PARK SCIENCE

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PARK SCIENCE

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A report to park managers of recent and on-going research in parks with emphasis on its implications for planning and management

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Cover: *A filament of the diatom* Melosira *(the thinner strand) is shown here (magnified 106 times) attached by a gel extrusion (left of and just below center) to the surface of a "leaf" of benthic moss. The association was discovered during deep explorations of Crater Lake. See story pages 3-4.*

Editorial

El Nino, global warming, ozone holes, acid precipitation, loss of genetic diversity – almost every major impact on humanity's life support systems is rooted in a scale of size that lies far outside of our everyday range of vision.

There are worlds within worlds, all of them interlocked and interdependent, and this issue's lead story is our first journey into another level of these myriad scales. Dr. Phinney's fascinating story of a new association of organisms describes what was found when *two* dives were made at Crater Lake last summer – one dive via submersible vehicle into a hitherto unexplored world deep in the lake, the other dive via microscope into a world inaccessible to our naked eyes – the world of the very tiny.

The jelly-laced jungle shown on the cover requires magnification 106 times to present itself to our limited eyesight. Instead of simply oohing and aahing over the slender slice of microscopic life its view affords, we might do well to let it lead us into thinking of the thousands of levels on down – the subatomic world where "things are happening" – things that affect us all.

Those things that we can see and deal with directly, at a resource management level, are indeed "only the tip of the iceberg." The "tao" of science – the "way" of research and experiment and varied application – provides us with glimpses and hints of a "total picture" that *hides* most of its connections, but *constantly reveals* its connectedness.

The National Parks, our responsibility, are part of a cosmic blueprint that is currently demanding our attention with a gigantic "ahem." Look at the cover again, and marvel at the intelligence expressed in this tiny world. Have we the wits to match it in our own?

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Biota Associated With Deep Benthic Moss Creates Scientific Excitement at Crater Lake

By Jean Matthews

"Yes, I'll be glad to look at it – but there's really no point in it. I've seen so many of these samples and they're all basically commonplace."

Emeritus Professor Harry K. Phinney of the Oregon State University Department of Botany was understandably bored at the prospect of having to look at yet another sample of what some young college professor thought was a strange and wonderful new find.

Gary Larson, NPS limnologist at the NPS Cooperative Park Studies Unit at OSU, was standing in Dr. Phinney's office with a carefully packaged bit of material collected by Dr. Sylvia Earle of the California Academy of Sciences from 725 feet down the wall of the Crater Lake basin. Larson was pretty sure this was something really big.

Dr. Phinney ambled over to his microscope, placed the sample on a slide, squinted through the eyepiece, and murmured "Umhmm, ummhummm, well ... wait a minute ..." and his voice began to rise with excitement.

What he was seeing, in addition to a possible world record (for depth) mat of moss *(Drepanocladus uncinatus),* was a possibly unique association of attached epiphytic flora, some unattached but thoroughly interlaced filaments of various green algae, and a smattering of tiny animals – an intricate congregation of living matter, and at a depth that few scientists would have expected.

Dr. Phinney's following account of the truly thrilling "find," is so thoroughly professional that we felt it necessary to re-inject the note of triumph and discovery the story deserves. Dr. Phinney is preparing articles for scientific journals, as probably are others who participated in the summer 1988 Deep Rover exploration of Crater Lake. But for those of us who do not read the journals – resource managers and interpreters – the excitement needs to be spelled out. So here it is. Now read on.

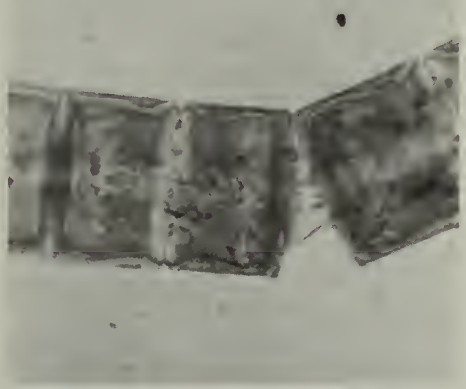
By Harry K. Phinney

The history of the discovery and identification of the moss growing deep in Crater Lake is half a century long and, by this time, the details are somewhat murky. In his undated "Preliminary Report on Bottom Flora and Fauna," A.D. Hasler in 1937 recounted the collection of random bottom samples by Ekman dredge "at depths down to 375 ft." in the vicinity of Wizard Island. He reported "the most astonishing result was to find a green plant *(Elodea)"* (Angiospermae, Hydrocharitaceae) "growing at the greatest depth dredged."

Hasler also reported here that "This same plant furnishes such dense matting of growth at depths of 60-200 ft. east of Wizard Island, that the dredge was not heavy enough to penetrate to the bottom below them." In a letter to Dr. John C. Merriam, then Director of the Carnegie Institution of Washington, dated Oct. 26, 1937, Hasler described "dredging green plants *(Fontinalis)"* (Bryophyta, Fontinalaceae) from a depth of 375 ft. and accompanied this information with a Secchi disc reading of 120 feet. However, in his published report Hasler (1938) reported the plant to be both *Fontinalis* and *Drepanocladus* (Bryophyta, Amblystegiaceae).

The reason Hasler simultaneously ascribed the deep growing moss to two genera is unclear. The fact that a sample of moss found floating but completely submerged near Wizard Island, 13 July 1935, had been submitted by Robert H. DuVall to Dr. Winona Welch of DePauw University who identified that moss as *Fontinalis howellii* Ren. & Card. (= *F. antipyretica* v. *oregonensis* Red. & Card.) may have influenced the author to use the name *Fontinalis.* However, J.S. Brode (1938) published an article in which he described "the water moss *Fontinalis"* as occurring in the sublittoral and states that ... "it covers much of the lake bottom from just below the visibility line to 200 meters or more ... The only place where it comes near the surface is on the 'Old Man of the Lake.'" The latter appellation refers to a deadhead log that has been observed floating in the lake for many years.

In fact, the moss on the log was sent by C. Warren Fairbanks, then Assistant Park Naturalist to Dr. Henry S. Conard formerly of Grinnell College who identified it as *Scleropodium obtusifolium* (Mitt.) Kindb. (Crater Lake Nature Notes Vol. 18, pp. 21-25, 1953). Fairbanks also sent a sample of the moss dredged (grapnel) from 425 ft. (129 m) to Dr. Francis Drouet, then Curator of Crytogramic Plants at the Chicago Museum of Natural History (Field Museum), who identified the moss to be *Drepanocladus fluitans* (Hedw.) Warnst. (Crater Lake Nature Notes, Vol. 20, pp. 34-36, 1954).



Gelatinous strands, *apparently coming from the pores of the epiphytic diatom* Melosira undulata, *can be seen in the top photo actually connecting two separate strands of the organism. This picture (mag. 106X) shows clearly the bracket shape of the two valves that make up each cell of* Melosira *and the light area between, known as the girdle. In the photograph below, a single cell has been separated at the girdle, leaving only half a cell, attached again by gel strands, to a moss leaf.*

During the early 1950s a survey was made to determine the distribution of the deep benthic moss on the bottom of Crater Lake. This was accomplished using grapnels operated from a power winch. The participants in this survey were Dr. Richard M. Brown, C. Warren Fairbanks, Dr. John R. Rowley of the Department of Botany of the University of Minnesota and Joanne Rowley.

In a letter to Warren Fairbanks dated Dec. 10, 1952, John Rowley said "We have not established the maximum depth at which *Drepanocladus* occurs on the steeply sloping sides of Crater Lake ... we have taken over 100 bottom samples in Crater Lake at depths from 10 feet to over 1900 feet. *D. flutitans* has been recovered in all quadrants of the lake. The pattern of recovery indicates that the occurrence of the moss in Crater Lake is non-random."

Richard M. Brown, then Chief Park Naturalist sent two samples of the moss from deep in Crater Lake to Dr. Elva Lawton of the University of Washington and in a letter dated Nov. 5, 1965, thanking her for her identification of the moss as *Drepanocladus aduncus* (Hedw.) Warnst., Brown mentioned that the moss previously had been so identified by Herman Persson (of the Riksmuseet Paleobotaniska, Stockholm, Sweden). A sample of the moss from 221 m (725 ft.) taken in August 1988 was sent by Dr. Gary L. Larson to Dr. W.B. Schofield of the University of British Columbia who identified it as *Drepanocladus uncinatus* (Hedw.) Warnst.

The apparent confusion over the specific identity of this moss is understandable. The existing descriptions of the moss species were taken from specimens growing under very different conditions from those which the deep benthic plants experience in Crater Lake. These plants have grown at a year-round temperature of 3 + C, at light intensities estimated to be as low as approximately 0.01% of the intensity available at the surface or the equivalent of 20 μE sq m^{-1} sec. $^{-1}$.

The primary, perhaps the only, causes of the slight water movement at these depths would be convection and turbidity currents. As the only means of reproduction of the moss that have been observed are vegetative, it appears entirely possible that the moss population on the bottom of Crater Lake is a clonal culture, i.e. the vegetatively developed progeny of a single plant or spore, that survived transport to the bottom of the lake and found it possible to grow there, surprisingly successfully.

The plants observed during the summer of 1988 were collected by Dr. Sylvia Earle of the California Academy of Sciences while piloting the submersible *Deep Rover.* The sample studied was growing attached to the surface of a rock detached by the mechanical arm of the submersible, from the wall of the basin at a depth of 221 m (725 ft.).

In the laboratory the moss plants were observed to

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Crater Lake

Continued from page 3

be 3-5 (-8) cm in height and ranged in color from bright green through greenish golden to a dark brownish red that occasionally was so dark that the plants appeared black. Near the tips of the translucent green axes ("stems") the "leaves" were usually closely overlapping and strongly turned to one side (falcate-secund). On the lower portions of such axes and particularly on the darker, presumably older axes, the "leaves" were more remote, at times the tip of a "leaf" did not even reach to the base of the "leaf" next above. The "leaves" were long acuminate lanceolate with entire margins and a costa (mid-rib) that extends well beyond the middle of the "leaf." The cells of the costa were distinguished primarily by a pigmentation in the walls that appeared to accumulate more rapidly there than in the walls of the cells of the lamina (blade) of the "leaf" generally.

The cells of both the axes and "leaves" of green axes exhibit numerous, prominent, discoid/lenticular chloroplasts. In plants that had aged and darkened, the plastids in the cells of the axis were difficult to impossible to discern. The cells of the darker leaves appeared to have reduced cell contents including reduced numbers of plastids. Even some of the cells with more lightly pigmented cell walls appeared to lack plastids. In some cases the plastids were missing in the more marginal cells of the lamina while still visible in cells adjacent to the costa. The "leaves" of the darkest axes had usually lost their tips and commonly all of the lamina had been eroded except for the very base of the leaf.

Three means of vegetative reproduction were observed; no other means of reproduction, i.e. sexual or asexual, were noted. First, most numerous and most obvious were the dark, essentially leafless, horizontal lateral branches that not only tended to weave the mass of plants into a mat, but also occasionally gave rise to erect young, bright green axes. Second, a number of examples were observed of old, erect, very dark axes from which fresh, bright green horizontal branches erupted. The leaves produced on such young branches were elliptical, spoon-shaped, lacked both the costa and the acuminate tips. Third, there were occasional, seldom branched, protonemal, i.e. vegetative, filaments whose origins were doubtful.

The moss sample from 221 m supported a rather uniform attached epiphytic flora as well as some unattached but intimately entwined and entangled filaments. The entangled filaments consisted of an unbranched green alga *Rhizoclonium* and a branched siphonaceous alga *Vaucheria* (Xanthophyceae). The attached epiphytes were a filamentous diatom *Melosira* and three species of filamentous green algae, two *Oedogonium* species and a *Bulbochaete*. In addition to the filamentous diatom *Melosira*, a number of pennate diatoms were seen, attached primarily to the leaves of the *Drepanocladus* and to a lesser extent to the *Rhizocloniun, Melosira* and *Vaucheria*. A complete species list of all the epiphytic diatoms presently is being prepared.

Observed to be living on or about the moss plant was a very sparse fauna in terms both of numbers of individuals and of species. A single tardigrade (waterbear), 2 unidentified nematodes (roundworms), 2 species of rotifer (wheel animalcules), one of which was a *Collotheca* and the other probably a *Philodina* were observed. Several ciliates were seen, the more highly mobile forms were nearly impossible to identify under the conditions of observation. The most freely motile form appeared to be a species of *Stichotricha* while a species of *Vorticella* and a species of stentorid were observed attached to the moss plants usually in the axils of the "leaves."

Dr. Phinney, Professor Emeritus at Oregon State University Department of Botany, wishes to acknowledge the assistance and encouragement of Dr. Gary Larson and Dr. David McIntire and the technical assistance of Mary Debacon and Dean DeNicola.

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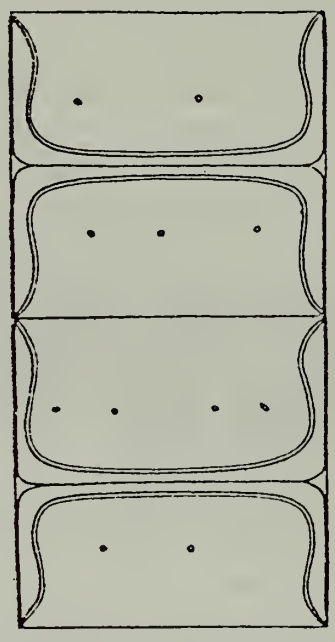
mab notes from Nape Shelton

The biggest recent news out of U.S. MAB is the decision to *restructure the program.* At its Jan. 6, 1989 meeting, the U.S. National Committee approved consolidating the 10 existing directorates into 5 biogeographically oriented directorates: Temperate Ecosystems, Tropical Ecosystems, High Latitude Ecosystems, Human Settlements, and Marine and Coastal Ecosystems. Seven cross-cutting themes have been identified that will be addressed, as appropriate, by the directorates: Aquatic Areas and Wetlands, Arid Lands/Desertification, Biological Diversity, Cultural Diversity, Global Change, and Sustainable Use/Development.

The chairmen of the existing directorates have been requested to identify current program activities that should be continued and supported during the transition. Bill Gregg, NPS MAB Coordinator, believes the new structure will strengthen the biosphere reserve program because biosphere reserves will be a component of the activities of each directorate. A biosphere reserve coordinating committee that would include many members of the present biosphere reserve directorate is being considered.



A strand of Melosira undulata *is shown here in diagram, drawn by Friedrich Hustedt in 1930 for Die Kieselalgen – Part VII of Dr. L. Rubenhorst's book,* Kryptoglamen-Flora. *The view shows a lengthwise view of the strand. Each cell is composed of two so-called "valves" that fit together rather like a medicine bottle and its top. Each valve contains dot-like pores, from which the gelatinous stands apparently are extruded.*

Among other actions, the U.S. National Committee approved the allocation of $50,000 for support to establish priorities for the U.S. biosphere reserve program and to fund new feasibility studies and selection panels; and $15,000 for bilateral exchanges of scientists involved in the developing cooperative ecological research programs in the biosphere reserves of the U.S. and U.S.S.R. A group of Soviet scientists is expected in May for a joing workshop at Pinedale, Wyoming to initiate field studies.

Mexican and American participants at a MAB workshop held last November at Big Bend NP during the Third Symposium on Resources of the Chihuahuan Desert Region discussed possibilities for **cooperation among the Chihuahuan Desert biosphere reserves.** The managers of the three Chihuahuan Desert biosphere reserves – Mapimi (Mexico), Big Bend NP, and the Jornada Experimental Range – agreed to collaborate. Principal scientists, managers, and interpreters from the three reserves will meet in March to discuss projects.

Two that have been suggested are applying grassland restoration methods developed at Jornada to overgrazed areas at Big Bend, and reestablishing the desert tortoise, which now survives only in the Mapimi region, at Big Bend. This slow-moving, colonial tortoise was extirpated from the Big Bend region in prehistoric times, most likely as a result of overharvesting for its meat by early Indian populations.

Regional enthusiasm for a proposed **Arizona-Sonora Biosphere Reserve** is accelerating, reports Carlos Nagel, President of Friends of Pronatura. Funded by U.S. MAB, Nagel is discussing environmental concerns and the biosphere reserve idea with community leaders and representatives of government agencies and organizations concerned with the conservation and sustainable use of a large region roughly centered on Organ Pipe Cactus NP. A fall workshop is planned to bring such people together to consider ways to institutionalize regional cooperation under MAB. Nagel will be preparing a feasibility report documenting the issues of regional concern, interest in MAB as a framework for cooperation, and options for establishing a regional MAB program. The recently established Southern Appalachian MAB Cooperative will serve as one model.

Designation certificates are being sent to the seven administrative units of the Central California Coast BR, which includes Point Reyes NS and parts of Golden Gate NRA; the Southern Appalachian BR, which includes three existing BRs – Oak Ridge National Environmental Research Park, Great Smoky Mountains NP, and Coweeta Hydrological Laboratory; and the New Jersey Pinelands BR, now designated separately as a biosphere reserve from the South Atlantic Coastal Plain BR, which formerly included it.

The *Proceedings of the Symposium on Biosphere Reserves,* held during the World Wilderness Conference in September 1987, should be published in March of this year. Copies will be sent to each Regional Office, each CPSU, and each biosphere reserve unit. For further distribution, contact Bill Gregg, MAB Coordinator, National Park Service (490), P.O. Box 37127, Washington, D.C. 20013-7127. Phone: (202) 343-8122 or FTS 343-8122.

Exotic or Alien – Either Defines 'Pest'

By Robert F. Doren

Environmental threats posed by exotic pest plants have been seriously recognized and addressed in southern Florida only in the last 20 years or so. This may well be due to the fact that alien (exotic) plants haven't been around much longer than that. Of those that have, few have had the opportunity to spread. Other factors such as population dynamics and desirable invasion sites also have a large impact on the rate of spread from initial introduction.

Most of southern Florida's alien pest plants were brought here, ostensibly, to "do good things" for the environment. Many were brought to help "reclaim" the wetlands, to dry up the "swamp," and to allow people to live and farm these otherwise "useless" places. This is often the case of such imported pests. Such plants are almost never conceived of as potential problems, but as assets. Still today, though the numbers are fewer, there remain some who argue against control of these pests because of special interests.

Most of the problems first noted with alien pest plants were related to difficulties encountered by people, such as canals or lakes that became "choked" with aquatic weeds. Eventually environmental problems became evident as loss of native habitat, through alteration of plant and animal communities, was seen in natural preserves. People responded to these early problems, but usually as individuals. Sometimes a single State or county park, one agency or even one person in an agency reacted, but usually without any other participation or communication. Most of the work was isolated and done virtually alone. Occasionally individuals within an agency might share information, but coordinated efforts on a broader scale were essentially non-existent. Additionally, the size of the alien problem and the fact that alien pest plants did not recognize political boundaries made the whole issue (at least as far as woody weeds were concerned) unmanageable on the scale at which they had become problems. A concerted effort was called for.

No coordinated effort to begin such a program existed until the formation of the Exotic Pest Plant Council. It began at first through information contacts, the sharing of information and ideas about the issues, and eventually meetings among people involved with the management, control and research of exotics. After several attempts and some hard work, the Council was formed. Its purposes are outlined in the bylaws:

a) to facilitate communication and exchange of information regarding all aspects of exotic pest plant control and management;

b) to provide a forum where all interested parties may participate in and share in the meetings and benefits from the information generated and promulgated by this Council;

c) to promote an understanding regarding exotic pest plants and their control;

d) to serve as an advisory council for the continued needs for funding, research, management and control of exotic pest plants;

e) to serve as an advisory panel for various interests concerned with exotic pest plants and suggest possible management actions to meet specific management needs;

f) to provide a focus for the issues and concerns regarding exotic pest plants;

g) to promote dissemination of pertinent information regarding exotic pest plant management;

h) to review exotic pest plant management problems and activities and provide updated information to interested parties.

***John Gifford** proudly stands in front of the first* Melaleuca *introductions in south Florida. Planting located at the Gifford home. Photo 1906, Courtesy of The Historical Museum of Southern Florida.*

Some of the ways the Council has been effective in pursuing these goals include:

– development of a model county ordinance as a guide for local governments in writing exotic pest plant control legislation;

– support for an interagency agreement for a biological control program for *Melaleuca;*

– a complete, prioritized listing of exotic pest species for Florida;

– production of a management handbook for control of exotics;

– provision of news information to the media regarding exotic pest plant problems;

– aid in the development of an integrated management plan for interagency funding and control of *Melaleuca* on natural lands outside Everglades NP Boundary, that has procured over $300,000.00 of outside funds to help protect the park;

– aid in the coordination of a mitigration plan for control of *Schinus* in Everglades NP that has procured over $500,000.00 of outside funding for the study.

On November 2-4, 1988 the Exotic Pest Plant Council, National Park Service, University of Miami, Florida Division of Forestry, Fairchild Tropical Garden, The Nature Conservancy and the USDA Agricultural Research Service sponsored a symposium on the worldwide problems of exotic pest plants. The symposium was organized to discuss the biological, ecological, and socio-political problems that occur when exotic plant species become pests in natural areas.

A proceedings will be available sometime this summer for persons interested in the specifics on the biological implications and management strategies and initiatives regarding exotic pest plants.

Nat Reed, former Assistant Secretary of the Department of Interior, led off the symposium, labeling this action "a last ditch effort," and calling for "an all-out initiative to fund these programs." Said Reed: "I remember water hyacinth as the once dreaded plant ... it palls when compared to *Melaleuca* or Brazilian Pepper ... and, excepting Agent Orange, we should be bold in our experiments." His implications are clear, that if action isn't taken now, we may well have lost our last opportunity.

Case studies from Hawaii, California, Florida and Australia presented the scope of the problem. Dr. Ron Myers, an ecologist with The Nature Conservancy, and long involved with exotic plant research, summarized the symposium with these observations: alien plants like *Melaleuca*, significantly and permanently alter community structure and ecosystem properties; "if species like *Melaleuca, Schinus, Casuarina*, and *Mimosa pigra* are allowed to go unchecked ... the Everglades will be no more ... we know it will happen, but I wonder if we have the resolve to prevent it."

Dr. Myers first asked, "Is there a solution?" and went on to say, "I contend there is." The State of Florida, he pointed out, successfully controls aquatic weed species on Florida's waterways by spending $13 million annually. "The ultimate cause for lack of success with things like *Melaleuca*," Dr. Myers said, "is insufficient, inconsistent and poorly directed funding, not only to proceed but also to monitor past efforts. It would take consistent funding and direction to provide a long-term control strategy."

Do we commit to Nat's last ditch effort, or do we simply allow much of our natural heritage to be lost – there will be no options after-the-fact; it will have gone too far. Many people fail to see the seriousness of the alien weed problem because "a plant is a plant" and exotic plant problems develop slowly and do not have the dramatic impact of a fire in Yellowstone. It seems ironic that so much effort and money was spent on one such issue as the Yellowstone fires of 1988, even though scientists consider it a natural and positive thing for Yellowstone's ecology, while a real threat so great as to someday mean the literal end of places like Everglades NP continues almost unchallenged.

I, for one, vote with Nat Reed, but the final effort requires something new. We need not just the Exotic Pest Plant Council, or another symposium, but a coalition to undertake the political action necessary to fund a coordinated control program. Without taking this new direction, we can't be serious about our efforts, and we will only fail for the final time.

Doren is Supervisory Botanist at Everglades NP.

And the Voice of the Grey Tree Frog Was Heard Again in the Land ...

By Robert P. Cook

It was the summer of 1988 and a long-silenced sound pulsed in the air over Jamaica Bay. It was juvenile grey tree frogs calling at dusk from woodlands near the pond within Gateway National Recreation Area, and it was a thrilling moment for park employees, who had transplanted the tiny singers as tadpoles in 1987.

Gateway NRA, 26,000 acres scattered among four counties and two states, lies within and adjacent to New York City. Its lands range from relatively intact natural landforms such as Sandy Hook and Breezy Point, to the dredge spoil and landfill that underly most of the upland habitats of the Staten Island and Jamaica Bay units. Of these "human created" lands, habitats such as freshwater ponds and marshes, grasslands, shrub thickets, and pioneering woodlands have developed ... the result of planting programs and plant colonization. Gateway management now is directed toward preservation and restoration of natural processes.

Inventory Shows Declines

Inventory efforts have shown that compared to historic records for the area, the herpetofauna (amphibians and reptiles) of Gateway is impoverished. For example, Noble (1927) listed 37 species as indigenous to Long Island. In the Jamaica Bay unit, on western Long Island, only four species were found recently to occur as viable populations. This pattern, repeated at the other Gateway units, is partially due to the coastal nature of the park and the lack of certain habitats (e.g. cold, rocky streams). However the major factors are human related.

On Sandy Hook, the eastern hognose snake and its primary food, the Fowler's toad, have been extirpated, with pesticides the suspected cause. For the Staten Island and Jamaica Bay units, the upland habitats have developed on substrate deposited atop what once was salt marsh. While these habitats were being created, rapid urbanization of the surrounding areas was eliminating habitats and local populations (Schlauch 1976, 1978). Some species managed to survive in remnant habitats, but for most, the highways, urban neighborhoods, and tidal creeks proved to be effective barriers to dispersal. Thus, few of the survivors of urbanization were able to colonize the recently-created habitats that eventually became Gateway.

Transplanting Begun

In 1980, a pilot program of transplanting locally-collected native herpetofauna began at Gateway's Jamaica Bay Wildlife Refuge, based on the belief that "restoration" should include all components of an area's biota, not simply cleanup and revegetation. It was recognized that local gene pools of native species were still being lost to urbanization at the same time that Gateway habitats capable of supporting many of these species were going unoccupied.

Gateway now is undertaking to restore or recreate to the extent possible the community of amphibians and reptiles native to the habitats now present. Similar programs had been proposed in theory (Campbell 1974) or undertaken for the purpose of protecting or enhancing a single endangered species (Beebe 1973, Gates *et al* 1985). This program differs only in its attempt to transplant several species rather than just one.

***Northern Brown Snake,** an urban tolerant species, is easily transplanted and has been released in three Gateway areas. (Photo by W.A. Tompkins)*

From 1980 to 1986, Jamaica Bay Wildlife Refuge staff carried out the pilot program, which now serves as the basis for Gateway-wide implementation. At the Bay, candidate species for transplanting were those native to Long Island and adapted to the habitats present. Only individuals collected on Long Island would be released.

Collections Made With Care

Animals used in the transplant program are collected from populations facing imminent destruction from habitat loss or from secure populations capable of sustaining collection. Depending on the species, different life stages or a combination of life stages are released. The northern spring peeper, for example, is most easily collected as larvae whereas the spotted salamander is most easily transported as egg masses.

Prior to release, all snakes and turtles are marked, using scale branding and carapace notching, respectively. Due to their relatively short lifespan, their larger numbers, and the inherent difficulties in long term marking, amphibians are released unmarked. Monitoring efforts consist of observations at breeding ponds, live trapping, searching under boards and logs, and miscellaneous encounters (e.g. road kills and animals found by visitors.)

In monitoring these transplants, we usually document overwinter survival and then confirm breeding or production of offspring. The latter is determined by records of neonates, metamorphs, and unmarked individuals of species marked prior to release. Offspring records, however, do not necessarily prove establishment because gravid females sometimes are released. We have been conservative about deciding when a species is established, but when a pattern emerges of continuing progeny, recorded over a few years and combined with evidence of a spread from the introduction point, it is fairly safe to assume establishment.

Early Results Encouraging

Early results at Jamaica Bay were encouraging. Spring peeper and northern brownsnake were established within three and four years, respectively. By 1986, 11 species had been released and survival and reproduction had been documented for most.

Table 1. Population status of amphibians and reptiles released on Ruler's Bar Hassock Island, Jamaica Bay Wildlife Refuge, New York, New York, 1980 - 1987.

Species Released	Year	No. of Individuals	Overwinter Survival	Breeding Records	Established
Spring peeper	80-83	58 adult 3600 larvae	Yes	Innumerable	Yes
Gray tree frog	1987	1000 larvae	Yes	a	a
Green frog	85-87	130 adult 212 larvae	Yes	a	a
Spotted salamander	1987	14,000 embryos	a	a	a
Redback salamander	83-86	361 juvenile 1443 adult	Yes	12 offspring recorded	a
Northern brown snake	80-84	23 juvenile 49 adult	Yes	42 offspring recorded 83-84	Yes
Smooth green snake	81-86	17 juvenile 64 adult	Yes	10 offspring recorded	a
Eastern hognose snake	84-85	21 hatchling 4 adult	Yes	a	a
Eastern milk snake	84-87	19 juvenile 13 adult	Yes	1 offspring recorded	a
Black racer	85-87	6 juvenile 18 adult	Yes	25 offspring recorded	a
Snapping turtle	83-87	320 hatchling 12 juvenile 38 adult	Yes	3 offspring recorded	a
Eastern painted turtle	82-87	28 juvenile 361 adult	Yes	8 offspring recorded	a
Eastern box turtle	80-86	12 juvenile 183 adult	Yes	6 offspring recorded	a

a = Insufficient elapsed time or data to determine.

In 1987, aided by funds from the Natural Resources Protection Program, Gateway's Office of Resource Management and Compliance expanded the project parkwide. For each unit, the above process of historic research, inventory, habitat suitability assessment, collection, release, and monitoring was begun. For each site, a list of candidate species for release was developed.

At the New York Zoological Society's Bronx Zoo, the curator of herpetology, Dr. John Behler, and his staff entered into a cooperative agreement. The zoo's reptile house is currently rearing eastern hognose snakes for release into the coastal dune habitats of Breezy Point unit. The hognose, once common, has long been extirpated locally, and on Long Island not enough exist in the wilds for the usual collection and release methods. In summer 1988, 16 hatchlings were produced and 10 were released at Breezy Point. The remaining six will be used to supplement the wild-caught breeding stock. Within another year or two the annual release of hognose snakes should double and a population become established.

Restoration Started

Work has begun on restoring the Fowler's toad to Sandy Hook and once established, the hognose snake will follow. Meanwhile, at Jamaica Bay Refuge with its greater habitat diversity and acreage, the program is at its most advanced stage. Individuals of 13 species have been released and records of survival, dispersal, and reproduction continue to grow. (Table 1). It is hoped that the juvenile grey tree frogs who sang last summer at Jamaica Bay will begin breeding in 1989.

Gateway inherited lands with a history of initial abuse for which recent efforts at restoration are attempting to compensate. It is unrealistic tc expect the entire pre-urbanization fauna can be restored here, but as a result of this program, continued existence of many of these species in the metropolitan New York area will be ensured. By adapting the principles of this program, other urban areas may also be able to preserve and manage local herpetofauna gene pools and thus provide visitors the opportunity to experience greater wildlife variety.

Cook is a Natural Resource Management Specialist at Gateway NRA.

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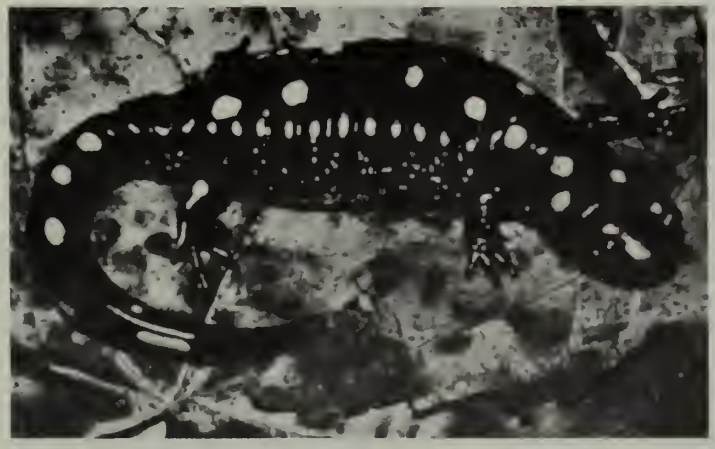
Juvenile Black Racer, *a species that has produced successfully at both Jamaica Bay Wildlife Refuge and Floyd Bennett Field. (Photo by Don Riepe)*

NPCA Update of Leopold Report to DI Secretary on March 19

The results of one year's deliberations on NPS research and management policy for the 21st Century were scheduled to go to the Interior Department Secretary on March 19 – presstime for *Park Science's* Spring 1989 issue. Current NPS policies for wildlife have been largely based on a 1963 report by an advisory board headed by Dr. A. Starker Leopold. A 17-member panel, convened early in 1988 and chaired by Dr. John C. Gordon, dean of the Yale School of Forestry and Environmental Studies, has produced a "Successor to the Leopold Report," which was presented at the opening session of the 54th North American Wildlife and Natural Resources Conference in Washington, D.C., March 19.

A detailed look at this report and its reception at Interior will be carried in the summer issue of *Park Science.*



Spotted Salamander. *Transplanted egg masses of this species have successfully hatched and metamorphosed at Jamaica Bay Wildlife Refuge. (Photo by W.A. Tomkins)*

Eastern Hognose snake, *shown here hatching out. The Bronx Zoo's Reptile House is captive rearing hognose snakes for release at Breezy Point.*

Proposed Migratory Bird Watch To Encompass Research, Monitoring and Interpretation

By Ted Simons, John Peine, and Richard Cunningham

Concern over the impending free-fall in global biological diversity is based primarily on the unprecedented destruction of natural habitats currently underway worldwide. Neotropical migrant passerines (North American songbirds) are particularly vulnerable to this phenomenon due to the pell-mell destruction of their wintering grounds in the tropics, urban development of their migratory stopover habitat in coastal areas, and the fragmentation of breeding habitat in North America.

Migratory birds provide a uniquely compelling subject to showcase the global biological diversity issue. Their heroic journeys are an inspiration of will and physical ability. Their dependence on critical habitats is not well known. We feel that populations of neotropical migratory birds provide a model system for interpreting and studying biological diversity issues in national parks. Their life cycles illustrate the interconnection of global ecosystems and the need for a broad, cooperative approach in addressing threats to biological diversity.

A monitoring and interpretive program is proposed as a joint initiative between the National Park Service (NPS) and the U.S. Fish and Wildlife Service (USFWS). Efforts will be concentrated in four areas: population monitoring, habitat assessment, interpretation, and international cooperation.

As the focus of a long-term monitoring effort, migratory bird populations should provide a useful umbrella for other species. They comprise a diverse group with a wide range of ecological requirements, and are sensitive to a variety of factors that can affect biodiversity. These include: changing competitive relationships, the loss, alteration or fragmentation of habitats, and a species' ability to adapt to a changing environment. Therefore their populations serve well as indicators of environmental change.

In addition to identifying changes within parks, monitoring migrant populations should provide insights into the broader problems this issue reflects. A network of national parks will provide a unique opportunity to standardize methods and experimental designs, conduct long term research, and provide for the information exchange necessary to address an issue of this scale.

Initial population monitoring protocols will be based on the USFWS Breeding Bird Survey. Data management and analysis will be the responsibility of the Migratory Bird Office. Data from parks will be compared to results from over 2000 surveys conducted each year by the USFWS nationwide. As the program matures, standardized park-specific bird census protocols will be developed and incorporated into park inventory and monitoring programs. Applied to a network of parks, representing a wide range of habitats, sizes, and boundary configurations, this work will provide important insights into the role these factors play in structuring natural communities. Many parks will be able to build on substantial historic databases on bird populations, on-going research, and local expertise. We anticipate that much of the field work in this project could be conducted with the assistance of volunteers recruited through local Audubon chapters.

An analysis of 15 years of data from the North American Breeding Bird Survey by USFWS scientists has revealed that most neotropical migrant bird species that breed in the eastern United States and Canada have declined in abundance during the last 10 years. Most scientists attribute these losses to changes in critical habitat ranging from forest fragmentation in the breeding range, to loss of stopover habitat, to total deforestation in the winter range. Coastal development in recent decades has reduced enormously the stopover habitat for migrants. These habitat areas provide refuge and nourishment for many North American migrants during a critical phase of their annual cycle. They are the jumping off point for literally hundreds of thousands of birds that cross the Gulf of Mexico every fall, and the first landfall for individuals returning north each spring.

The habitat component of this project will assess changes in migratory bird habitats in and around selected parks, and attempt to correlate those changes with changes in bird populations. Our goal is to engage other agencies, including NASA and USGS, in a project that will demonstrate the transfer of remote sensing technology to a conservation issue of global importance. Anticipated products would include a continental scale map of critical habitats for migrants and a trend analysis of habitat change at selected parks.

Although research and monitoring efforts will provide valuable information, the interpretive component is by far the most important element in this program. Clearly the greatest contribution the National Park Service can make to the conservation of migratory birds and their habitats will be through its unparalleled opportunity to educate and motivate more than 300 million visitors a year.

A network of "Linkage Parks" will form the nucleus of the migratory bird interpretive initiative. Representative migratory birds have been selected that link NPS areas during their annual cycles. For example Blackpoll Warblers may be found in the Virgin Islands, Gulf Islands, Everglades, Great Smokies, Cape Cod, and Acadia during their annual trek from Venezuela to eastern Canada. Interpretive programs in linkage parks will focus on the ecology of these birds during their annual cycle, and their dependence on healthy ecosystems from the tropics to the arctic. Linkage parks would then be encouraged to exchange interpretive materials from their park with others in the network. Additional interpretive elements will include the production of a traveling exhibit and slide file on migratory bird conservation issues, and the development of a "Kids Net" educational module on migratory birds in cooperation with the National Geographic Society.

The final objective of the program is to foster international cooperation by involving the participation of parks in Canada and Latin America and the establishment of complementary linkages through the U.S. Fish and Wildlife Service. Initially we hope to have a representative of a Canadian and Costa Rican park participate in an interpretive workshop on migratory bird issues to be held at Gulf Islands in April 1989.

Our goal is to begin work in a representative network of 10 U.S. parks, and one Canadian, and one Costa Rican park in 1989. We have submitted a request for start-up funding through the Washington Office. We hope to highlight a fully operational program in 1992 as part of formal ceremonies commemorating the Quincentennial of the Columbus landing. We anticipate participation by National Audubon, the World Wildlife Fund, National Geographic, and other organizations as the program evolves, and hope to establish linkages to additional parks and reserves in Canada and Latin America.

Our objective is to demonstrate how a relatively modest commitment of resources can be leveraged to elevate awareness of critical conservation issues. We have put together a packet of material on the program including the funding proposals, a comprehensive overview of the issue prepared by Dick Cunningham as an interpreter's reference, and a questionnaire soliciting interest and park-specific information. We would welcome your comments, ideas, and especially your participation. Please contact us if you are interested and would like more information.

Simons, (601) 875-9057, is Research Biologist at Gulf Islands National Seashore; Peine (615) 436-7120, is Research Administrator at Great Smoky Mountains NP, and Cunningham (FTS 556-3184) is Chief Interpreter for the NPS Western Region.

American Academy of Underwater Sciences

The 1988 symposium was held Sept. 30 - Oct. 1 at Scripps Institute of Oceanography in La Jolla, Calif., attended by approximately 130 people. Twenty-six papers were presented at concurrent sessions and proceedings were distributed at the meeting.

Primary focus was on diving technology, but papers on dive program management and scientific applications of diving also were delivered. Prior to the symposium, Sept. 26-28, the Academy co-sponsored a workshop on decompression computers with Sea Grant. The results of the workshop and a draft set of guidelines for decompression computer use in scientific diving were presented by Dr. W. Hamilton. Proceedings will be published by the Academy.

Workshops on dry suit construction and repair, remote duty first aid, emergency oxygen administration, and dive accident management were conducted on October 3-4.

Review Team Finds Fire Policy Sound But 'Application Needs Changing'

By Bruce M. Kilgore

On Sept. 28, 1988, the Secretaries of the Departments of Agriculture and the Interior appointed a 10-person interagency Fire Management Policy Review Team to investigate and recommend modifications to agencies' current fire management policies for national parks and federally designated Wilderness Areas. NPS representatives on that team were Boyd Evison, Alaska Regional Director, and Bruce Kilgore, Western Regional Chief Scientist.

In its 12/14/88 report, the Team indicated the objectives and the philosophy behind the current prescribed natural fire policies in national parks and wilderness areas are fundamentally sound. But these policies, which permit lightning-caused fire to burn under predetermined conditions (prescribed natural fire), need to be refined, strengthened, and reaffirmed.

The 10-page report, published in the 12/20/88 Federal Register, noted that the ecological effects of prescribed fire support resource objectives in parks and wilderness, but in some cases the social and economic effects may be unacceptable. Prescribed natural fires may affect permitted uses of parks and wilderness, such as recreation, and may also impact areas outside parks through such phenomena as smoke and stream sedimentation. The report called for major changes in policy implementation to limit application to legitimate prescribed fire programs and to prevent any inappropriate uses of these policies.

The report contains 14 specific recommendations for strengthening and reaffirming existing fire management policies in wilderness and national parks. For example, it noted that many current fire management plans do not meet current policy, and that so-called weather and fuel "prescriptions" for use of prescribed fire do not place enough limits on fire management decisions. To meet these deficiencies, the panel report recommends plans be strengthened by joint interagency planning along common boundaries, by improving weather and fuel prescriptions, and by clearly identifying areas needing protection from fire – including developments within or adjacent to wilderness and parks.

To ensure implementation of these concepts at the field level, the report recommends a certification process whereby each line manager confirms daily that adequate suppression resources are available to assure that a prescribed natural fire will remain in prescription, given reasonably forseeable weather conditions and fire behavior, or that the fire will be declared a wildfire, and appropriate suppression will be initiated.

Other important changes in policy implementation include:

– Federal agencies will reaffirm their policy that fires are either prescribed fires or wildfires.

– No prescribed natural fires will be allowed to burn until fire management plans meet the revised implementation requirements contained in the report.

– Federal agencies will develop regional and national contingency plans to provide necessary program monitoring and direction, including curtailment of prescribed fire activities when necessary.

– Agencies will re-evaluate opportunities to use agency-ignited fires (prescribe burns) to complement prescribed natural fires (lightning-ignited) programs and to reduce hazard fuels, particularly around developments and near boundaries where there are high values at risk.

– Agencies will strengthen training programs and establish additional full-time regional fire coordinators to ensure the availability of fully qualified staff and knowledgeable line officers for developing, implementing, and managing prescribed fire programs.

– The National Wildfire Coordinating Group should take the lead in developing common terminology for prescribed burning programs and wildfire suppression alternatives.

– Agencies will develop joint criteria for selecting appropriate suppression tactics in wilderness and parks. Preplanning should include these tactics.

– Agencies will improve the understanding and acceptance of the policy of using suppression tactics that meet fire management objectives and minimize impacts on wilderness and parks.

– The National Wildfire Coordinating Group needs to develop interagency guidelines for light-hand-on-the-land suppression tactics.

– Agencies will ensure that the NEPA process is followed for fire management plans.

– The Departments of the Interior and Agriculture will review methods of funding prescribed fire and fire protection programs to improve interagency effectiveness. Planning and presuppression activities need program funds rather than emergency funds.

– Interpretation and public information before and during fires will be improved to provide timely, accurate, and consistent information on the purpose, presence, and status of prescribed natural fires.

– Joint research, involving both USDI and USDA, will seek to improve the ability to predict severe fire behavior, to forecast long-term fire weather, and to find ways to prescribe burn forests using stand-replacement fires.

The 12/20/88 report was the subject of 11 public meetings held throughout the country the first two weeks of February, 1989; written comments were solicited until February 21, 1989. A careful review will be made of such public input – both from the public meetings and from written submissions, and the Review Team will meet again to consider what additional modifications may be appropriate in view of such suggestions from the public and any additional review considered necessary by individual land management agencies. It is expected that approved policy implementation changes can be in place prior to the 1989 western fire season.

The NPS Branch of Fire Management at Boise is gearing up to review all NPS fire management plans; individual prescribed natural fire programs will be suspended until plans have been certified as being in conformance with NPS and DOI policies. A comprehensive wildland fire management program called FIREPRO 3 is in its final stages of development. Based on a thorough analysis of fire occurrence on lands managed by the NPS, the program will professionalize this high-risk program throughout the agency. For example, full-time regional fire coordinators would have responsibility for allocating fire management resources on a regionwide basis. The program would also provide for a substantial increase in presuppression activities to reduce hazardous fuels near park boundaries and developed areas.

In transmitting the report to the Secretaries, the Review Team noted the important role of fire in natural ecosystems, but indicated that it believed that the suggested improvements in fire management policy implementation will reduce the risk of repeating the experience of this past summer. Everyone realizes, however, there are limitations to what any fire management program can accomplish when extremely dry and windy conditions occur in forests with the heavy fuel loads found in Yellowstone and similar forest types in 1988. Some high intensity fires will occur in these forests, regardless of our best efforts, but we need to be certain to have used our best efforts.

Kilgore is Chief, Division of Natural Resources and Research, Western Region.

computer corner

A National Park Service bibliographic database proposal, developed by Pacific Northwest Regional Librarian Ellen Traxel at the request of the NPS Information Management Division in Washington, D.C., has been submitted to the NPS Director by PNR Director Charles H. Odegaard.

A standard format in COMMON was devised to combine three existing database sources into one computer-accessible "BIBNET" containing input from the Denver Service Center, the Washington Office Cultural Resources Division, and NP libraries. The database would be further enriched by citations from a variety of sources by an "Other Sources Manager," whose work would be on-going as new information becomes available.

Benefits would include potential for increased efficiency of managers and planning staffs Servicewide. Implementation would be in three phases, over two fiscal years, at an estimated Servicewide cost of $244,000, with recurring annual operating costs of $80,000. Basic requirement for hooking into the system is an IBM compatible PC with hard disk at the park level, and a 286 AT-type computer with a large hard disk at the Regional office level. The required software already has been programmed by Richard Aroksaar of the PNRO Library staff, to accommodate a variety of local-option park computer operations.

The basic ingredients and strategies were formulated by Traxel and Glenn Hinsdale, PNRO Interpretive Specialist. Principal project participants in addition, are Edie Ramey, DSC Technical Information Center; Alicia Weber, WASO Cultural Resources Management Bibliography; and Kevin Killeen, WASO Information and Data Systems Division. Susan Smith (WASO), David Nathanson (Harpers Ferry Center), Jeff Marion (Delaware Water Gap), Patti Dienna (Mid-Atlantic Region), and Anne Frondorf (WASO) complete the task force.

Non-Native Mountain Goat Management Undertaken at Olympic National Park

By Bruce B. Moorhead

After extensive research and public review, a Decision Record was issued on March 18, 1988, by Supt. Robert S. Chandler of Olympic NP, outlining a program to eliminate non-native mountain goats *(Oreamnos americanus)* from most of the park and to control their numbers elsewhere. This report briefly describes the goat problem, the new management initiative, and progress made in 1988.

The Problem

About a dozen mountain goats from Alaska and Canada were released in the Olympic Mountains in the 1920s, 10 years before the park was created. There is no prior record of mountain goats in the Olympics. A detailed aerial census in 1983 revealed a widespread population of approximately 1,200 animals; more than 80 percent – about 1,000 goats – were within the national park.

The Olympic Mountains have long been isolated from other ranges. The fauna is less diverse than in the nearby Cascade range; a number of mountain-dwelling mammals found elsewhere in Washington but absent in the Olympics are bighorn sheep, grizzly bear, lynx, wolverine, golden-mantled ground squirrel and pika.

The introduced mountain goats now occur throughout the Olympic range, but in particular in subalpine and alpine plant communities that comprise about 30 percent of the park. Nine endemic plant species and varieties have been identified in these mountains; most occur in goat habitat. Studies over the last 10 years have documented goat impacts on a number of subalpine communities and endemic species. Soil erosion due to goat wallowing also has been measured.

The Management Program

The new program goals are to eliminate mountain goats from the park interior and to control their numbers along the eastern boundary. A priority will be to remove animals from the core of the park, where most of the population now occurs. Alongside the eastern boundary, goats are managed by the Washington Department of Wildlife (WDW) to sustain an archery hunt annually in Olympic National Forest. Within a specified near-boundary zone, goats will be reduced but not eliminated in the park to a level that reverses habitat damage and inhibits recruitment to the interior population.

Live-capture will be used exclusively to manage the population in the first three years of the program. Captured animals will be turned over to the WDW for relocation in Washington, or other western states and possibly Canada. All live trapped animals will be turned over to the Washington State Dept. of Wildlife for release in native habitat areas of Washington or provided to other states for release on native range. Consideration also will be given to transferring some goats to qualified zoos and other wildlife organizations, as appropriate.

Field Testing Extensive

Various restraint and handling procedures for goats have been field tested in the park since 1980, including capture and relocation of over 230 animals using drop-net, netgun, and chemical immobilization techniques. Helicopter support has been essential in such operations. Management of goats by fertility control, or sterilization, also has been tested. Available treatment methods, however, were not found to be widely applicable in the mountainous circumstances. The park staff will continue to monitor the technology of wildlife fertility control and its possible application to the problem.

After three years, progress in managing the population by capture and relocation will be assessed. If it is no longer feasible to capture goats, those remaining in the park interior may be removed through a shooting program by park rangers or other federal wildlife control agents. Live-capture will remain a preferred method where possible.

A technical advisory committee has been established to monitor the overall conduct of the program. Included are representatives from major interest groups and agencies involved in the issue. The committee also will serve as liaison with interested organizations and agencies. It will meet annually with the

***Medication is administered** by Natural Resource Specialist Cat Hawkins and Research Biologist Doug Houston to a captured mountain goat at frontcountry staging area. (NPS photo by Janis E. Burger)*

***Author readying goat for transport crate.** Leg hobbles and blindfold are removed prior to loading; floor of crate is lined with snow as coolant and water source during transport. (NPS photo by Janis E. Burger)*

Captured goats *in helicopter transit to frontcountry staging area. Note special hauling bags that hold animal upright during flight to allow exhalation of rumen gases and prevent bloating. (Photo by R.W. Olson)*

park staff to review program results and make recommendations on possible modifications.

Progress in 1988

Eighty goats were removed from the park in capture and relocation operations from May 16 to July 19, 1988. Captures were carried out by a team of three park rangers and a pilot with a Hughes 500-D helicopter. Most of the goats (72) were captured by chemical immobilization through darts fired from the helicopter. Eight animals were captured with a netgun fired from the helicopter.

Captured animals were "sling-lined" in specially designed hauling bags by helicopter to a frontcountry staging area where they were treated for injuries, given a standard protocol of medications, placed in wooden crates (packed with snow as coolant), and trucked as soon as possible to release sites. Seventy-three goats (91%) were successfully released elsewhere in Washington and Utah. Seven goats (9%) died or were destroyed due to major injuries incurred during capture operations. Minor lacerations and bruises were evident on 31 of the animals shipped (39%). No injuries were apparent on 42 animals (52%).

Although the capture operations spanned 65 days, capture attempts were possible on only 33 days (51% of the time involved). And successful captures occurred on only 16 days (25%). Unsafe flying conditions (weather) forced shutdowns on 20 days; weekends-holidays, logistical delays, and conflicting ranger or helicopter duties (e.g., search and rescue) shutdown operations on another 29 days. Such problems suggest a rather limited "window of opportunity" for goat captures during even the most optimal period of the year.

Over 1,500 staff workhours were required to plan and capture 80 animals, or about 19 hours per goat. Each capture required approximately 0.9 hours of helicopter flight time. Total park costs (personnel, aircraft, drug supplies, etc.) were at least $68,000, or > $850 per goat.

A critique of the capture operations suggested a number of relatively minor planning and equipment changes that could assist in future efforts. All in all, the program was considered a successful step in a direction consistent with the National Park mission.

Moorhead is Wildlife Management Biologist at Olympic NP.

Research Natural Areas Get Hard Look From Scientists and Managers

"Do not speak of oceans to a well frog, creature of another sphere. Do not speak of winter to a summer insect, creature of another season."

Old Chinese Proverb

More than 50 researchers and managers – creatures of different spheres and seasons – met Feb. 1-3 in Portland, Ore., to discuss research natural areas (RNAs), their mission and management. The untypical blast of snow-laden wind and deep freeze temperature that persisted doggedly all week outside the meeting room were balanced by the heated discussions taking place inside.

The different values that drive research scientists and land managers can usefully be separated under the headings long-term and short-term. Of the more than 600 RNAs now either existing or on the verge of establishment, most lie within the boundaries of either USFS or BLM lands – lands whose managers are under tremendous pressure from timber, grazing, and mining interests to "turn a profit." To a lesser extent, even the RNAs within U.S. Fish and Wildlife Refuges and Nations Parks are feeling the hot breath of an increasingly numerous and recreation-hungry population. Recommendations for how to handle this conflicting clamor for immediate, as opposed to long-range, gratification, was the workshop objective.

The burning need, according to the scientists, is for a management plan that spells out specific objectives for RNAs and makes it part of the manager's job description to see that those objectives are carried out. Greater commitment, better definition of "natural," inclusion of RNAs in the area land management plans, and line item funding for long-term research were among the most urgent needs to emerge. Secondary, but vastly important, was the felt need to educate the public and the parent agencies themselves as to the vital role RNAs can play in monitoring national and even global environmental health.

The managers present, although not averse to the goals and objectives of RNAs as described by the researchers, deplored the "fuzziness" of the RNA concept and seemed almost to be pleading for the same kind of specific objectives for RNAs that they have for timber, grazing, and mining activities.

Words describing RNAs and their intended uses are not lacking. In a document titled *Standards and Policy Guidelines for RNAs,* written for all Federal land-managing agencies, a Research Natural Area is defined as "a physical or biological unit in which current natural conditions are maintained insofar as possible." The need for a comprehensive RNA system, representing all biomes and ecotypes, is based primarily on three factors: Science and education, base line studies, and germ plasm reservoirs.

Two days of presentations and intensive discussion were followed by a half-day of formulating recommendations. The product of six work groups, while not yet finalized, achieved rough unanimity on the needs described above. Sarah Greene, Research RNA Scientist with the USFS, coordinated the workshop and is working with the steering committee to gel the recommendations and devise an action plan.

Jean Matthews, *Editor*
Park Science

Florida Bay Seagrasses Are Dying Off

Seagrasses in western Florida Bay, the base of the complex food web that extends to shrimp, game fish, and wading birds, are rapidly dying. No one yet knows why.

About 30 percent of the western part of the Bay, 56,000 acres, may be on the sick list, according to Dr. Michael Robblee, Marine Ecologist with Everglades NP. Florida Bay is within the park's boundaries. Mike Finley, park superintendent, feels this situation is significant and that it is necessary to determine whether it is naturally caused or induced by water management. Dr. Robblee reported on Nov. 15, 1988, the fall emergency field sampling of the seagrass die-off had just been completed. Four groups of researchers looked at the situation, including Dr. Ron Jones of Florida International University, Dr. David Porter of the University of Georgia, Dr. Joseph Zieman of the University of Virginia, and Drs. Michael Durako and Paul Carson of the Florida Institute of Marine Research. Those who had seen the die-off were struck by how much it had changed. Die-off now is present in three new basins and has spread tremendously in those basins previously known to be impacted. Recovery in older die-off patches has occurred.

Dr. David Porter and his graduate student, Lisa Muehlstein, felt that they were seeing disease in association with die-off in the Bay, although whether it is the cause of the die-off or a secondary effect resulting because of other stresses remains unknown. They took numerous samples back with them to analyze. Dr. Zieman visited the lower keys where he has done a great deal of work over the past decade and confirmed that die-off was present in Big Pine Channel. This is the first reported die-off outside the park. Dr. Brian Lapointe mentioned that he has taken pictures of mass movement of floating seagrass leaving Florida Bay past the Seven Mile bridge. All of these observations indicate that die-off is continuing.

regional highlights

Alaska Region

Temperatures plummeted to −50 degrees F. at Chena Hot Springs, near Fairbanks, during a Feb. 23-27, 1989 workshop for Alaska Region Natural Resource Management Specialists. The lodge, cabins, and pool all rely on water from the hot springs for heating – and so did the participants!

The workshop emphasized inventory and long-term monitoring techniques. Scientists invited to attend came from the Hubbard Brook and J.H. Andrews Experimental Forests, the Universities of Vermont and Alaska, Michigan Tech University, the Idaho National Engineering Lab, and Channel Islands NP. Also participating were NPS Assoc. Dir. Gene Hester, Alaska Reg. Dir. Boyd Evison, and his associate director, Paul Haertel.

Pacific Northwest

A six-member team of NPS rangers and scientists from Oregon State University is continuing to sample the water quality of Crater Lake throughout the winter weather there. The team flies to Wizard Island by helicopter when weather conditions permit to study the physical, chemical, and biological characteristics of the winter lake. This is part of the 10-year Congressionally-mandated study of the lake.

Midwest Region

Ronald Hiebert, formerly Chief, Division of Science at Indiana Dunes National Lakeshore, became Regional Chief Scientist on Nov. 20, 1988.

* * *

Dan Fagre, formerly on the faculty at Texas A&M University, has joined the research staff at Indiana Dunes as the Animal Ecologist.

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Six proposals were received in response to an RFP for a Great Lakes Cooperative Park Studies Unit (CPSU). The top proposals were from the University of Minnesota and the University of Wisconsin-Madison. CPSUs will be established at both universities. U/Minn will function as the Social Science Field Unit for the Midwest and Rocky Mountain Regions. The U/Wisc CPSU will emphasize ecosystem restoration and special species studies. It is planned for both units to be operational by the fall of 1989.

Southwest Region

The Division of Natural Resource Management and Science has been transferred from Park Operations to Planning and Resource Management in a reorganization that administratively combines cultural and natural resource activities. The division's fire management and forestry responsibilities are being transferred to the Division of Ranger Activities.

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A natural resources management workshop is being held April 3 in San Antonio, Tex., for all Southwest Region natural resource management personnel. Agenda covers IPM, cave management and cave wilderness, air quality, water resources, fire management, computer applications, contract development and management, GISs, biodiversity and global climate change, and resource management interpretation.

Addition of the Harte Ranch to Big Bend NP will necessitate an extensive Resource Basic Inventory effort. A larger-scale RBI effort in the Davis Mountains of West Texas will be coordinated by the Denver Service Center.

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A GIS has been installed at Big Thicket operating on UNIX, using GRASS as the language to assist in processing oil and gas leasing requests and to maintain an extensive resource data base. The system was assembled through an agreement with Texas A&M. Similar systems, operating with data mounted by Texas A&M, will be installed this summer at Padre Island and Big Bend.

Southeast Region

Stephen Nodvin, CPSU leader at U/Tenn, has organized a seminar, "Environmental Impacts to Forest Ecosystems," offered through the Department of Forestry, Wildlife and Fisheries. The course introduces students to current research initiatives in the environmental sciences. Presentations are made by scientists actively pursuing research in fields such as acidic deposition, air pollution, global climate change, and alien and endangered species. Students also survey and discuss current literature. The course seeks to foster interest, in both the students and the presenters, in the environmental problems as they relate to National Park lands. A focus of the seminar is potential impacts of climate change.

* * *

Research projects recently begun at the U/Tenn CPSU are: (1) A Georeferenced Ecosystem Database for the Southern Appalachians, funded through MAB; Hazard Prediction and Assessment of Gypsy Moth Infestations at Great Smoky Mountains NP and Blue Ridge Parkway, and Potential Impacts of Global Climate Change to Southeastern Region Units of the National Park System.

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John Peine, the research administrator of Great Smoky Mountains NP, spent January 1989 in New Zealand, touring the national parks and universities to study how research is conducted in the national park system there. This opportunity was created by the Horace Albright Employee Development Fund.

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From Oron (Sonny) Bass, Wildlife Biologist at Everglades NP, comes an update on their project Ecology and Population Dynamics of the Florida Panther in the Everglades, aimed at determining the status of the Florida panther *(Felis concolor coryi)* in the park. The study is part of a research program to evaluate the overall status and recovery needs of the Florida panther, in corporation with the ongoing Florida panther research program of the Florida Game and Fresh Water Fish Commission and USFWS.

In this, the third year of a 5-year project in Everglades NP, 9 individuals have been documented, of which 7 have been radio-collared. Reproduction by the females indicates that an adult male inhabits the park; however, he has not yet been captured.

Three new Technical Reports, published out of the South Florida Research Center, are:

SFRC-87/01: Abundance and Distribution of Ichthyoplankton in Florida Bay and Adjacent Waters, by Allyn B. Powell, Donald E. Hoss, William F. Hettler, David S. Peters, Larry Simoneaux, and Stephanie Wagner. NOAA Southeast Fisheries Center Beaufort Laboratory. Beaufort, NC.

SFRC-87/02: Distribution and Abundance of Fish Communities Among Selected Estuarine and Marine Habitats in Everglades NP, by Gordon W. Thayer, William F. Hettler, Jr., Alexander J. Chester, David R. Colby, and Patti J. McElhaney. NOAA Southeast Fisheries Beaufort Laboratory. Beaufort, NC.

SFRC-88/01: Hydrologic Effects of the 1984 through 1986 L-31 Canal Drawdowns on the Northern Taylor Slough Basin of Everglades NP, Robert A. Johnson, Joel I. Wagner, Deborah J. Grigsby, and Virginia A. Stern. South Florida Research Center, Everglades NP, Homestead, FL.

Western Region

From Gary Fellers, NPS Research Biologist at Point Reyes NS in California comes word of a new book that "looks very good and might be of assistance to NPS field biologists. Many of the animals and diseases are widespread and hence the book's focus on the southeast is not a serious problem for the rest of us."

The book is *Field Manual of Wildlife Diseases in the Southeastern United States,* by William R. Davidson and Victor F. Nettles of the University of Georgia, and is available for $10 from the Southeastern Cooperative Wildlife Disease Study group in the U/GA College of Veterinary Medicine, Athens, GA 30602.

* * *

Thomas L. Stohlgren (U/Cal Davis CPSU) recently published two papers titled "Litter dynamics in two Sierran mixed conifer forests I, and II" in the *Canadian Journal of Forest Research.* The first paper, "I. Litterfall and decomposition rates" (18:1127-1135), details a 4-year study of litter dynamics in a giant sequoia-fir and fir-pine forest in Sequoia and Kings Canyon NPs. The second paper, "... II. Nutrient release in decomposing leaf litter." (18:1136-1144), describes the chemical factors influencing leaf litter decomposition.

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A personal note from Bill Halvorson, research biologist at Channel Islands NP, accompanied his report (see page 23) on the organizational meeting of the new Society for Ecological Restoration and Management in Oakland, Calif., in January. "The conference," he wrote, "was exceptional in that it focused on the NPS by having park people talk about what they were doing and how *they* perceived the world of natural area management. Then they had interested outsiders talk about *their* views of how management should be done. All this was done in the context of everybody learning new restoration/rehabilitation techniques and procedures.

"It was a discussion of management right down to the grass roots, literally," Halvorson continued. "What was so refreshing to me is that the debate came down from lofty idealism to the practical and applicable. I think everyone who went with an interest in natural area management came away with a more balanced realization that there are no easy or universal answers. 'Let it be' or 'Let it burn' are not always the highest good, and neither is manipulation. What we need is more and better information, better monitoring, and more informed decisions about the state and management of our always changing resources."

information crossfile

How about a bacterium that lives with and "fixes" nitrogen for certain plants, but uses the sun's energy instead of the plant's to survive?!?

The discovery highlights nature's unexplored biological diversity, according to Ralph W.F. Hardy, president of the Ithaca, NY-based Boyce Thompson Institute for Plant Research where the scientific research was done.

Other photosynthetic nitrogen-fixing bacteria are known to exist, Hardy said, but these are the first known to form symbiotic relationships with leguminous plants – a family including soybeans, alfalfa and peanuts. Hardy suggests that the discovery could some day be used to increase the yield of these crops. The story is highlighted in *Science News*, Vol. 135, p. 36.

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"The Appalachian Trail – A Never-ending Story" by Pamela Underhill of the Appalachian Trail Project Office, delivered in Tucson, Ariz., at the November 1988 George Wright Society conference on Science in the National Parks, appears in Volume 6, No. 2, the Spring '89 issue of FORUM, the GWS journal. Underhill, who is Trail Project coordinator, describes the evolving management story that has covered more than half a century and the maturing strategies with which volunteer Trail Club members have established and perpetuated what amounts to "a long, skinny, vulnerable national park." The cooperative management she describes makes a unique case follow-up to the Superintendent's Corner by Everglades NP Assistant Superintendent Robert Arnberger, carried in the Winter 1988 issue of *Park Science*.

Regional Highlights

Continued from page 12

Technical Report No. 33, *Avian Species of Management Concern: Mill and Deer Creek Drainages, Tehama County, California*, by A. Sidney England, Mark K. Sogge, and Charles van Riper III, is the latest in this series of U/Cal Davis CPSU publications. The report details a two-year survey to identify and map significant avian resources and is complete with 15 foldout maps and extensive field notes. It describes numerous raptorial species found, their habitat, and a number of management actions that can contribute to long-term maintenance of the many significant avian resources documented.

North Atlantic

Managing Public Lands in the Public Interest, edited by Benjamin Dysart and Marion Clawson, is the latest of the Praeger Press's Environmental Regeneration series. Its 10 papers grew out of the 1983 conference in New York City sponsored by the Rene DuBos Center for the Human Environment and Rockefeller University. It includes a chapter by John T. Tanacredi on "Policy Restraints and Trade-offs in an Urban National Recreational Area." Tanacredi is a Natural Resource Management Specialist and is responsible for coordinating research, natural resource management, and environmental compliance activities at Gateway NRA.

Robert M. Pyle of Grays Harbor, Wash., author of the Audubon Society's Field Guide to North American Butterflies and *Handbook for Butterfly Watchers*, has come out with a new book, *Wintergreen: Rambles in a Ravaged Land*. This profile of the debilitating effects of logging in the Willapa Hills of southwest Washington was awarded the prestigious John Burrough's medal for distinguished efforts in conservation.

In the late 1970s, Pyle helped establish a program of both farming and habitat preservation for butterflies in Papua, New Guinea – the world's second largest island and home to many rare species of butterflies, including a giant birdwing butterfly whose wing span is nearly a foot. Pyle is presently chairman of the Monarch Project, an effort to save that butterfly's wintering grounds in Mexico and Southern California. He is founder of the Xerxes Society, a national butterfly conservation group now headquartered in Portland, Ore.

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The Autumn 1988 issue of *NPS Interpretation*, assembled by contributing editors Sam Vaughn of National Capitol Region and Dan Murphy of Southwest Region, focuses on "magic, or creativity, or provocation." Descriptions of magic moments in interpretation come from Anna Castellina at Kenai Fjords NP, from Robert Fudge at Independence NHP, from Glen Kaye of the Southwest Region, from Jack de Golia at Yellowstone NP, from Bill Clark at Harpers Ferry, from Joe Geary at National Capital Park, and from Rita Cantu at Guadalupe Mountains NP. Just reading the issue brings tears to the eyes. Imagine what "being there" must have been like. (General editor is Julia Holmass of Harpers Ferry Center, West Virginia.)

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The value of a tree is at least $193,250, says a University of Calcutta professor quoted in *Northwest Landscape Professional*. He itemized the value as follows: Living for 50 years, a tree generates $31,250 worth of oxygen, recycles $37,500 worth of water, provides $31,250 worth of soil erosion control and fertility, provides $62,000 worth of air pollution control, and provides $31,250 worth of shelter for animals. Side effects are its contributions of fruit, lumber and beauty.

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The extensive summer drought in 1988 in the United States is traced to its 1987 origins and associations with the 1986 and 1987 El Nino in the tropical Pacific Ocean by three scientists writing in *Science*, Vol. 242, pp. 1640-44. K.E. Trenberth and Grant W. Branstator of the National Center for Atmospheric Research in Boulder, Colo., and P.A. Arkin at the Climate Analysis Center, NASA, Camp Springs, Md., concede that land surface processes "probably contributed to the severity and persistence of the drought; however, the large-scale atmospheric circulation perturbations associated with natural variations in the coupled atmosphere-ocean system in the tropical Pacific were most likely the primary cause."

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Eugene P. Odum, Callaway Professor Emeritus of Ecology at the University of Georgia and author of three widely used ecology textbooks, has come up with another, *Ecology and Our Endangered Life-Support Systems*. The publishers, Sinauer Associates, Inc., of Sunderland, Md., call it "accessible to the beginning student and layperson," in its description of how natural and domesticated ecosystems provide us with air, water, and food. The 288 page book contains 65 illustrations and is available in paperback for $14.95.

The 1989 Wilderness Work Skills programs of the Student Conservation Association begin this year on April 10 with a four-day workshop at Pinnacles National Monument in California, hosted by the National Park Service. The 13 programs scheduled for this year include a new offering – Wilderness Management School – five days of lectures, discussions, and comprehensive field studies in Greater Yellowstone. The school will be held June 5-9, hosted by the USFS, Region 4, and NPS. Tuition for the school, as well as for all 12 workshops, is $325, with 15% tuition discount for SCA alumni and members and for parties of three or more registering together.

For a complete listing of programs offered and registration forms, write The Student Conservation Assn., Inc., Wilderness Work Skills Program, P.O. Box 31989, Seattle, WA 98103.

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Proceedings of the Third International Conference on Lyme Disease and Related Disorders is now available from the New York Academy of Sciences. It offers the most current research on Lyme disease, its biology and ecology. Two of the articles resulted from work conducted for NPS at Fire Island National Seashore: "Presence of Lyme Disease in a Barrier Island Deer Population" by Allan O'Connell, Mark Sayre, and Edward Bosler, and "A Model of the Spring of Lyme Disease in Natural Populations" by Howard Ginsberg.

⁂

"Lurking in every researcher, an interpreter struggling to get out; consuming every interpreter, a desire to know what he/she is talking about."

With this "Olde Instant Proverb," Bill Brown, NPS Historian at Denali NP in Alaska, dives headlong into the subject of "Research and Interpretation – and Reintegration" ... his title for a solicited article in the Spring 1988 issue of *Interpretation*. The result is an eloquent plea for "communication cum substance via gifted interpretive leadership by people doubly gifted in art and knowledge."

Brown describes with painful clarity the general trend of "interpretive exhibits" over the past 20 years and ends with the comment that "This process is a formula for formulaic products. Design, flash, and hyperbole substitute for substance and the simple profundities of the park. Empty excellence is the best result; vacuous mediocrity the worst."

Where, he asks, is the old individualized, distilled essence of the park? "Until art and substance are reintegrated beginning at the park level and progressing to the top level, interpretive integrity will elude us, except as the exception."

⁂

Christine Schonewald-Cox, NPS Research Scientist at the U/Cal Davis Cooperative Park Studies Unit, is the author of "Boundaries in the Protection of Nature Reserves," carried recently in *BioScience*, Vol. 38 No. 7, pp. 480-486. The boundary model she describes "suggests that management pay close attention to localized breakdown (biological leakage points) either in filter of protection or to sites where gradients of change across the generated edge are so steep and narrow that localized collapse of protection is likely."

Enforcement of respect for buffer regions around nature reserves can encourage obedience, she notes, but the buffer region concept "should be pushed further to make the buffer (or experimental) areas strongly reflect the spatial, natural, and cultural (including economic) heterogeneity along the boundary's length."

Information Crossfile

Continued from page 13

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A 6300-square foot traveling exhibit entitled "Tropical Rainforests: A Disappearing Treasure" is opening a four-year nationwide tour March 12 in Portland, Ore. – offering an opportunity for visitors actually to experience such a rainforest. Organized by the Smithsonian Institution Traveling Exhibition Service (SITES) in cooperation with the World Wildlife Fund, the exhibit educates the public to the dangers of deforestation of the world's tropical rainforests and presents solutions to the problem.

Dioramas, photo murals, back-lit transparencies, video stations, interactive devices, models, ethnographic objects and scientific specimens – all are used to involve visitors in the drama and beauty of the world's jungles, as well as the specter of destruction. It teaches the visitor about the fragility of tropical forest ecosystems and why it is necessary to maintain their enormous biological diversity.

The exhibition will remain in Portland through June 4, 1989 and is scheduled for 13 other cities over the ensuing four years.

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"Technology could easily develop means that would allow us to live in peace with our planet. All we have to do is plan *with* the Earth instead of *against*."

The speaker was Elliott Norse, Wilderness Society ecologist. His audience was a week-long biodiversity seminar sponsored by the U.S. EPA and the general science department of Oregon State University in Corvallis, where the seminar was held.

Sandra Henderson, a geologist contracted to EPA, told the group that "We are scientists and we don't recommend policies. We provide scientific answers to questions concerning EPA policy and regulatory issues and information on possible consequences. Then it's up to the policy makers."

The Corvallis EPA lab is convening a conference in Washington, D.C., in May, to determine the EPA's role in the biodiversity arena.

A nationwide survey by the National Science Foundation has revealed that only 28 percent of American adults understand basic scientific terms, only 12 percent understand the scientific process well enough to realize that astrology is not a science, and only 6 percent know enough about scientific terms and process to make intelligent decisions about issue as complex as nuclear power or acid rain. Almost two-thirds think the earliest human beings shared the Earth with dinosaurs and more than half think an electron is larger than an atom.

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Thomas Lovejoy of the Smithsonian Institution told *Science* magazine that allocation of $250 million to $500 million for a "quick and dirty" survey of areas still rich in biodiversity over the next two or three years was the only way – because of the rate of extinction – to protect species before they disappear. According to a 1987-88 survey by the Center for Plant Conservation, a national botanical organization, more than 250 U.S. plants may become extinct in the next five years, and 425 more by the year 2000. No matter what conservation policies are developed, it is already too late for 52 species that are too decimated to save, according to *Science News* (Vol. 134, No. 24, p. 372).

Bills that would support funding for surveys of plant and animal species and create protection policies were still in committee when Congress adjourned last session. The bills will be reintroduced in both houses this session.

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Jerry Franklin, USFS Research Forester and professor of forestry at the University of Washington, challenged a conference on "Oregon's Forests in 2010" with his own vision of the direction in which the forestry of the future should be moving.

"As an ecologist," he said, "I see, as essential, a 'kinder, gentler forestry,' a forestry which may be less efficient (on a per unit basis) in producing wood fiber but which accommodates a full range of ecological values while yielding economic benefits."

Society wants and needs commodities from forest lands, Franklin conceded. But society also wants amenities maintained, as exemplified by concerns about biological diversity and threatened and endangered species and increasing concerns about sustainable productivity. In short, "Society wants a longer view."

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Copies of *Endangered and Threatened Wildlife and Plants* (50 CFR 17.11 and 17.12) are now available from the Publication Unit, U.S. Fish and Wildlife Service, Washington, DC 20240. The 34-page publication is current as of Jan. 1, 1989 and lists individuals by common name, scientific name, historic range, status, when listed, critical habitat, and special rules. It also contains a listing for vertebrate population where endangered or threatened.

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The word "polynya" is pronounced "pa-lean-ya" – a Russian word that is used to identify an area in an ice field that is persistently free of ice. Arnold Gordon, a professor of physical oceanography at Columbia University in New York, is an authority on such holes, and believes that they may be contributing significantly to the global greenhouse effect.

The Antarctic zone where these holes are occurring is where, according to Gordon, the ocean loses heat to the atmosphere. Polynyas, by venting excess ocean heat and providing outlets for excess carbon dioxide that could kill marine life, are "acting like our burning of fossil fuels and putting more CO_2 into the atmosphere," Gordon suggests. These ice-free regions, some as large as all of France, were discovered only in 1974 from satellite images and little is known about them. Teams of scientists from the Soviet Union, the United States, and West Germany have worked on learning more since 1981.

Private Grants for Field Research

In 1990, EARTHWATCH will award grants of $10,000 to $100,000 for 110 projects addressing significant questions in the sciences and humanities. The Center for Field Research invites scholars engaged in resource management to apply for awards of funds and volunteer staff. Proposals will be considered from scholars of any nationality, covering any geographical region.

All funds are derived from the contributions of participating volunteers selected from the EARTHWATCH membership; therefore, non-specialist volunteers must be integrated into the research design.

Preliminary proposals can be made by telephone or by a detailed letter to The Center. Upon favorable review, full proposals will be invited to be submitted 12 months before the proposed fielding date of the project.

For further information contact: The Center for Field Research, 680 Mount Auburn Street, P.O. Box 403, Watertown, MA 02272. (617) 926-8200.

U.S. Attorney Files Environmental Suit

A lawsuit was filed Oct. 11, 1988 by Attorney Dexter Lehtinen of Miami, Fla., against two state agencies, Florida Department of Environmental Regulations and South Florida Water Management District. The complaint alleges that the State failed to enforce State law and protect Everglades NP and Loxahatchee National Wildlife Refuge from damage.

While the Department of the Interior (DI) did not request the lawsuit, DI has repeatedly expressed concern about this issue in the administrative record to these two agencies. DI has stated in testimony and in the print and broadcast media for years that nutrient-induced biological changes have been destroying native Everglades habitat in Loxahatchee, and that without long-term control of nutrient loading into the Everglades, the ecological integrity of Everglades NP is *seriously* and irreparably threatened. This suit is in the DI's interest and should be expanded to embrace the Endangered Species Act and Wilderness Act, according to the Departmental position set forth in the lawsuit.

Issues Background

The Everglades NP resource is dependent upon water delivered from an intensively managed system of upstream canals, levees, and structures. The Everglades wetlands are known to require *pristine* water for their ecological integrity to remain intact. Highly polluted nutrient-rich water originating from a 500,000 acre agricultural area has been pumped for years into the adjacent Everglades system through structures operated by the State of Florida. The result has been *severe* changes to the Everglades system in Loxahatchee and adjacent marshes, including but not limited to, major changes in the algal community, which is at the base of the aquatic food web, the loss of more than 25,000 acres of native plant communities, and the loss of water dissolved oxygen, which directly supports fisheries and other fauna and indirectly supports Everglades wading birds.

The State of Florida to date has not regulated the agricultural industry, including the quality or quantity of polluted water pumped from the agricultural area to the Everglades via state canals and structures. The state does have regulatory means to solve the problem. The State of Florida has convened numerous committees and technical groups to address the issue, but to date no comprehensive permanent solution is proposed and no action has been taken to reduce the quantity of nutrients that continue to destroy Federal property and ultimately will destroy Everglades NP.

Superintendent's Corner

Let's Bet the Ranch and Learn the Game

Winston Churchill once advised, "Play for more than you can afford to lose and you will learn the game." He wasn't talking about park management at the time, but he certainly could have been.

At Mammoth Cave we are in similar straits to those in which most national parks find themselves. We have no complete baseline inventory. We have endangered species that probably are inadequately protected. We have visitors who have an "effect" on the resource, but we're not always sure what or how much. We're a Class 1 airshed, which seems meaningless while we monitor ever-thickening "haze." In short, we – like *you* – have more problems than answers.

But we have learned one thing: the quantity and quality of our groundwater is absolutely integral to the ecological health of the park. And we came to that conclusion through research. We have subsurface drainage basins that bear little resemblance to surface basins. We found the old saying that the "solution to pollution is *dilution*" is far from true, for when many small sources find their way to underground watercourses, the opposite effect occurs. The sewage is carried away by water but then coalesces as various sources combine until it becomes concentrated in the underground rivers typical of karst terranes. That seems simple, until you stop to consider that the whole theory behind "percolation tests" is that those pollutants will *disperse*.

Good, solid research gave us that critical information.

As a result, Mammoth Cave has become involved in an unprecedented partnership with three nearby communities to build a *regional* sewage treatment system. The Service has contributed major funding and sits on the board of directors. Once completed, it will go a long way toward protecting the underground water on which the park and surrounding communities all are dependent. The partnership has led to working with a local area development district; involvement in the location of solid waste disposal sites in surrounding counties; cooperation with agricultural programs to study the effects of farm chemical applications on water quality; and an enhanced staff awareness that the park is not an island.

This partnership will allow sustainable economic development to occur, but development that is compatible with and cognizant of those park values that are water dependent. It's the Man and the Biosphere program in *fact,* not theory. We will help insure the development that does occur will neither pollute nor pose a threat to park values.

We did not look beyond park boundaries because a law requires us to, or because of some "good neighbor" policy. Rather, solid research gave us the right information to make proper decisions in managing park resources. We know the addition of the sewer infrastructure may allow development to which we may object in the future. But in terms of resource preservation, the tradeoff of the potential for future development that may be ecologically disastrous against the potential for increased, but environmentally compatible development, is worth our current efforts. Plus, we now have a "seat at the table" of a basic resource regulating agency.

How did all this come about? The basis is good research – done by the park's hydrogeologist, Jim Quinlan. "Applied" research in that Dr. Quinlan had the foresight to realize implications long before park management, but "basic" in the sense that it began long before the problem became apparent. This was basic research that doesn't even have a charge in our Service's enabling legislation ... basic research that *had* to occur outside park boundaries – "had to" because that is where the *need* was to answer the research question.

But that's not the point. It seems most research we do is begun after the problem has become acute. That didn't happen in this instance. What occurred is how research in the Service *should* be: the potential is recognized; dollars are budgeted; top minds are put to work; results are achieved.

But there's more: management decisions must be made. You see, management at the park, region and Washington levels had to realize that research only pointed out the problem, the potential for disaster, and possible solutions.

The point is that research is not the end ... it's the means. We can't just say "spend X percent of the budget on research" and expect current problems to disappear. In a perfect world I believe that is how we should manage parks. Any smart industry will put a percentage of its budget into "research and development." That's known as an *investment* in the *future*. But what about our existing problems, the ones we already have more of than answers? Given our current budgetary constraints, 5, 10 or 15 percent of our budget for research is not likely to occur when a similar case could be stated for all our other programs.

But we do have options. There is nothing that says we can't change the rules. And the rule change needed right now is one giving the National Park Service a basic research mandate. We can always point to the obvious – the water problems at Everglades or at Old Faithful. Or, we can appeal for that which *has* appeal – the wolf, bear, or bison. But in doing so, we will always insure the survival of the "mega-charismatic" to the detriment of whatever it is that *isn't*.

We need a basic research *mandate*. But when we go after it, let's go for the research *dollars* as well. That's where we can use the mega-charismatic to justify the need! The fact is, we don't have enough money to study the problems we have now. My fear is that we may get what we want, without the wherewithal to accomplish what we need. A research mandate will be just one more charge to our growing list of responsibilities and we'll end up trying to do even *more* with less.

As a superintendent, perhaps I find it easier to see the backlog in maintenance, the Interpretive Challenge's charge to "double the budget," the crumbling fabric of historic resources and lost artifacts, and the plea for just "X" percent of the budget. But the latter – the "(5, 10, or 15) percent" – could apply equally to any of the former. What that really tells me is that the Service, and the resources in its charge, are all in the same boat ... *and it's leaking.*

The underground water of Mammoth Cave is out of sight ... and out of mind. Were it not for basic research, park managers' finally realizing the potential for disaster, the support of park neighbors, money to contribute to the solution, and a lot of luck, we might have a different story to tell.

It seems to me we could follow a similar scenario on a national level to identify park problems, point out the potential, garner support, and change the rules. After all, we have a leaky boat, we're loaded to the gunnels, and the wind is picking up.... We seem to be arguing over whose leak gets fixed first. Maybe we need a bigger boat.

Let's appeal for that which has appeal. "Mega-charismatic ..." hey, what's the most charismatic federal agency *you* know?

David A. Mihalic, Supt.
Mammoth Cave National Park

Editor's Note: The complete paper from which this Superintendent's Corner was condensed appears in the Spring 1989 issue of the George Wright Society FORUM, Vol. 6 No. 2.

Quinlan Participates In China Conference

James F. Quinlan, Research Geologist, Mammoth Cave NP, Kentucky, visited Guilin, China, and vicinity from Oct. 2-27, 1988, to participate in the 21st Congress of the International Association of Hydrogeologists. Theme of this Congress was Karst Hydrology and Karst Environment Protection.

Dr. Quinlan presented an invited paper, "Protocol for reliable monitoring of groundwater quality for karst terranes." He gave two additional papers at related meetings: "Problems of land use in karst terranes and methods to maximize protection of the environment," and "Methods of study of karst in Kentucky." He participated in technical sessions and field excursions to learn applications of research for solving problems of spill-response and for detecting and monitoring groundwater pollution that threaten Mammoth Cave and other national parks also in karst terranes. New techniques were learned for tracing groundwater, for interpretation of water quality data, and for design of research studies in karst terranes.

Quinlan was requested to return to China to conduct training in electromagnetic techniques for locating cave streams and low-technology techniques for tracing groundwater.

Journal Devotes Issue To Greenhouse Effect

In response to a request from Congress, EPA has produced a report on potential consequences of the greenhouse effect, under scenarios developed using three different global circulation models. The January/February issue of the EPA Journal, titled "The Greenhouse Effect: How It Can Change Our Lives," presents nontechnical summaries of EPA's findings. Bill Gregg, an NPS representative to the Interior Department Task Force on Global Change, obtained 500 copies of this issue and has distributed them to WASO Divisions, Regional Chief Scientists, and Regional Chiefs of Interpretation, for further distribution to park units.

Why Monitor Park Health?

By Gary E. Davis and William L. Halvorson

Some pragmatic park managers are asking "Why should I monitor park resources? I already know about more problems than I can afford to address for a long time, why spend money looking for additional problems?"

These are serious questions, especially when asked in the fiscal climate of Gramm-Rudman deficit reduction and eroding park budgets. The immediate answer stems from our profound lack of knowledge of park resources and the forces that sustain them. With the current level of knowledge we cannot be certain we are addressing the most critical issues. We may find ourselves treating ingrown toenails while our patient is dying of undiagnosed cancer.

The authors have been professionally concerned about the conditions of natural resources in national parks for nearly a quarter of a century as fire control aid, park ranger, resource management specialist, and research scientist. Our experience and research in aquatic and coastal ecosystems provided early opportunities to witness, in short time periods, the dynamic nature of such systems. We witness firsthand how important were extreme "catastrophic" events in shaping long-term resource conditions in places like New England, the Virgin Islands, South Florida, and the California Channel Islands. From this perspective, it was apparent that the Service was trying to preserve natural systems without understanding how they were constantly changing.

In addition to natural dynamics, we also saw the ecological integrity of parks threatened because the NPS did not have adequate information upon which to act or with which to compete in political battles over urban encroachment and allocations of water and fishery resources. It became clear to us that if the parks were to survive into the 21st century as anything more than pleasuring grounds and emotional retreats from urban landscapes, the NPS must obtain and maintain evidence that is defensible in a court of law on the condition of park resources.

What is needed is nothing less than a continuous program for monitoring natural resources, equivalent to those programs that already exist for monitoring facilities, personnel, and fiscal resources. In 1980, Congress provided a legislative mandate to inventory and monitor population dynamics of marine and terrestrial species in Channel Islands NP. We used that opportunity to develop a park-based ecological monitoring program. Based on that experience, we will share with you our ideas about WHY the National Park Service needs to monitor natural resources, WHAT natural resources should be monitored, and HOW to monitor them. Furthermore, we propose that the Channel Islands NP program could serve as a useful model for other parks.

WHY Monitor

In addition to being pleasuring grounds and emotional retreats, national parks as natural ecosystems also provide society with the greatest possible diversity of wild gene pools and serve as ecological standards of "miner's canaries" for the biosphere. The NPS mission is to maintain healthy park ecosystems by preserving and protecting unimpaired parks and restoring others to produce vignettes of primitive America.

Healthy parks, just like healthy people, maintain themselves. However, the NPS must play the role of family physician for parks by:

1. Determining when the park is sick by monitoring ecological health with regular checkups.
2. Treating illness (disfunction) and repairing damage, and
3. Preventing illness and mitigating threats.

A natural resource monitoring program must provide the same kinds of information to park managers that health monitoring provides to physicians. It must indicate current health, predict future conditions, be sensitive to subtle chronic stresses, identify overt lethal threats, and suggest effective treatments for disfunction. An effective monitoring program also will help identify *causes* of system disfunction in addition to identifying signs and symptoms.

Development of modern medicine provides a good analogy to understand the "state of the art" of natural resource management. Diagnosis and treatment of dread diseases like cancer have come a long way in the 400 years since William Harvey discovered the function of the heart and circulatory system. In the 17th century, people died of cancer without diagnosis or treatment of underlying causes. Fifty years ago cancers were diagnosed posthumously but not treated. Twenty years ago, with late diagnosis, radical surgery, and harsh chemical and radiation treatments, few people survived cancer. Today we monitor our bodies, diagnose earlier, treat with minor surgery and chemotherapy, and many survive. In the next generation, more reliable monitoring, precursor diagnosis, and more effective treatment will "cure" our children's generation of cancer. And in the near future, we hope to understand cancer's cause and prevent it from occurring in our grandchildren.

Natural ecosystems are dying in parks and we can't even diagnose the illnesses, let alone identify their causes, prescribe treatments, or begin preventive actions. Our present level of knowledge of ecosystem management is equivalent to the 17th century level of human medicine. Long-term ecological monitoring is the first step in learning how to assess ecosystem health, establish normal limits of variation, diagnose illness, and develop preliminary treatments. We have to learn what and how to monitor, and how to use the results before we can develop our first generation of treatments. Development of effective treatments for ecosystem disfunction require knowledge of causes. Clinical observation and experimental research identified causes of human disease, but causes of change in natural systems are poorly known. Monitoring identifies potential agents of change by correlation, like clinical observation, and helps frame experimental designs to identify actual causes that will lead to development of effective treatments.

WHAT To Monitor

We need to discover the "vital signs" of park ecosystems, learn how to monitor them, define normal conditions, and develop treatments to mitigate human impacts. Just as a physician monitors patients' vital signs we need to monitor ecosystem parameters. Physicians measure pulse, blood pressure, temperature, weight, height, age and can determine prresent health and project near-term future health from these and other basic parameters of human physiology.

There are several legitimate ways to describe ecosystems. Among the more popular and potentially useful for long-term monitoring are biodiversity, energy flux, nutrient cycles, and population dynamics. Biodiversity is an important attribute of the biosphere that functions at many levels: genetic, individual, population, community, and even ecosystem. The repeated inventories required to monitor biodiversity are expensive and difficult to conduct. They require highly skilled surveyors to identify the elements of diversity. The most common level of ecological diversity, the species, is not very sensitive to environmental stresses and provides only a record of the past. Changes in diversity are difficult to assess and ambiguous to interpret in terms of system changes. They are also difficult to apply to management issues.

Energy flux provides a common currency for comparisons among system elements by reducing everything to kilocalories. Measurements of energy in ecosystems is often complex and difficult in the field, and frequently requires destructive sampling (e.g. estimating biomass in root systems). Changes in energy flux also are difficult to interpret in terms of system health.

Ecological limiting factors, such as nutrients, can be used to characterize ecosystems. Drawing on an important management principle, this approach to system monitoring selects a few critical control points in the system and evaluates the flow of selected constituents through those points. This approach requires an extensive *a priori* understanding of ecosystem structure and function, and as with energy flux, measurements are often complex and difficult to conduct in wilderness settings. The results also are difficult and ambiguous to interpret.

Population dynamics, the ways in which populations change, offers the best solution to the biological component of NPS ecosystem monitoring. Parameters of populations like abundance, distribution, age structure, reproductive effort, and growth rate are easily measured, sensitive to subtle, chronic stress, and can project future conditions. This approach also reflects a wide variety of environmental conditions because organisms integrate effects of influences like predation, competition, and food condition, and express their responses as easily measured population parameters. Parameters such as age structure and reproduction permit projections of future conditions, providing early warnings of pending problems. Subtle, chronic stresses are reflected in reduced growth and reproductive rates. Interpretation of these parameters is direct and can be synthesized into system level applications, and most management controls operate at the population level, so applicant to management issues is direct and measurable.

The selection of taxa to monitor may be one of the most perplexing aspects of designing a monitoring program. At Channel Islands NP we took a Delphi approach, with selection guidelines. After dividing park resources into an exhaustive list of large, mutually exclusive, classical taxonomic categories, experts in each taxon were asked to select species that represented a broad array of ecological roles, with examples of many trophic levels and life forms from primary producers to top carnivores and sessile invertebrates to wide ranging birds and mammals. Species with legal status or specifically mentioned in park enabling legislation were included, as were endemics and aliens, harvested taxa, dominants characteristic of whole communities, common taxa, and heroic or charismatic species. Major environmental factors, such as weather and sea temperature are also important determinants of system dynamics, and must be monitored. Some professional judgment is required to determine if exist-

ing resource inventories are sufficient to identify system "vital signs," but we suspect that most parks have enough information with which to proceed.

Site selection is also important. It is important to put the thermometer under your tongue every time to get reliable body temperature readings, but it is not necessary to measure body temperature on a uniform grid all over your body to get an accurate reading. Monitoring locations need to be stratified to efficiently sample selected populations. Sites need to be representative of the entire system to be monitored, but it's too expensive to sample on uniform grids just to satisfy GIS software.

HOW To Monitor

At Channel Islands NP a step-down plan was used to describe the tactics of monitoring system design (Fig. 1). The major activities were a literature review funded by the Man-in-the-Biosphere Program, monitoring population, dynamics, and report preparation. Design and testing of monitoring protocols was the major research effort, which consisted of two activities: 1) species selection, accomplished through literature reviews, field surveys (inventories) and application of selection criteria, and 2) a series of design studies to develop monitoring protocols. Each design study summarized historical data, selected or designed sampling systems, established data management procedures, established reporting procedures, and field tested and documented the protocol in a handbook.

Long-term programs must be capable of adapting to changing conditions and improved technology without losing continuity. Changes in monitoring protocols are documented in the annual report on the condition of each resource category and the handbooks are updated accordingly. Ten handbooks have been completed to date: pinnipeds, sea birds, rocky intertidal communities, kelp forest, terrestrial vertebrates, land birds, terrestrial vegetation, fishery harvest, weather, and visitors. Two more are in production: terrestrial invertebrates and sandy beaches and estuaries.

Even though this approach divides park ecosystems into arbitrarily defined, but manageable units, application of results will require synthesis, into ecologically complete units. This synthesis requires collaboration of both resource management and research personnel. Natural resource monitoring must be conducted as a scientific endeavor, but it is conducted as a base-funded resource management operation, not as research.

The population dynamics based system deesigned for Channel Islands NP is a good model for other NPS units. Channel Islands NP faces overt threats to park ecosystems that are common to many parks: alien species, air and water pollution, and direct human impacts, such as fishery harvest, trampling and collecting, trail erosion, and wildlife disturbance. The diversity of marine and terrestrial resources at Channel Islands also assures analogs with most other park units.

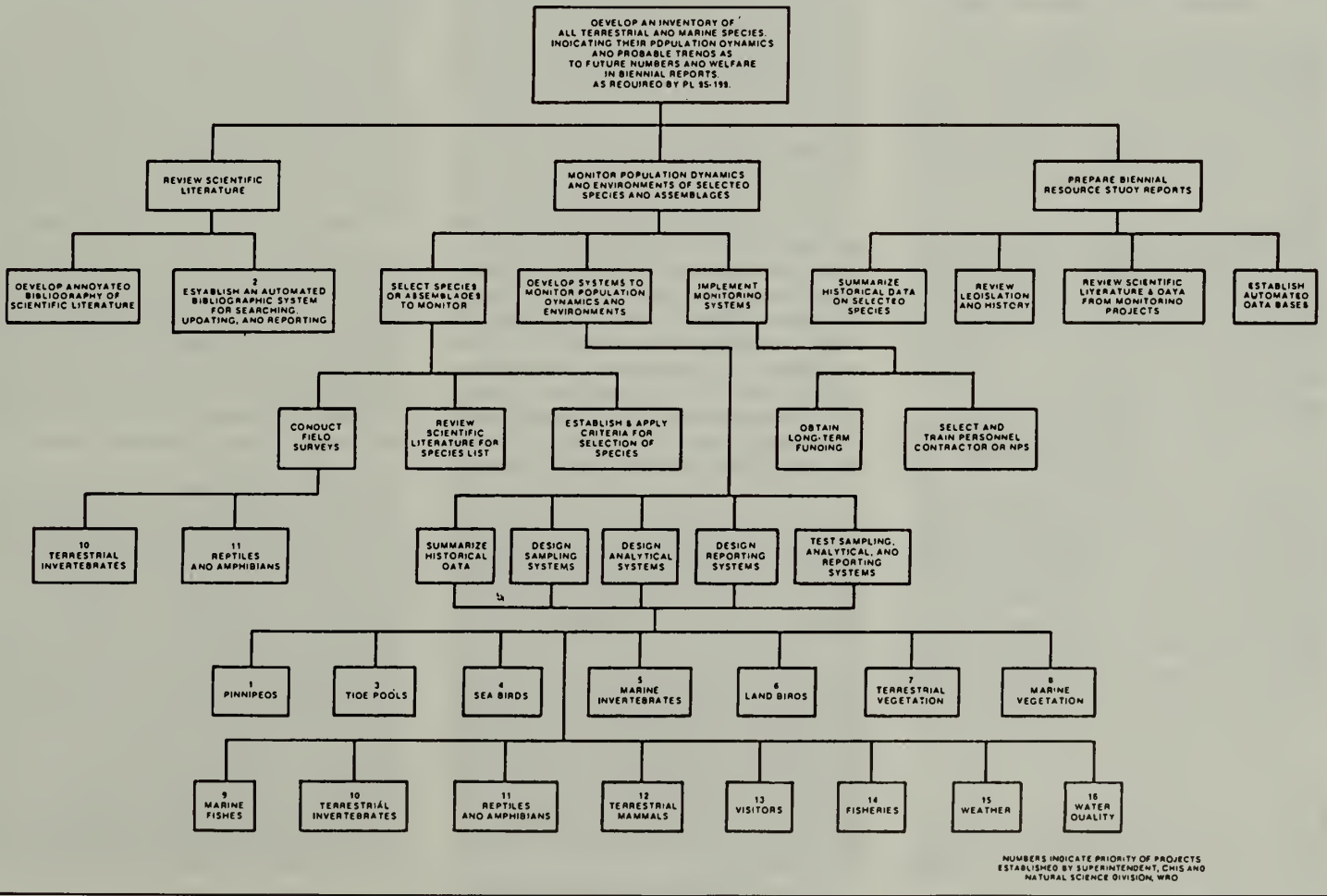
Summary

Natural resources need to be monitored to assess the health of park ecosystems, to determine normal limits of variation, to identify illnesses early enough to effectively and economically treat them, and to understand park systems well enough to prevent disfunction. The biological components of natural resource monitoring in national parks should be based on population dynamics of key species. These populations integrate environmental conditions and respond with changes in easily measured parameters, project future conditions for early warnings, are sensitive to subtle chronic stresses, permit direct interpretation of resource conditions and can be synthesized into system level applications.

In addition, many management controls on the system function at the population level. The Channel Islands model can be adapted for Service-wide application. The next great challenge is implementation and institutionalization. Now that we have begun determining why, what, and how to monitor, we need a commitment to scientific management and park-level base-funding to do it. If accountability for knowing the condition of park ecosystems were made equal to that for facilities, personnel, and fiscal resources, managers will find the best solutions for their units.

Davis is Marine Biologist and Halvorson is a Research Biologist at Channel Islands NP.

STEP-DOWN PLAN FOR NATURAL RESOURCES MONITORING AT CHANNEL ISLANDS NATIONAL PARK, CALIFORNIA



letters

Expansion of NPS Science?

Should the NPS science program seek broader (outside NPS) fields? Is this an idea whose time has come? I believe it at least needs exploration and thought, for if NPS science is ever to seek to expand outside the parks, now may be a good time. The National Parks and Conservation Association blue ribbon committee is contemplating, inventory and monitoring guidelines and natural resource management guidelines are in preparation, the Hill-Soukup Report recommends internal changes, a "white paper" on cooperative park studies units is in draft, and biological diversity and global climate change are buzz considerations heard almost daily.

Why should NPS science expand outside the parks? I believe only one basic reason is valid – service to the nation. What does NPS science have to offer the nation? Arguably, leadership in inventory and monitoring, wildlands research, natural fire research, and research in park management and preservation such as "landscape ecology" ala Noe and Hammitt's Scientific Monograph No. 18 and restoration of cultural landscapes to those of historic eras, perhaps several more; I don't have a good grasp of this from my big, but isolated, corner of the world.

What are some expected benefits of expansion to NPS science? Hopefully, added personnel, funding, prestige and, most of all and related to all, increased capability. The U.S. Fish and Wildlife Service (USFWS) does wildlife research nationwide, not just in National Wildlife Refuges; the U.S. Forest Service (USFS) researches forestry nationwide, not just in National Forests, and both science programs are stronger because of those added responsibilities. We are now contemplating establishing research centers but USFWS, a smaller agency, already has nearly a dozen ranging from the Patuxent Center to the Northern Prairie Center to the National Fisheries Center. The size and importance of USFS research needs no elaboration.

What are possible drawbacks? One is dispersion of effort. NPS Science does not have the means now to do the job that has to be done just in the National Parks. Another is possible isolation of science from parks and their managers. I said expansion is an idea, I *didn't* say it's necessarily a *good* idea, only that we should consider it; whether it would turn out to be good or bad would depend on many factors and decisions.

For added perspective, consider NPS archeology: Our cultural colleagues, by law and executive order, have a national role. According to their brochure "Archeological Assistance Program" (1986), they maintain close liaison with other federal agencies to identify and plan needed archeological projects; assist federal agencies in planning for archeological resource preservation and management; offer technical assistance to other agencies in training, review of program documents, contracting and other activities; and investigate notifications that federal actions may destroy archeological data. And those are only "Archeological Assistance Field Operations" (there are more).

Would NPS archeologists want to abandon those responsibilities? Not the ones I talked to. Is the program of value to the nation? Of course. I believe NPS Science should explore the possibility of performing similar national service for living things. The Service's land base draws outside researchers now, often with benchmark studies of value to many other areas.

I suggest the concept of expansion needs thought, not only by NPS scientists and science administrators but by resource managers, rangers, superintendents and others both within and outside the Service. Maybe we should make "Parkery" an equivalent to "Forestry." Should expansion consist of an extension role and/or conduct of actual projects? Maybe expansion will happen (or won't happen) despite what we want. Maybe such things are only decreed from above in response to identified needs, not by design, but we can help with the identification. Maybe the Act of June 23, 1936 "To authorize a study of the park, parkway, and recreational-area programs in the United States, and for other purposes" provides at least partial authority. What do you think?

Al Lovaas, Chief Scientist, *NPS Alaska Region*

NPS Holds First GIS Conference

The National Park Service held its first national GIS conference in Luray, Va., Oct. 12-14, 1988. Participants included current and potential users of GIS and related technology from around the country. About 100 attended – nearly double the number anticipated.

The objectives were to bring together GIS users from throughout the Service to discuss their applications and concerns and to provide direction for the GIS Division in Denver. Parks making presentations included Shenandoah, Yosemite, Gulf Islands, Capitol Reef, Indiana Dunes, Everglades, Santa Monica Mountains, Mount Rainier, Great Smokies, Grand Teton, Glacier, Wind Cave, Lake Mead, Death Valley, Natchez Trace, and George Washington Memorial Parkway.

Other units making presentations were the National Capital and Alaska Regional Offices, the Denver Service Center, the Interagency Resources Division in Washington, D.C., and North Carolina State University. One evening was devoted to hardware and software demonstrations and discussion groups on such topics as GIS data sources, GIS plans, new remote sensing technologies, and global positioning systems.

Users presented papers on actual and intended applications of GIS and CADD technology. GIS applications were almost exclusively devoted to natural resource issues – management of exotics (aliens), fire, pests, fisheries, wildlife, and water; management of rare, threatened, and endangered species; analysis of island geomorphology; distribution and habitat mapping; and habitat modeling.

Other GIS applications included site restoration, impact analyses, land use planning, boundary assessments, analysis of disturbance history, and location of archeological resources. CADD applications included cave mapping, minerals leasing, buildings and grounds management, development siting, highway planning and maintenance, and impact assessment.

One year ago four sites were up and running with the technology. Today, the number is about three dozen and growing. Roles, requirements, and responsibilities are changing rapidly, and an important segment of the conference was a free-wheeling discussion of the exploding use of GIS technology in the Service.

1. *GIS institutionalization.* This involves Regional support roles and communication. In most Regions, the Regional GIS Coordinators' roles need to be strengthened and given greater priority. GIS responsibilities should be recognized as *primary* duties, rather than as duties as ass*igned.* Reporting responsibilities, for communication and understanding among the coordinators, their parks and other units, and the Denver GIS Division, need to be formalized. Responsibilities for A16 (USGS annual request for mapping support) and Regional annual GIS workplan priorities need to be strengthened and better documented.

The relation of the GIS coordinator to the various Regional divisions should be more clearly articulated. Using the GIS coordinators as Regional technical GIS specialists also should be considered.

2. *Continuing support from the GIS Division.* There is rising apprehension that with the rapid growth in NPS use of GIS technology the Denver GIS Division will not be able to provide and maintain an adequate level of support for users. The Division's staffing and funding levels are stagnant, or even slightly declining, in the face of a roughly order-of-magnitude increase in demand for such support. It was recommended that the GISD seek additional staff and funds to continue its centralized park and Region support. It also was suggested that reigonal centers (Regional Offices, DSC, CPSUs) could be expanded to provide support under the GISD umbrella of Servicewide standards and improved communications.

3. *Training.* The GISD should continue to provide training for developing GIS plans, data base construction, image processing, and GIS use. The growth in users is accompanied by a growth in training requirements. Greater GISD support for operational park GISs means less training support available for new park GISs. A standing program in a standing facility should be established to provide ongoing training.

4. *Software.* The consensus over directions for future software development requested improvements in usability of existing capabilities and continuation of central technical support rather than relying on commercial software and accompanying support. Work already is in progress on a menu-driven SAGIS interface, online help, and up-to-date documentation.

Other suggested SAGIS improvements were an integrated interface for SAGIS and GRASS, hardware independence, online tutorials, simplified vector data editing, improved handling of graphics text, easier transitions to and from relational data base systems, dBASE link and support, and facilitated data base exchanges (between GIS and CADD systems.)

5. *Data security.* The creation and potential availability of digital data bases on park resources have raised the issue of data security. Parks and the GIS Division must give attention to preventing indiscriminate access to sensitive data, such as archeological sites and endangered species. Adequate archiving and backing up also must be done. Satellite-derived data present their own special case, because commercial copyright and licensing agreements control certain aspects of their distribution.

6. *Role of the GIS Division.* Users reaffirmed the role of the Division: (a) technical assistance in acquiring and analyzing remote sensing data, in constructing GIS data bases, and in operating GISs; (b) establishment of GIS policy, standards, and guidelines; (c) providing technical consultation in selecting hardware and software for remote sensing and GIS; (d) providing training; (e) developing, enhancing, and supporting software; and (f) acting as liaison with other agencies.

7. *Alternatives to GIS.* Several parks are using mapping and CADD systems as alternatives to GIS. The simplicity of use, flexibility of display, and low cost of these systems were pointed out as their attractive features. Parks with limited staff and budget for GIS activities were urged to look into these alternatives.

Harvey Fleet, *Chief, Digital Cartography Branch*

Yellowstone Elk and Bison: A Mid-winter Report

By Paul Schullery

Yellowstone Park natural resource issues are once again in the news. Media attention is now focusing on both the hunter harvest and natural mortality of elk and bison on the park's northern range.

The situation is typically complex, and much reporting is regrettably simplistic. A brief summary of the situation follows. Readers are of course welcome to contact the park for more details.

Since the late 1960s, Yellowstone's wildlife populations have been under experimental management to determine to what extent these populations are "self-regulating," that is to what extent human manipulation of their numbers is necessary. Elk especially have long been the focus of controversy in Yellowstone Park. Both elk and bison were drastically reduced within the park in the 1960s for a variety of reasons, relating especially to contemporary perceptions of the condition of the northern range. Current management seeks to test a series of hypotheses concerning the interrelationships of elk and other ungulates on the northern range, as well as to study the animals' effects on their range.

The 1968 winter census of elk showed 3,172 animals. Without reductions, the elk population grew to a counted 12,607 by 1975, and stayed between 10,000 and 12,000 until the early 1980s. The January, 1982 count was about 16,000. By January of 1988, the herd had increased to a counted 19,000.

There are three bison herds in Yellowstone Park: the Pelican Valley herd, the Mary Mountain herd, and the Lamar herd on the northern range. During bison reductions in the 1960s, in cooperation with a federal brucellosis control program, the NPS reduced the northern herd to fewer than 100 animals. Brucellosis is a bacterium that causes abortions in domestic cattle, and there has long been a fear that Yellowstone bison would infect livestock near the park. Since the conclusion of the 1960s reduction program, the park's bison population has grown to about 2,700 animals.

This winter, 1988-1989, both elk and bison have migrated down the Yellowstone Valley and out of the park in unusually high numbers. Media reports have routinely ascribed these movements to the effects of the fires of 1988, saying that the animals had no unburned range, and thus were forced to leave the park. This is an unfortunately casual interpretation of events.

Elk and bison occupy and use new range in fascinatingly different ways. In summary, while the elk of the northern herd have gradually "niched in" to available range, the bison, because of their gregariousness, are more likely to suddenly move en masse to a different part of the available range. This unpredictability is important to an understanding of the present situation. These are not uniformly stable movements, and one should not have the impression that the bison and elk are engaged in stately, picture-perfect textbook migrations. We are still learning, after all these years of research, just how these things work.

For the past 10 years, Yellowstone's northern range has experienced a series of 10 relatively mild, open winters, allowing high survival rates among animals that normally would have succumbed to winter stress. The summers of 1983-1987 were unusually wet, providing these survivors with a rich forage base and further bolstering the population. This temporary increase in the northern range's carrying capacity resulted in the elk population increase from 16,000 to more than 19,000, and contributed to the increase of the bison herds to a total of 2,700. The summer of 1988 witnessed one of the most severe droughts in Yellowstone's recorded history. That, coupled with the fires, substantially reduced forage.

Though it is difficult to quantify the effects exactly, it is probable that the drought's effects on the northern range were much more significant than the effects of the fires. As Dr. Mary Meagher, an NPS research biologist, has said, drought affects everything; fire only affects what it burns. Media reports that 34 percent of the northern range burned seemed to stem from a desire to use the most impressive number available. Much of that 34 percent is forested land, not of special concern in trying to assess how much forage is available. Only about 10-11 percent of the primary grazing areas – sage, meadows, and grasslands – on the northern range was affected by fire, and the burned areas were not necessarily the most important to the animals. The winter of 1988-1989 is the first in 10 years on the northern range to approach average severity and snow depths. A decade of mild winters means, among other things, that a large percentage of the elk now living on the northern range have little or no experience with even normal winter conditions.

Thus it was that a complex suite of factors over nearly a decade set up the present situation. As one state of Montana biologist put it, many of these animals were living on borrowed time before this winter began.

The annual late elk hunt, which harvests some portion of the northern herd most years, took 2,351 animals between December 9 and February 20; the hunter success rate was 94.6 percent. In 1985, the state of Montana established a sport hunt to eliminate bison that moved north from the park. The previous winter, 1984-1985, Montana wardens had shot 88 bison to keep them from wandering north down the Yellowstone Valley. Prior to the present winter, hunter harvests were usually a few dozen animals or less. But over the past few years, more and more of the northern herd has learned the migration routes, and these highly gregarious animals have developed a strong urge to move down the range even in mild winters when food was readily available on the upper end of the winter range. This winter, most moved early, and more than ever before left the park. As of Feb. 27, 1989, 515 bison had been taken in the Montana hunt, 448 by hunters and 67 by state wardens. Permits had been issued for another 250, though it seemed unlikely that all the remaining animals in the northern herd would leave the park.

As of February 24, 301 elk carcasses – the result of natural mortality – had been identified on the northern range in the park. Compared to the hunter harvest, that number might seem small, but the time of heaviest winter mortality is just approaching, and scientists, managers, and media are now waiting to see what the remainder of the winter holds. As of that date bison natural mortality was low, no more than 5 carcasses having been sighted.

It is too early to tell what percentage of these herds will die this winter. The March-April period is critical, and weather conditions could turn favorable to survival or worsen. But at this stage, a few general observations are in order. Sensational headlines aside, Yellowstone's bison and elk are not threatened with doom. They are experiencing one of a multitude of possible winters, just as they have done for centuries. The irony of present concerns is that most of the time the park is criticized for having "too many" of these animals. Even the northern bison herd, which probably will be reduced by hunting to a small fraction of its former numbers, has historically proven its resilience and ability to repopulate park ranges in a matter of years. And visitors will still have numerous opportunities to observe some of the 1,800 bison in the park's other two herds. The ecological effects of suddenly removing most of the northern herd from its range will merit attention, as will the process by which the herd reestablishes itself (and, alas, relearns the migration routes down the valley to the Montana state line).

But there are other concerns than the survival of wildlife populations. The bison is a powerful and emotional American symbol, and the public does not take kindly to television news footage of hunters crippling cow bison 30 yards away. The bison hunt has been very popular among hunters, but has outraged animal rights groups, and has revealed the political inadequacies of current understandings among the various agencies trying to manage these animals.

Humanitarian concerns also may pose a serious threat to park experimental management. Some large segment of the public is uncomfortable with the idea that winter mortality must occur at all. Pressures to feed park animals have so far been resisted, partly because there is an unprecedented unanimity of opinion among agencies and independent observers that feeding would be a bad idea. The state of Montana, the USFS, the NPS, and a special panel of independent ecologists convened in the fall of 1988 to assess just such issues, all agree that feeding would, among other things, short circuit important natural culling processes, concentrate animals on feed grounds and increase risk of disease transmission (elk also carry brucellosis, at lower percentages than bison), and do irreparable harm to numerous scientific research projects that depend on the uninterrupted function of natural processes within the park.

But ecological and scientific issues are not the only ones being dealt with here. This new "Yellowstone problem," coming so close on the heels of the great fire controversies (which are by no means over), again puts Yellowstone Park and its ecological setting in a political and even cultural spotlight, as the public is once again confronted with complex natural resource issues that are not widely understood beyond resource management circles. The stakes are high, and it promises to be an interesting spring and summer.

Schullery is with the Research Division of Yellowstone NP.

book reviews

Our Common Lands: Defending the National Parks. Edited by David J. Simon. National Parks and Conservation Assn., Island Press, Washington, D.C. 1988. xiii + 569 pp. $24.95. ISBN 0-933280-57-2. $45.00. ISBN 0-933280-580

Our Common Lands is about law but, the editor continues, it is intended for the much broader audience of all those interested in parks and park protection. The book contains 498 pages, 18 individually authored chapters divided into four parts: The Realities of Park Protection (one paper), General Authorities (six papers), Protecting Specific Park Resources (six papers), and Regulating Development in and Around National Parks (five papers). Also included are four appendices, 51 pages in length, containing a list of National Park Service (NPS) environmental impact statements, a list of Bureau of Land Management wilderness study areas adjacent to NPS units, approximately 150 selected references for those interested in more detailed study, and A Basic Primer on Legal Source Materials for Non-lawyers. The book has an excellent index; extensive documentation for each article comprises 100 pages of footnotes, notes and references.

The 18 chapters vary considerably in length and in detail. The abrupt endings result from placing conclusions and recommendations in the beginning rather than at the end. Many readers will read only select portions that are of most personal interest or will use the book only as a reference. This, however, does not detract from the book's utility.

The work is mixed in its presentation of legal possibilities, legislative musts, and present authorities; it contains a wealth of well-documented information and thought-provoking ideas.

The editor states in the preface the book's three key messages: (1) the National Park Service has substantial existing authority to protect park resources, (2) existing authority "permits – and requires – the NPS" to be a pro-active land management agency, and (3) litigation should be used as a last resort. Working to meet these goals, the authors point to past and present failures to fully use numerous existing authorities to protect parks. They present, in detail, specific existing legislation and legal precedent and specify a number of laws that provide powerful and useful authority for use in protecting parks.

As one reads through the book, however, one gets a clear sense that it would be much easier to protect parks with specific legislation. This argument begins with Joseph Sax's discussion of the difficulties encountered in attempting to enact park protection legislation in support of "resources based, natural system management." The topic is expanded by William Lockhart, with a plea for specific modern legislation that would provide clear-cut jurisdictional authority to NPS to protect park resources from the complex threats posed by both private development and other government agencies. In lieu of this option, other authors endeavor to argue with varying degrees of strength that other laws or authorities are available. These laws are discussed in detail in Chapters 2 through 18. Thus, Joe Sax describes this book as being about the use of "de facto park protection legislation."

Another important message which may escape the casual reader but is supported by a number of the authors is that the NPS is limited in its ability to protect resources by its lack of resource information. This is true whether we are dealing with the very specific requirements of the Endangered Species Act, the Clean Water Act or the Clean Air Act, the Park Specific Authorities of the Park Planning, Historic Resources or the National Historic Preservation Act, the Organic Act and the Geothermal Steam Act, or the potential protection provided by the National Environmental Policy Act, the Wild and Scenic Rivers Act, or the Federal Reserved Water Rights Doctrine. A number of examples are cited of the need to enter into adversary proceedings, both administrative determinations and litigation, where the Service's options were, and are, limited under existing statutes because the necessary inventory and monitoring data do not exist, making it impossible to establish a clean-cut cause and effect relationship between resource threats and resource deterioration.

In summary, this work is pro-preservation and often critical of past actions or lack of action on behalf of the long-term preservation of National Park resources. *Our Common Lands* should be must reading for NPS personnel and others in the public or private sectors responsible for, or interested in, preserving park resources.

Ray Herrmann
NPS Water Resources Division

Jerry F. Franklin, William H. Moir, Miles A. Hemstrom, Sarah E. Greene and Bradley G. Smith. 1988. The forest communities of Mount Rainier National Park. U.S.D.I. National Park Service, Scientific Monograph Series No. 19. U.S. Government Printing Office, Washington D.C., 194 p. + maps.

This easy-to-read and well organized book is directed toward park managers and visitors to Mount Rainier National Park.

A brief introduction into the climate, geology, soils and topography is followed by a description of major vegetation patterns within the Park. Wildfires, snow and rock avalanches, volcanic eruptions, mudflows, floods and wind are discussed as natural disturbance factors which influence the structure and composition of the forested ecosystems. Field sampling methods, data analysis and terminology employed in the forest classification are clearly and concisely summarized in a manner that is understandable to a general readership. Unlike much of the work done today on vegetation classification, this book goes to great length to explain the procedures and types of analyses undertaken to derive the classification units.

The classification comprises 14 plant associations and 5 community types. Each type is discussed in detail under one of four broad environmental groupings: moist forest ecosystems, modal forest ecosystems, dry forest ecosystems, and cold forest ecosystems. Field data providing structural and compositional information on each type are clearly summarized in tables and cross referenced to a written text. A wealth of information is presented in each written text, typically including information on: geography within the Park; elevation range; soils and landforms; forest structure; major dominant or characteristic trees; understory shrubs and herbs; bordering community types and the nature of the transition; and the relationship of the type to others within the Park and elsewhere in the Pacific Northwest. Each written description is accompanied by a black and white photograph of a representative stand. Two high quality, color plates depict the distribution of habitat types and forest age classes in the Park.

Following the classification and discussion of individual plant associations, a chapter is devoted to exploring environmental and floristic patterns in six major drainage basins within the Park. Forest associations are arrayed and discussed in generalized, 2-dimensional diagrams. The horizontal axis depicts a generalized topographic gradient; the vertical axis depicts an elevational gradient. The chapter closes with a discussion of statistical and analytical procedures employed in construction and refinement of the classification. This later section is somewhat esoteric, but has heuristic value not only to the classifiers themselves, but to managers and the general public who are not often given a full view of the complexities and mysteries of classification.

The role of large-scale natural disturbance (especially wildfire) is examined in terms of its effect on natural succession within the Park. Fire frequency and natural fire rotation are determined for each plant association. The successional role that each major tree species plays within each habitat type is presented in a summary table. A short discussion on the role of small-scale disturbance (tree gaps) in forest succession completes the chapter.

The final chapter, "Management Interpretation of the Habitat Types," is where one of the important by-products of forest classification becomes most evident. Classification of the landscape into habitat types (all of the land capable of supporting the same association) provides the land manager with an ecologically based classification which accentuates the constraints or potential of a given piece of land. The power of this approach as a planning tool is revealed in the discussion of the forest habitat types in relation to physical conditions (growing season, drainage, snowpack), biological conditions (productivity, plant diversity, wildlife), natural disturbances (fire, pathogens, wind), and development potential (resistance, resilience).

The visitor to the Park, especially those curious about natural history, will be exposed to ideas usually missed or glossed over in species-oriented accounts of natural history. The "big picture," landscape oriented approach offered in this volume is a welcome addition to the science, managment, and natural history of Mount Rainier.

Reid Schuller
Natural Area Scientist
Washington Department of Natural Resources

Chris Maser. 1988. The Redesigned Forest. R&E Miles, PO Box 1916, San Pedro, CA 90733, 234 p., $9.95

Chris Maser, trained as a vertebrate zoologist and with 20 years experience as a research scientist in natural history and ecology in forest, range, subarctic, desert, and coastal settings, writes in a way that is superbly accessible to the lay reader. Here he tackles the challenge of changing our approach to natural resources (in this case using forests as the example) in response to a worldwide population that threatens to use up most of our remaining resources within the next few generations.

This lively, extremely readable book is divided into four sections: (1) Nature's design of a forest vs. *our* design of a forest; (2) As we think, so we manage; (3) Change, why are we afraid of it?, and (4) We are as free as our imaginations.

"It is a critical time," says Maser in his preface, "to re-evaluate our philosophical foundation and to re-emphasize human dignity in management decisions.

"*The Redesigned Forest* is a unique literary gem ... (It) presents an extraordinary perception of forests in hard terms. Beyond this, the author's analysis is a work of art. There is a balance of philosophic, psychologic,

With a renewed focus on human dignity as a 'product' of the resource decision-making process, we can broaden the philosophical basis of management to include forests and grasslands, oceans and societies rather than only a few selected commodities that they produce." Maser rejects an approach that produces battles that force choices between, for instance, old-growth trees *or* woodfiber *or* native trout *or* clean water. Instead, he proposes that we recast our goals in *inclusive* terms – "a healed, healthy, sustainable forest that includes old growth trees *and* woodfiber *and* wilderness *and* native trout *and* clean water, and ..."

The message is clear: We must have sustainable forests before we can have sustainable forest products, and the things that sustain a forest are clean air, clean water, clean soil, and sunshine. It is no accident that three of these essentials are also among the "products" (or outgrowths of the processes) of healthy forests.

This is no clarion call to arms and battle. This is a passionate, poetic look at where we are and where we will arrive eventually if we continue in the same direction. Beyond that, it is full of suggestions as to how we can eliminate controversy and plan together for a productive, healthy worth of "and"s rather than a splintered, acrimonious world of "or"s.

The Redesigned Forest provides a look at where we are today, the kind of decision-making that put us here, what we have left to work with, and how we can apply what we know toward achieving "a collective dream – (one that is) large enough to encompass tne transcend all our small, individual dreams in a way that gives them meaning and unity."

Maser describes the flexible, timeless continuum of species that go to make up nature's forest, and compares this to the rigid, time-constrained monocultures that most foresters prefer. He details the make-up of nature's forests – diverse, unpredictable, consisting of interrelated components "all of which are neutral" and processes that act themselves out over the long term, resulting in a self-sustaining, self-repairing entity.

Our present preferred design for forests, Maser suggests, assigns "good" and "bad" values to essential forest components (timber trees are good, insects are bad) and focuses only on desired forest *products* for their immediate payoff value.

"It is critical," he writes, "that we both understand and accept the effects we cause by redesigning global forests, because we are simultaneously redesigning the structural and functional processes of the world, such as soil fertility, cycles in quality, quantity, and belowground storage of water, and cycles in climate. At risk is human survival on earth and in the universe."

Jean Matthews, *Editor*
Park Science

Some additional views of the book:

"Chris Maser's *The Redesigned Forest* should be compulsory reading for all those in a position to control the destiny of the world's forests, for it provides a glimmer of hope that short term exploitation of our precious forestry resource some day will be replaced by enlightened custodianship involving conservation of the whole of the forest ecosystem, not just commercially viable tree species." **B.G. Baillie,** *barrister at law, Adelaide, South Australia.*

"This is an erudite and beautiful book, but is far more ... It is a triumph in revolutionary environmental thinking and a light in a darkening world. I would rate *The Redesigned Forest* alongside Aldo Leopold's *A Sand County Almanac.*" **David Chapman,** *Regional ranger and head of wilderness trails, Kruger National Park, South Africa.*

economic, and emotional basis of decision-making ... It is not a book of argumentation, but a series of essays of beauty." **Dr. Murray Johnson,** *The Burke Museum, Seattle, WA.*

"Maser's personal, down-to-earth style promises to make the subject of forest ecology accessible to a wide and diverse audience. Yet this work goes far beyond the study of old growth forests *per se*. For in his forays into a stand of western red cedar or Douglas fir, Maser is also guiding the reader towards a greater understanding of the sorts of cultural snags and personal entanglements that prevent us from forming healthy relationships towards each other and the natural world." **Dr. Duncan M. Taylor,** *Environmental studies program, University of Victoria, B.C. Canada.*

Ecosystem Management for Parks and Wilderness. Edited by James K. Agee and Darryll R. Johnson. University of Washington Press #96817-6, $20 + 8.1% tax if WA resident and $2 handling charge.

The need for cooperation among government agencies as well as an interdisciplinary approach to the increasingly challenging and complicated problem of managing park and wilderness areas prompted the University of Washington College of Forest Resources, the NPS, and the USFS to sponsor an ecosystem management workshop for scientists, planners, and managers in April of 1987. This workshop was attended by 33 nationally prominent scientists and managers of Park and Wilderness areas.

To develop an improved conceptual approach to managing change in ecosystems crossing natural and political boundaries, the workshop focused on defining terms, uncovering areas of misunderstanding and barriers to cooperations, and developing methods to determine the most important problems and issues.

The results of these efforts represent the substance of this timely book. The book includes an introductory chapter by the editors and a summary in which they outline a direction for ecosystem management in the next critical decades. The other chapters, by individual contributors, include studies on laws governing park and wilderness lands, paleoecological records that reveal the historic effects of climatic variations on vegetation change, succession and natural disturbances in relation to the problems of what can and should be preserved, managing ecosystems for large populations of vertebrates, the management of large carnivores, effects of air pollution, lake acidification, human ecology and environmental management, the role of economics, cooperation in ecosystem management, and management challenges in Yellowstone NP.

Air Quality Research Seeks To Protect Park Resources

By Christine L. Shaver, Darwin (Dee) W. Morse, and Keith A. Yarborough

Air pollution can damage and destroy the very resources and values that NPS units have been created to protect and preserve. Data from the NPS air quality research and monitoring program show that park units are not islands isolated from the by-products of an urban and industrial society. Man-made air pollutants are transported long distances and have been detected at all NPS monitoring sites. Air pollution effects often are subtle and insidious.

The report, *Air Quality in the National Parks*, July 1988, summarizes the significant findings from the NPS air quality research and monitoring program. Collected from 1977 through 1987, this information helps the NPS to remedy and prevent resource degradation. The research and monitoring focuses on:

- Visibility and particulate characteristics in the air.
- Visitor experiences as affected by visibility impairment.
- Gaseous pollutant concentrations in the air.
- Modeling of major air mass/pollutant transport.
- Biological effects on flora and fauna.

The program relies heavily on park personnel to collect the data on a day-to-day basis and to ensure that these data are reliable. Without this dedicated work, the NPS would not be so well armed to protect park units containing some of the world's most spectacular scenery, unique cultural and historic resources, and diverse wildlife and vegetative communities. These people deserve appreciation for their continuing fine efforts.

To provide detailed technical operation of the NPS air quality program, a team of experts has been established in Denver and in Fort Collins, Colo. These people respond to the air quality needs of the parks and oversee the research and monitoring activities.

The Research and Monitoring Program

Air quality research is conducted to determine the current status of air quality in NPS units, to identify any effects air pollution is having or may have on NPS resources or visitor experiences, and to determine sources of air pollution in the parks and the sensitivity of park resources to air pollution.

Air quality modeling is developed and used to study the transport and transformation of pollutants in the atmosphere. Information from the visibility monitoring network along with air quality models is used to determine the effect of man-made air pollutants on visibility at NPS sites.

Visibility monitoring has shown that, in addition to natural sources of visibility impairment, varying degrees of visibility impairment result from man-made pollution in virtually all monitored parks. NPS research findings suggest that fine sulfate particles are the single most important contributor to visibility impairment in most park units. Fine sulfate particles can be transported long distances in the atmosphere. They are primarily the result of sulfur oxide emissions from energy and industrial sources. Levels of sulfur dioxide as high as 40 percent of the short-term National Ambient Air Quality standards are found in some parks.

In the Colorado Plateau area, where Grand Canyon NP and several other units are located, fine sulfate particles are responsible for 40 to 60 percent of the visibility impairment. In eastern areas of the country, fine sulfates play an even larger role in visibility impairment. In the Pacific Northwest, sulfates are not the primary cause of visibility impairment; instead, fine carbon from controlled burning of timber and agricultural lands and natural forest fires play a prominent role.

Research on effects of visibility on the visitor experience in five NPS units indicates that clean, clear air is one of the parks' most important features. It appears that visitors value an environment undisturbed by man above all other features. Research findings on the effects of changes in visual air quality suggest that a

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Air Quality Research

Continued from page 21

John Sacklin, at Redwood NP, *is shown with the IMPROVE (Interagency Monitoring of PROtected Visual Environments) particulate sampler. The IMPROVE program is designed to determine extent and causes of visibility impairment at selected Class I clean air areas throughout the United States. The cooperative program involves several federal agencies including the NPS. The monitor automatically takes 24-hour samples on Wednesdays and Saturdays. These are analyzed for trace elements, mass, ions, and carbon.*

small increase in air pollution is more easily noticed and more disturbing to the human observer where the atmosphere is initially relatively clean.

Ambient air quality monitoring has found that ozone concentrations are high in some NPS units and even exceed National Ambient Air Quality Standards in several of these areas. These high concentrations occur not only in units located near urban areas, but also in areas that are relatively remote, such as Acadia, Great Smoky Mountains, Guadalupe Mountains, Mammoth Cave, Sequoia/Kings Canyon, Shenandoah, and Yosemite NPs, and Joshua Tree and Pinnacles National Monuments. Some ozone occurs naturally, but most of the ozone in the atmosphere results from the photochemical reaction of man-produced hydrocarbons, nitrogen oxides, and sunlight.

Even Admissible Concentrations Hurt

It is especially significant that some injury to sensitive plant species has been documented at ozone and sulfur dioxide concentrations *below* the National Ambient Air Quality standards. Biological effects research has found ozone effects, which appear as characteristic foliar injury on one or more species of plants and trees in virtually every park surveyed. This suggests that ozone injury is a widespread problem that occurs even at NPS units remote from urban areas.

There also is evidence suggesting that reduced growth and increased mortality of some sensitive species are occurring in some of the more heavily affected areas. Research has found an apparent loss of lichens in two urban parks and effects on these sensitive plants in many parks located near sources of sulfur dioxide. Elevated levels of sulfur and heavy metals have been found in vegetation in several parks.

The Park Service uses the information obtained from the air quality research and monitoring program to guide its participation in the following:

- Resource management planning within the National Park Service.
- Permit review concerning potential effects from increased emissions from proposed new major industrial and energy facilities outside park boundaries.
- Participation with state and local officials and industry in reaching decisions to minimize or eliminate potential impacts to the park resources and to the visitor experience.
- Reviews of environmental impact statements developed by other federal agencies concerning activities that might affect NPS units.
- Regulatory and legislative analyses.
- Development of interpretive programs to inform visitors about the importance and value of the air resource in parks.
- Development of NPS educational courses and materials to inform personnel about air quality roles, responsibilities, and management programs for the protection of park resources from air pollution.

Research's Role in Decisions

Information from the air quality research program is used to support NPS participation in decisions for protecting and managing air resources. In most cases, the air pollution affecting park resources and values comes from outside the parks. NPS concerns and recommendations regarding proposed or existing air pollution sources are directed to the governmental agency that has permitting or regulatory authority. Cooperation also is elicited from industry to ensure protection of NPS resources.

The Clean Air Act requires that the National Park Service be involved in reviewing state implementation plans and designed to prevent significant deterioration of air quality and to protect visibility. The Park Service also is required to evaluate the effects that a new air pollution source might have on nearby park resources. The NPS Air Quality Division has Servicewide responsibility for ensuring compliance with Clean Air Act requirements, in coordination with NPS regional offices and park units.

This is just one of the ways the Service is working "to conserve the scenery and natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." (16 U.S.S.1). Our hope is to maintain the Park System's national treasures at a quality level that will continue to astound and inspire visitors. We hope they will also place a high value on knowing these resources are being protected and preserved for future generations.

Shaver is Chief, Policy, Planning and Permit Review Branch, Air Quality Division; Morse is an Environmental Protection Specialist with the same branch; Yarborough is a Physical Scientist working out of the NPS Southwest Regional office.

Monitoring Protocols Documented in Handbooks

In October, 1988, a team of 32 research scientists and park managers, under the direction of Nancy Ehorn, Gary Davis, and Bill Halvorson, completed a comprehensive set of natural resource monitoring handbooks for Channel Islands NP. Ten handbooks and an overview document formalize the population dynamics monitoring protocols used in the park. Each handbook describes detailed procedures for sampling, data management, and reporting information on a discrete resource category, such as sea birds, terrestrial vegetation, or kelp forests.

The design of this program may serve as a model for other parks. Production of the handbooks was made possible by funding from the WASO Inventory and Monitoring Initiative administered by Al Greene in the Office of the Senior Scientist. Copies of the overview, entitled "Inventory and Monitoring of Natural Resources in Channel Islands National Park, California" were sent to 150 parks, CPSUs, and central offices.

Ecological Restoration Society Organized

"Restoration: The New Management Challenge," the first conference to be conducted by the now one year old Society for Ecological Restoration and Management (SERM) was held Jan. 16-20, 1989, at the Claremont Hotel in Oakland, Calif. It was attended by over 400 professionals in the field of ecosystem restoration. Represented were universities, nurseries, private consulting firms, landscaping companies, and local, state and federal governments. A conference proceedings will be published in 1989.

Because of the pre-conference interest generated within the National Park Service, the meeting organizers chose to highlight the Service at this year's meeting and they were not disappointed. Of the 89 contributed papers presented, 14 (ca. 16%) were by the NPS. Most of these contributed papers dealt with descriptions of individual restoration projects. The NPS areas represented included Channel Islands, Denali, Indiana Dunes, Lake Mead, North Cascades, Olympic, Redwood, Rocky Mountain, and Sequoia/Kings Canyon. Reflecting the size of their restoration/rehabilitation program, Redwood NP presented the largest number of papers. In addition to contributed papers sessions, the conference included two half-day symposia. The first was on the aftermath of this summer's fires in Yellowstone and the second was on Standards for Restoration projects.

A number of workshops featured computer applications and restoration methods. One of these was conducted by Bill Weaver of Redwood NP, dealing with removal of roadbeds and restoring natural slopes and drainages. At one poster session, Glacier, Mount Rainier, and Redwood participated.

The formal meeting concluded with a banquet at which Alston Chase discoursed for an hour on his belief that Yellowstone has been and continues to be mismanaged. Much of what he said to this group was from his book, *Playing God in Yellowstone*, but directed at the point that restoration or management is extremely difficult without good scientific information and without clear goals. In this regard, he lamented the fact that NPS support for research is so meager (approximately 2% of the NPS budget). As did others at the conference, he spoke enthusiastically against the "let nature take its course" school of management, believing that the world has been too dramatically altered by the hand of man to allow a "hands off" approach to be effective in long-term maintenance of ecosystems.

Society business discussions included the need for a journal for articles in restoration and management of natural ecosystems and for the Society to take a role in improving the standards that govern restoration and mitigation projects. These topics will be primary concerns for the Society as it seeks members and ways to focus the growing interest in natural area restoration and management.

The next SERM meeting will be in the spring of 1990 in Chicago. Anyone interested in further information or in joining may write the Society for Ecological Restoration and Management, University of Wisconsin Arboretum, 1207 Seminole Highway, Madison, WI 53711.

Bill Halvorson
Channel Islands NP

meetings of interest

1989

April 14-16, THE AVANT-GARDE AND THE LANDSCAPE: CAN THEY BE RECONCILED? at U/Minn, Twin Cities campus. Contact: Landscape Conference, School of Architecture, U/Minn, 89 Church St. S.E., Minneapolis, MN 55455.

April 17-21, INTERREGIONAL RESOURCE MANAGEMENT INTERPRETATION CONFERENCE ON SEASHORE PARKS, at Gulf Islands National Seashore; Contact: Dick Cunningham, NPS Western Regional Office, (415) 556-3184.

April 21, GLOBAL CLIMATE CHANGE AND NATURAL RESOURCE IMPLICATIONS FOR THE INTERMOUNTAIN WEST, at Utah State University, Logan, covering water resources, animal habitat, fire regime, rangeland and agriculture, and land management policy. Contact: Dean's Office, College of Natural Resources, U/St/U, Logan, UT 84322-5200 or (801) 750-2445.

May 18-20, RESTORATION AND PRESERVATION OF GREAT LAKES COASTAL ECOSYSTEMS, at Indiana Univ. Northwest, Gary, sponsored by Indiana Dunes National Lakeshore and Ill/Ind Sea Grant; chaired by Alan Mebane of Indiana Dunes NL, 1100 N. Mineral Springs Rd., Porter, IN 46304; (219) 926-7561.

May 30-June 2, INTERNATIONAL ASSOCIATION OF GREAT LAKES RESEARCH, 32nd Annual Conference; at Madison, WI, Contact: Dr. Gary Glass, EPA, 6201 Congden Blvd., Duluth, MN 55804; (218) 720-5526.

1990

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

Managers, Interpreters Focus on Seashore Parks

Seven National Park Service Regions – those with seashore parks – have been invited to attend the sixth Interregional Resource Management Interpretation Conference in a series initiated and led by Dick Cunningham, Chief Interpreter in the Western Regional Office.

The conference will be held April 17-21 at Gulf Islands National Seashore. As with the previous conferences, emphasis will be on information interchange among research scientists, resource managers, and those who are charged with interpretation to the public. The premise is that the best interpretation is that which tells the story of the basic resources for which the park was created and the processes that keep those resources in good working order.

The focus of prior such meetings has been on Pacific Mountain parks, Southwest Desert parks, Pacific Coastal parks, Fossil Area parks, and Island parks. Regions attending are North Atlantic, Mid-Atlantic, Southeast, Southwest, Western, Pacific Northwest, and Alaska.

"In the end we will conserve only what we love; we will love only what we understand; we will understand only what we are taught."

– African ecologist

Fire Ecology Symposium

An international symposium on – "Fire and the Environment: Ecological and Cultural Perspectives," will be held in Knoxville, Tenn., on March 20-24, 1990. It will be sponsored by several units of the University of Tennessee, Clemson University, the USFS, the NPS, the Society of American Foresters and others.

The ecological roles of fire as a natural part of the environment will be considered, as will man's regard for it as an agent of destruction in forest and other wildland environments. This conference will provide a current statement on fire in the ecosystem and society which will be useful as policies are formulated and implemented. An agenda and a call for papers will be forthcoming shortly. For further information write: Fire Ecology Symposium, Department of Forestry, Wildlife & Fisheries, University of Tennessee, Knoxville, TN 37901-1071 USA, or call (615) 974-7984.

Biological diversity isn't something we inherited from our parents – it's on loan from our children.

In the Next Issue

"CAD Applications at Wind Cave NP" by Jim Nepstad, "Superglue – Tagged Stoneflies Aid Aquatic Food Web Research" by Jerry Freilich, "White-tailed Deer Ecology on Fire Island" by Allen F. O'Connell, Jr., Mark W. Sayre, Edward M. Bosler, and Henry Art, and "Environmental Effects and Monitoring of Abandoned Drilling Muds: The Wrangell-St. Elias Approach" by Timothy E. Law.

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