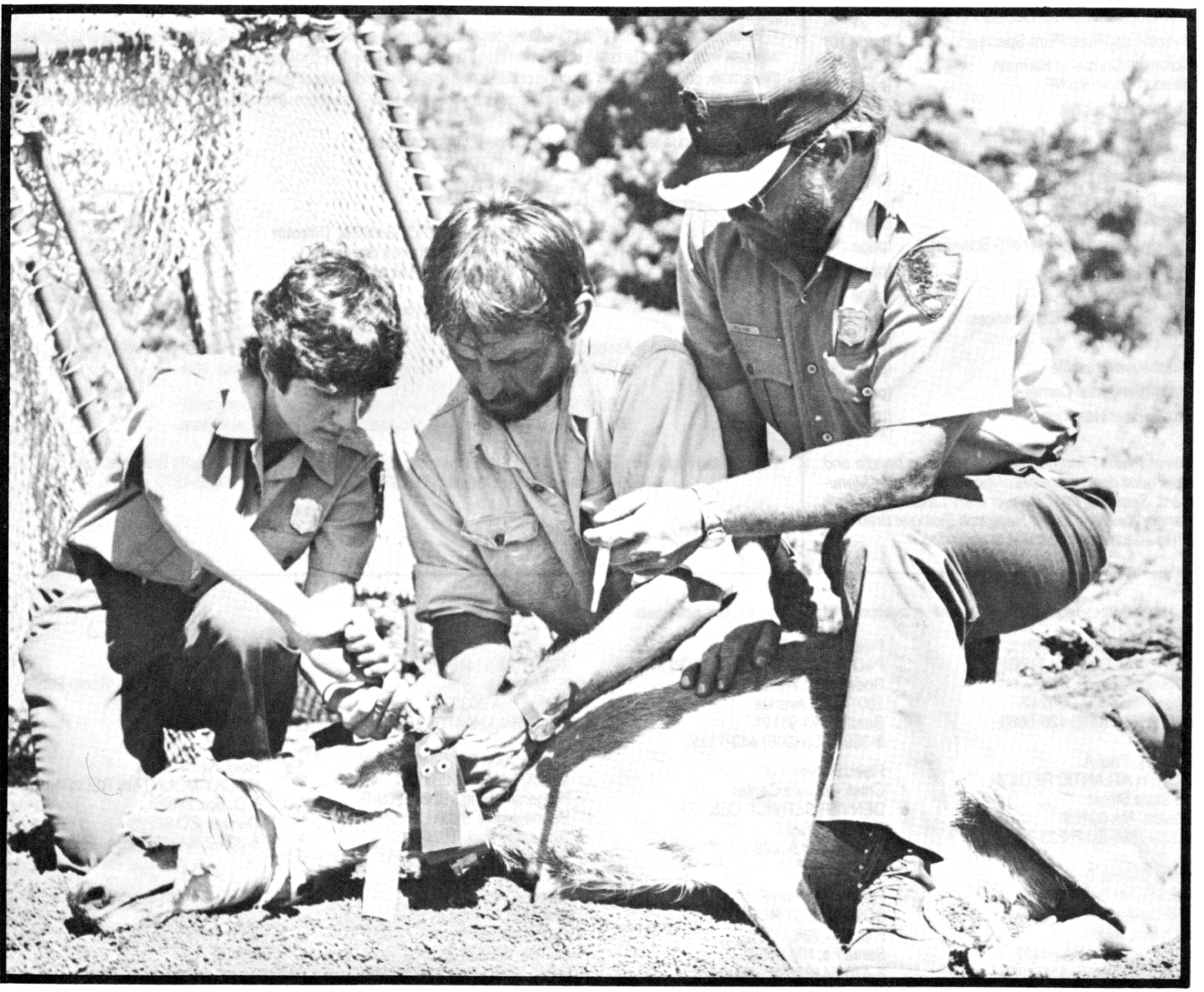
PARK SCIENCE

A RESOURCES MANAGEMENT BULLETIN

NATIONAL PARK SERVICE
U.S. DEPARTMENT OF THE INTERIOR

VOLUME 2 – NUMBER 1 FALL 1981



PARK SCIENCE

NATIONAL PARK SERVICE

SPRING 1981

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

In This Issue

Cover Photo: *Team effort is required to handle and mark adult deer at Craters of the Moon National Monument. Seasonal Park Ranger Mary Laspina and Park Ranger Neil King assist Research Biologist Brad Griffith in attaching radio collar to adult doe.*

From the Editor,

With this issue, Volume II, No. 1, *Park Science* drops its regional designation and becomes what indeed it has been from the beginning – a truly national bulletin.

The change will not be in presentation or subject matter, but in emphasis – shifting from a Pacific-oriented view of the National Park System to one that gives equal consideration to all regions.

The focus will remain on field activities – the information developed through research and the applications of that information to the field management of park resources and sites. Natural, cultural and historic research as it relates to management, maintenance, planning and interpretation are welcome in these pages, and the application of research findings are most important of all. Pure research has its own outlets in the various refereed journals of the scientific community – an extremely important activity. This bulletin has another purpose: to keep managers and research personnel in touch through a communication process that closely parallels the research/management application process.

Because the success of this venture depends so much on lively input from the field – scientists and managers alike – it was decided to start off this first issue with the piece by Jim Thompson (page 1). The editorial staff feels that this article, developed over a period of half a decade, speaks directly to the opportunity presented by *Park Science*. Thompson winds up with "find the vehicles for that dialogue, use them, and make sure that they continue to serve that purpose."

This is the challenge we echo. Let us hear your response.

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A Manager Looks At What Science Can Do

Editor's Note: *Perhaps nowhere has the sometimes stormy marriage between science and management been better described than it was four years ago by James B. Thompson – then associate regional director for management and operations in the Pacific Northwest Region. In a message sandwiched in slices of light wry, Thompson told a Park Service gathering how a manager (himself) sees the contributions of "these diverging subspecies" and how they can be made to function together in managing park resources. Here is a lightly edited version of the 1977 message with a 1981 postscript from Thompson, now Deputy Regional Director for the Rocky Mountain Region.*

By James B. Thompson

During the past several years as a park manager, I haven enjoyed a harmonious and rewarding relationship with scientists studying park resources. Perhaps the most rewarding involved the management of what may be the world's smallest vertebrate habitat – that of the Devil's Hole pupfish. This critter was endangered because its habitat was being destroyed by a subsistence farming operation in Nevada conducted by an absentee landlord in Mississippi.

The culmination of cooperative efforts of park management and scientists was the simultaneous success of an experimental species recovery plan and a decision by the U.S. Supreme Court in favor of the pupfish, which is also the precedental case for Federal reserved water rights for underground water. At the New Orleans science conference you may have seen Dr. James Deacon's 3-screen extravaganza on this subject; I was as proud of that presentation as Jim was!

But at that same meeting I was shaken to learn that scientists and managers do not coexist peacefully, let alone function cooperatively. As I wandered from session to session, hearing more about "us and them," I resolved to explore what bad traits I had been blissfully overlooking among scientists and what shortcomings managers intrinsically possess to the irritation of scientists.

Having been repeatedly told that week that my friends were in fact my enemies, I have subsequently learned that others were wiser than I, and that in fact we canNOT get along. For those of you who have failed to NOT get along, perhaps I can help you perceive problems where none now exist.

IF park managers wish to manage scientists, and scientists wish to manage parks, problems WILL arise. And if such subliminal or hidden agendas exist, it may be useful to explore the differences and characteristics that natural selection has decreed to distinguish scientists and managers, and how these diverging subspecies might be brought to bear on the problem of managing park resources.

My task today is to relate to scientists a manager's view of the Resources Management Plan. I have been employed in the past as a scientist in both government and industry. I have also had the responsibility of managing four different areas of the NP System, including archeological, historical and natural areas. However, a scientist friend recently told me, "All you managers are alike!" Apparently in transition from scientist to manager one loses all the virtues of the scientist (objectivity, scientific methodology, etc.), and begins making bad decisions he never would have made before.

I might interject here that some researchers I have known hold "right thinking" to be a substitute for objectivity and a philosophical premise as a substitute for scientific method. These approaches to research are decision-oriented rather than data-oriented, yet the manager must either accept them or make a "wrong" decision. In fact, the manager serves more than the wishes of the scientist, the local people, conservationists and user groups. He soon learns that he cannot please all of these some of the time, nor some of these all the time.

The manager arrives at this sorry state in roughly the following manner: If he is fortunate he has available a resources management specialist who is, in fact, a generalist, and a research scientist who is, in fact, a specialist. A specialist is one who knows a great deal about very little and goes on learning more and more about less and less until he knows everything about nothing. A generalist, on the other hand, starts out knowing very little about a great deal and goes on learning less and less about more and more until he knows nothing about everything. A manager is a person who presumably starts out knowing quite a bit about quite a lot and ends up knowing nothing about anything, due to his reliance on specialists and generalists.

Another definition is that specialists are people who come to these meetings, give their papers and leave. Generalists come to these meetings, give their papers and stay. Managers come to these meetings and sit in the back of the room.

I have been appalled by the unfamiliarity shown by NPS managers and scientists alike with the actual policies of NPS toward resources management. Some characterizations are more reflective of conservationist periodicals than of the actual policies derived from the Leopold report. (*Wildlife Management in the National Parks,* Leopold, et. al., 1963.) Take such a divergence of viewpoints of right thinkers and the uninformed, combine them with the inability of managers to make right decisions, and obviously some vehicle must be found for bringing together the disciplines of science, the legal requisites, the managerial responsibilities and capabilities, and the public review of both policy and method.

The Resource Management Plan is such a vehicle, with an added dimension – that of coping with matters of monetary significance. Such matters must be placed in the perspective and context of their longterm impacts on both resources and policy. If the RMP is sufficiently flexible it can cope with such items without their overwhelming the purposes of the park and sound longterm management.

What we do in managing park resources must, like the actions of any public servant, be based on law. Legislation established each park for particular purposes. Another body of law, including the Antiquities Act, the National Park Act, and others, establishes the framework of National Park policy.

The evolution of an RMP starts with the "Statement of Management" document, which reviews the legislative purposes of the park and applies NPS policy to these purposes. The result is a set of management objectives.

The next step is to inventory the natural and cultural resources of the park and then to analyze the status of each resource.

The difference between status and management objective is the definition of a resource management problem.

At this point we introduce a range of alternative solutions, including the identification of research needed to determine status, expand or evaluate alternatives, etc. This then, is the framework for an environmental assessment for internal and public review.

Following this step, alternatives are selected and recast in a resources management plan. The plan is a *public document,* but it is, *most* importantly, a guide to park managers that provides both longrange direction and shortrange "how to do it."

The superintendent is ultimately responsible for the stewardship of the natural and cultural resources of the park, whether or not he has the capability to manage them properly. Therefore, the RMP must be the guiding hand for the superintendent and his successors to bring continuity to the resource management process.

In my opinion, format is the least important and most discussed element of an RMP. Scientists and managers have argued it for years, set and changed standards, guidelines, etc. Yet each park is unique, established for unique purposes. It may contain historic zones where not only historic fabric is to be preserved, but associated natural resources are managed to perpetuate the historic scene. It may contain natural zones where natural resources are managed to perpetuate the natural processes as they functioned prior to the intervention of technological man. The manager is responsible for all these resources, *without regard* to programmatic and disciplinary subdivision of government offices, natural and social sciences, etc.

The format should be that which best facilitates the *management* of the particular park's particular resource problems. I am not arguing against separate treatment of natural zones, historic zones, research needs, program and budget requirements. Rather I argue for maximum flexibility for the manager to frame his own management tool and for recognition by others that THAT, primarily, is what the resource management plan is.

P.S. The above comments were made during a regional science conference in 1977. Much was impromptu observation made during the conference and added to my subject. I've been asked to update my views. My subject was resource management plans, but I was really talking about communications, and I still am. I was, and am, endorsing, as an essential part of our jobs, an active pursuit of continuing constructive

dialogue. If my tone is more somber, it is partly because it is easier to be glib in a stand-up routine. But it is also because our situation has changed significantly. Yet your ability to work as a team, to communicate and cooperate, have not kept pace.

Economic and political worldwide changes have affected park science needs. It sounds pretentious, but it's true. Just a few years ago, we were focusing much of science on basic data for planning and single resource issues. But world-wide economic problems, resource and energy demands have thrown us into a more defensive posture; i.e., protecting park resources and values from threats to their very existence. Most such situations have very little lead time, the other side has its homework done, and managers will react with extremely limited enthusiasm to the news that the answer they want will take five years of data gathering!

In addition, resource managers find themselves confronted with scientific and technological issues which are unfamiliar and will require unfamiliar responses. Every park manager must view research not only as a management tool, but as a litigation weapon – a weapon not just to be used, but also to be faced!

This dramatic shift in priorities and content vastly increases the need for frequent and continuing dialogue between managers and scientists. Neither can we assume, as we did 5 or 10 years ago, that environmental conservation is regarded by the general public as a morally superior philosophy that will stand ahead of economic and other demands. Park scientists and managers need to be together – down in the trenches.

In 1977 I regarded the resource management plan as a basic vehicle for that dialogue. But today's circumstances also dictate a need for a broader range of dialogue between scientists and managers – a dialogue which assures that both are reading society's signposts and can mutually see that those signposts have placed us on some new roads to some uncertain places.

In its simplest and most profound form, that dialogue needs to consider "where are we and what are we going to do?" The challenge to each of us is to find the vehicles for that dialogue, use them, and make sure that they continue to serve that purpose.

Interpretive Ideas

At Craters of the Moon NM, interpreters have covered the mule deer research (see p. 13) in a way that has added to both the visitor experience and to the success of the research. Dave Clark, park interpreter, included an item on the tagging of mule deer in the park newspaper listing interpretive activities and management problems. Visitors were asked to report any sightings of marked deer.

All four of the seasonal interpreters mentioned the deer research in their talks and several explained some of the reasons it was necessary. The information was well received at the evening campfires and on the early morning walks. Visitors expressed their interest by reporting 20 to 30 sightings, all of which helped the research team in monitoring the movements of the monument deer.

Cold and Soggy *are two words, the full meaning of which can scarcely be understood until one has worked and camped outdoors in the Olympics during the rainy season. members of Quest Northwest performed their burn site inventory duties at the park with such high good cheer "they even kept MY spirits up," said Jim Agee, CPSU Project Leader at the University of Washington, who worked with them in the field.*

NPS Fire Research In Olympic NP Aided By Quest

Park managers who are hardput, under personnel and budget constraints, to develop the scientific information they need in order to manage their sites at maximum levels of protection and use may be pleased to learn of a highly successful group now operating in the Pacific Northwest Region.

Quest Northwest, a non-profit outdoor school, has been assisting NPS researchers for two seasons at Olympic NP. After some initial discussions with James K. Agee, project leader at the University of Washington CPSU, Quest crews spent a week in 1980 inventorying the structure of a 180-year-old burn in the western Olympic Mountains. This pilot involvement was so successful that Quest returned in 1981 to help inventory another old fire site.

Since 1973, the Quest staff has functioned as an environmental education resource team for numerous schools, community organizations, and governmental agencies. Individual participants have ranged from high school students to adults. Success of the program stems from the community services being performed in stimulating learning environments, benefitting both the participants and the agency.

"The Quest crews are highly motivated and the high staff/student ratio makes careful data collection possible," says Agee. "They have always been safety conscious and very well prepared for unfavorable weather. On top of this, the cost efficiency of utilizing Quest Northwest has made them indispensible." During the 1981 Olympic fire research, crews worked effectively and camped uncomplainingly in chill, rainy weather. They completed water quality sampling projects at Olympic and North Cascades National Parks this past season, and proved their ability to work with minimal NPS supervision.

The Quest Northwest crews could prove useful for other national park management and research projects, Agee pointed out. They are able to handle a wide range of activities, and are developing particular expertise in water quality sampling. Anyone interested in obtaining their 1981 prospectus or discussing potential projects may write Miles Hanchett, Director; Quest Northwest, 1140 Sierra Place, Edmonds, WA 98020, (206) 776-4027. For further information, contact Dr. Agee at the Cooperative Park Studies Unit, College of Forest Resources (AR-10), University of Washington, Seattle, WA (206) 543-2688.

River Recreation Research Published

"Some Recent Products of River Recreation Research" is the title of a USDA Forest Service General Technical Report (NC-63) published by the North Central Forest Experiment Station, 1992 Folwell Ave., St. Paul, MN 55108. David W. Lime of the Forest Experimental Station and Donald R. Field, Associate Director for Science and Technology in the NPS Pacific Northwest Region did the technical coordination of the nine papers, originally presented at the Second Conference on Scientific Research in National Parks, Nov. 26-30, 1979, in San Francisco. An introductory "Highlights" statement observes: "One conclusion from the Conference was that the future of social science research in support of resource management hinges upon the accumulation of national and regional data. Once established, the data base could provide the foundation to determine whether management concerns and issues associated with a specific site require additional research . . . and might likewise provide trend information on changing patterns of recreation use, changes in the composition of user populations, and provide comparisons in recreation use between Forest Service, Park Service, and Bureau of Land Management areas . . . Finally, a national and regional data base might well provide the basis upon which management objectives and policies are examined, leading to a more effective resource management policy."

Olympic NP Stages Well-Run Removal Of Exotic Goats

By Bruce B. Moorhead

Between June 30 and July 8, 1981, a team of rangers and scientists at Olympic NP successfully live-captured 52 mountain goats (*Oreamnos americanus*) and transferred them by helicopter from high atop Klahhane Ridge. The animals were distributed elsewhere under the direction of the Washington Department of Game. The operation initiated a three year experimental attempt at Olympic to reduce the number and impact of mountain goats on Klahhane Ridge and, in the process, to develop information leading to an overall management plan for this exotic species.

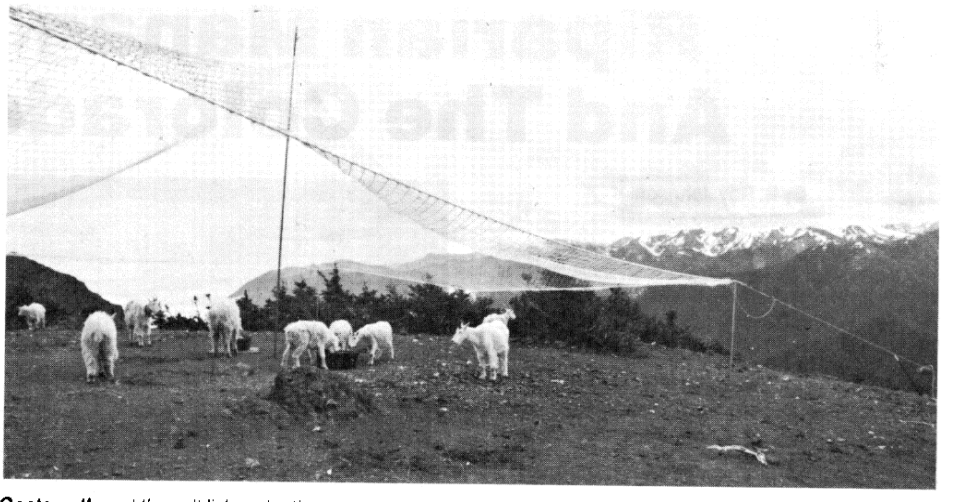
Mountain goats are large herbivores adapted to mountains throughout the Pacific Northwest and Alaska. However, they never occurred in the Olympic Mountains of northwestern Washington until 11 or 12 were introduced by man in the 1920s, well before the Park was created in 1938. The Olympics have been isolated by continental glaciers and, more recently, by lowlands and saltwater of the Puget Sound trough. A number of mammals, including the mountain goat, in the high Cascade Mountains of central Washington, were unable to reach the Olympic Peninsula. Other mammals unable to cross the Puget trough barrier include bighorn sheep, pika, grizzly bear, wolverine, and lynx. Alpine isolation in the Olympic Mountains also led to unique life forms, including 11 endemic plants and four mammals.

For many years goats were only occasionally reported in small numbers from a few remote locations. However, by the late 1960s increases were noted. Studies by NPS and University of Washington scientists in the 1970s confirmed an estimate of a widespread goat population of 600 to 700. 90 percent of the goats were found in the park, with the remaining 10 percent on adjacent U.S. Forest Service lands.

Intensive research begun in 1977 on Klahhane Ridge, in the north central mountains, documented a presence of at least 200 goats, or about 40 per square mile – one of the heaviest concentrations recorded in North America. Observations of marked animals show much movement from Klahhane Ridge to other parts of the mountains. Five of nine monitored subpopulations showed increases in 1980. On Klahhane Ridge, contracted studies by University of Washington plant scientists under Dr. L.C. Bliss, documented disturbance by goats, including numerous trails, dusting wallows and related erosion, endemic plants, grazing, declines in abundance of preferred forage species, and other changes to the structure and productivity of affected plant communities.

To complicate problems, goats are attracted to people, whose perspiration and urine deposits are eagerly sought as salt. As goats increase, more reports are received of disruptive and even potentially hazardous encounters between salt-hungry goats and backcountry hikers and campers. Moreover, increased trampling and erosion is occurring along popular routes, such as the Klahhane Ridge trail, as groups of goats and curious visitors continually interact.

In February 1981, an environmental assessment for public review of these problems was completed. Three management alternatives were considered: (1) no action, (2) control goats to limit their impact, and (3) remove goats to restore the native environment. Although no single alternative was chosen, an experimental program was recommended to test the feasibility of control or removal as alternatives. To assist in presenting the problem to the public, an audio-visual program entitled "Olympic's Alpine Transplants: Blessing or Blunder" was prepared. This proved helpful in nine public meetings and 19 other presentations throughout western Washington during March and April. Over 750 people attended these meetings. Of these, nearly 350 wrote comments indicating they opposed no action (75%), and favored control (84%) over removal (38%) as an alternative. Most (76%) also favored an experimental management approach, which was presented in a questionnaire and described in public briefings.

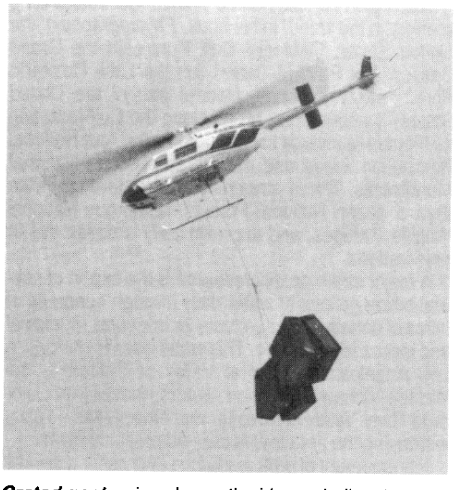


***Goats gather** at the salt lick under the capture netting.*

A decision was reached by Superintendent Roger Contor in mid-April, 1981, to embark on an experimental program over three years using small-scale herd manipulations to evaluate the relative effectiveness and cost of various control strategies. Each year, 50 to 60 goats will be removed from the dense Klahhane Ridge subpopulation, which is also believed to affect abundance elsewhere. The reproductive ability of goats to compensate for these known removals will be closely monitored to estimate levels of control required. Field experiments will be conducted on the practicability of tubal ligation and other reproduction inhibiting procedures as indirect controls. Hypotheses about recovery changes in various plant communities following releases from grazing pressure also will be tested on Klahhane Ridge.

A major incentive to experiment with various control procedures at Olympic is the tameness of goats and relative ease of capture. Scientists here have captured and marked well over 200 goats, using simple rope foot-snares placed around salt. To capture family groups, a large drop-net measuring 40 by 40 feet was specially designed and constructed. It is erected tent-like, atop conduit poles tightly moored in place over a capture site. Manual trigger-lines pulled at the corners and a center pole rapidly collapse the net around animals lured beneath to salt. This makes possible the capture of six or more goats at one time, including small kids (the preferred grouping for release at the transfer sites.)

The safe capture and relocation of 50 to 60 large animals required close planning and teamwork between park rangers, scientists, various collaborators, and volunteers. Eleven NPS employees were principals in the 1981 operations. Team roles included: public information, equipment preparation, and site security; animal restraint, measurement, and care; crating and helicopter transfers, and truck coordination and hauling to release sites. A medical protocol developed by Dr. James Foster, veterinarian at the Woodland Park Zoo in Seattle, contributed to minimal injuries and prevention of animal loss. Scientific meaurement of the animals, as well as before-and-after census of the population, was the responsibility of Doug Houston, Pacific Northwest Regional scientist assigned to Olympic.



***Crated goat** swings beneath airborne helicopter.*

Total cost to the Service for the 1981 transfer operation on Klahhane Ridge was $19,482, or $364 per goat. A recurrent cost estimate (total minus capital equipment and training) reduces costs to about $274 per goat. Helicopter costs were lowered approximately 30 percent by combining goat flights with other park flying needs.

On July 1, a "press day" was held at the capture site for 25 to 30 news representatives, who were hiked to the top of Klahhane Ridge to photograph and report on the event. Very positive coverage was given to the operation by the media. A press-packet, given to each news person, provided background information and particulars about the operation.

The program in 1981 is off to a good start. Management and science are in a close-working partnership at Olympic and public support of the program has grown as information is developed and made available.

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GOAT ECOLOGY TREATED IN NATURAL HISTORY

For an informative, well-illustrated article on mountain goat ecology in the Olympic NP, see the January 1981 issue of *Natural History* and the article by Michael Hutchins and Victoria Stevens.

Riparian Management And The Colorado River

By R. Roy Johnson
(Second of two articles)

The Colorado River is probably the single most important resource to several million inhabitants of a large portion of the Rocky Mountain, Colorado Plateau, and Basin and Range (geologic) Provinces.Originating in and near Rocky Mountain NP, the river drains about 245,000 square miles – an area the size of 12 northeastern states from Maine to the Virginias. Major tributaries in the Upper Colorado River Basin include the Green, Gunnison, and San Juan; the Lower Basin is drained mainly by the Little Colorado and Gila. After nearly a century of management, almost no water now flows into the Gulf of Mexico through the nearly dry Colorado River delta.

The region contains some of the most outstanding scenery in the world. In his book, *Physiography of the United States,* Geologist C.B. Hunt calls the Grand Canyon and Painted Desert (on the Little Colorado River) "easily the most colorful part of the United States." National Park areas along the Colorado and its tributaries include six National Parks, four National Recreation Areas and more than a dozen National Monuments. These streams also flow through more than a dozen National Forests, numerous National Wildlife Refuges, and approximately a dozen Indian reservations.

A major strain on this resource is the export of several billion gallons of water daily through hundreds of miles of canals and aqueducts for irrigation, municipal and industrial purposes. This water goes to millions in Los Angeles, the Central Valley of California, the Wellton-Mohawk Irrigation district, the Lower Colorado River Valley in Arizona, and other areas – vastly increasing the area that is dependent on the river.

Management of park resources and visitor activities along the Colorado is one of the most challenging tasks facing the National Park Service today. This challenge is perhaps the most difficult of all at Grand Canyon NP, where bitter disputes among the NPS, river running concessionaires, private whitewater boatmen, and conservation organizations have gone on for a decade. Champions of one cause or another have chosen as their battlegrounds the air waves, newspapers, television, letters, courtrooms, even the floor of Congress. Key issues have included motors vs. oars, user levels, and allocation of use between concessionaires and private users. Actually, even more basic issues of nationwide interest, such as "what constitutes a wilderness experience?" and "what is a proper role of concessionaires on public lands?" are at the heart of the matter.

In 1973, the NPS embarked on three years of research, consisting of approximately 30 separate, multidisciplinary projects, to determine the quality of the whitewater experience as well as the interrelationships between whitewater recreationists and the natural environment. While sociologists attempted to determine visitor attitudes, biologists studied the aquatic and riparian ecosystems. Effects of the Glen Canyon Dam 16 miles upstream often complicated attempts to answer resource oriented questions and these effects *continue* to compound the problems of both the manager and the researcher.

In July, the press announced a new plan by the Bureau of Reclamation – to add turbines at the Glen Canyon Dam that would increase power output, and at the same time reduce the river flow to a trickle for most of the day and then release huge volumes of water in sudden bursts.

Researchers measure *amounts of human debris, charcoal concentrations, and sand discoloration to determine impacts on heavily-used recreational sites along the Colorado River in Glen Canyon NRS.*

Fire pits *pose a serious resource management problem along the Colorado River in Grand Canyon NP and Glen Canyon NRA. Without containerization of fires, debris degrades the surrounding beach area.*

Research by NPS and cooperating scientists continues to document changes in the Grand Canyon. A vastly modified river regime has greatly affected the riparian and aquatic ecosystems. Impacts that continue to pose problems include such systemic changes as (1) clear water due to the dropout of sediment in upper Lake Powell, more than 100 miles upstream from Grand Canyon in contrast to the reddish, silt laden pre-dam water; (b) stable, year-round lower temperature (approximately 50°F.) of water released from deep, cold waters of Lake Powell, in contrast to pre-dam waters warm enough for comfortable swimming in summer but freezing in winter; (c) invasion by exotic plant and animal species and expansion of their populations; and (d) change in the river regime from *seasonally* alternating flows (flood to low water) to *daily* "yo-yo" fluctuations – the result of increasing/decreasing flows related to changes in generation of electricity at Glen Canyon Dam.

These changes have aided the development of a whitewater recreation industry that grosses several million dollars annually; but the native ecosystem, including several threatened or endangered animals, has suffered. Notable is the humpback chub, known to breed now in only one locality – the warmer waters near the mouth of the Little Colorado River.

In addition to dam influenced changes* in the aquatic ecosystem of the Colorado, numerous riparian (streamside) changes have occurred. In Grand Canyon, these consist of (a) increases in non-native plant species; (b) development of new riparian plant and animal communities; and (c) erosion of beaches suitable for camping.

Establishment of stable riparian plant communities in Grand Canyon NP is a post-dam development. Prior to Glen Canyon Dam, frequent floods scoured the streamside, preventing permanent establishment of these plant communities. The new plant communities with their associated wildlife are of great interest to scientists and visitors alike. Birdwatching is one of the favorite activities of a good number of the 15,000 whitewater recreationists who pass through the Park annually. Scientists such as Dr. Steven Carothers at the Museum of Northern Arizona and Dr. Mary Willson, University of Illinois, are aiding NPS scientists in studying the effects of these new plant communities on nesting birds. Bryan Brown, a seasonal biologist, is working with our research staff at the University of Arizona on the importance of these new habitats to migrating birds.

This newly developed habitat is of two principal types – marshy vegetation such as cattails, bullrushes and reeds in wet areas, and riparian scrub, with coyote willow, saltcedar and arrowweed on sandy, dry terraces. Estimates of riparian habitat loss range from 80 to 95 percent for the Colorado River lowlands. Thus, the establishment of new riparian habitat in this region is a major event. The vegetation in these areas is composed to some extent of introduced species such as saltcedar, camelthorn and Russian thistle. Camping, picnicking, and other recreational activities are difficult to impossible where these plants have taken over.

Visitor related problems, include trampling of riparian vegetation, trailing from the river to attraction sites, fires (usually set in vegetation by burning toilet paper), and littering.

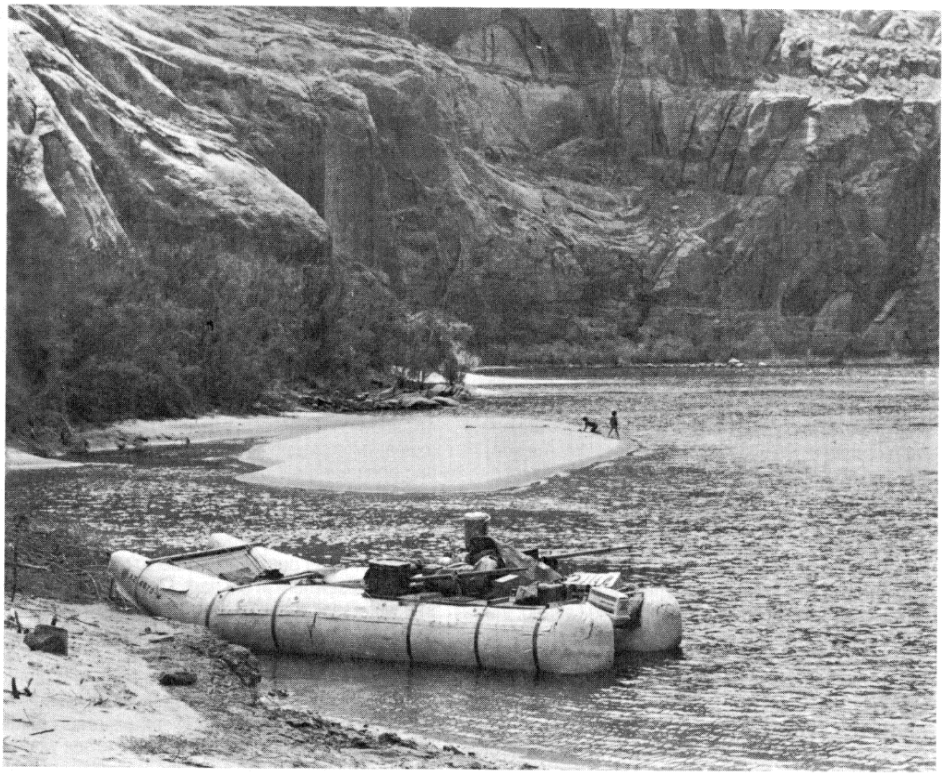
Some of the most severe problems arise from complicated interaction between direct man-caused and dam-related factors. Drs. Robert Dolan and Alan Howard, beach erosion experts at the University of Virginia, have conducted studies related to these problems. River-running recreationists spend more time on shore – camping, eating, hiking to attraction sites, etc. than on the water. Before construction of the dam, river terraces (beaches) were eroded away and redeposited by periodic flooding of the river, but with the cessation of seasonal flooding this is no longer the case. Even though great care is taken by most river guides and boat crews to keep these prime campsites clean, ashes from campfires or other debris dropped on the sand remains – almost indefinitely – and creates what Dolan calls "a sandbox condition."

Another post-dam problem involves the clear, fast water, coupled with the daily river level fluctuations, which gradually is eroding many of these beaches. As people walk on them, the sand is pushed downslope into the river and washed away.

Management schemes on the Colorado are changing constantly. Joint planning efforts currently are being conducted between NPS, Bureau of Reclamation, U.S. Fish and Wildlife Service, Arizona Game and Fish Department, and others. Of particular concern is the recently proposed generation of up to an additional 250 megawatts of electricity at Glen Canyon Dam; flows through the Grand Canyon would reach approximately 40,000 cubic feet per second (cfs) rather than the approximately 5,000 to 25,000 cfs released during the current rafting seasons. This would affect whitewater recreation, the outstanding trout fishery just downstream from the dam, and the newly formed riparian habitats in Grand Canyon.

Thus, combined teams of resource managers and researchers must continue strenuous efforts to develop management schemes that will match the rapidly changing river conditions and preserve as many resource values as possible for the continuing enjoyment of park visitors.

Roy Johnson is Senior Research Scientist and Leader of the NPS/CPSU at the University of Arizona. Research photo taken in 1981 by S.W. Carothers.



Research raft *used by the Museum of Northern Arizona in aquatic and riparian studies along the Colorado River. 1981 photo taken in Glen Canyon NRA 9 miles below Glen Canyon Dam.*

Threats To Parks Symposium Set

Five NPS scientists will jointly present a symposium on "External Threats to Ecosystems of the National Parks" on Friday, Jan. 8, 1982, at 9 a.m. in the Pan American Room of the Capital Hilton in Washington, D.C. – part of the Jan. 3-8 annual meeting of the American Association for the Advancement of Science.

J. Robert Stottlemyer, NPS research scientist with the Great Lakes Research Area study unit and adjunct professor in the Michigan Technology University department of biological sciences at Houghton, MI, arranged the symposium and will preside. R. Roy Johnson of the Western Region will handle "Ecosystem Impacts Resulting from Hydrologic Regulation;" Paul G. Godfrey of the North Atlantic Region and an associate professor of botany at the University of Massachusetts, "External Influences on the Management of Barrier Island Parks;" Susan P. Bratton, research scientist at Great Smoky Mountain NP, "Effects of Exotic Plant and Animal Species on Park Ecosystems;" and Clifford J. Martinka, research biologist at Glacier NP, "Effects of Co-terminus Land Use on Endangered Grizzly Bear." Stottlemyer will discuss "Ecosystem Evaluation of Anthropogenic Atmospheric "Inputs."

The Symposium abstract reads: "National park resources are becoming increasingly important in the international conservation of genetic resources and their supporting environment. Designation of almost 15 national parks as international biosphere reserves is recognition of this value. Present administrative authority appears adequate to resolve most resource impacts that originate within park boundaries. But a recent survey shows most threats to park natural values originate beyond park boundaries. The mitigation of such threats will require a considerable expansion and major shift in Park Service research. Case studies documented by research on topics as diverse as the external regulation of hydrologic budgets, exotic species, management of barrier islands, air pollution, and co-terminus land use, point out the need to use an ecosystem approach in assessing the magnitude of these external threats. This approach more fully accounts for the complexity of such threats, and provides better information for mitigation strategies."

Scientists Measure Acid Rain Problem At Great Smokies NP

By Jim Wood

Acid rain is its name. Environmental degradation is its game. It begins with the nation's automobile factories, coal- and oil-fired steam plants, steel mills, refineries and smelters, which spew myriad chemical gases into air already contaminated by cars and trucks. These pollutants combine chemically with water vapor to form caustic sulfuric and nitric acids and may be transported great distances by winds. Eventually they fall back to earth in the form of acid rain and snow.

Acid rain knows no political boundaries. It falls on the trout lakes of Ontario, the fir and oak forests of New England and the Adirondack mountains of New York. It spreads southward through the Appalachians of Pennsylvania, the Virginias, and Kentucky and reaches the Great Smoky Mountains of Tennessee and North Carolina.

High up on Clingman's Dome in Great Smoky Mountains NP, data on acid precipitation are being gathered, using special instruments made for the purpose. NPS scientists fear that the Great Smokies soon may experience ecological damage similar to that already encountered in the Adirondacks and elsewhere.

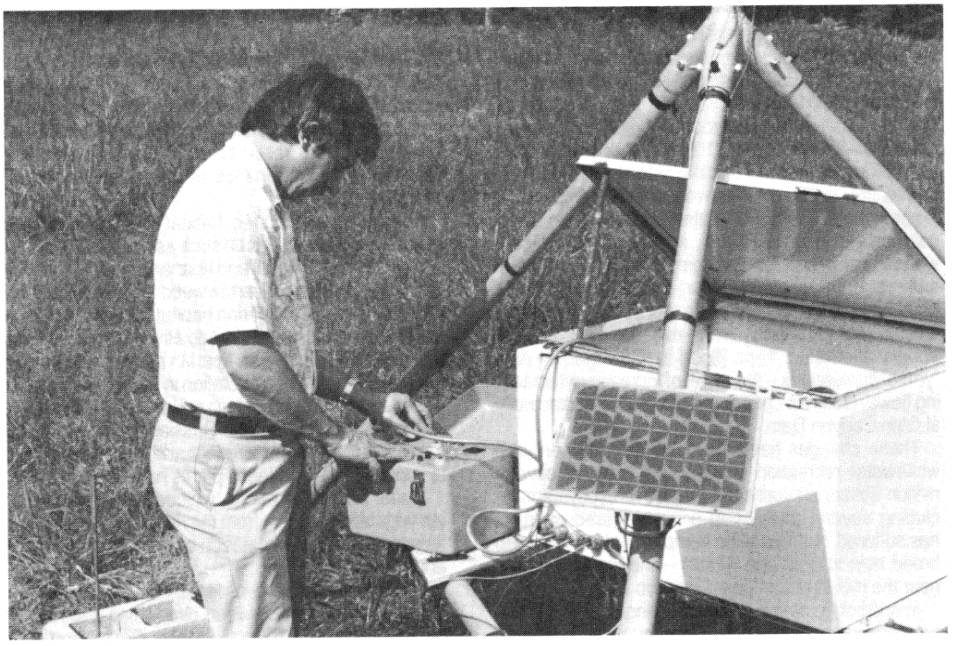
A 1975 survey showed more than half of the Adirondacks' high elevation lakes were devoid of all fish life, due to acid rain. In Ontario, 148 lakes have now been pronounced "dead." Canadian scientists say that if acid rain continues unabated, another 48,000 lakes in Ontario will die within 20 years.

The effects of acid rain are not restricted to lakes and fish. In the cities, marble statues and stone and metal buildings corrode. House paints and auto finishes deteriorate. Acid rain effects on highways and bridges are the subject of federal government studies. Some scientists suspect that already acid rain may be causing declines in farm crops and timber harvests. Dr. Tom Crocker of the University of Wyoming estimates damages to materials (such as stone and auto paint), forest and aquatic ecosystems, crops, water supplies and other health-related systems at $5 billion for 1978 in the eastern U.S. alone.

The acidity of any solution is measured with what is known as the pH scale, numbered from 0 to 14. A pH of seven is neutral, neither acidic nor alkaline. Distilled water is an example of a neutral substance; anything under seven is acidic, anything over seven is alkaline. The pH scale is logarithmic – that is, each change of one pH unit represents a 10-fold change in acidity. Thus, a drop from pH 6 to pH 3 is a thousandfold increase.

Pure rainwater has a theoretical pH of 5.6 because some acidity occurs naturally due to dust and carbon dioxide in the atmosphere. However, during the past 20 years, the average acidity of rain and snow along the eastern U.S. has dropped from pH 5.6 to between 4 and 4.5. This change represents a value 40 to 50 times more acidic, and some recent individual storms have dumped rain at pH levels even lower. Kane, PA, for example, recorded a shower at pH 2.3, a level far more acidic than vinegar.

Exactly what causes acid rain? The complex chemical process starts with oxides of sulfur and nitrogen emitted by the burning of fossil fuels. These gases stay aloft long enough to interact with water and create sulfuric and nitric acids. The sulfur oxides emanate mostly from power plants, while the nitric oxides come from both power plants and internal combustion engines of cars and trucks. The Environmental Protection Agency (EPA) estimates the country's total man-made sulfur dioxide emissions at 26 million metric tons per year. For nitric oxides, the yearly metric tonnage is 23 million. These very fine acidic particles can stay in the atmosphere for an indefinite period and can travel thousands of miles. When they finally fall, they can cause extreme changes in local environments, especially aquatic environments.



***Ray Mathews checks out** weather instrumentation on Convertible Data Collection Platform (CDCP) mounted at Elkmont, a low elevation sampling site in GRSM. The CDCP is powered by lead-acid batteries augmented with a recharging system provided by a solar panel.*

When the pH of a lake or stream drops below five, the acidity can kill young fish and prevent reproduction in older fish. In the Adirondack lakes, not only have fish died, but the increased acidity has killed countless salamanders, frogs, plankton, and bacteria – all components of the aquatic ecosystem.

High acidity also increases the solubility of toxic heavy metals, such as aluminum, mercury and lead. In lakes that have not yet gone dead, such metals contaminate the fish and can make then unsafe to eat. If these lakes happen to serve as public drinking water supplies, human health may be endangered in hidden ways. Water from New York's Hinckley Reservoir has acidified to such an extent that when the water passes through household plumbing systems, lead from soldered joints dissolves into the water at concentrations higher than maximum recommended health levels.

A recent two-year study in southern California showed a mean pH of 3.9 for rain in Pasadena. Acid precipitation readings between pH 4 and 5 now are being recorded in Portland, OR, Spokane, WA, Tucson, AZ, and the state of Colorado. Across the Atlantic, Swedish scientist Svante Oden has reported 20,000 acidified lakes in Sweden, with at least a third of these dead. Norway's lakes are similarly affected. Oden traced their acid rain sources to the heavily industrialized areas of Great Britain, Germany and France.

Small high elevation lakes like those in Ontario, the Adirondacks, the High Sierras, the Rocky Mountains, Sweden and Norway, are especially sensitive because they are poorly "buffered." Their soils are thin and their bedrocks do not contain enough alkaline substances (such as limestone and calcium carbonate) to counter the acidity. According to Gene Likens of Cornell University, Cayouga Lake in New York has not gone acid because it is located in a geological area rich in limestone. The limestone serves as a built-in "Rolaid" to neutralize the acidity. However, in other areas where the buffering capacity is small, this Rolaid factor can be used up in a very few years.

Because many parks and wildernesses are in acid-sensitive mountains and forests, the NPS has set up air pollution monitoring stations in 16 parks throughout the nation. Great Smoky Mountains NP (GRSM) is one of them.

"Our monitoring program consists of three parts," Dr. Gary Larson of the NPS said. (Dr. Larson recently transferred to Omaha, NE, where he now is Midwest Regional Chief Scientist.) "First, we collect weekly rain and snow samples for pH analyses. Second, we study stream pH – how the acid precipitation changes the chemistry of streams in the park. And third, we study the effects of these chemical changes on a selected living organism – in our case, salamanders."

Ray Mathews, NPS biological technician, who works with Dr. Larson, explained why salamanders were chosen as environmental indicators. "Salamanders often spawn in pools or pockets of standing water along the streams," he said. These pools are formed by rainwater or melted snow and could be more acidic than the main body of the stream itself. Any problems may show up in the salamanders first. We think of them as living environmental barometers."

Mathews and Larson have installed specialized rain and snow collectors at five locations within the park . . . four at different elevations along the park perimeter and one near the top of Clingman's Dome, the park's highest point (6,642 feet above sea level.) Equipment at all five sites was designed and constructed by the Tennesse Valley Authority.

Stream water quality also is being monitored at two streams elsewhere in the park. One stream is located in a watershed that was cut over about 70 years ago; the other is in a virgin (unlogged) watershed. Although both watersheds are classified as cove hardwoods, the logged area has fewer large trees and a greater number of small trees, saplings and shrubs. The NPS team wants to compare differences in stream chemistry between logged and pristine areas, to see whether acid rain affects the two watersheds in different ways.

Hourly stream analyses are made using special remote sensing instruments. A sensor called a "Hydro-

lab Surveyor" is immersed in the stream. It contains probes for measuring pH, water temperature, dissolved oxygen and other water quality parameters. This sensor is connected to a convertible data collection platform (CDCP) that transmits the data to an orbiting Geostationary Operational Environmental Satellite (GOES). The CDCP also is connected to a weather instrument package that measures rainfall, air temperature, relative humidity, barometric pressure, and wind speed and direction. "The system has the ability to correlate changes in stream pH with changes in the weather," Mathews explained. "We are then able to see how major and minor rainstorms affect the streams' pH."

During the past year, the team has recorded rainfall at weekly average pH levels of slightly less than 4, with drops during the winter. "Contaminants in the snow are flushed out in the first melt and runoff into the streams causes steep drops in stream pH," Mathews said. "Also, runoff from heavy rainstorms contains a significant amount of acid water that has not been greatly buffered by the soil. Fortunately, the streams are able to recover within a few days."

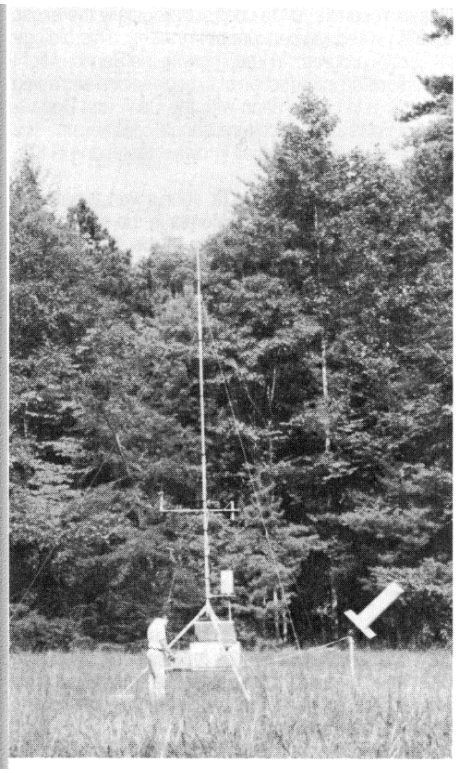
A contract with the National Climatic Center seeks to produce data on what areas in the country are most responsible for the air pollutants that affect the Smokies. The study takes into account air mass trajectories and storm fronts of the U.S. weather system. Preliminary findings indicate that most trajectories are from areas east, south, and west of the park.

Paradoxically, one of the problems adding to today's acid rain dilemma is air quality standards set by the Clean Air Act in 1970. The standards then in effect called for reductions in emissions around local areas and communities surrounding factories. This resulted in construction of taller smokestacks. Such "superstacks" – some up to 1,200 feet high – reduced local pollution by pumping the chemicals higher into the atmosphere. Prevailing winds then carried them far and wide, changing the chemical composition of rain and snow over the nation and the world.

As the results of the testing at Great Smokies and elsewhere come in, measures with political and economic ramifications are sure to result. Whatever actions are taken, the condition of our National Parks will be affected, and park scientists are keeping close track of the situation.

Jim Wood is writer-editor with the Natural Science Division, SERO.

For a scientific description of acid rain and a report on its occurrence and monitoring on the west slope of the Northern Cascade Range, see Robert C. Wasem's summary of progress on pp. 33-34 of the 1980 Science Annual Report, Pacific Northwest Region, NPS, now in press. (Available through the PNW Region headquarters, Westin Bldg., 2001 6th Ave., Seattle, WA 98121.)



View of the Elkmont *CDCP note the tube-shaped GOES antenna to the right of the platform. Weather information (wind speed and direction, relative humidity, rainfall, etc.) is collected by the CDCP and transmitted to the GOES satellite on a 24-hour basis.*

feedback

Letters to the editor may be slightly edited to fit space requirements.

To the Editor:

I just received and read my copy of Pacific Park Science, Spring 1981 (?!?!). I'm not writing to complain about the delayed mailing/delivery of the issue, that could have been the result of several factors; as a matter of fact, I am very appreciative of being on your mailing list and I enjoy reading the publication, anytime.

Two things have aroused my curiosity, however. One is the location of Sunset Crater as being in New Mexico: "From the Editor" and "Incident at Mount St. Helens??" I thought perhaps the Sunset Crater National Monument in Arizona where we camped in 1978 may have a namesake in New Mexico but the statement "in the shadow of the San Francisco Peaks" assured me they were one and the same. Now, I know the only thing constant in nature is change and I accept the continental drift theory but 1978-1981 is a little rapid for Sunset Crater *and* the San Francisco Peaks to shift from Arizona to New Mexico, don't you agree? My other question regards reference to the St. Croix (River) as a "small stream" ("Riparian Resources and Endangered Ecosystems"). Having lived most of my 52 years almost within "spittin" distance of the St. Croix River and knowing it to some extent from near its origin to its junction with the Mississippi where the St. Croix is the larger of the two rivers, I wonder what Mr. Johnson means by his designation. If the St. Croix River is a "small stream" he would probably also refer to Lake Superior as a "pond."

These may be moot points but they did arouse my curiousity. Sincerely,
Dr. Carl D. Finstad
Associate Professor of Biology
University of Wisconsin – River Falls

The Editor Replies: *The reason Spring was a little late this year is the government-wide moratorium placed on all publications at the precise moment last May when the Spring issue was camera-ready. The bulletin languished 16 weeks before permission to print came through. I admit that NM as an abbreviation for National Monument can be confusing – especially when the printer precedes it with a comma that the near-sighted editor overlooked. You will find it again in the page 3 story* ***sans*** *comma. As for your final question: Perhaps Roy Johnson will make his own case for characterizing the St. Croix as a "small stream." As a last resort, he might fall back on the counter-question of the researcher who, when asked "How's your wife?" replied "Compared to what?"*

Management And Science Reorganized

In revisions to the Departmental Manual approved in June 1981, the Division of Natural Resources, formerly in the Office of Science and Technology, was restructured into two divisions: the Division of Natural Science, within Science and Technology, and the Division of Natural Resources Management, within Management and Operations. The intent of this reorganization action was to move to M&O those activities that relate specifically to the management of natural resources and to retain in S&T those natural science research activities that support the preservation and integrity of in-park natural ecosystems and natural processes.

The functions transferred to M&O encompass field-related programmatic activities such as ADP responsibilities for bear management, pesticide management and the backcountry permit system. M&O also will assume responsibility for the Resource Management Plans, for development and prioritization of Significant Resource Problems, and a variety of training, reporting and planning relating to management of in-park natural resources.

The Natural Science Division remaining in S&T will be responsible for natural science and natural history research, for long-term biological/ecosystem monitoring, for science publications, for special research studies, for evaluation of field natural science programs, for coordination of Service-wide programs involving scientific subject matter such as the Endangered Species Program, and for budget, policy, guidelines and standards relating to the conduct of NPS natural science research programs.

The Natural Science Division, together with the Regional Chief Scientists, will take steps to develop long-term relationships with universities to provide improved response capabilities to such research needs as coastal and riparian, desert, eastern and western forest, and Hawaiian and Alaskan ecosystems.

International Mountain Society Formed

Overuse and abuse of mountain lands throughout the world has led to organization of the International Mountain Society, P.O. Box 3148, Boulder, CO 80307, "to strive for a better balance between human welfare, mountain environment, and development of resources."

Jack Ives, professor of mountain geoecology at the University of Colorado, is the Society's first president. The $25 membership includes a subscription to the quarterly Journal, *Mountain Research and Development,* co-published by United Nations University and the Society, with support from UNESCO. Journal contents will embrace a wide range of disciplines in the natural and human sciences, medicine, architecture, engineering and technology as they apply to highland areas.

Society aims are to further international collaboration for the protection of mountain lands and peoples and for the rational development of natural resources, to encourage basic and applied interdisciplinary research throughout the mountain world, to disseminate and apply knowledge that may help solve mountain land-use problems, and to help create research centers and national institutions throughout the world.

Inventorying Rare Plant Species

By Larry L. Norris

It is important that park managers have an accurate data base upon which to rely when making decisions that will affect rare species. Federal law requires the protection of species that have been classified as threatened or endangered. Many plants are now classified and many others have been proposed for classification and must be given special consideration for protection. The importance of gaining knowledge of rare plants, including their numbers, localities, vigor, and habitat is obvious whenever park operations threaten to alter an area. The expansion of a campground or relocation of a section of trail may impact one or more populations of rare plants. In order to protect rare plants, managers in charge of such projects need information on the species and populations that might be impacted.

In the National Park Service the need for rare plant inventories is now being recognized and a number of studies have been or are being completed. In Sequoia and Kings Canyon NPs this represents a sizable undertaking. The combined acreage is 862,429 acres. Much of the park's 862,429 acreage is rugged, isolated and difficult to access. The manner in which an inventory was to be carried out had to be carefully planned.

Before the inventory could begin a list of rare plants known or suspected to occur in the parks had to be developed. Four sources of information were consulted to learn what species should be considered. First we recognized the rare plant list for the state of California, compiled by the California Native Plant Society and adopted by the U.S. Fish and Wildlife Service as definitive for the state. Plants appearing on this list and known to occur in Sequoia and Kings Canyon were of primary concern. Those likely to occur within the parks also were considered.

Secondly, an extensive herbarium search was conducted to gain more detailed information on known localities within park boundaries of the plants of concern. These localities were then plotted on a park vicinity map to indicate rare plant concentrations and areas requiring intensive field survey efforts. Next, an inspection of other rare plant inventories by neighboring agencies (in our case three National Forests) or private researchers was made to determine possible rare plant localities near the park boundary.

Finally, personal contact was made with those botanists who have collected or made observations within the parks in the past. Their information was of considerable help in planning and carrying out the field inventory.

After compilation of the rare plant list (30 species in Sequoia and Kings Canyon NPs) the habitat requirements of each species had to be documented. This was accomplished through literature research, through information gained from the herbarium labels, and from botanists familiar with the plants. The next step was to deduce where each rare species was likely to occur in the parks. This was done with the help of topographic maps and air photos. For instance, one species, *Oreonana purpurascens,* grows on clear ridges surrounded by red fir forests at elevations between 800 and 8500 feet. Topographic maps helped the inventory team locate such ridges, and air photos indicated whether they were forested or not. Field searches to some of these "ideal" ridges located several populations of *O. purpurascens* in the parks. These were of only suspected occurrance prior to the study.

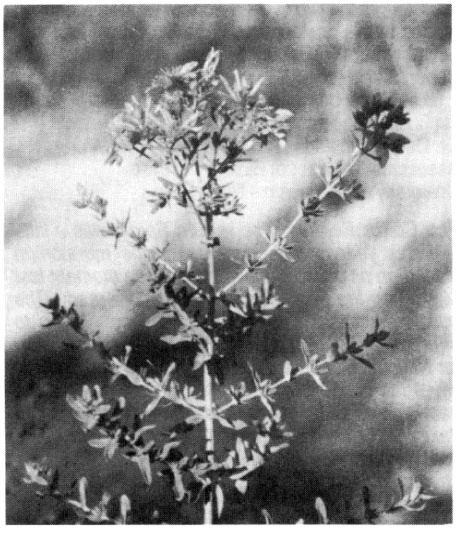
The known populations of rare plants provided the basis of each inventory field trip. Locations plotted on the park vicinity map showed what areas needed emphasis, what the general elevations were, and how much time would be required for the inventory trip. The field trips were then planned in a route that connected the known populations. Suspected localities would be searched as they were encountered along the way. In areas of the parks that had no recorded rare plant populations the inventory consisted of surveying all potential sites for rare plants thought possibly to occur there. These trips often yielded botanical surprises.

Each population site encountered was inventoried on a field data collection form made especially for this study. The form gathered information of the site location (geographic locale, and legal subdivision) and description (elevation, physical setting, slope aspect, and substrate). The second half of the form deals with the species' surrounding plant community, associated species and the population description (size of area, number of plants, phenology, population health, vigor, density, and, lastly, any endangerment factors).

After the data had been collected on field forms and the populations accurately mapped on USGS 7½ minute quadrangles, a park status report for each species was written up. Attachments to each report included a professional line drawing, black and white 8x10 photo of an herbarium specimen, and color photographs showing a close up of the flower, a general plant photo, and a photo depicting the plant's typical habitat. Status reports, maps, and illustrations were then placed in large, three ring binders and copies distributed to those park managers who have a need to know the locations and status of these rare plants. Accompanying each copy was an index referring to map and detailed location guide for quick reference. This saves the park manager the task of thumbing through the rare plant report every time a project arises.

In short, it is essential that park managers understand where rare plant species occur and what factors or activities might threaten their survival. A prepared methodology to follow in designing and carrying out a field inventory of known and suspected rare plants is presented here. It has proved quite successful in Sequoia and Kings Canyon NPs, as well as a number of surrounding National Forests. (Note: examples of data collection field forms can be obtained from the Research Scientist's Office, Sequoia and Kings Canyon National Parks, Three Rivers, CA 93271.)

Larry L. Norris is a research technician at Sequoia and Kings Canyon National Parks.



Klamath weed (Hypericum perforatum).

Klamath weed beetle on Klamath weed.

Biological Control Of Klamath Weed In Yosemite NP

Once again, Yosemite NP is a biological battleground.

In May and June, 1981, some 15,000 *Chrysolina quadrigemina* beetles were released at five affected sites in Yosemite NP to control biologically the exotic Klamath weed (*Hypericum perforatum*). This biological control program, in keeping with the Services tight restrictions on introduction of exotic species and being carried out in cooperation with the California Department of Food and Agriculture, should continue until the beetles have eliminated all known infestations of Klamath weed.

The weed, also known as St. John's wort, is native to Europe. It showed up in California in the early 1900s and was identified in Yosemite in the 1940s. Since then, various eradication programs have been mounted. The first two attempts, hand eradication and chemical spraying, were ineffective; the third, biological control, was successful.

In 1951, 9,800 Chrysolina beetles were released at six locations in Yosemite, and within 10 years the beetles had virtually eliminated the Klamath weed. Apparent demise of the beetle in recent years resulted in reinvasion by the weed, which rapidly took over roadsides and meadows. Klamath weed's presence constitutes undesirable alteration of the natural scene because of its ability to choke out native vegetations. In addition, it can cause skin irritation in humans and blisters in animals that eat it.

Klamath weed has an extremely high reproductive capacity. It quickly spreads from one favorable site to another and establishes dense colonies throughout each site. Chrysolina beetles feed specifically on Klamath weed, and they are so selective that they actually differentiate between the unwanted exotic and two closely related native plants.

If for any reason the Chrysolina beetle should fail this time to knock the weed "out of the park," two pinch hitters are available – a root crown beetle and a gall midge. These two organisms also are known for their ability to target and control Klamath weed, and park management is considering their introduction should supplemental actions become necessary.

regional highlights

NATIONAL CAPITAL REGION

An Urban Forest Soils Workshop, co-sponsored by Consortium for Environmental Studies – U.S. Forest Service, the College of Environmental Sciences and Forestry – Syracuse University, and the National Capital Region – NPS, was held in Washington, D.C. Oct. 26-28. Focus was on urban soils, their characteristics, management techniques, and specific applications toward effective long term management.

A 7-chapter workbook was prepared for pre-workshop distribution and a hands-on session and field trip dealt with soil properties, soil profile evaluation, soil sites, tree pit design, the "engineering" of plants into urban soil systems, and long term management implications of all these things.

For full information, contact James C. Patterson, research agronomist with the National Capital Region, (202) 426-6796.

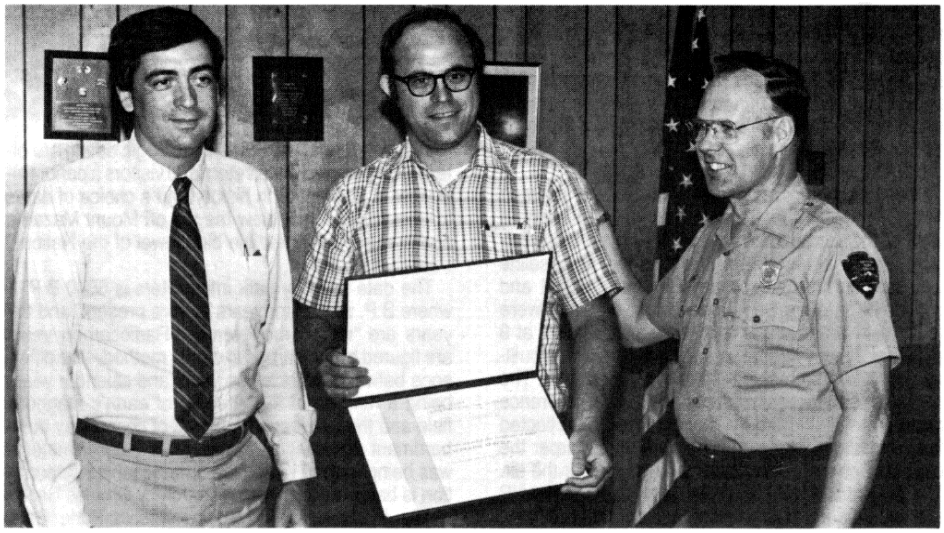
New Technology in the Parks is the title of a report on "better conservation management through use of alternative fuels and vehicle technologies," compiled for the Energy and Technology Transfer Division of the National Park Service in May 1981 by John Hoke, Urban Park Program Specialist with the National Capital Region. Hoke describes ground maintenance equipment, presents guidelines for selection of alternative vehicles, discusses alternate fuels (including the operation of conventional equipment on alcohol and ways to extend the range of electric vehicles), and covers mobile auxiliary power and vehicle maintenance and parts supply.

Hoke has kept operating records that show favorable comparison with conventional methods. Beyond the cost efficiency in relation to standard operation procedures, a whole new package of unexpected benefits seems to have emerged – lower basic equipment costs, lower maintenance costs, simpler operation, a marked reduction in energy usage, less damaging impact on the environment, quieter operation of maintenance vehicles, and enhanced human-scale interaction between visitors and NPS patrols. Hoke was assisted by the NCR Maintenance Division. Copies of the illustrated 18-page report are available free from the E&TT Division, National Park Service, Department of the Interior, Washington, D.C. 20240.

WESTERN REGION

"Effects of Injuries on Spiny Lobster, *Panulirus Argus*, and Implications for Fishery Management," by Gary E. Davis, NPS research scientist now at Channel Islands NP, appeared in **Fishery Bulletin:** Vol. 78, No. 4, 1981, apparently adding new information to the published literature with regard to the precise effect of injuries in the wild and definition of their origin.

A new Redwood NP technical report, "Sediment Sources and Sediment Transport in the Redwood Creek Basin: Progress Report," identifies sources and causes of erosion and sedimentation in the highly erosive Redwood Creek watershed of northern California. Published in May 1981, the paper is the third in Redwood's technical report series. Earlier reports included evaluations of 1978 watershed and of the 1979 Airstrip Creek watershed rehabilitation sites. Upcoming reports will deal with static pile composting, vegetation succession after logging, and revegetation techniques.



Gary Larson, *center, poses with his award, presented by SERO Chief Scientist Jay Gogue, left, and GRSM Superintendent Dave Beal, right.*

Larson Cited for Superior Service

The Department of the Interior Superior Service Award was conferred June 26 on Gary L. Larson, fishery biologist at Great Smoky Mountains NP. Larson, who joined NPS in 1977, for the past three years has served as research coordinator of the Uplands Field Research Laboratory in the Great Smokies. His work has resulted in "an outstanding multidisciplinary natural science program at the park." He was instrumental in implementing a network of remote, automatic atmospheric pollution and water quality monitoring stations in the park (see story on page ??), the first of its kind in the National Park System.

Larson has accepted the position of Regional Chief Scientist, Midwest Region, and is now at his new duty station in Omaha, NE.

SOUTHEAST REGION

The Third Annual Southeast Region Research Prospectus for Fiscal Year 1981 is now available from the Natural Science and Research Division of the Southeast Regional Office, 75 Spring St., S.W., Atlanta, GA 30303. The 132-page document contains reports of ongoing scientific studies in the region and carries in an envelope attached to the inside back cover a brochure providing general information about the region's science program.

PACIFIC NORTHWEST REGION

An old adage, "Nothing is more useless than the answer to an unasked question," provides the philosophic backdrop for OSU/CPSU Report 81-2: *Social Impacts of Design Alternatives – Crater Lake National Park,* by Bo Shelby and Donald W. Wolf of the OSU School of Forestry. Visitor behavior and management alternatives based on that behavior are presented in text, figures, tables and graphs, with important clues for providing information that fits visitor needs and motivations. The report leaves to management the decision as to what is preferred behavior, and then discusses the various results that can be expected if certain facilities are or are not provided and, if they are provided, the manner in which their provision is accomplished. The study makes no value judgments about one behavior as opposed to another, but does present findings as to what management can reasonably expect in the way of behavioral response to differing management actions.

A 53-page report (OSU/CPSU Report 81-1) by Kurt Jenkins, *Status of Elk Populations and Lowland Habitats in Western Olympic National Park,* published in May 1981, found cow elk productivity to be lower than during an earlier study (1936 and 1938) but found winter survival and calf recruitment was greater in the more recent study – leading to the conclusion that current elk populations are better adjusted to the forage base now than they were in the Thirties. The 1980 study showed higher productivity among cow elk that summered in valley lowlands. Additional comparisons inside and outside the park would be useful, Jenkins states, to determine influences of hunting and forestry practices on productivity of elk in managed lowland ranges outside the park.

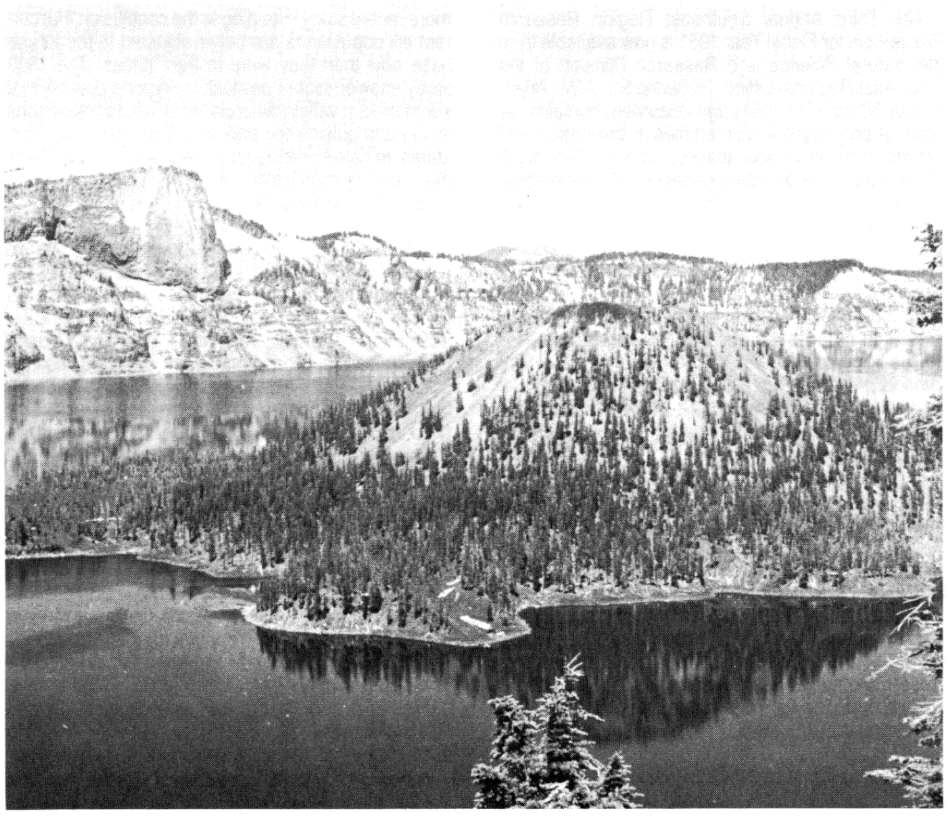
Fire Research Needs in National Park System Areas of Oregon and Washington, by James K. Agee, (CPSU/UW 81-14), published in May 1981, deals specifically with Crater Lake, Mount Rainier, North Cascades, and Olympic National Parks and Oregon Caves National Monument. It is presented "as one scientist's view of where the information gaps lie" in fire research in the Pacific Northwest and was compiled as one input toward the formulation of future fire research priorities. NPS personnel preparing or updating Fire Management Plans and Resource Management Plans in the Northwest have been alerted to this report and encouraged to contact Agee if they have questions.

Results gleaned from NPS patrol boat data describing downstream congestion on the Colorado River in the Grand Canyon are documented in *Monitoring Social Impacts of River Management in Grand Canyon: 1980 Patrol Trips,* OSU/CPSU Report 81-3, published in June 1981. Authors are Bo Shelby and Richard Harris of the OSU School of Forestry. The authors point out that a "final" version of the river management plan was approved in December 1979, but that the Hatch Amendment to the Park Service appropriation bill in November 1980 has prompted revision of some policies. With these policies now going into

effect, the on-going process of monitoring is important as insurance that management objectives are being accomplished. The study can be used as a comparison to data gathered during a 1975 study and also to establish a baseline for comparing patrol trip data gathered in the future.

Telephotometer readings from The Watchman (which overlooks Crater Lake and offers a 180-degree view of the surrounding countryside) have been collected this year for four "targets" to serve as baseline visibilty data for future years. Beginning July 1 and continuing through September, eight readings were taken daily (each of the four targets was "read" at 9 a.m. and 3 p.m.) through powerful lenses with a built-on computer that measures the intensity of light. The computer automatically figures the ratio of difference between the light from the sky and the light reflected from the target. The wider the ratio (the sharper the contrast between sky and target), the clearer the air. The project is a joint effort between Crater Lake NP and the Oregon Department of Environmental Quality. Evaluation of the raw data is being done by EPA's Environmental Monitoring Systems Lab in Las Vegas. *Park Science* will report the lab's findings in a later issue.

Managers in need of information about the Mountain Pine Beetle (MPB), *Dendroctonus ponderosae,* will find useful a recent publication, *Management of Mountain Pine Beetle Infestations at Coulee Dam NRA,* by R. Gerald Wright of the University of Idaho CPSU and graduate student Richard Nathanson. The publication is CPSU/UI B 81-5. The information includes life history of the beetle and its use of host species, plus an examination of different commonly used control measures and their environmental implications.



Llao rock looms over Wizard Island at Crater Lake.

Crater Lake Explosion

Greenland Ice Yields Data

Two different approaches to geologic dating are offering Crater Lake interpreters and visitors a panoramic view of ancient earth history and a choice of dates for the eruption that blew the top off Mount Mazama and created the incredible blue jewel of the National Park System.

The date used by park interpreters is 6840 B.P. – where B.P. stands for years "before present" and the years are "radiocarbon years." (Radiocarbon years are figured by the carbon l4 dating method – the difference between radiocarbon years and calendar years being a function of the strength of earth's magnetic field and the consequent amount of cosmic ray bombardment occurring at the time the subject material was being formed.) The data on which this interpretation is based comes from research by Charles Bacon of the U.S. Geological Survey, Menlo Park, Calif. Bacon first suspected and then produced conclusive stratigraphic proof that there were *two* eruptions within the overall climactic action that produced the lake. His carbon-14 dating is based on four different charcoal samples taken from the ends of the original pyroclastic flows, tens of kilometers away from the blast site, and from one charcoal sample found underneath the original pumice fall (a scattering of extrusive material less dense than is found in pyroclastic flows). From these five carbon samples, Bacon deduced a mean age of 6840 radiocarbon years, plus or minus 50 years, before the present day as the time of the eruption.

The so-called "main event" – the unroofing of the mountain, its collapse and the formation of the lake – is now known, through Bacon's studies, to have been preceded by perhaps l75 years by an eruption that produced Llao Rock – the rhyodacite (thick lava) flow which is so prominent a feature of the lake's northwest rim.

Duane Champion, also of the USGS Menlo Park complex, was called in the past two years by Bacon to bring his "paleomagnetic secular variation" analysis to bear on Bacon's radiocarbon-based results. It was the way the magnetite in the instantly formed rocks of the two explosions lined up with the magnetic poles of the earth at the time of the two blasts that confirmed the time separation.

Champion's work is based on the fact that the earth's magnetic pole changes position gradually over time, both in inclination and in declination. *Declination* is the angle between "true north" and magnetic north (which is not always at the spin axis of earth.) *Inclination* of the magnetic field varies from generally horizontal near the equator to vertical at the magnetic pole. At the latitude of Crater Lake, the magnetic inclination down from the horizontal is typically about 60 degrees, varying from shallower to steeper than 60 degrees in the same way the declination angle changes. As Bacon had predicted, the two-eruption theory was corroborated by the different recordings of magnetization found by Champion.

Then, on August 9 of this year, the *New York Times* front-paged a story about an international team of scientists working on a platform in southern Greenland, from which they have drilled almost to the bottom of the Greenland ice sheet. In a chart accompanying this item, the Mount Mazama explosion is given as having occurred 6381 years B.P., a seeming discrepancy of nearly 500 years from the radiocarbon date. As of August 9, the team had penetrated 6,687 feet and expected shortly to reach bottom, "where the ice may date back 100,000 years to a warm period before the last Ice Age."

The drilling is a joint American-Danish-Swiss project and the dating method uses the relative abundances of two forms of oxygen for counting ice layers like annual growth rings. In colder weather, the heavier of the two oxygen isotopes – oxygen 18 – is less likely to precipitate. Therefore,winter snow is made up predominately of oxygen l6, the lighter isotope. This summer-winter cycle of oxygen layers makes possible the pinpointing of volcanic eruptions for the past nine centuries with an error margin of only one year. The layers grow progressively harder to count, until at about 8000 B.C. "it becomes difficult . . . but ages can be roughly estimated."

Champion warns about the "fudge factor" that must be taken into radiocarbon dating considerations, but points out that this factor works to *increase* the radiocarbon age of Crater Lake – setting it back possibly as far as 7,650 to 7,770 absolute years before the present, and thus separating it even further from the time indicated by the Greenland drill team.

"I can't quarrel with their methodology," Champion said. "After all, they're counting real layers of absolute years. I can only surmise that the ash they found may have come from some other explosion – not Mount Mazama."

From WASO

The Natural Science Division, WASO, has a large supply of *Preserving Our Natural Heritage, Volume I: Federal Activities.* Individuals wishing free copies should write to Gary Johnston, Natural Science Division (494), National Park Service, DI, Washington, D.C. 20240.

Mule Deer Study Provides Needed Baseline Data

By Brad Griffith

Historically, Craters of the Moon National Monument area was inhabited by grizzly bears, bighorn sheep, and mule deer. After the turn of the century, domestic grazing and subsistence hunting by local miners created pressures that severely depressed the populations of these three large native mammals. Establishment of the monument in 1924 eliminated these pressures but the grizzly bear and bighorn sheep never recovered and now are extinct within the monument.

The mule deer were a different story. They not only survived, but increased in numbers. In 1967 the total population was estimated to be about 350 animals and the population now totals 500 to 600 animals.

By the late 1970s, deer were being killed regularly while crossing the highway, were feeding extensively on residence lawns, and were using forested areas heavily for bedding. Park managers became concerned that protection from hunting and lack of competition from other ungulates would allow a population increase that could result in range deterioration. Accordingly, they requested some kind of long term deer population and habitat monitoring systems that could be carried out through routine park operations. They also asked for estimates of population levels and productivity and for an evaluation of deer usage of the wilderness areas so that impacts on deer habitat of a proposed fire management plan could be evaluated.

Field research designed to satisfy management requests began in May 1980, and has continued through November 1981. Morning and evening deer census routes and monitoring procedures were implemented and four clusters of line-intercept transects were established to monitor long term trends in deer habitat. Seasonal classification counts were used to estimate productivity; wilderness area utilization was determined from relocations of 18 radio-collared and 55 ear-tagged deer. From the proportion of marked deer observed on regular censuses, the population level was estimated. Sources and magnitudes of mortality also were investigated to identify factors limiting the herd size.

Study results indicate that the Craters deer herd is extremely productive and experiences little fawn mortality related to nutrition. In addition, it was found that the deer use two distinct summer home ranges within the monument and suffer a greater degree of hunting mortality than might be expected. Together, these factors identify a herd with fascinating, complex characteristics.

Because of excessive snow depths, mule deer are residents of the monument only in summer. The study has shown the Craters herd to be composed of deer from at least two separate winter ranges on BLM and private lands. Approximately half of the current population (500-600) winters 40 miles to the south and the other half winters 20 miles to the northwest.

Deer begin arriving on the monument summer range in early April; by late April they are distributed throughout the monument's 35 square miles of deer habitat. Approximately 70 percent of the range is within the wilderness portion of the monument, where little, if any, free water is available. Permanent water sources are limited to melting ice in lava tubes – water not accessible to the deer. Currently, it is assumed that in spring and early summer deer using the wilderness obtain their moisture from temporary water sources (such as rain puddles) and from consumed vegetation.

As the summer progresses, vegetation becomes too dry to satisfy deer moisture requirements. When this occurs (in late July, as indicated by depressed fuel moisture readings from fire weather stations), wilderness deer migrate 5 to 10 miles north to ranges in the north portion of the monument. Free water from two creeks is available there. The deer occupy the new dry season home ranges during August and September. When fall rains green up the wilderness vegetation, the deer migrate back to the same wilderness home ranges they occupied in the spring and early summer, remaining there until December when they migrate to winter ranges.

The mid-summer northward migration causes a temporary four-fold increase in deer density for the northern non-wilderness portion of the monument. From April through July, when uniformly distributed throughout the monument, deer densities average 15 per square mile – a normal density for intermountain mule deer on good summer range. In August and September, however, densities in the northern portion of the monument approach 60 per square mile, accounting for the large numbers of deer observed by park personnel. Censuses conducted in 1981 commonly revealed 40 deer per mile of census route.

An average summer density of 60 per square mile, as observed in northern portions of the monument, is unusual. Were the densities not transitory, range deterioration certainly would occur. To date, forage communities in the northern part of the monument deer habitat do not show signs of excessive use.

Forage communities in the wilderness portion of the monument, where 70 percent of the fawning occurs, show even less utilization than in the northern part. Bitterbrush is widespread, abundant, and in excellent condition. Native bunch grasses are plentiful, the forb community is diverse, and limber pine stands provide excellent fawning cover. The forage communities provide excellent nutrition for does during the critical last one-third of pregnancy.

As a result of the high quality nutrition available, initial productivity in June is high. Nearly all does have twins, and triplets are not uncommon. On the average the herd produces at least 200 fawns per 100 adult does. This level approaches the maximum biological potential for free ranging mule deer.

Craters herd fawns have a high survival rate during the first six months of life. By August, less than 20 percent have died and 165 fawns per 100 adult does remain. Fawns experience little additional mortality from September through November.

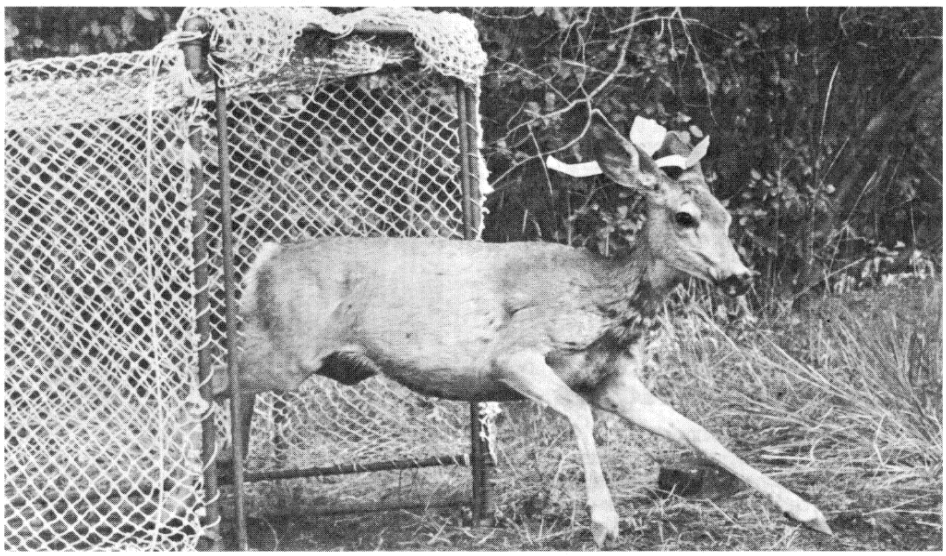
Over-winter fawn survival also is high. By September fawns typically have fat deposits on all key indicator areas of the body and arrive on adequate winter ranges in excellent condition. As a result, mortality on winter ranges in 1979 and 1980 was not substantial. In the spring of 1980 the Craters herd was characterized by 75 yearlings per 100 adult does and in 1981 the spring ratio was 125 yearlings per 100 adult does. Few, if any, mule deer herds have spring age ratios this good.

With such high productivity and survival figures the Craters herd would be expected to grow rapidly and noticeably impact its summer range. Since this has not occurred, limiting factors must be acting to slow the growth rate of the population. Some factors that may limit the growth rate are predation, disease, periodic severe winters, dispersal, and hunting mortality. Evaluation of the importance of severe winters and dispersal will require several years. Disease of significant magnitude to limit the population level has not been observed thus far, and predator densities in the monument are low compared to surrounding areas. Preliminary evidence suggests that hunting mortality may be an important limiting factor. Areas adjacent to the northern boundaries of the monument are accessible and receive heavy hunting pressure. Deer move freely across the boundary and, as a result, the Craters herd does not receive complete protection from hunting. In the fall of 1980, 10 to 20 percent of the known herd of 500 to 600 animals was killed by hunters. Adult females were harvested at a higher rate (15 to 30 percent were killed) than the population at large. Since adult females are the key to recruit numbers and growth rate, hunter removal of them may serve to suppress the population growth rate.

Based on the findings of high productivity, low natural mortality, and unusual home range utilization, research on the Craters herd will continue. The long term research goal will be to identify and evaluate factors limiting the population. Future emphasis will include refinement of hunting mortality estimates, food habits, the role of dispersal and weather patterns in population regulation, and the influence of winter range conditions on herd dynamics. The deer population and habitat monitoring systems devised will facilitate long term documentation of the interaction between the deer population and the forage community.

As demands for consumptive use of public lands increase, the value of national parks and monuments as baseline natural areas becomes more evident.

The long term studies at Craters of the Moon will



Off and away! *Adult doe marked with an individual color combination of ear tags and streamers leaves a trap. Salt is an effective bait during hot dry weather.*

help identify the population characteristics that can be expected of an intermountain mule deer herd not limited by food. A complex relationship between the Craters deer and their unique volcanic habitat has been documented by current studies. As further understanding of the Craters herd develops, more precise park management direction can be defined.

Griffith is a PNR roving research biologist, assigned to parks in the Region as the need arises. Photos are by David R. Clark.

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DEER STUDY PUBLISHED

For definitive treatment of deer that frequent many Western National Parks, see *Mule and Black-tailed Deer of North America*, a Wildlife Management Institute publication edited by Olof C. Wallmo and published by the University of Nebraska Press, 901 N. 17th St., Lincoln, NE 68588. The amply illustrated volume is $29.95 and 605 pages.

Data Banks On Old-growth Forest Jointly Funded

Two programs based outside the NPS but offering a variety of cooperative hooks for research and applications are the Old-Growth Wildlife Habitat Research and Development Program and the Natural Heritage Program. The former was launched by the Pacific Northwest Forest & Range Experiment Station, the latter by the State of Washington.

The Forest Service program recognizes that old-growth forest stands are becoming more rare as they are harvested and addresses the "increasingly key issue" that is posed by the continued cutting of these "silviculturally decadent stands" – especially in view of the National Forest Management Act's mandate that production must meet "diversity" and multiple-use requirements.

The Washington State program (which became law in July 1981) establishes a data bank of information about Washington's unique natural features and is supported by environmental, governmental and industry groups. The information assembly was started in 1977 by The Nature Conservancy at the Evergreen State College under a contract with the Washington Department of Natural Resources and other state agencies. The 1981 legislature picked it up and provided money to match federal funds to continue development of the data bank.

Al O'Donnell, supervisor of DNR's Natural Area Preserves program, pointed out that the data base will allow public and private resource agencies to learn the locations of rare habitat or unique geological features *in advance* of preparing management plans . . . thus saving time and costly legal delays. He estimates that local, state, and federal agencies in Washington, which prepare more than 300 environmental impact statements each year, could save an estimated $620,000 a year by utilizing information from the Heritage Program data bank.

Research Notes

Application of the ecological theory of habitat islands and edges (biogeographic principles) to the preservation of regional biotic diversity and the scheduling of timber cutting in the Douglas-fir region is the subject of a one-year study by Larry Harris of the University of Florida, working out of the Forestry Sciences Lab at Oregon State University, Corvallis. BLM is contributing part of the cost through an interagency agreement.

Society Named For First NPS Scientist

***George M. Wright** – 1904 - 1936*

George Wright, was in effect the first "chief scientist" of the National Park Service, and he felt so strongly about the need for acquiring knowledge in order to manage intelligently the System's resources that he personally funded the NPS Wildlife Division's first year of operation. In his name, and with the energetic participation of a number of NPS scientists and historians, both currently employed and alumni, the Society got off the ground in the spring with a charter meeting at the Grosvenor Center in Maryland, hosted by Gordon Fredine and Dan Beard of the Renewable Natural Resources Foundation. Vernon C. (Tommy) Gilbert was elected president. Wright's daughter, Pamela Wright Lloyd, was made a member of the board of directors.

This new society (the George Wright Society) is dedicated to the protection, preservation and management of cultural and natural parks and reserves through research and education. Membership of $25 includes subscription to the *George Wright Forum*, published by Robert M. Linn, former NPS Chief Scientist and secretary of the Society, P.O. Box 65, Hancock, MI 49930.

Wright, whose early single-handed efforts to bring science into the park management picture were strongly supported by then Director Horace Albright, was killed in an automobile accident, together with Yellowstone Supt. Roger Toll, as they headed home from a research assignment part of a U.S.-Mexican Border Commission. Conrad Wirth, then Assistant Director of the Park Service, also was a member of that Commission.

Together with Ben Thompson and Joseph Dixon, Wright authored the precedent-setting report, *Fauna of the National Parks of the United States*, the first of a series that continues today under the title "scientific monographs." In that report, the authors stated: "The realization is coming that perhaps our greatest natural heritage, rather than just scenic features is nature itself, with all its complexity and its abundance of life." They suggested that Americans might soon find that "awesome scenery" can be sterile indeed without "the intimate details of living things, the plants, the animals that live on them, and the animals that live on those animals."

It is the present intent of the Society to pick up sponsorship of the "science in the parks" conferences heretofore sponsored biennially by the National Park Service, expanding their focus to include natural and cultural parks and reserves from the local to the international level. Gilbert stressed synthesis as a primary goal of the Society – to bring together all relevant disciplines from all the interlocking levels of impact and management, the better to coordinate information exchange, research efforts, and educational dissemination of results.

***This 1936 photo** was taken during the Mexican border trip of the Commission to formulate plans and policies for forest reserves and wildlife refuges. George Wright is at far left, next to a Dr. Bell of the Biological Survey (later the Fish and Wildlife Service). Connie Wirth is in the center, next to Roger Toll, third from right. Does anyone know the names of the other three men in the picture?*

Bass Collection Bares Historic Concession Roots

Editor's Note: Royal Jackson, Associate Professor in the Department of Resource Recreation Management at Oregon State University, has received University funds for research-related travel and a grant from the OSU Research Council for preliminary cataloguing, conservation and preparation of a guide to the Bass Collection. The NPS-CPSU at OSU has agreed to publish the product, for the light it can shed on historic tourism at one of the nation's most famous scenic treasures. Photographs are courtesy of Heritage Associates, Inc.

By Royal G. Jackson

An important historical collection brought to light recently by Heritage Associates, Inc., a private cultural resource consulting firm, concerns the Bass family, which played a central role in the history of the Grand Canyon National Park and the development of tourism in Arizona at the turn of the century. The Bass Collection is an assemblage of documents, letters, manuscripts, photographs, diaries, books and memorabilia belonging to the late William G. Bass of Wickenburg, Arizona.

William W. Bass came to Arizona from New York in 1883 and in 1884 became one of the first settlers on the South Rim of the Grand Canyon. His original purpose in coming to the Canyon was mining and prospecting but he soon realized the tourist potential, built a stage road from Williams, Arizona, to his camp on the rim 75 miles distant, and began to take tourists there in 1885. He continued to do this for the next 38 years. In 1926, at the age of 77, he sold his holdings to the Santa Fe Railway.

During his years at the Canyon, Bass built 140 miles of roads to connect his enterprises with transportation networks, more than 40 miles of trails within the Canyon, and numerous dams, cisterns, and even a 10-acre garden and orchard on the north side of the Colorado River. He established a boat ferry across the river and built the first cable crossing over the Colorado. He had several working mines in the Canyon and filed claims on many others. His wife, Ada, was the first white woman to raise a family on the south rim. He also constructed numerous facilities at what became known as Bass Camp, and at other locations.

The first schoolhouse at the Grand Canyon was built by Bass. A self-taught poet, miner, geologist, photographer and businessman, he had friends and guests who included politicians, poets, writers, and photographers well-known in their day. Bass played an active role in the various legislative proposals affecting the Grand Canyon, from the initial establishment of Grand Canyon Forest Reserve in 1892 until the creation of Grand Canyon National Park in 1919.

Bass was a good friend of the Havasu Indians and often visited them, alone or with tourist parties. He gave them seeds and was instrumental in having a school and post office established there. He employed some of them from time to time and interceded on their behalf in Washington. His longstanding friendships with Sen. Henry F. Ashurst and Cong. Carl Hayden, both of Arizona, were helpful at such times.

Bass' wide ranging interests, intellectual curiosity and desire to learn were qualities unique among the early tourist operators at the Grand Canyon. His guests appreciated it and returned time and again, establishing lifelong friendships with him. George Wharton James, the prolific author of travel books and F.H. Maude, the noted landscape photographer were two who spent a great deal of time at Bass Camp.

With some justification Bass has been called a "visionary" by some of his contemporaries. He not only foresaw some of the later developments at the Canyon but took steps to adjust to them. He built stage roads to accommodate the tourists that were sure to come with completion of the Atlantic-Pacific Railroad (the forerunner of the Atchison, Topeka & Santa Fe). He saw the need for a spur line to the Grand Canyon and actively lobbied for its construction, chairing the first organizational meeting of the Grand Canyon Railroad at the town of Williams in 1894.

He was quick to recognize the importance of the automobile and the changes it would create in travel patterns; he welcomed the opportunity it presented to break the railroad's monopoly on Grand Canyon travel. Although he never learned to drive, he bought the first car for his business in 1914 and added others later on.

Finally, as his Canyon years drew to a close, he dreamed of incorporating an airplane in his tourist business. He should not be faulted if he did not foresee the problems that signs, automobiles, airplanes and an ever increasing number of visitors would create half a century later.

When Fred Harvey was given the contract as the principal concessioner at Grand Canyon National Park, in 1920, the days of the Bass tourist business were numbered. The 71-year-old Bass had neither the energy nor the resources to compete with Fred Harvey and the Santa Fe Railroad. In 1923 Bass entertained his last guest and the family moved to Wickenburg. Three years later, in 1926, Bass sold his holdings to the Santa Fe Land and Improvement Company. He died at Wickenburg in 1933, aged 84. In accordance with his last request, his ashes were deposited by airplane on Bass Tomb, a prominent peak in the Canyon which commands a view of the section he explored.

Although the name of William Wallace Bass is not unknown to people familiar with the history of Grand Canyon and northern Arizona, the wide range of his accomplishments has gone curiously unrecognized. This is understandable since the western section of Grand Canyon National Park, so closely associated with the name of Bass, is not easily accessible and until recently the Bass Collection has been a rather closely guarded family treasure.

Preliminary cataloging of this collection resulted in the following: Seventy-three books; 503 photographs identified and annotated by William G. Bass; 129 glass plate photographic negatives; over 500 nitrate negatives; some 400 hand tinted glass transparencies and the projector for showing them; 200 stereographs; diaries of both William W. Bass and his wife Ada; hand and typewritten manuscripts of poetry and prose by William W. Bass; letters to and from Senator Ashurst and Congressman Hayden; correspondence with Fred Harvey and the Atchison, Topeka & Santa Fe Railroad; permits and mine location notices and other, miscellaneous documents; 19 hours of oral history with William G. Bass and Ed Kahle, a former employee of William W. Bass; and various items of memorabilia.

Stephen G. Maurer, President of Heritage Associates, Inc., is serving in an advisory capacity to the Bass family concerning financial support for curatorial needs and for locating a suitable repository for the Collection. A broad program of research by various H.A., Inc. affiliates include an oral history of the Bass family and others who worked at the Grand Canyon during these early years, analysis of diaries and personal correspondence, location and documentation of Bass-related sites in the Canyon, and investigations based on historical photographic materials. A recently completed work based on the Collection is Lisa Madsen's thesis, *The Grand Canyon Tourist Business of the W. Bass Family* (University of New Mexico, 1980).

The Bass Collection – a unique, irreplaceable resource, encountered in a dusty, and forgotten attic in the Wickenburg home of Bill Bass – provides a priceless opportunity to open up an hitherto neglected area in the history of Grand Canyon National Park and northern Arizona. In a larger context, it offers valuable insights into some aspects of life in turn-of-the-century America. No other collection related to Grand Canyon history, can match the variety and significance of the materials found in these papers.

Bass Camp, *on the Grand Canyon's south rim, is the setting for this turn of the century photo. William W. Bass is second from right.*

THE MAB PROGRAM: What It Means To The World And To NPS

By William P. Gregg, Jr.

In essence, MAB is a way of approaching problems that recognizes the intimate interrelationship that exists among natural ecosystems, human behavior and value systems, and the advancement of human civilization. It takes full cognizance of a world increasingly dominated by our human species, which alone possesses the intelligence to sustain the world indefinitely or to alter, perhaps forever, its resource-providing ability. MAB operates on the premise that an understanding of these relationships must underlie any attempt at problem management.

Most institutions, governmental and non-governmental, have been established to pursue sectorial objectives and their survival depends on how well these usually short-term objectives are achieved. Given this framework, institutions tend to cooperate with one another only to the extent they can do so without appearing to compromise their objectives. The long-term public interest often takes a back seat to the short-term interests of individual institutions, especially if these are able to control allocation of material and fiscal resources. Yet national governments and intergovernmental organizations like the United Nations are duty-bound to further the broad public interest in ways that satisfy immediate material and social needs without compromising the future. Few would disagree that the track record in this direction has been less than exemplary. Despite enormous material productivity, the quality of human life in much of the world attests the failure of traditional institutions to deal with population growth, environmental pollution, mismanagement of natural ecosystems, and inequitable distribution of resources.

To deal with such growing disasters in numbers and on a scale unprecedented in the history of the human race will require balanced problem-solving approaches, the necessary first step to which is more and better information. Without such information, problem-solving becomes guesswork, bias enters the picture, and mistakes are too frequently assured. In addition, information must be available at the right time and in intelligible form if it is to be used effectively.

MAB RATIONALE

MAB was established 10 years ago by the United Nations Educational, Social and Cultural Organization (UNESCO) to improve the use of the natural and social sciences in helping governments deal with growing environmental and resource management problems. It developed in a climate of heightened public awareness that these problems, left unchecked, would threaten the well-being of human civilization, if not its very survival. This same climate heralded a new U.S. era of governmental concern and the creation of new laws and institutions to protect the environment and prevent hazards to the health and well-being of people. It also resulted in a new awareness of the need to balance environmental, social, and economic considerations in reaching decisions.

The National Environmental Policy Act (NEPA) of 1969 set the tone. It required Government to "utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and decision making which may have an impact on man's environment." The essence of MAB is to help provide the government-connected scientific support necessary to implement this policy, at all levels including the global scale. It is the science/government tie that offers the next toehold by which rational, science-based intelligence may further penetrate the public decision-making process.

ROOTS IN THE IBP

Many of the people involved in MAB's early planning also were involved in the International Biological Program (IBP), the first international effort to apply the principles of the rapidly evolving science of ecology toward improving our understanding of how the world's major ecosystems are structured, how they utilize energy, and how they metabolize the chemical constituents of the environment.

Although IBP is now history, its "big biology" approach firmly established the ecosystem as a basic unit of study in ecology, supplementing the traditional emphasis on populations and communities. In so doing, it gave us a new conceptual framework for assessing natural and human-caused changes and new tools for land management, many of them involving use of the computer.

In some respects, MAB is the successor to IBP. However, it differs importantly in its strong problem-solving orientation (vs. IBP's emphasis on basic studies); its focus on the interplay between natural resources, human activities, and human value systems (vs. IBP's predominant emphasis on natural systems); and the involvement of both the scientific community and the **users** of scientific information – particularly government administrators at all levels of organization (vs. IBP's management by scientists.)

Thus, although MAB has roots in IBP and deals with many of the issues that mission-oriented institutions do, **it is one of the few scientific organizations in the world that operates as a voluntary cooperative effort between government agencies and the scientific community.** It exists for the primary purpose of enabling effective communication between scientists of different disciplines and between scientists and decisionmakers.

UNIQUE ORGANIZATION

MAB's global program is given general direction by an International Coordinating Council (ICC), which meets annually to review accomplishments, recommend priorities, and coordinate activities. It contains representatives from UN organizations (such as FAO and UNEP), nongovernmental organizations (such as the IUCN), and some of the national MAB committees from participating countries. These committees, now operating in 101 nations, consist of scientists, government officials, and conservation organization representatives. They operate autonomously within the broad ICC framework, and often cooperate on regional and global scientific and education projects of common interest.

The ICC has established 14 MAB project areas: 1 through 7 deal with the structure, function, and resource management problems of the world's major natural ecosystems; 9 through 14 deal with human influence on these ecosystems. Project 8 – perhaps most active and visible at present – deals with the conservation of genetic and ecological resources and establishment of a global system of Biosphere Reserves for long-term monitoring and problem-oriented research.

In the U.S., directorates have been established for 12 of the 14 MAB projects. Similar situations exist in the Soviet Union, the Federal Republic of Germany, and other countries. Day-to-day administration is performed by MAB secretariats. A small secretariat within the U.S. National Commission for UNESCO at the State Department provides financial and administrative support to the MAB directorates for help in research, publications, workshops, etc.

In the U.S., as in most countries, Federal agencies are the lifeblood of MAB. Its ability to support better management depends upon the willingness of these agencies to participate in planning and developing projects and to contribute toward their financing. Support for MAB has grown steadily. The 35-member U.S. National Committee now contains representatives from 10 Federal agencies; additional membership on MAB directorates brings Federal agency participation to 19. Nearly all U.S. agencies responsible for natural resource management and environmental protection are taking part in the development of MAB, but participation in the funding is less universal.

FINANCIAL SUPPORT

Federal agencies can support MAB in three ways: First, through internal means such as direct funding of MAB publications, workshops, etc., or by allocating personnel to be used by MAB in furthering an agency's mission; second, through financial or personnel assistance to the U.S.-MAB Secretariat or to the international Secretariat in Paris; third, by supporting the MAB Consortium, which awards research grants for projects that further the missions of participating agencies and MAB project directorates.

The Department of State, the Forest Service and NPS have been the principal agencies staffing and funding the U.S. MAB Program. The Department of State provides office space and funding for the MAB Secretariat and funds for MAB workshops, publications and research through the directorates. The Forest Service provides funding, details a full-time position to the Secretariat, and presently is the major contributor to the Consortium. The NPS has long supported all of MAB's institutions. Between 1973 and 1978, it detailed a position to the MAB Secretariat in Paris to help develop the Biosphere Reserves project. In 1979, it established a MAB Coordinator position in the Washington office to promote use of MAB within the Service and other bureaus, to plan and coordinate MAB's Biosphere Reserves project, and to work with field offices in developing strategic science programs for the NPS-administered Biosphere Reserves. Since 1975, the Service has directly supported domestic and international workshops related to development and scientific use of the MAB Biosphere Reserve network, and to various joint NPS-MAB publications. In FY 1981, the NPS supported both Secretariat-administered projects and the Consortium. Funds from MAB's three principal supporters, plus some additional funds, gave U.S.-MAB a total operating budget of about $930,000, enough to conduct significant work but hardly sufficient to make MAB a major influence in today's major resource management decisions.

NEW OPPORTUNITIES

In 1979, the Forest Service entered a partnership with MAB by establishing a consortium linking the agency with several MAB project directorates. The purpose is to award relatively long-term grants for the kinds of research not easily carried out by the agency itself. Particular emphasis is placed on multidisciplinary, problem-oriented research dealing with the interplay between human activities and natural ecosystems and often involving collaboration between investigators in two or more countries. (The Consortium, in these cases, pays for the U.S. side of the project.)

The intent is to focus scientific attention on problems of interest to the Forest Service and thereby to develop new approaches to complex forest management problems of regional, national, and international importance. The Consortium thus provides a new avenue for research funding, and for the Forest Service an opportunity to improve the coverage and impact of its research program. By pro-

viding peer review of submitted proposals, MAB helps assure high quality research and maximum problem-solving effect.

In March 1979 Office of Management and Budget (OMB) and the Office of Science and Technology Policy issued a joint memorandum supporting the MAB concept and assigned responsibility for international coordination to the Department of State and for domestic coordination to the Departments of Agriculture and the Interior. The memo directed various Federal agencies to work together on a plan for developing and using MAB's capability. To implement the memorandum at Interior, the Secretary assigned lead responsibility to the Asst. Sec. for Fish & Wildlife & Parks and he encouraged and provided oversight for MAB development.

In 1980, NPS, Heritage Conservation and Recreation Service (HCRS) and the U.S. Fish and Wildlife Service (USFWS) strengthened their support of MAB by signing the Consortium Charter, which contains a provision that signatories will provide funding to the extent of their ability. The three bureaus together matched the contribution of the Forest Service in FY 1980 and planned to do so again in FY 1981, although USFWS withdrew support at the eleventh hour because of budget cutbacks.

In the past two years, 26 projects totalling about $1 million have been funded by the Consortium. The majority of projects interest more than one agency, enhancing the overall cost effectiveness. In FY 1981, 7 of the 10 funded projects were relevant to the NPS mission, and 4 are being carried out wholly or partially in NPS Biosphere Reserves. Since NPS provides only 21 percent of the funding, the Service investment is expected to be highly cost effective.

A good probability is that State's Agency for International Development (AID) will join the Consortium, substantially increasing funding and providing additional support for bilateral projects. Some of these will likely be cooperative projects involving NPS biosphere reserves. At this writing, although individual agency contributions fluctuate, the trend seems to be toward progressively increasing agency support.

THE GRANT PROGRAM

All natural and social scientists, in and out of Government, are eligible to compete for Consortium research funds. However, in FY 1982, Federal employees will be required to develop proposals cooperatively with one or more scientists in private institutions; the Consortium will make no awards to Federal agencies. Grants will be for periods of up to three years in amounts not to exceed $60,000 total. The grants will be for problem-oriented research, for resource inventories and monitoring undertaken as part of such research, as well as for innovative syntheses of scientific information focused on major current resource management policy issues. Preparation of plans, guidelines, handbooks, and similar non-research proposals will not be considered.

FY 1982 guidelines for grant applications are available from the Regional Chief Scientists. The deadline for submission of proposals to the MAB Secretariat is January 29. Awards will be made in June 1982.

THE MAB ARGUMENT

The MAB Program, as typified by the Consortium, is dedicated to effective use of national and international scientific and resource management capabilities to address problems of interest to domestic Federal agencies. It is not a foreign assistance program; it is not in any way controlled by international organizations. It does not require contributing agencies to lose control of their funds.

On the contrary, MAB provides a way for agencies to buy into a cost effective approach to solving problems through cooperation. It provides a means to develop new methods and perspectives with important bearing on future policies and operations. It provides a reasonable counterweight to the overwhelming tendency to focus scientific and management activities on immediate or short-term problems – often when it is either too late to solve the problem or too costly to afford the solution. Through a small investment, MAB can focus the collective wisdom of government, resource managers, and scientists in ways that can bolster our confidence and help us face up to the immense problems immediately ahead.

BIOSPHERE RESERVES

The benefits of science in supporting wise stewardship depend increasingly on how well we are able to understand complex cycles and trends, to compare these cycles and trends in selected locations, and to predict the effects of alternative land management and development policies. Because of the rapid pace of landscape alterations, our options are fast being foreclosed. Decisions on where we intend to collect baseline ecological data to support such scientifically based stewardship must be made quickly.

Biosphere Reserves and other protected research sites will play increasingly important roles as focal points for scientific studies. The 193 Reserves designated to date by UNESCO in 50 countries constitute the only internationally recognized system of conservation areas that have a common mission to carry out long-term research on the interrelationships between human activities and the world's major ecosystems.

The ideal Biosphere Reserve consists of a large conservation area (or core zone) for long-term baseline monitoring and one or more adjoining buffer zones where experimental manipulations may be scientifically studied and compared with the core. In the U.S., this condition has been difficult to achieve, and the U.S. network consequently consists of Reserves managed primarily for one purpose or the other. Most of the nation's major biomes have at least one Reserve of each type, but they are far from adequate to represent the diversity work site requirements within major biomes.

MAB has begun a systematic effort to evaluate potential sites in each biome and complete the U.S. network by 1984 . . . no small task. Most of the 36 existing U.S. Biosphere Reserves are managed by the NPS (15) and the Forest Service (14). Qualifying Federal sites do not exist for many of the still unrepresented ecosystem types, and future expansion will have to focus more on sites under state, local, and private administration. Biosphere Reserves consisting of multiple sites under the same or different administrators are likely to become the rule. A precedent for this type of reserve was set recently by the nomination of the 12-unit Big Thicket National Preserve.

The NPS's Biosphere Reserves are large, natural areas, most of which have long histories of monitoring and research, in-house scientists and resource management specialists, and some scientific support facilities. All are beset by threats – an average of 35 per Reserve, according to the 1980 State of the Parks Report. They represent exceptional sites for long-term baseline studies, for research and development projects in ecosystem modeling, resource inventory, monitoring, research and data management; for professional training and public education relating to major environmental issues, and for cooperative activities with other agencies and bilateral projects with other nations.

In the last few years we have begun the groundwork for these kinds of actions by soliciting the broadest possible involvement from the scientific community and other agencies to develop programs for the Reserves.

PROTOTYPE STUDY

In August 1980, a prototype study was begun in Great Smoky Mountains NP Biosphere Reserve to develop a comprehensive assessment of available data bases, facilities, existing and planning research, and opportunities for interinstitutional cooperation to detect and deal with ecosystem management problems. The Service contracted with Southern Appalachian Research and Resources Management Cooperative, a linkage of Federal agencies and southeastern universities, to prepare a four-phase assessment, completed in October 1981. An annotated bibliography for the park and its immediate vicinity was developed; a preliminary summary of the coverage, methods, and importance of available literature on particular subjects was prepared and the package was sent to leading authorities for review and recommendations.

The overall effort involved more than 90 scientists and provided a comprehensive, updatable reference on scientific activity in the park, as well as a framework for developing a phased, balanced science program. Similar assessments are planned in FY 1982 for Isle Royale, Glacier, Channel Islands, and Organ Pipe Cactus Biosphere Reserves. Initial assessments are being funded by the NPS Washington office, in cooperation with regional and park staffs and will be used with resources management plans to support programming of work from both WASO and field sources.

Progress on other fronts includes elaborate pollutant monitoring in the Great Smoky Mountain and Olympic Biosphere Reserves, and ecosystem modeling as a management tool. Major bilateral projects are underway or planned with Canada, Mexico, and the Soviet Union. Cooperative programs are operating between the Olympic and Cascade Head Biosphere Reserves in pollutant monitoring and between the Great Smoky Mountains and Coweeta Reserves in nutrient cycling and wild boar ecology. Public communication was the subject of a MAB workshop in July 1981, and recommendations to improve the use of the Reserves in providing information will be available soon.

GENETIC DIVERSITY

Two major MAB-sponsored conferences being convened to address the growing problems relating to conservation of genetic resources are discussed in detail elsewhere in this issue.

The workshops bring together for the first time at the national level scientists and managers to develop the basis for dealing with what may be the most significant problem facing the world for the remainder of this century. The all but certain need for more active management of genetic resources and environments to prevent extinctions, to reintroduce extirpated species, and to maintain the vigor of plant and animal species will have profound implications for NPS policies and management techniques, not to mention the impacts on our relationships with the public.

MAB is facilitating cooperation between the NPS and other institutions, both domestically and internationally, by using science to address problems of common interest. By providing access to vast interdisciplinary scientific resources, MAB can substantially augment NPS policy-making and problem-solving capability. Biosphere Reserve status will increasingly draw scientific attention to our finest park units, encourage their evolution into world centers for improving knowledge of natural ecosystems, and assure their sustained conservation for the overall advancement of human civilization.

Gregg is MAB Program Coordinator and this article is background to MAB Notes – a sometime feature of Park Science.

Gene Preservation Occasions Pair Of Conferences

Two related meetings on biological diversity have been scheduled 10 months apart in Washington, D.C., beginning with the U.S. Strategy Conference on biological diversity Nov. 16-18, 1981, co-sponsored by the Department of State and AID, and continuing Aug. 9-13, 1982, with a 5-day International Symposium and Workshop on the application of genetics to the management of wild plants and animal populations.

The Strategy Conference will seek to provide guidance to the U.S. government on how to proceed domestically and through international channels to promote the maintenance of biological diversity.

Vernon C. Gilbert, who is coordinating conference proceedings, described the aimns:

–to review the scope, magnitude and sources of worldwide plant and animal species losses;

–to assess the economic, social, ecological, political and strategic implications to the U.S. and other countries of a continuing decline in species diversity, particularly as it may relate to world food supply, energy demand, and industrial output;

–to identify and evaluate technologies, institutions and scientific knowledge available for conserving biological diversity;

–to review the nature and effectiveness of U.S. government domestic and international policies and programs; and

–to recommend initiatives the U.S. should undertake to stimulate and assist an expanded worldwide effort in this area.

The rapid dwindling of genetic resources, worldwide, could reach ruinous proportions in the short space of a few human generations, Gilbert said. An important means of correcting this situation would be to increase the numbers of national parks, reserves and protected areas and to improve the management of the biological resources in these areas. This will be the subject of the second conference, in 1982.

Christine M. Schonewald-Cox, biologist in the WASO natural science division and Symposium Chairman, says: "The purpose of the second conference is to transfer new knowledge and technology to the field of biological resources management in order to improve the long term success and fiscal efficiency of biological resources management programs. An additional aim is to short-cut the decades it normally takes for such information to filter from academic circles to the remote field locations where biological resources management actually takes place.

"The importance of genetic data in promoting the health and adaptability of populations has been virtually unrecognized except in crop and livestock production, where management goals are less complex and more limited in scope," Schonewald-Cox points out. Recent developments, she maintains, have made it easier to genetically characterize populations so that managers can consider genetic factors along with other data in making management decisions.

The symposium and workshop will provide perspective on the potential for managing the genetics of biological resources. It will address specifically the problems associated with the management of wild animal and plant populations, primarily in the temperate zone. The increasing isolation of the protected areas where these populations still exist will be considered as such isolation interferes with historical patterns of movements and migrations between populations.

Other topics to be discussed include species declines, extinctions, the founding of new populations, the merging of separated populations, and the maintenance of natural diversity among populations and taxonomic units.

"We expect the symposium to identify gaps in our knowledge, and to develop recommendations for interim management practices that could be implemented immediately," Schonewald-Cox said. "The shape of future studies also should emerge as we identify adverse conditions and trends known to be occurring or anticipated in protected areas."

Each of the five conference days will feature a one-topic section, where advances in knowledge and techniques will be presented from the pertinent academic and applied fields. These presentations will be followed by exploration of the relevance and feasibility of this information for resource managers. Limitations and advantages of diagnostic methods for recognizing problems and subjects for additional research will be discussed and summarized, including the testing of hypotheses in the field.

The conference wind-up will consist of formulating resources management initiatives, policy initiatives for state and federal governments, and recommendations for additional research.

Section topics for days one to five will be: the isolation of populations, the extinction of populations, the founding of new populations, the merging of naturally disconnected populations, and preserving the natural diversity of populations and taxonomic units.

Speakers will include botanists, zoologists, geneticists, biogeographers, systematists, field resource managers, wildlife biologists, and individuals engaged in genetic research and application from the fields of agriculture, horticulture and silviculture.

The audience will be individuals who hold field management and policy formulating positions in state, federal and international agencies or organizations that have an interest in natural resources management.

*Editor's Note: It's hard to arouse public enthusiasm for saving question marks. The whole question of what **might** exist in vanishing habitats – what **might** be disappearing forever before we can explore its possible future uses – is a difficult concern to sell. It can therefore be viewed as serendipitous that the object of the Squibb Institute's worldwide search for a substance that will battle penicillin-resistant infections seems to have turned up in the Squibb lab's own back yard – the Jersey Pine Barrens.*

In a soil sample from the moist forest land that covers 1.1 million acres of southern New Jersey, scientists at last found a bacterium that gave them the structural clue they needed to produce a new kind of monobactam – one whose singular molecular structure is resulting in a new class of antibiotics that is not easily neutralized by bacteria able to deactivate penicillin and other groups of antibiotics.

(Monobactam is shorthand for monocyclic beta-lactam, which differs markedly from the bicyclic beta-lactam structure of penicillin – a compound first recognized in fungi.)

Squibb scientists spent two years screening more than a million soil samples from all over the world, looking for the chemical configurations in nature they could work with to produce effective synthetic pharmaceuticals. The designation by Congress of the Pinelands National Reserve was seen by Richard B. Sykes, chief microbiologist at the Squibb Institute, as a large factor in the preservation of the required pattern for combatting premature human death.

"Our discoveries have always come from soil samples taken from places such as the Pinelands and the Great Swamp (also in New Jersey and also protected) where there is little or no pollution," he said, adding that a relatively unspoiled environment permits a tremendous variety of life forms to flourish, whereas the number of species in a polluted ecosystem narrows considerably.

Extinctions

***Editors Note:** Harvard Magazine in its January-February issue, 1980, asked "What is the most important problem facing this nation or the world at the start of the decade and what resolutions should we be making to deal with it?" The following reply came from E.O. Wilson, author of Sociobiology and other monumental works of scientific research:*

"Permit me to rephrase the question as follows: What event likely to occur in the 1980s will our descendants most regret, even those living a thousand years from now? My opinion is not convention, although I wish it were. The worst thing that can happen – will happen – is not energy depletion, economic collapse, limited nuclear war, or conquest by a totalitarian government. As terrible as these catastrophes would be for us, they can be repaired within a few generations. The one process ongoing in the 1980s that will take millions of years to correct is the loss of genetic and species diversity by the destruction of natural habitats. This is the folly our descendants are least likely to forgive us.

"Species extinction is now accelerating and will reach ruinous proportions during the next 20 years. No one is sure of the number of living species of plants and animals, including such smaller forms as mosses, insects, and minnows, but estimates range between five and ten million. A conservative estimate of the current extinction rate is one thousand species a year, mostly due to the accelerating destruction of tropical forests and other key habitats. By the late 1980s the figure could easily rise to 10,000 species a year (one species per hour) and it is expected to accelerate further through the 1990s. During the next 30 years, fully 1 million species could be erased. The current rate is already by far the greatest in recent geological history; it is vastly higher than the rate of production of new species by natural evolution. Furthermore, many unique forms that emerged slowly over millions of years will disappear. In our own lifetime humanity will suffer an incomparable loss in aesthetic value, practical benefit from biological research, and worldwide environmental stability. Deep mines of biological diversity will have been dug out and discarded carelessly and incidentally in the course of environmental exploitation without our even knowing fully what they contained.

"This impoverishment cannot be halted during the 1980s, but it can be slowed. We need to shift the emphasis of conservation from the temperate zone to the tropics, from the preservation of isolated star species, such as the harpy eagle and Indian white rhinoceros, to the entire ecosystems in which they live. A more powerful, global conservation ethic should be cultivated. The endemic plants and animals of each nation should be treated by its citizens as part of their heritage, as precious as their art and history. When national leaders such as former president Daniel Obuder Quiros of Costa Rica have the courage to advance the preservation of ecosystems within their domains, they should be accorded international honors up to and including the Nobel Peace Prize, in recognition of the very great contributions they make, not just to their own generation but to generations as far into the future as it is possible to imagine."

Information Crossfile

The July 1981 issue of *Courier,* NPS Newsletter, carries a piece by Park Technician John Apel on prescribed burning as a method of clearing a Gulf States Utilities right-of-way in the Big Thicket National Preserve. The fire plan, successfully carried out in March 1981, was written to obtain a hot, slow ground fire that would kill loblolly pine saplings and woody shrubs, and would reduce ground litter. It would not kill most of the larger long-leaf pine growing under the powerlines. These seed trees will be cut out individually as they grow to within 15 feet of the lines. Success of the first burn indicates that prescribed fire will be an important management practice for all pipeline and power line rights-of-way that crisscross the 12 widely scattered units of Big Thicket, according to Apel.

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In *Forestry Research West,* June 1981, an article on "Using biologic organisms to test water quality" details the methodology by which these organisms can indicate lake and stream water quality. Bill Fowler, principal meteorologist for the Pacific Northwest Forest & Range Experiment Station's Wenatchee (WA) lab, describes the new opportunities this system opens up to managers of forested areas. Detailed information about the research can be had from William B. Fowler, Forestry Sciences Lab, 1133 N. Western Ave., Wenatchee, WA 98801. FTS 390-0315, (509) 662-4315.

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"Federal Funding of Basic Research: The Red Tape Mill" by H.S. Gutowsky in the May 8, 1981 issue of *Science* discusses the "administrative burden associated with federal support of research at universities," much of which "is viewed as unnecessary and counterproductive by the scientists and administrators who must bear the load." Topics covered include project versus programmatic support, the indirect cost game, accountability, federal regulations, and the bureaucratic syndrome.

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For ecologists interested in patterns of species distribution and the "deterministic vs. the stochastic approach" (the assembly of species into communities as a function of interspecific competition vs. a random process), the *Bulletin of the Ecological Society of America's* Spring issue (March 1981) contains a tongue in cheek piece by Peter Feinsinger, Robert J. Whelan and Richard A. Kiltie, (University of Florida) titled "Some Notes on Community Composition: Assembly by Rules or by Dartboards?" Using J.S. Bach's Prelude to the first Suite for Unaccompanied Violoncello (Malkin 1918) the authors attempt to determine whether the 12 tones distributed over an archipelago of 42 insular measures were distributed by a structured act of composition or by some such random process as Bach's blindfolded children throwing darts at a board full of musical notes. Using the simplest null hypothesis and the chi-square test for independence, the authors conclude that "the effects of composition are not demonstrated for the Prelude at this stage. Frankly we suspect that musecologists have been overeager to implicate composition for other such data sets. We recommend re-examination of species lists for larger archipelagos such as Beethoven's Fifth Symphony . . ." They concede however that "there is alternative evidence that composition does in fact affect music" and pose a final question: "Does our result tell us more about an absence of organizing forces, or about the inappropriateness of certain null hypotheses?"

A new Forest Service research and development program, "Old-growth Forest Wildlife Habitats," was approved by the Pacific Northwest Region and recruitment of a wildlife biologist to manage the program was authorized. The mission is to provide answers about old-growth forest ecosystems, especially their role as wildlife habitat west of the Cascade Range in Oregon, Washington and California. The objective is to develop an information base and integrate information into guidelines for managing old growth in accord with wildlife habitat requirements.

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The Center for Information and Library Services, Office of Information Resources Management, (OIRM), Department of the Interior, has access to over 150 automated literature retrieval data bases. A summary of each of these systems is available from Reed Phillips, Jr., Director of OIRM, Dept. of the Interior, Washington, D.C. 20240. The charge to DI is for the time the terminal in the Library is connected to the computer doing a search of the automated files. Connect time for most files is $65 per hour. An average search takes about 15 minutes and costs about $25. A 38-page list of the data bases to which the DI Library has access can be had from Ellen J. Cook, Chief; DI Library Information Services.

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A 97-page handbook, *Agate Fossil Beds,* published in May 1981 and available through Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 for $3.95, explores the history and significance of the rich natural archive that is now a national monument near the town of Agate, Neb. Fossils dating back 21 million years and discovered accidentally in 1878, indicate the area once hosted rhinoceros and camel-like creatures, three-toed horses and beavers that lived in corkscrew-shaped burrows. GPO stock number is 024-005-00785-7.

An article on "The Salinity of Rivers" by Arthur F. Pillsbury in the July 1981 *Scientific American* analyzes 15 major river systems in the U.S. to see how the quantity of salts carried by a river at a given point is related to the quantity of water that had entered the river above that point. The 15 rivers analyzed for a 10-year period carry the bulk of precipitation that falls on the 11 westernmost states and includes the Colorado (about which Roy Johnson writes in this issue on p. ??). Pillsbury considers various measures being taken to deliberately impede the flow of salts to the sea and finds that "the measures being planned and effectuated to accomplish this ideal are dangerous for the future." In this finding, he admits running counter to "the law of the land, reflecting the demands of both environmentalists and water users."

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Publication of a new journal for a wide, interdisciplinary audience to deal exclusively with the conservation of natural areas disturbed by human activities has been announced by the University of Wisconsin-Madison Arboretum.

The 40-page glossy journal, entitled **Restoration and Management Notes** is designed to encourage communication among people in areas ranging from mine reclamation and wildlife ecology to forestry and landscape architecture. Present plans are four issues annually for $8. Those interested in contributing or subscribing should contact Editor William Jordan at the Arboretum, 1207 Seminole Highway, Madison, WI 53711. Phone (608) 263-7888.

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The American Institute of Biological Sciences journal, *Bio-Science,* carries in its October 1981 issue an article by Cowling and Linthurst on "The Acid Precipitation Phenomenon and Its Ecological Consequences."

superintendents' corner

Editor's note: *The following two pieces of correspondence came to us from Jim Thomson, Fort Vancouver NHS superintendent, with a cover note that ended "The important thing is that the information was made possible by the publication in the newsletter, so chalk one up for you!"*

To James Thomson, Fort Vancouver NHS, Vancouver, WA, from William N. Jackson, Superintendent, Fort Stanwix NM, Rome, NY.

"Dear Mr. Thomson: I just finished reading an article in *PPS* (Fall '80 issue) concerning decay of wood at Fort Vancouver. I am particularly interested in learning more about the volatile fungicide prescribed by Prof. Robert Graham of Oregon State University to control it. Here at Fort Stanwix we have perhaps the same kind of problem with our wood and earthen fort. Fort Stanwix NM is a completely reconstructed wood over concrete fort with earthen glacis, fraise and pickets made of yellow pine. Originally this fort was built by the French in 1758, and later rebuilt by American forces in 1776 as a frontier outpost, and it served as a very significant stronghold during the Revolution. This site was set aside because of the role it played in repulsing the siege of Gen. Barry St. Leger in August of 1777, and the outcome of this repulse led to the eventual capture of Gen. Burgoyne at Saratoga in October of that same year.

"Fort Stanwix is known as the fort that would not surrender. However, it may fall prey and surrender to the forces of nature if the erosion and decay problem is not stopped. The severity of the winters in this part of the country (annual snowfall over 100 inches) has been detrimental to this wooden fort, causing the pickets to decay much more rapidly than anticipated. I would appreciate any information you have on remedying or controlling this decay, or perhaps you can direct me to someone that can help me."

From James M. Thomson to William Jackson:

"We appreciated very much hearing from you and knowing of the problems you have that are similar to what we have here in the Pacific Northwest. By now, we assume that Prof. Graham has contacted you and hopefully given you some good advice about the potential for arresting the spread of decay.

"We have not yet awarded the contract for treatment of our palisade, but the bid opening is this week. Work will be done after Labor Day, since it is necessary to close the fort for a brief period to avoid any possible contamination of humans from the gasses that might exude from the posts. We'll let you know how it goes with the work and what results we observe after it has been done. We wish you well in overcoming the erosion and decay so that Fort Stanwix will not have to give up its distinction of being the fort that never surrendered."

PARK SCIENCE

NATIONAL PARK SERVICE
U.S. Department of the Interior

Grizzly Bear Hearings Held At Glacier NP

The grizzly bear program at Glacier NP received "the kind of support that any manager could only dream about" at the Aug. 14, 1981 field hearing at the park, according to Ro Wauer, chief of the NPS Division of Natural Resources Management.

The session was called by U.S. Reps. John Seiberling, Pat Williams and Beverly Byron (of Ohio, Montana and Maryland, respectively) and was attended by 150 persons, 37 of whom presented verbal testimony.

Suggestions for dealing with grizzly/people problems were mostly positive, and ranged from "aversive conditioning" (dealt with at length in an article in the August 1981 Smithsonian Magazine, by Montana writer Robert Gildart who also works summers as a backcountry ranger in Glacier NP) to a proposal that bears be removed from the park and used to stock other areas. The latter idea was presented by Charles Jonkel of the University of Montana, head of the Border Grizzly Project.

Some negative notes lent contrast to the chorus.

Joe Cutter of the Yellowstone Foundation warned that poaching is becoming a serious threat to grizzlies, citing out-of-sight prices on these contraband items: $100 to $175 each for a single grizzly bear claw and up to $2,500 for a hide and claws. The present law governing possession of hides and claws Cutter called "unenforceable" – he estimated that 20 to 40 grizzlies are being poached annually. He noted at least 12 "flagrant violations" within the past 30 days. The Montana representative, Jim Challinor of Libby, opposed inclusion of the grizzly on the threatened species list and expressed hope that a regular hunting season for grizzlies could be reinstituted.

The profusely illustrated Gildart article in the Smithsonian Magazine, discusses historic management of grizzlies, describes current methods for tracking the bears, and delves into the concept of aversive conditioning – designed to reinstill fear of humans in bears that have been "habituated" to people.

The long awaited NPS Scientific Monograph No. 14, *The Grizzlies of Mount McKinley,* by Adolph Murie, is now available from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (Stock No. 024-005-00814-4, $6.00). The observations of grizzly bear behavior and ecology presented in this monograph are based on the author's work in Mount McKinley NP from 1922 to 1970. During the last 20 years of that time, Murie received continuous support from his employer, the National Park Service. When he died in 1974, Murie had completed most of his manuscript in draft. *The Grizzlies of Mount McKinley* was completed posthumously by his son, Jan. The book discusses various aspects of grizzly bear behavior and ecology, beginning with details on range and movement, reproductive behavior, care of offspring, and food preferences. Also covered are the interactions of grizzly bears with other animals, from ungulates and rodents to birds and insects.

In The Next Issue:

"Management of Gray Squirrels and People in a Downtown National Park" by David Mansk;, Restoration of the Atlantic Ridley, Milford Fletcher; "Wilderness Management, Outgrowth of Wilderness Research Program," by Jan Van Wagtendonk, and "Hawaiian Exotics" by Don Gardner.