshoe crabs contains a chemical extract which clots upon contact with endotoxins. This extract is used for diagnosis of spinal meningitis, bubonic plague, and Legionnaire's disease. Yet millions of horseshoe crabs have been killed by commercial fishermen, or by pollution, or for fertilizer and chicken feed. Horseshoe crabs have not yet been bred in captivity and must be harvested from wild populations.

Preservation of species for industrial and other uses (such as bee's honey used to monitor air pollution by heavy metals) are further subjects you may wish to investigate. At Organ Pipe Cactus National Monument bee's honey is being studied for accumulation of pesticides.

Another important reason for preservation of biological diversity could be called "ecosystem services." Examples include the production of oxygen; maintenance of the chemical composition of the atmosphere; the natural self-cleansing of water; the critical action of decomposers; the role of ecosystems in watershed storage, prevention of flooding and soil erosion; and climate modification. In other words, ecosystems and their component organisms **maintain the habitability of the Earth.**

It has been stated that there is not a single species for which it can be said with complete confidence that we know it in its entirety. We simply do not know enough to dismiss any species as having absolutely no value at all. Present scientific thinking sees the best solution for biological diversity in the creation of "genetic islands" or gene preserves . . . where healthy, diverse species populations of plants and animals could be maintained. Natural areas such as national parks may be the saving grace for biological diversity.

Interpretation of biological diversity offers a unique opportunity in providing the personal "hook" to the

"Why should I care?" crowd. We can extend ourselves beyond our park boundaries to develop visitor awareness and concern for global environmental issues that can and will affect each one of us.

When father's high blood pressure, or mother's cancer, or your best friend's kidney disease are related to treatment by a chemical derivative from a living wild plant or animal, species preservation hits home. Who knows what future cures still lie in some currently unknown plant or animal?

Examples of the importance of biological diversity can be interwoven into our existing interpretive activities. I'm sure you still get questions, as I did when I was in the field, on "What's the value of a (mosquito, coyote, weed, tree, etc., etc.)?" Knowledge of the utilitarian and ecological role of organisms will help to answer this question.

Interpretation of biological diversity ties in with what national parks are all about and what our role as interpreters should be . . . an opportunity for communicating global conservation awareness and the values of parks, wherever they are.

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# PARK SCIENCE

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## In the Next Issue:

"Water Purification for *Giardia*: What Works in the Back Country?" by Don L. Monzingo, Juliette Wilson, and Sam Kunkle; "Effective Visitor Communications at Big Smoky Mountains NP" by John Piene; "Rabies, Raccoons, and People: Oral Bait Acceptance" by John Haddian; "Shenandoah NP Adopts New Fisheries Management Policy" by David A. Haskell; "Vegetation Monitoring of a Subalpine Oil Spill" by Regina M. Rochefort and Mignonne M. Bivin; "A Systematic Approach to Comprehensive Resource Management for Caribbean NPs" by Ro Wauer.

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