PARK SCIENCE

A RESOURCE MANAGEMENT BULLETIN

NATIONAL PARK SERVICE
U.S. DEPARTMENT OF THE INTERIOR

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FALL 1983

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

In This Issue

Cover Photo: Sara Molden (left) and Annie Esperanza, resource management employees of Sequoia/Kings Canyon NP's, weigh small woody debris (1" to 4" in diameter) as part of the pulse study (See story page 3).

Sometimes it's hard to see the moving shape of change – especially if it involves a system you, yourself, are part of. Several items in this issue, if they are viewed as one whole piece of information, offer some interesting insights into the changing nature of resource management in the National Park Service.

The Resource Management Trainee program is the subject of three separate submissions that floated into the editorial office this quarter from center field. One of these items came from the Western Region and can be found in Letters to the Editor, signed by the Region's Chief of the Natural Resources Management Division, an air quality specialist, an aquatic ecologist and a plant/fire ecologist.

The other two came from Bruce L. Freet, a Resource Management Specialist at Big Cypress National Preserve in the Southeast Region. The longer of Freet's two submissions appears on p. 7 and deals with a DSC training session on remote sensing and mapping and the tremendous management advantages these tools afford. Beyond Freet's description of these benefits is the obvious exhilaration he feels over the opportunity to perform more effectively.

The third item (this one might almost be said to have come from left, rather than center field, since it was forwarded from another publication that could not use it) is addressed specifically to Resource Management trainees. We run it here because it offers another insight into a very positive, almost revolutionary movement that goes even beyond bringing park management into the mainstream of the computerized information age. It tells us that the Service is peculiarly blessed with a group of young men and women earnest, eager, dedicated, enthusiastic, and "in touch" – with one another and with their jobs.

They are definitely on the move and the Service will never again be quite the same. Here is the item:

Sharing Your Resource Management I.D.P.

By Bruce L. Freet

If they have not already done so, I wish to encourage other Resource Management Trainees to develop their Individual Development Plan (IDP) component files and make them available as a park-wide self-study program. For the trainee, the I.D.P. outlines an ambitious training program of formal courses, self-study, and on-the-job experiences including more than 30 subjects or components. With the sincere commitment of regional coordinators, park management, and trainees, 37 trainees should complete their individualized packages by the end of FY 84.

The potential of the Resource Management Trainee Program to influence future NPS decisions far exceeds the few enrollees of today. As the training progresses, each trainee essentially builds a library of resource management information and techniques by component. Many of these subjects coincide with the project statements of Resource Management Plans. The importance of the library concept lies in the ease in which information can be shared with others. If the information is indexed by component, it can be organized by file folders. However, as more materials are collected, folders will be gradually replaced by notebooks. These are easy to organize and edit. Other interested employees can "check-out" components for their own self-study and career development.

See what we mean?

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Cross Disciplinary Approach To Complex Park Problems Supplied by 'Pulse Studies'

By Jean Matthews

As environmental problems proliferate and ecosystem functions are increasingly compromised, it becomes both more difficult and more urgent to understand how pristine, or near-natural, ecosystems function. To the resource manager's mind, too often the outside pressures impacting the systems are insufficiently documented, and in any event a mind-boggling number of variables usually is involved.

In the past four years, an innovative approach called a "pulse study" has been applied at strategic places in the West – measuring, monitoring, recording, and hypothesizing – looking for relationships that can lead to more effective management of natural resources.

The cover story of Vol. I, No. 1 of this publication (Fall 1980) dealt with the pulse study of Olympic NP's Hoh River valley. Three years later, still going strong under the same leadership, another such energetic effort has been made at Sequoia and Kings Canyon NPs in California.

Jerry Franklin, research scientist with the USFS Forestry Sciences Lab in Corvallis, Oregon, is the instigator and prime mover of the pulses . . . a term that seems to refer both to the heartbeat of the ecosystem under study and to the concentrated periods of research that go into "taking the pulse."

Initial Pulse

At Sequoia/Kings Canyon, the initial pulse took place in September 1982. (See Supt. Boyd Evison's enthusiastic endorsement of the pulse in the Letters section of *Park Science,* Spring 1983 issue). The final field phase was conducted June 26 to July 9, 1983. Under Franklin's leadership, approximately 75 researchers examined the interactions between streams and an arid mixed-conifer forest (giant sequoia, white fir, Jeffrey pine, and red fir) and the contribution of riparian vegetation to stream productivity.

The actual study plots were laid out with an eye to answering management questions for the park and to testing concepts suggested by previous pulse studies in the Hoh, at the H.J. Andrews (USFS) Experimental Forest, and at other locations. Researchers examined log decomposition and the roles played by insects and the mountain meadow plant communities associated with sequoias. Permanent sample plots were established in several of the forest types so additional data can be collected on size and age of trees.

Participants are the investigative lifeblood of the pulses; they come from as many institutions and agencies as are needed to make the research picture whole. Team Leader Franklin, however, is the heartbeat – clowning, coaxing, badgering, inspiring his chosen group into a closeknit, interacting unit. It's at night, around the campfire, that Franklin's magic club (no puerile *wand* for him) beats what could be merely a *multi*-disciplinary exercise into an *inter*-disciplinary triumph.

How It Works

Operationally speaking, it works something like this.

All day long the various teams are out in the field, loading up on observations and data, according to their pre-arranged assignments. At night they unload their mental baggage at a Franklin-led, total attendance get-together. As each group reports, *all* groups pay attention. Light from a dozen different disciplines is brought to bear as hypotheses are *pro*posed, *ex*posed, thoroughly chewed over, sometimes accepted conditionally, more often shot down and disposed of. The process serves to short-cut the usual route of publishing in the journals and then awaiting scholarly response.

The touchstone against which the gold of hypothesis is tested is the variety of education and experience represented by the multi-disciplinary science team, the technicians, and the resource management types who participate. As the discussions proceed, discipline distinctions blend into any number of shadings. The sharp edges of riparian, limnological, geological, or hydrological wisdom tend to soften and interconnect. The result often is a new light thrown into the area being discussed; the resident scientist in that area comes up with an "Ah *ha*!" reaction.

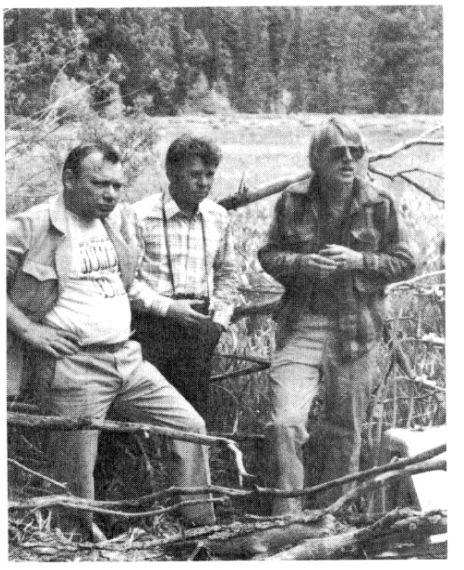
(Not every idea floated gets such favorable treatment. There are also a lot of "boos" and "no-ways"; hubris and humility live in precariously close quarters at the pulse study campsite.)

Management Interacts

In all this discussion and interaction, management personnel from the host park sit in – interjecting the management perspective into all that transpires.

The team maintains its mission and identity even as its membership changes. Some stay on for the entire pulse; many come and go, lending change and continuity and giving the constantly emerging results a sort of life and longevity of their own. Ecosystems will continue to evolve; problems will change; the visitor component of parks and the interpretation and management will continue to evolve also. The whole scene benefits enormously (according to the testimony of both park managers and resident scientists) from such dynamic group efforts to keep abreast of conditions that converge and must be dealt with on human terms. Some of the "pluses" (an interesting anagram of "pulses") were described by NPS Research Scientist Doug Houston, commenting on the Hoh pulse at Olympic NP, which now dates back four years:

"The pulse team generated some very interesting hypotheses about the effects



Air sampling set-up *is described by Bruce Wiersma (right) to Drs. Yuri G. Puzachenko (left) and Valery A. Petrukhin. Dr. Wiersma is with the national engineering lab EG&G Idaho, Inc.; Puzachenko is from the Russian Institute of Animal Evolutionary Morphology and Ecology; Petrukhin is from the Russian Hydrometric Survey, Executive Secretariat of Bilateral Environmental Agreement.*

The pulse's "rotten wood group," *(invertebrate people) pursue their quarry in one of the study plots. From left, John Oswald, OSU research assistant; Gary Parsons, research scientist at Sequoia/Kings Canyon, and Jack Lattin, associate dean of science and professor of entomology at OSU.*

Cross Disciplinary (Continued)

of elk and other ungulates on old growth forests – their subtle impacts on forest regeneration and plant species composition. They looked ino the roles of down trees in the streams and on the forest floor. These are all effects we had not been aware of; we can now look for them and deal with them."

One startling finding in the Hoh study was the result of establishing elk exclosures in the grassy plots. Without grazing, in only four years these plots are filling in rapidly with shrubs and ferns. No grass. A future *Park Science* will describe these findings and the management implications stemming from them.

The work of Bruce Wiersma, an air quality scientist now working for private industry at the international level, demonstrates two distinct ways in which the pulse approach functions as an integrator and synthesizer. Wiersma's own work involves tying air quality network to network – NPS air quality programs, state air programs, university programs, individual park programs, and the pulse study group with its broad science and agency composition – all different sets of sensors focusing on one small slice of ecosystem. Wiersma brings these insights to the pulse study, whose way of functioning is almost exactly the opposite. Where Wiersma concentrates on getting *one* kind of reading from all over the world (air quality), the pulse study concentrates on getting as *many* readings as possible from one small slice of the ecosystem, with the goal of gaining new insights into how all (or any of) the components act, interact, and *work*.

This kind of information is well-designed to address overall park management problems.

***Ken Cummins,** stream team leader, about to go wet suit diving in Log Meadow.*

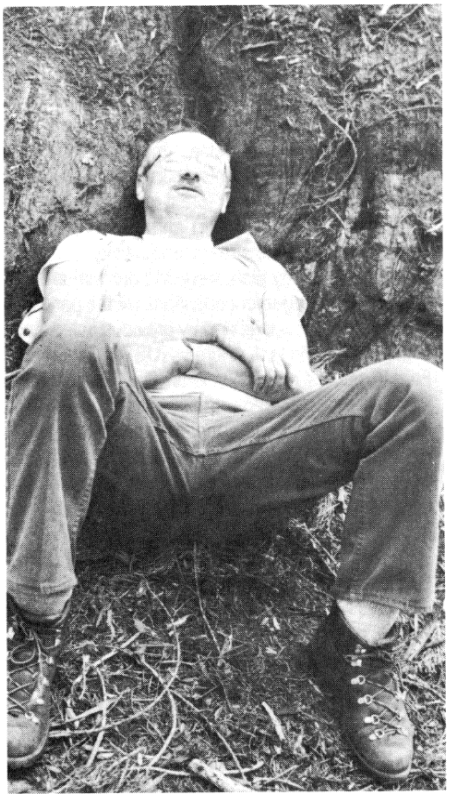
Sierran Pulse

The first pulse at Sequoia/Kings Canyon took place from Sept. 12 to 24, 1982 and involved 41 researchers from eight different institutions and organizations. This included seven individuals from the research and resource management staffs at Sequoia NP. Disciplines represented were plant ecology, geomorphology, hydrology, entomology (aquatic and terrestrial), aquatic biology, forestry, and geography.

Focus of the first pulse was largely on collections of basic descriptive data on the stream, riparian, and forest systems at the selected study sites. These included four stream segments associated with mixed-conifer forest (Suwanee and Dorst Creeks), giant Sequoia forest, and a meadow. Over 400 m of stream reaches were analyzed and mapped. Characteristics studied included channel morphology (including cross-sections), woody debris, retention features other than woody debris, flow patterns, retention characteristics (based on leaf release study), and biomass and composition of the riparian vegetation. Four hectares of adjacent forest were analyzed with

***Measuring a trout** from one of the numerous deep streams that were completely masked by meadow growth, are Stream Team Leader Ken Cummins (left) and high school volunteer Colter Hessel.*

***New woody debris** in Suwanee Creek is typical of the interaction taking place at Sequoia/Kings Canyon NP.*



***Dynamic Group Leader** Jerry Franklin, exhausted from excessive whistle-blowing, "takes five" at the foot of a towering sequoia.*

stem mapping and measurement of all live trees, snags, and down logs and descriptions of the understory vegetation. Material was collected for construction of biomass equations for the major riparian species and for biomass estimates in Log Meadow.

Long-term Plots Established

Other accomplishments included establishment of long-term snag decay plots, collection of data on decomposition of down logs (including the role of insects), establishment of an upland mixed-conifer reference stand (area of mapped and measured forest), collection of increment cores for an age-structure analysis of the Suwanee mixed-conifer stand, and extensive sampling of meadow vegetation within the mixed-conifer zone.

Data bases for the establishment of volume equations for local trees and on litter fall (leaf and fine woody debris) were developed in mixed-conifer and giant Sequoia stands and littertraps were set up in Crescent Creek. These are being collected by NPS personnel at three to four week intervals. Data will be valuable for both this study and the baseline studies for appraisal of effects of acid precipitation. Stream, air, and soil temperatures are being monitored at Crescent Creek using two dual-probe, 31-day Partlow thermographs.

The June/July phase of the pulse involved 50-odd scientific personnel, including four Russian scientists. Work concentrated on aquatic process studies (e.g. production), aquatic insects and fish in the selected streams, and establishment of additional upland forest sample plots (reference stands) for study of forest composition, structure, and function. Other work included additional analyses of log decomposition (especially invertebrate roles), extension of meadow analyses, fungal ecology, vertebrate use of riparian zones, and physiological studies of riparian plants.

Publication Underway

Currently in production is a single large document, data-rich, with maps, covering all aspects of the work. Individual publications (mostly in refereed outlets) have been assigned, and major participation in the 1984 spring NPS Regional Science Conference in California has been arranged.

In typical Franklin style, the memo that ties all this work into retrievable form and makes it publicly available reads:

"No bent noses, please, over omissions. This is just an effort to get your minds rolling."

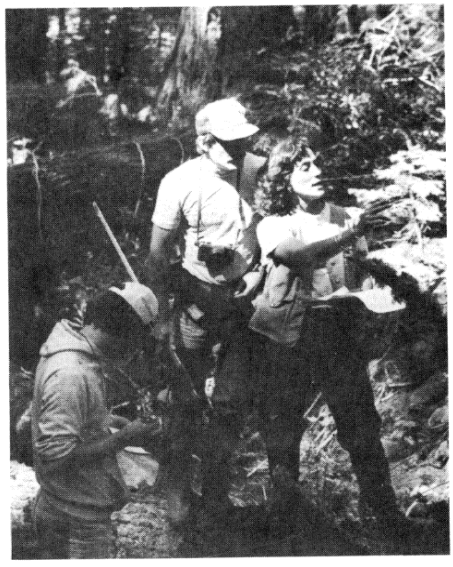
One peculiarity of the Sequoia/Kings Canyon area is the fact that no "cobbles" (as in Oregon streams) can be found. The rock outcrops tend to disintegrate directly into sand-size particles. The Oregon and Washington cobble/pebble stage is one in which benthic life abound.

The tongue-in-cheek suggestion of one observer at an evening campfire:

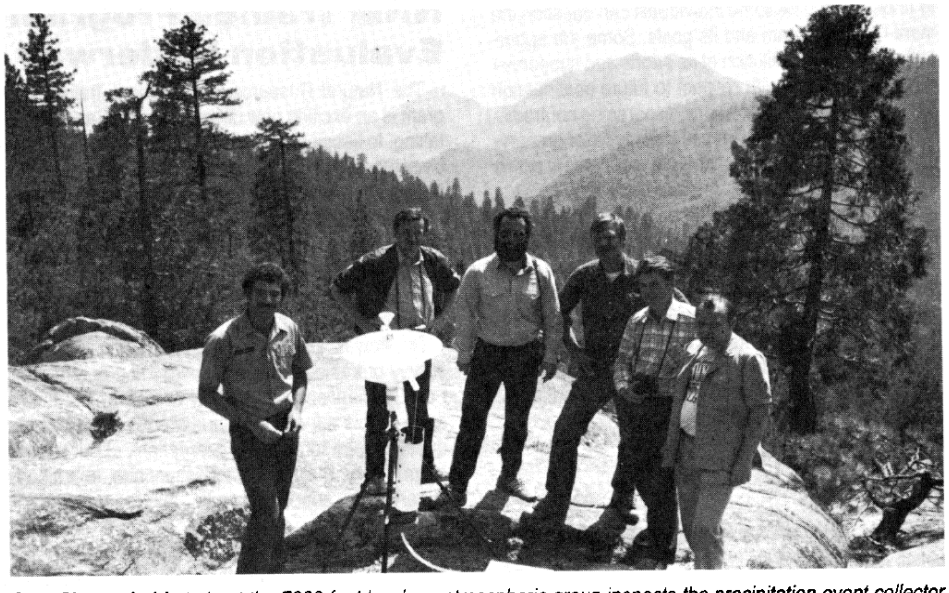
"It would be interesting to run an empirical test on how many people fall into a stream when trying to cross it in the Pacific Northwest as opposed to the Sequoia/Kings Canyon environment."

The critical factor, presumably, would be the slippery life forms that make footing chancy in the Northwest, as opposed to the lack of such slimy life on logs and stream bottoms in the Sequoia/Kings Canyon area.

Pulse leaders *enjoy a good laugh over some heartbroken hypothesizer's ruined construct. From left, Art McKee, ecologist and manager of the Andrews Experimental Forest; Pulse Leader Jerry Franklin; Dana Abell, ecologist from Davis, California; and Dean Taylor, OSU forestry research associate.*



Stan Gregory *(left) of OSU Fish and Wildlife Department, and Jim Brock, biologist from Idaho State University, listen as Karen Luchessa, principal investigator for stream channel mapping, outlines the day's work.*



On a Sierran bald *at about the 7000-foot level, an atmospheric group inspects the precipitation event collector for chemical analyses. From left, Dan Drisco, Sequoia/Kings Canyon NP resource management specialist; Kirill D. Zykov, Ray Herrmann, NPS Water Resources Lab Chief; Yuri A. Starikov, Valery A. Petrukhin, and Yuri G. Puzachenko. The Russian participants in the pulse study were there courtesy of the U.S./U.S.S.R. Bilateral Environmental Agreement.*

letters to the editor

To the Editor:

We read with great interest the letter written by William E. Brown, Regional Historian, Alaska Regional Office, which appeared in the Spring 1983 issue of *Park Science.* We certainly support Mr. Brown's views that "on site" natural resource managers are needed throughout the National Park Service. Furthermore, we are pleased to report that the Regional Director of the Western Region has taken necessary steps to satisfy this need.

In a recent audit of our field positions we determined that 60 full time and less-than-full-time permanent employees in the Western Region manage natural resources on an uncompromised basis. This figure excludes seasonal employees and Regional Office people who also work full time on natural resources related issues. These 60 positions represent approximately half of the total number of all Natural Resource Management positions in the National Park Service. Properly managing natural resources in parks is much more of a complex problem than simply writing such responsibilities into a position description. Responsibility should be inseparable from action, requiring full-time dedication and effort. Other park workloads should not dilute efforts and attentions of the natural resource manager.

In light of all the discussion over how to recruit natural resources management specialists, potential career ladders for the individuals and how to fund such positions in those parks which demand such expertise, we continue to experience similar confusion and consternation as do some others. The National Park Service remains extremely fragmented in its approach to these problems, and concrete national consistency on this issue continues to elude the Service. It is hard to conceive that there appears to be less than 100 percent support nationally for the new Natural Resources Management Trainee Program. We fail to understand how some individuals can question the merit of the program and its goals. Some are apparently agreeable to dilution of its efforts and supportive of pessimistic talk with respect to future continuation of the program. In short, many disparaging contradictions surface when we discuss the needs for preserving ecological processes through concerned active management of the natural resources of parks.

In summary, we applaud Mr. Brown's recognition of this problem and are enlightened to know that others feel as we do. Recognition of our deficiencies in natural resources management expertise within parks is the first step toward emphasizing a viable solution. Prioritizing our limited dollars in such a way that natural resource management specialists and the wherewithal to do a job be placed in parks where sufficient demand exists, is the task at hand.

Sincerely,

Francis H. Jacot
Chief, Division of Natural Resources Management

Milton Kolipinski, Ph.D.
Aquatic Ecologist

Donald Christensen
Air Quality Specialist

Thomas Gavin
Plant/Fire Ecologist

To the Editor:

Editor's Note: *Proceedings of the two-day June 1983 conference, Acid Rain in the Rocky Mountain West, are available for $10 each from the Colorado Department of Health, Office of Health Protection, 4210 E. 11th Ave., Denver, CO 80220. Because acid rain is a high priority item on the national agenda and an increasingly significant resource management problem for the NPS,* Park Science *offers the following subjective account of what occurred as viewed by one NPS scientist participant.*

In June I attended a conference on Acid Rain in the Rocky Mountain West, sponsored by the Colorado Department of Health and a lengthy list of co-sponsors including the National Park Service. It focused for two days on what is *known* about western acid rain, and just as importantly, what is *not* known. To my mind, the conference defied objective reporting, but it was too interesting to ignore – especially in such a publication as *Park Science,* where views on scientific subjects are supposed to be aired.

In the words of the planners, the conference progressed "from the realm of science into the realm of religion," and ended with a short exclamatory session between the Environmental Defense Fund people and representatives from Ford Motor and Kennecott companies. I would like to comment on the conference – the good, hard scientific facts it reported and the smattering of speculative conjecture.

Acid rain is an emotional issue, charged on both sides with believers and non-believers. The Rocky Mountain West conference was a microcosm of the national debate and for two days emotions ran high.

It is a fairly well accepted fact that for acidic fallout to be damaging to an environment there must be a sensitive receptor. Croplands are rarely "sensitive receptors" because their soil chemistry is highly manipulated by farmers to maintain optimum crop-growing conditions. On the other hand, high elevation lakes and streams can be quite sensitive, depending on the inherent buffering of their surroundings to the incoming acids.

Of the first session, four papers dealt with areas found by researchers to be sensitive to acidic rain. Alkalinity was defined as the buffering capacity available to counter incoming acids; there was no dispute that alkalinity decreases with increasing elevations. Well presented arguments made the case for the sensitivity of high country areas of much of Colorado: the Flattops Wilderness Area, the Galena Lake/Mexican Cut area near Aspen, and Rocky Mountain NP.

Not so convincing was research claiming to document the loss of alkalinity from acid rain. Much of the work was conducted in reservoirs and other manipulated receptors such as croplands. The contention that a 20 percent drop in buffering capacity has occurred over the last 15 to 40 years implies a 100-fold increase in the acidity of rainfall – a claim not supported by national deposition chemistry data.

The afternoon sessions of the first day were highlighted by two outstanding papers on the nature of acidity in Colorado. Fred Fehsenfeld reported indisputable evidence of nitric oxide pollution in the mountains near the Continental Divide when updraft winds blow from the Denver metropolitan area. Since there has been much speculation on the source of acidic rain in the mountainous areas of the West, this paper was exciting in that it confirmed at least one source. Adding to this excitement was the presentation by Michael Grant of the results of a statewide network of precipitation collectors. Point sources, notably Four Corners area and the Denver metropolitan area were implicated in contributing to noticeably higher sulfate and nitrate concentrations downwind. The reporting that pH values throughout much of the western part of the state, including the high elevation areas, averaged 5.6 or less, sent reporters off to formulate headlines of the occurrence of acid rain, the sensitivity of our resources, and the gravity of the problem. So ended the first day, with conference participants in a general uproar.

Day two of the conference will be known as the day of the voice of reason. The first day had given good press to some questionable conclusions, the second day was to highlight uncertainity, Acid rain is an emotional issue in part because researchers give conflicting results. The tools are not available for allowing us to say yes or no unequivocably to the sources of acid deposition and to the effects it causes. One of the tools affording us the luxury of conclusions is a long-term monitoring network. The chemistry of precipitation is of dynamic and varied composition. This was clarified in a presentation by Jim Gibson, coordinator of the National Atmospheric Deposition Program. He pointed out spatial changes in rainfall chemistry, the perceived "acid rain" in parts of the west can be attributable in part to airborne gypsum, a natural phenomenon. Also discussed were the temporal trends now in question. Does rainfall appear more acidic today than 30 years ago due to the rain of pollutants, or due to artificially high pH's of the drought-wracked '50's?

Setting the tone of the day, Gibson discussed the limits of our knowledge and just how to interpret them. Carrying on in this vein, other nationally known scientists came back again and again to the uncertainties involved in measuring the acid deposition

NRM Trainee Program Evaluation Underway

The Natural Resource Management Trainee Program is an exciting new direction for the Service to be taking. In keeping with its being a new direction, it has been undergoing several types of evaluation – self-evaluation in parks, regions, and WASO; and now external evaluation as the result of a WASO arrangement with Dr. Paul Nowak, Director of Continuing Education and Chair of the Behavior and Environment Program of the School of Natural Resources, University of Michigan.

Dr. Nowak and his colleagues conducted a pilot survey of trainee attitudes toward the program at the Fort Collins/Denver air quality course. Using the results of this survey, they prepared a more detailed questionnaire to evaluate perceptions about the program. They mailed this questionnaire to trainees, supervisors, superintendents, and coordinators in mid-August.

In early November Dr. Nowak will convene a workshop of trainees, superintendents, and coordinators to present his findings. From these findings, the work group will recommended programmatic changes and revisions for the Trainee Program.

John Dennis, Ecologist
Natural Resources Division, WASO

phenomenon. An unknown amount, possibly 50 percent of total deposition, comes as dryfall. At present there is no accurate way of quantifying dry deposition. The best scientists in their fields are up against the state of the art in modeling transport, measuring dry deposition, or predicting damage thresholds, and their predictions are necessary for adequate government standards decisions on how to regulate.

This conference emphasizes that we have come a long way. One could say with certainty that regions of the Rocky Mountains are sensitive to the effects of acid rain. One could talk with confidence about the chemistry of the region; whether there was "acid rain" with all its unpleasant connotations was less certain. One could only speculate on where our pollution comes from, and it was pure conjecture that one could predict where the emissions from a point source would end up.

The final session began with a plea for statements from the scientific community to help the policy makers devise some way to gauge change, set emissions regulations, and then enforce these regulations. This came from Dennis Haddow, speaking directly for the agencies with Class I responsibilities: The U.S. Forest Service and the National Park Service. No matter how nebulous the results of acid rain research are today, he implied, policy makers have to act, and those of us with Class I responsibilities have to act soon. "God gave us this land," said Bob Yuhnke of EDF in the next presentation, "and we have not yet reached that sad point in time where we have to destroy our last vestiges of wilderness." A representative of the Kennecott Mining Company gave the other side of the picture. The control of stack emissions are costs that must be passed on to the consumer, for to bear the costs themselves will put many industries out of business. Big industry did not deny the existence of acid rain, but rather conceded it is an industrially caused problem. The cost of cleaning it up and preventing further acidification, however, presents another story. The problem becomes one of forcing more costs on an already strapped industrial economy, or allowing some degradation (how much?) of pristine natural areas, or some combination of both of these. At this point, the discussion is no longer a scientific question, but rather a political one.

Earlier in the day Congressman Tim Wirth spoke knowledgeably about acid deposition nationally and just how Congress might go about writing legislation to deal with its cleanup. Government works by COMPROMISE; *on one side* should have to bear the costs of a problem that affects the entire country, resources and economy alike.

To bring these disparate groups together for two days to discuss such an emotionally charged topic as acid depostion, to air the facts, the speculations and the exploratory routes toward solution was a big task. The conference planners must be highly commended.

Jill Baron, Biologist, NPS Water Resources Lab,
Colorado State University, Fort Collins, CO 80523

Resource Baseline Mapping Training at DSC Described

Editor's Note: *The following article was written for other Resource Management Trainees, but is included here because it contains much of interest to NPS scientists and managers in general.*

By Bruce L. Freet

Recently I combined a trip to the Air Quality Course with an orientation and training session at the Denver Service Center (DSC). I spent three days at DSC and fulfilled several aspects of the information Baseline/Ecosystem Mapping component of my individual development plan (IDP). Some of the other Resource Management trainees have satisfied similar goals by attending the USGS Remote Sensing and Mapping course or the USFS Vegetative Mapping course, but I believe that a training session at DSC might be more pertinent to our needs.

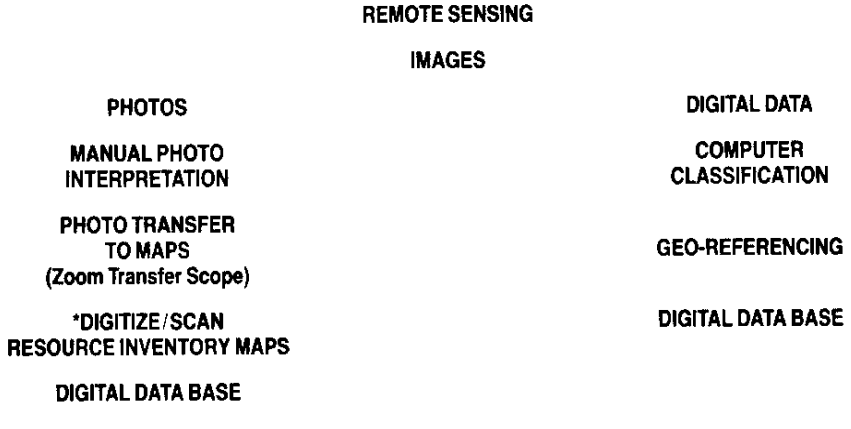
Because it is part of the same agency we work for, the DSC staff shares common management philosophies and goals, is interested and conversant with the resource issues of our particular areas, and so can establish an interactive working relationship with us. Most of the DSC staff I dealt with had biological science backgrounds and understood my needs.

Gary Waggoner of the Remote Sensing Section was my host and created an itinerary that included baseline mapping materials and techniques, computer hardware and software for ecosystem maps (digital data base), a search for past and present aerial photography at the National Cartographic Information Center (USGS), a search of the Technical Information Center (DSC) files for historical documents and maps, plus discussions with micrographics personnel, regional planning teams and WASO staff for minerals management and air quality.

The majority of my time was devoted to developing a strategy for mapping resource baseline data. It needed to be practical NPS-operations-oriented, and yet provide the accuracy and compatibility for eventual computer entry. Objectives, costs, and benefits were examined. The flow chart evolved from these discussions. For example, we decided that all resource data should be mapped by theme or subject (archeological sites, wildfire/year, exotic plant encroachment, etc.) on individual four mil. frosted mylar overlays, using mylar maps as the base. Whereas the dimensions of paper maps will vary with changes in temperature, humidity, and use, the mylar maps are stable. This assures greater accuracy, which is essential when the data are computerized later. The mylar bases (chromatin maps) are more expensive than paper, but their dimensions do not change over the years and they can be used to make very inexpensive black-and-white diazo paper copies (a few cents per copy).

We also discussed the benefits of using Universal Transverse Mercator (UTM) points for mapping resource data with some modifications for mapping fires. Because of their irregular size and shape, wildfires and prescribed fires will employ UTM coordinates to designate the ignition point. Size and shape will be depicted by actually drawing the fire perimeter on mylar overlay keyed to the chromatin base maps. (These can be precisely reproduced by the computer). Information management is complicated to some degree by the Individual Fire Report, DI-1201 form and the FIREPRO data form, which require location by either Township and Range or latitude and longitude. However, the latitude/longitude coordinates can be converted to UTM coordinates and vice versa using the Remote Sensing Section's computer programs.

At the National Cartographic Information Center (NCIC) we conducted a preliminary file search on microfiche for black/white and color aerial photographs and on slides for Landsat 4 satellite imagery (digital data). We also requested that USGS search their files for high altitude photographs. These could form a resource baseline for Big Cypress National Preserve. From our initial findings, priorities were established to purchase certain photographs and magnetic tapes. This will be done through DSC. In the future, we can contract with DSC to classify and geo-reference the information on the magnetic tapes to form a digital data base.



***If good base line map data exist for an NPS area, it can be entered here and the above phases bypassed. Inquire further.**

Resource Baseline (Continued)

Photointerpreting the aerial photographs and then digitizing the results for entry into the computer is another way to create a digital data base. A third option is to digitize an NPS area's existing resource inventory/ecosystem maps for entry into the computer. The accuracy obtained depends almost entirely upon the scale of your source materials. For Big Cypress, I chose to use 1:24,000 map scale and resource inventory map overlays to further define the digital data base.

Using either SAGIS (Systems Applications Group Information System) or ELAS (Earth Resources Laboratory Applications Software – a NASA product), one can make virtually unlimited comparisons between and among different data themes. Both systems have extensive editing capabilities, allowing changes to the data base to be made easily at any time. Each requires special computer hardware; SAGIS runs on a Bureau of Reclamation mainframe computer in Denver while ELAS runs on the Remote Sensing Section's own minicomputer. There may be limitations to tying in to either of these systems from the field, but Denver is keenly aware of the potential problem and is working on solutions. In any event, I recommend thinking about getting your data base into a form that could readily be entered into a computer when desired.

Resource Management trainees can benefit enormously by organizing a training session at DSC as regional group. DSC will need some funding assistance to conduct the training, but as trainees, you can transfer funds to DSC from your special accounts. The best option in terms of cost and individual attention might be to have five trainees per DSC session. I would anticipate that you would want some unstructured time while there in order to pursue your individual interests. You should contact Dr. Maury Nyquist, Chief, Remote Sensing Section, and/or Dr. Harvey Fleet, Program Manager for Digital Cartography, to arrange for a training session. (303-234-4527).

Before going to DSC it would be helpful to read *Remote Sensing of Wildlife Resources: A State of the Art Review* by Robert C. Aldrich (GTR RM-71 Rocky Mountain Forest and Range Experiment Station, USFS, USDA, 240 W. Prospect St., Fort Collins, CO 80526). Three short articles have been published in *Park Science* (Spring 1981 and Winter 1983) which discuss natural resource data base construction at the DSC. Also check the DSC telephone directory or staff roster to see what other contacts you may wish to make.

Freet is Resource Management Specialist at Big Cypress National Preserve.

Correction

An error occurred in the Wilderness Campsite Selection story by Dave Cole and Jim Benedict in the Summer 1983 issue. In Paragraph 10, on page 5, the sentence should read "A night or two of use every year is sufficient [not insufficient] to do considerable damage."

Turtles and Burros Make SWR Headlines

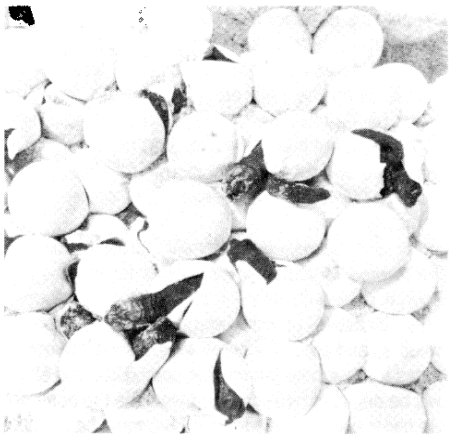
By Milford R. Fletcher

The top science news from the Southwest Region can be summed up in two phrases: "More on the Heartbreak Turtle," and "Feral Burro Roundup at Bandelier National Monument."

We reported previously on the reintroduction of the Atlantic Ridley turtle efforts, (*Park Science,* Winter 1982). The project has been going well and over the last six years we have received some 13,000 eggs from Mexico. The normal procedure is to collect the eggs directly from the turtles in Mexico, place them in styrofoam boxes filled with sand from Padre Island National Seashore, and transfer the sand-filled boxes and eggs to Padre Island in Texas. At the island, the turtles are hatched, imprinted, and transferred to the National Marine Fisheries in Galveston, Texas, for raising to approximately one year of age.

This year we received 2,006 eggs from Mexico and 242 hatched without incident. The remaining 1,764 failed entirely to hatch.

A number of possibilities may have caused this catastrophe. We are looking for the presence of pesticides heavy metals, or other environmental contaminants in the eggs and sand. We also are having the National Marine Fisheries culture and identify two species of fungi and three species of colonial bacteria which may be implicated in the failure.



***Atlantic Ridley Turtles** fight their way out of their shells.*

We have researchers working to determine the embryonic stage of development at which death occurred. Turtle eggs are very susceptible to damage if they are moved during certain times of the incubation period. Whether this contributed to the death of the embryos will be determined when Padre Island and Mexican researchers get together to compare notes.

Although the situation does not mean a complete loss of a year's class, the fact remains that the 1983 class is comprised of only 230 turtles as opposed to the yearly program average of 1,600, and it may have a longterm effect on the reproduction structure of the Padre Island imprinted population.

We are baffled over the cause of this failure, but every effort is being made to learn as much as possible from the incident. The program has been very successful during its first five years and we are committed to seeing the whole 10-year project through to its conclusion.

The removal of feral burros from Bandelier National Monument under an order by the 10th Circuit Court of Appeals in Denver early in 1983 was begun on May 16, 1983 by the New York-based Fund For Animals, Inc. The Fund was allowed 60 days to capture and remove as many of the burros as possible before the NPS exercised its option of direct reduction.

A string of attempts, beginning with roping (which proved non-productive), the placing of snares along established burro trails (which netted one burro), tranquilizing dart guns (which involved expensive sling-loading by helicopter of the tranquilized animals and transportation to the corral), and pursuit by saddle horses and hounds – all were tried.

Eventually, 12 burros were verified by rangers as having been captured at Bandelier. Another 14 burros that appeared in the base camp corrals were not verified as having been captured at Bandelier. The 26 burros involved 634 NPS hours of monitoring and 968 total capture hours by the Fund for Animals. The capture hours worked out to 37 per captured burro.

It is our opinion that once the boundary fence is completed on the west side of the Monument (sometime in January 1984), there will no longer be a problem with feral burros.

Outdoor Recreation Issues Addressed

"Government's role in outdoor recreation will continue to adjust to political, economic and social changes, and the private sector will react to government and market signals. Ultimately, a new balance between government and the private sector will emerge."

These lines are from the Executive Summary of a new document just released by the American Forestry Association. *Renewable Resources Recreation in the United States: Supply, Demand, and Critical Policy Issues,* by H. Ken Cordell and John C. Hendee, deals with the supply situation, the demand situation, and predictions in the areas of primitive, semiprimitive, roaded natural and rural, rural, and urban recreation opportunities.

General recommendations are for a more responsive delivery system, acknowledgement of the importance of outdoor recreation in American life, a major research effort to better predict future recreation demands, decentralized recreation delivery systems, fiscal solvency and equitabilty, and expanded coordination, cooperation, and partnership between the public and private sectors.

The 88-page publication is being used as a basic source document by several federal and state agencies and was one of the principal information sources for the recent Outdoor Recreation Policy Review Group. It is available for $5 from the American Forestry Assn., 1319 18th St., N.W., Washington, D.C. 20036.

Shenandoah White-Tailed Deer: Ecology and Management Implications

natural resources to maintain and perpetuate their inherent integrity. Specific natural resources in particular parks can pose difficult management problems, and the white-tailed deer population in Shenandoah National Park (SNP) is a good example. It also demonstrates how the NPS has responded to the challenge.

Visitors to SNP often comment on the scenic vistas along the 105 mile Skyline Drive, and on the white-tailed deer along the roadsides. Of all the natural resources SNP has to offer its nearly 2 million annual visitors, this deer is one of the most observable resources in the Park. High concentrations of deer exist near campgrounds, picnic areas, and along the grassy roadsides of Skyline Drive. Visitors enjoy seeing these deer but Park personnel are apprehensive about visitor safety. The number of deer-motor vehicle accidents in the Park is high each year (15 in 1980, 36 in 1981, and 29 in 1982); visitors who stop along the road to watch deer may cause traffic jams and unsafe driving conditions.

Park administrators, in an effort to obtain sound biological information on which to base white-tailed deer management practices, initiated a short term research project with the Virginia Cooperative Wildlife Research Unit at Virginia Tech to study the population characteristics and ecology of SNP white-tailed deer. The distribution and movement patterns of deer in the Park were the major study objective. A second goal was to determine the nutritional condition of deer and to evaluate the impact of these animals on their habitat – especially on the native vegetation. Collection of field data was completed in December 1982.

Study Procedures

To accomplish the first objective it was necessary to monitor the movements of individual deer within the Park. Two study areas were established in regions of the Park where high deer populations were known to exist; 25 animals within each area were live-captured, fitted with numbered, colored collars for easy identification, and released. Subsequently, when a collared deer was sighted along the Skyline Drive or along a trail, the individual identification number of the deer and the location of the sighting were recorded. Over time, as the number of sightings for a particular deer mounted, movement patterns became apparent.

Park rangers in the interpretive division introduced the study to visitors during formal programs and informal conversations. The response from visitors was positive, and once informed about the research, visitors made a valuable contribution by reporting sightings of collared deer.

Most of the 50 deer were captured on or near the Skyline Drive, but a total of seven were captured in backcountry areas two or more miles from the Drive. Because these animals were not as likely to be sighted as deer along the Drive, these seven animals received a colored collar with a small radio transmitter attached to it. This enabled researchers to monitor the daily movements of these deer and to approach them unnoticed for visual observations. Careful observations helped researchers determine which Park

Four of the deer captured along the Skyline Drive also received radio-collars. This was important for a number of reasons. Daily monitoring of deer in the backcountry and along the Skyline Drive allowed researchers to determine how these animals interacted. Also, the areas over which they ranged in the course of their daily activities (home ranges) could be compared. Locations of deer originally captured along the Skyline Drive could continue during times when they were not highly visible, such as during fawning and cold winter weather.

Seasonal Movements

Some deer originally captured in the backcountry occasionally moved out of and back into the Park. During late summer, when daily movements were greatest, these deer frequented areas near the Skyline Drive. For example, one adult doe captured two miles from the Skyline Drive in October 1981 and who used only backcountry areas throughout the fall, winter and early spring, moved more than three miles to have her fawn in a lush area directly along the Skyline Drive. Also, some deer originally captured along the Skyline Drive moved as much as three miles into the backcountry and thus to lower elevations for short periods during severe winter weather, only to return to a particular area along the Drive when atmospheric conditions improved.

These data seem to indicate that the high concentrations of animals found along the Skyline Drive and those found in the backcountry do not constitute distinct populations. Rather, deer in the Park apparently exist along a continuum. At one extreme are deer that spend all of their time close to the Skyline Drive; at the other, deer that spend all of their time in the backcountry. The deer population in Shenandoah NP probably has representatives all along this gradient, with a high concentration near, but not at, the extreme by the Skyline Drive, a smaller concentration near the extreme of the backcountry, and an intermediate level at the center of the continuum. Rather than a clear separation of populations, there appears to be a gradation and interaction of deer from the Skyline Drive and into the backcountry areas.

Though there is some interaction of deer throughout the Park the home range of deer associated with the Skyline Drive is considerably smaller than the home range of deer associated with the backcountry. This is true for bucks (average home range of 7.2 km^2 in the backcountry vs. 3.3 km^2 near the Skyline Drive) and does (3.8 km^2 in the backcountry vs. 1.2 km^2 near the Skyline Drive), and likely results from the year-round availability of grass for forage along the Skyline Drive. Deer that were killed by cars along the Drive were necropsied to determine nutritional condition and were often found to have stomach contents of up to 60 percent grass.

Deer have a great impact on their habitat throughout the Park, and this impact is especially noticeable near the Skyline Drive where abundant grass supports artificially high deer populations year-round. Woody browse is used extensively by deer in the backcountry and especially in wooded areas along the Skyline Drive. Enough deer are likely removed from the Park's population each year through predation, road kills and hunting of animals that move outside the Park boundary to prevent gross over-use of the habitat, but the impact of deer on native vegetation still is greater than it would be without man's influence on the animal's habitat. (While the Park contains

Visitor pleasers *are these perky white-tailed deer, highly visible along the Skyline Drive. Radio collars help park management keep track of their movements.*

Shenandoah (Continued)

about 300 mi² of land, it is long (105 mi) and narrow (2-10 mi) and so has over 500 mi of boundary with private and state owned land open to hunting.)

Management Strategies

The options for managing the SNP deer population range from hands-off management to severe cropping of the population in high concentration areas. Regardless of the management strategy selected, the high concentrations of deer along the Skyline Drive should not be managed separately from the other deer in the Park. Instead, the habitat provided for deer as a result of human impact (along roadsides, in campgrounds, etc.) might be modified so that its appearance and composition is no more attractive to deer than the backcountry areas, which more closely represent the native Blue Ridge Mountain conditions that the Park was established to protect. Visitors could then be encouraged to leave their cars for short hikes so that sightings of deer would occur in a more natural environment.

It may prove feasible to manipulate forested regions in high visitor use areas so that they are maintained in natural, early successional stages which are very attractive to deer. There is ample evidence that native American Indians did this, and modern day visitors can benefit in the same way. This type of management would increase the likelihood of visitors' seeing deer along high-use trails near the Drive while decreasing the likelihood of deer-motor vehicle accidents along the Drive.

Vaughan is Unit Leader of the Virginia Cooperative Wildlife Research Unit, USFWS; Scanlon is a Research Technician with the Unit.

Coyote Study Underway At Lava Beds Monument

By Suzanne Shoemaker

Local ranchers have long contended that Northern California's Lava Beds National Monument (LABE) and adjacent Tulelake National Wildlife Refuge (TLNWF) protect and harbor coyotes responsible for livestock depredation on surrounding lands. Similar claims are made concerning other wildlife sanctuaries in the western United States. Based on current knowledge, management personnel can neither confirm nor deny these claims.

A radio-telemetry study currently is underway to investigate daily and seasonal movement patterns of a protected population of coyotes on LABE and TLNWR, in particular, to learn if these coyotes make regular excursions off the protected area.

Food habits of coyotes on undisturbed rangeland (LABE) are being compared with those on irrigated cropland (TLNWR) by scat analysis. A concurrent study of the relative abundances of small mammal prey in representative habitat types will aid in determining coyote food preferences.

It is hoped this information will shed light on the extent to which land use practices have altered coyote movements and food habits on the study area.

Shoemaker is a graduate student working with David de Calesta, associate professor of Fish and Wildlife at Oregon State University.

***Burying the trap** for coyotes at Lava Beds National Monument are Dave deCalesto, left, and Graduate Assistant Gary Whitmer. Jaws of the trap are padded to prevent injury to the coyote, and a bag of tranquilizer is attached. Chewing the bag calms the animal and makes it less likely to injure itself while it awaits tagging and release.*

Information Crossfile

"The western United States has scores of volcanoes likely to erupt in the future; some of them may be waking from long slumbers."

This is the "overline" on "Volcanoes to Keep an Eye On," by Richard A. Kerr, an article appearing in the "Research News" section of the August 12 issue of ***Science*** (Vol. 221). The report is based on a recently released preliminary list of more than 35 U.S. volcanoes likely to erupt in the future. The report, by R.A. Bailey, P.R. Beauchemin, F.P. Kapinos, and D.W. Klick, is titled ***The Volcano Hazards Program: Objectives and Long-Range Plans*** (USGS Open-File Report 83-400, 1983), and it cautions that Mount St. Helens could be "only the harbinger of renewed volcanic activity in the western United States."

Kerr's article describes 75 centers of activity arrayed in linear bands extending from the north-south trend of the Cascades in Oregon and Washington eastward through Idaho to Yellowstone, and southeastward along the entire California-Nevada border. Another band curls from southeast Utah throughout Arizona and New Mexico.

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"The interactions of acid rain, acid soil, and vegetation need to be carefully examined on a watershed basis in assessing benefits expected from proposed reductions in emissions of oxides of sulfur and nitrogen," according to Edward C. Krug and Charles R. Frink. Their article, "Acid Rain on Acid Soil: A New Perspective," appeared in the August 5 issue ***Science*** (Vol. 221). Krug is an assistant soil scientist at the Connecticut Agricultural Experiment Station and Frink is chief of the Department of Soil and Water and vice director at the Station.

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The massively destructive spruce budworm, villain of defoliation outbreaks in every western state except California in the past 60 years, is the object of an accelerated research and development program jointly entered into by the U.S. and Canada in 1977 and now in the fifth year of a six-year charter. A report on the progress of this research – building on 30 years of studies by Federal, State, and local agencies and institutions – appeared in the March 1983 issue of USDA/FS ***Forestry Research West.***

The story, by Sam Frear, tells of 300 studies that will be completed by 1984, providing data on budworm populations, damage evaluation, stand dynamics and prognosis, economic impacts, sustained biotic controls, suppression strategies, and pest management systems. A technology transfer working group has concluded that the most effective information base at the end of the program will be a three-volume user's manual. The documents will summarize the basic entomological and host tree research effects on, and guidelines for, protection of individual trees and stands, and the implications of the budworm on a forest and regional basis for forest planning and policy.

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A July 26 story in the ***New York Times*** trumpets to the world the news that "animal and plant life is returning to the Mount St. Helens volcano." John S. Edwards, a University of Washington zoology professor who is one of 200 scientists conducting research on the volcano, states that animals and plants of the Northwest are good at colonizing as a result of the history of volcanic eruptions in the region. "The initial interest was on volcanology and geology," Edwards said, "but from here on out, it's a biological phenomenon."

James A. MacMahon, a Utah State University biology professor, is quoted in the ***Times,*** saying "The amazing part of it to me is just how many plants and animals survived the blast. let alone how many have recolonized."

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An article by Jeremy Harrison, "Maintaining a Database On the World's Protected Areas," in ***Parks,*** Vol. 7, No. 4 (1983), discusses the need for centralized information sources in such areas as technical evaluation and management of protected areas, genetic resource conservation, and a wide range of related research topics. Harrison is a member of the IUCN Conservation Monitoring Centre staff, responsible for running the Protected Areas Data Unit. He makes a strong plea for the development by international agencies of data collection systems that provide quick, large-scale overviews, plus details of the subject area.

He describes the Protected Areas Data Unit (PADU) inaugurated in May 1981 as part of the IUCN's Conservation Monitoring Centre – its updating, correction, and use, and its extremely manipulable character. ("Information from the data files can be sorted/selected using any combination of characters of groups of characters within the file. Lists could be produced ... laid out by political unit, or by biogeographical unit, in alphabetical order, by order of size, and so on . . .")

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The June 10 issue of *Science* (Vol. 220) contains abstracts of five papers dealing wth patterns of plant and animal extinction, taken from the Sixth Annual Spring Systematics Symposium at the Field Museum of Natural History, Chicago, held May 13-14, 1983. Papers reviewed dealt with the importance of competition in plant extinctions by Andrew Knoll of Harvard; the modern version of the meteor impact hypothesis relating to the Cretaceous/Tertiary extinction by Walter Alverez of the University of California, Berkeley; plant extinction patterns in mountain refuges in the U.S. Southwest by Bruce Patterson of the Chicago Field Museum's Department of Zoology; speciation and extinction in hominid evolution viewed in parallel with shifts among contemporary herbivores and carnivores by Alan Walker of Johns Hopkins University; and the relevance of bird population and habitat data to old and new extinctions by Jared Diamond of the University of California at Los Angeles.

Proceedings of the 1983 Systematics Symposium are being published by the University of Chicago and will be available in the spring of 1984.

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Trends in Computers in Parks and Recreation is the theme of the latest issue of ***TRENDS,*** Vol. 20, No. 1. Published jointly by the NPS and the National Recreation and Park Association, the magazine deals with the positive steps in the computer field being taken by the park and recreation profession, the problems yet to be overcome, and the question marks that crowd the future. Articles cover maintenance scheduling and management systems, labor cost-tracking systems, computer assisted reservatons, and plant management systems. "The Paperless Office" looks to computers to pick up the productivity lag among white-collar (4%) compared to blue-collar workers (84%) as information becomes an economic commodity accounting for 50 percent of the GNP.

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Three recent publications from the USDA Forest Service Intermountain Forest and Range Experiment Station of special interest to the National Park Service are:

(1) ***Assessing and Monitoring Back-country Trail Conditions,*** by David N. Cole, Res. Pap. INT-303, 10 p.

(2) ***Monitoring the Condition of Wilderness Campsites,*** by David N. Cole, Res. Pap. INT-302, 10 p.

(3) ***Problems and Practices in Wilderness Management: A Survey of Managers,*** by Randel Washburne and David N. Cole, Res. Pap. INT-304, 56 p.

Limited copies are available for distribution and may be had by writing the Station at 507 25th St., Ogden, UT 84401.

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The Hon. John Roberts, Canada's minister of the environment, opened the June 14 conference in Quebec City on Acid Rain and Forestry with the statement that 4,600 Canadian lakes now are dead; another 12,000 are moving toward the same condition; 18 percent of the lakes and 21 percent of the stream miles in the U.S. east of the Mississippi show acid rain damage. (This last statistic comes from the U.S. Congressional Office of Technological Assessment.) "Some of the best-documented acid rain losses to sportfishing stocks are American losses," Roberts said. "These include elimination of all fish in 180 lakes in the Adirondack vacation area of upstate New York."

Roberts compared the acid rain situation to the early 1970s threat to Lakes Erie and Ontario, when the process involved dealing with an escalating environmental problem on the basis of "managing risk – of taking decisions with necessarily limited scientific understanding – limited in the sense that at the time the decision must be made, scientific knowledge was not yet complete and would undoubtedly produce further useful data later.

"In my opinion," said Roberts, "we are now in the same position with regard to acid rain. We are ready to deal with acid rain on the basis of managing risk, using the knowledge we have so far."

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An important new clue to the uses to which prehistoric tools were put is reported in the June 17 (Vol. 220) issue of ***Science.*** The article is entitled "Prehistoric Blood Residues: Detection on Tool Surfaces and Identification of Species of Origin," by Thomas H. Loy of the British Columbia Provincial Museum, Victoria, BC V8V 1X4.

Detailed microscopic and chemical examination of tool surfaces (chert, basalt, and obsidian tools from 1000 to 6000 years old) show definite surface blood deposits, the presence of amino acids, hemoglobin, and red blood cells. Animal and plant tissue, feather barbules, and hair fragments also have been observed. The blood residues have been identified as belonging to humans, caribou, Columbian black-tailed deer, Stone Mountain sheep, moose, grizzly bear, snowshoe rabbit, and California sea lion.

The tools examined came from open-air sites along the western coast and the northern boreal forest of Canada.

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The ability to construct age profiles of fossil accumulations, using single teeth, is considered in an article by Roger Lewin appearing in the July 29 (Vol. 221) issue of ***Science.*** Lewin begins with the premise that the need for reliable mortality profiles in fossil assemblages is clear, and then asks "How do you get there?" He discusses a technique described (in Paleobiology Vol. 9, No. 70, 1983) by Richard Klein and Kathryn Cruz-Uribe of the University of Chicago that is based on the cumulative wear that teeth suffer through an animal's life. (Mandibles have an order of magnitude better preservation than other parts of the skeleton, and teeth have an order of magnitude better preservation than mandibles.)

Lewin describes the formulation involved in such profile building and then quotes Klein and Cruz-Uribe as calling it "an extremely tedious process to perform." Because the tedium is a source of all too easy error, Klein and Cruz-Uribe have devised a program that generates a mortality profile divided into 10 percent-of-potential-life-span intervals – a program the Chicago pair say "should substantially reduce the tedium and possibility of error."

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Do plants have some secret way of fighting off the moose of Isle Royale?

Will the wolf population (now at a fighting trim of 23, in three packs), remain more or less the same for the next several years?

An information-packed feature story on the Michigan natural science study of wolves and moose on Isle Royale graced the front page of the ***Wall Street Journal*** on Sept. 16, 1983. Written by Robert L. Simison, the article describes the history of wolf/moose relationships since the first wolves trotted across the ice to the island (15 miles) from Canada in 1949. The studies, begun by Dr. Durward Allen, are now being carried on by Rolf Peterson – "wolf man of Isle Royale National Park."

Instead of an arrived at "delicate natural balance," a "seesaw of survival" seems to be the order of nature. Wildly fluctuating populations of both species have been recorded, with factors never known or considered now entering the equation.

Presently, Peterson is "trying to sort out how the seesaw is affected by snowfall patterns, a nasty little tapeworm, the mysterious intricacies of wolf society, and the eating habits of moose," according to Simison. At least three more years of research are needed to test the current theories.

Vulture Research Begins at Gettysburg

***Like some Halloween** apparition, this lone Gettysburg vulture surveys the scene.*

By Victoria Brenner Greenlee

It all began a few years ago with a friendly argument between the newly arrived Natural Resource Management Specialist and the YCC Camp Director, a native of the area. In reality, it may have begun over 100 years ago, and the story gained in status and embellishment until it became local folklore, recounted to thousands of historically-minded Americans by the Battlefield Guides at Gettysburg National Military Park (NMP) in Pennsylvania.

The argument, and the legend, hold that today's unusually large colony of vultures on the battlefield is a direct result of the aftermath of the three day battle. Also, being very long-lived birds, some of those birds now soaring above the Round Tops and eyeing visitors and Park staff may have cast the same hungry eyes at the bodies of the unfortunate horses and soldiers in July, 1863. Naturally, being a native, the YCCer supported the folklore while the Park staffer cast a jaundiced eye at the whole idea.

After a bit of background study, Natural Resource Management Specialist Hal Greenlee found that Gettysburg's vulture population was indeed unusual, not just its size, but also in the fact that it included a large concentration of black vultures, whose known range is more southerly in nature. He found that very little authentic scientific research had been done on vultures anywhere in the United States, and after several years of talking, asking, cajoling, and conjecturing he was able, with the help of NPS Regional Scientist John Karish, to set up such a study.

Turkey and black vultures are important components of the fauna of Gettysburg NMP from ecological, aesthetic, and historical points of view. Ecologically, the vultures are the largest avian scavengers regularly observed in the park. They are capable of rapidly removing the carcasses of dead animals in or near the park and thus recycle the nutrients involved.

From aesthetic and recreational points of view, the vultures, as the largest soaring birds and most conspicuous social animals in the park, afford visitors the opportunity to view exceptionally beautiful aerobatic performances and interesting animal behavior at close range. The birds also are tied closely to the history of the park because, whether or not vultures were actually present before the the battle, it is likely that the carrion provided by the large numbers of dead horses resulting from those three days in July 1863, did indeed attract vultures from other areas.

Because Gettysburg NMP is currently involved in a large-scale vegetative restoration program designed to restore the 1863 historic scene, such restoration would be incomplete without the Gettysburg vultures. The current population ranges from about 200 birds in summer to 800 in winter. The terrain in the area of their identified roosts is wooded and rocky with farmfields, pastures, and historic farm buildings nearby. The casual observer can see vultures in all these locales at any season. In some cases, the observer can get close enough to see clearly such features as the featherless head, small eyes, ear openings, etc.

In 1981, 11 people interested in promoting research on black turkey vultures in the eastern United States met at the Park to discuss the voids in knowledge of the ecology and management of vultures and to initiate a long-term research program in the Park. In addition to Resource Management Specialist Greenlee and Regional Scientist Karish, representatives attended from the School of Forest Resources of the Pennsylvania State University, Pennsylvania Cooperative Fisheries and Wildlife Research Unit, the U.S. Fish and Wildlife Service (USFWS), the Department of Fisheries and Wildlife Science, Virginia Polytechnic Institute and State University (VPI & SU), and Eastern National Park and Monument Association (ENPMA), a non-profit organization operating in many eastern national parks.

As a result of the meeting, a two year, in-depth study of the vultures has been undertaken by the universities involved. National Park Service contributions will consist of logistical support and coordination, housing for the researchers, use of a vehicle for the program duration, and use of equipment such as spotting telescope, binoculars, etc. The ENPMA has agreed to fund part of the project, their first plunge into natural research, at a rate of $7,500 per year. These funds are being used to purchase radio transmitters, tags, airplane and helicopter tracking time, etc. At present, it appears that the USFWS has had to drop out of the study due to recent budget cuts, although they are funding part of Penn State's study.

Anthony Wright, a Master's degree student at the Pennsylvania State University arrived in Gettysburg in December 1982 to begin the part of the study to be accomplished by that University. He is living in the historic Slyder farmhouse on what is known as the Granite Farm, right in the middle of one of the identified winter roost areas. During the past winter and in 1983-84, he and other Penn State Biologists will be estimating population densities of black and turkey vultures at nocturnal roost sites, examining fluctuations in winter densities at these sites and determining which areas of the park function as actual roost sites, as opposed to staging areas prior to roosting. The emphasis of the Penn State study next winter will be given to describing and comparing habitat features of roost sites, determining diurnal use by both species of vultures and determination of habitat preferences and requirements.

Methods used include regular censusing of potential roost sites at dawn and dusk using a spotting scope and/or night-vision scope. A minimum of 11 habitat variables will be quantified around each roost tree. Statistical analyses will be made comparing actual roost sites with control sites. Land use features surrounding roost sites and distances from these sites to the nearest human dwelling, road, or activity will be measured.

Wright and his advisors Dr. Richard H. Yahner and Dr. Gerald L. Storm also are utilizing the services of selected members of the local Audubon Chapter in making their observations.

During the summer just passed, John Coleman, a Master's Degree student at Virginia Polytechnic Institute and State University and his advisor, Dr. James D. Fraser worked at the site with a team of researchers. Objectives of the two-summer Virginia Polytechnic Institute program was to estimate the summer home range and foraging distances of Gettysburg's

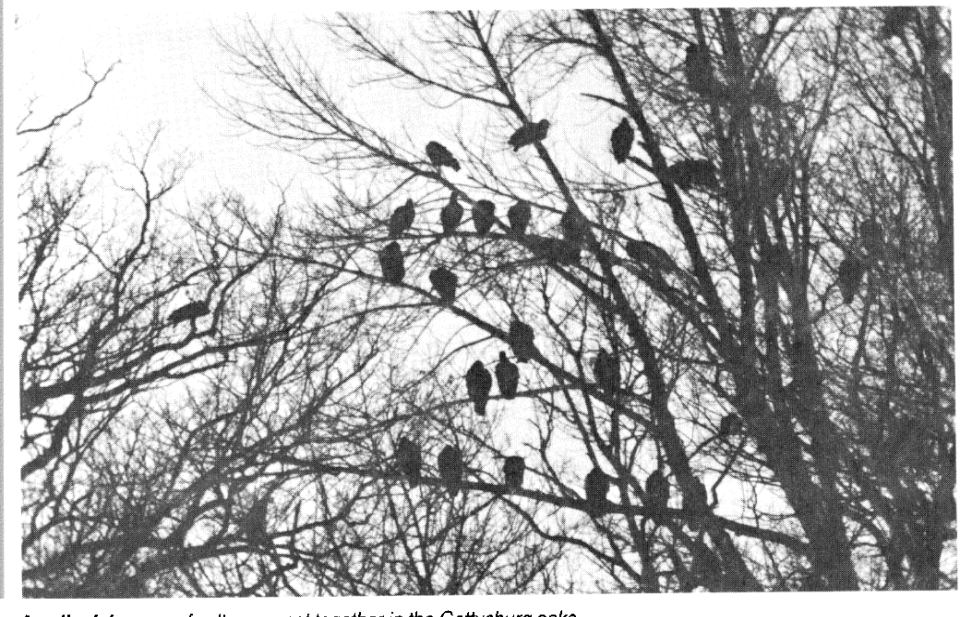
***Awaiting processing,** these trapped vultures stand in a holding pen. They will be weighed, tagged, and their blood sampled.*

black and turkey vultures, to determine whether important areas of congregation for feeding do exist, and, if they do, to locate and describe them. Their work involved capturing vultures using walk-in-traps, noose carpets, and cannon nets. Some captured birds were fitted with radio transmitters while others were marked with cattle eartags and patagial markers. Standard measurements were made on captured birds and blood was taken for hormone analysis. The radio-equipped birds will be followed by automobile and aircraft.

Both research teams are doing a complete review of the historical literature available on the Battle of Gettysburg to glean facts about the presence or absence of vultures during the battle. Results of the studies will be published as Master's theses by Wright and Coleman.

The results of all this natural research will be incorporated into the educational programs developed for visitors, adding a new dimension to their enjoyment of the Park. Increased information about the habitat requirements of the vultures will help Park officials plan and implement programs, such as restoration of the historic scene, so as not adversely to affect the vulture populations. National Park Service personnel will have explicit data and expertise available to counter any unfounded criticisms of Park management policies. Results also will contribute to development of urban forestry practices by identifying important wooded tracts used as roost sites. Features characterizing these sites can be delineated and incorporated into management recommendations of wooded habitats for vulture roost sites at other eastern Parks.

Radio transmission equipment *and tag are affixed to this vulture by John Coleman (left), wildlife biology graduate student at Virginia Polytechnic Institute and State University, his professor Dr. James D. Fraser (center), and Rose Norris, undergraduate wildlife biology student at VPI&SU, assisting in the field research. The radio equipment is made by the same outfit that has been fitting the California condors with tracking devices. Six of the vultures now are so equipped and are furnishing information on range and behavior patterns.*



A collegial group *of vultures roost together in the Gettysburg oaks.*

A compendium of historical fact regarding the vultures and the battle will be available to serious historians for the first time. The study will complete a priority research need, identified in Gettysburg's National Resource Management Plan at little cost to the Park and provide the scientific basis for a possible Eastern National Park and Monument Association publication on the subject. In addition to National Park Service benefits, this project will be affiliated with the Southeastern Vulture Research Project, so valid information obtained at Gettysburg will be available to all interested parties. Because vultures are thought to be decreasing in the Southeast, this benefit may take on increasing importance in future years.

Greenlee is a Volunteer-in-the-Park at Gettysburg National Military Park.

Cowles Symposium Held At Grand Forks Meeting

The annual meeting of the Ecological Society of America, held in Grand Forks, ND, August 7-11, 1983, was attended by Dr. Ron Hiebert, Dr. Doug Wilcox, and Mr. Norm Henderson of the Indiana Dunes Division of Science staff. All presented papers on current research activities at the Lakeshore. The papers were as follows:

Hiebert, R.D. *Succession in razed residential sites at the Indiana Dunes National Lakeshore.* The paper reported on effects of past land use on vegetation of razed residential sites.

Henderson, N.R. *Black oak woodlands of the southern Lake Michigan sand dunes:* structure, succession and fire. This paper reported findings on the effects of past fire history on the structure of oak woodlands at the Lakeshore.

Wilcox, D. *The aquatic macrophyte counterpart to plant succession studies at Indiana Dunes.* This paper reported on studies of aquatic plant succession in the interdunal ponds at Miller Woods.

As a part of the meetings, a Henry Chandler Cowles Memorial Symposium was held, featuring presentations from former students of Cowles and others receiving degrees from the University of Chicago. The meeting emphasized the outstanding contributions that Cowles made to the field of Ecology, the Ecological Society of America, and the University of Chicago. Friends and students of Henry Cowles depicted him as a teacher who was sincerely interested in his students and who taught them to solve problems. Speakers also referred to Cowles' sense of humor; examples included Cowles' eating a banana in one bite while on a field trip to the dunes. A tape of the proceedings will be acquired for the Lakeshore.

Dr. James Teeri, who presently holds the position created for Henry Cowles at the University of Chicago, reported on current activities. He expressed a strong interest in reestablishing close ties between the University and the Indiana Dunes. He also volunteered to share approximately 1,000 slides taken of the Indiana Dunes by Henry Cowles between 1896-1930. These photographs are of high quality and should be a great asset to interpreting the changes in vegetation in the Lakeshore over the last century. Dr. Hiebert of our staff and Dr. Teeri will meet soon to develop cooperation in research for the future.

Razed Residential Sites Restored At Indiana Dunes

By Ronald D. Hiebert

The Indiana Dunes, located along the shores of the southern tip of Lake Michigan, have been recognized since the turn of the century as a unique landscape supporting unusual vegetation assemblages. The publications on plant succession in the dunes by Henry S. Cowles (1900, 1901) established the area as the "birthplace of ecology" and as a natural laboratory to study natural processes. Efforts to save the area from development began as early as 1909.

The first director of the National Park Service, Stephen Mather, held hearings on a proposal to make the dunes a national park in 1916. However, it was the state of Indiana which acted first to save the dunes when it created a 2,200 acre state park in 1923. It was to take the efforts of many dedicated conservationists another 43 years before authorization of the Indiana Dunes National Lakeshore would become a reality. Through the original authorization and additional legislative authorizations in 1976 and 1980, the Lakeshore now consists of over 13,000 acres.

Unfortunately, the dunes were not exempt from development during the first half of the century; the area surrounding the park became one of the largest industrial complexes in the United States. In addition, it attracted low density residential development. The South Shore Railroad made it convenient for people to commute daily to Chicago from the dunes. More than 600 past and present residential sites lie within the boundaries of the Lakeshore. About half have been razed to date; the others are under reservation-of-use agreements, some extending until the year 2010. Most of the residential sites are located within areas of the Lakeshore designated "natural zone." The management goals in areas thus designated are to restore and/or manage for the protection of natural ecosystems for the education and enjoyment of the public.

Residential use modifies the natural communities directly and indirectly in many ways. Natural vegetation is removed; exotic plants and non-biodegradable materials are introduced; and soil characteristics are modified. Studies are in progress to aid in understanding the effects of these perturbations on the recovery process, and to identify specific problems that can be mitigated or eliminated through active management.

The study began with a survey of 250 razed residential sites to get a feeling for the extent of the problem, to identify specific factors which appear to influence the revegetation process, and to select sites for study. Factors which appeared to affect succession were (1) introduced exotic species, (2) the distance to and composition of seed source, and (3) past land use (i.e. lawns, building site, drive, garden).

Based on the above observations and a thorough review of existing literature on secondary succession, studies were designed in an attempt to describe the succession process and to determine the effects of past land use, seed source, and site condition over time. Thirty sites were selected; 15 on uplands, surrounded by black oak woodlands, 15 in lowlands, surrounded by swamp white oak/maple dominated forests. Sites cleared in 1971, 1973, 1975, and 1979 are represented. Each site was mapped, indicating

Sampling vegetation *at an old home site, Vicki Dunevitz and Dale Otto (top) set up their sample plot. The center picture shows a typical gravel road four years after abandonment. An "old lawn" in the lower picture provides a rich research resource for Ron Hiebert and biological technicians as they seek answers to questions of the struggle for dominance between lawn grasses and native species.*

size, past land uses, and woody vegetation over 1 m in height. The site boundaries also were described. Herbaceous and small woody vegetation within old lawns, building sites, drives, and gardens were sampled at each study site in 1982 and will be resampled in 1983. Permanent photo stations also were established to estimate vertical cover (ground cover and vertical cover are being used to estimate relative productivity) and to allow monitoring over time.

The initial field studies will be completed in the fall of 1983. The data collected in 1982 have not been fully analyzed, yet, but some preliminary observations are possible. First, succession on razed residential sites does not fit the descriptions of old field succession in the Midwest. Past land uses appear to significantly influence the rates and patterns of revegetation. As would be expected, revegetation in old gardens most closely resembles that observed in old fields. Establishment of native species in actual building sites is relatively rapid, and in lawns very slow. Species richness on old drives is relatively high, but consists mainly of exotic and/or weedy native species.

A few exotic species appear to retard recovery of sites and/or are spreading into surrounding natural communities. These include black locust, several species of honeysuckle, tree of heaven, and multiflora rose. Means of eradicating and/or controlling the spread of these species deserve further attention. For example, Kentucky blue grass and fescue lawns are found to be persistent for a minimum of 10 years and to retard establishment of native species. Thus, methods to decrease the dominance of these lawn grasses are being investigated, including testing the effects of fire and stratification.

Also, the proximity and quality of seed source correlates highly with species composition within the disturbed site. For example, if the area is surrounded by mature native communities, colonization by native species is rapid and vice versa. Finally, if the site is cleared of non-degradable materials and exotic species, topped with a layer of bare soil, and a quality seed source is adjacent to the site, recovery towards that of the surrounding natural community is rapid. The vegetation of the Lakeshore appears to have a high degree of resiliency.

Based upon these preliminary observations, the specifications for future demolition contracts are being modified to include stratification of lawns, removal of all non-biodegradable materials and long-lived exotic species. Also, the sites are being topped with native soil so as to provide an open habitat for establishment of native vegetation. In addition, the initial survey identified potential safety and health hazards (i.e. open cisterns, caved-in septic tanks). This information has aided administration in setting priorities for which sites would be cleared first.

The present prescriptions for the razing of residential sites at the Lakeshore will mostly likely be modified based upon additional insight gained from further studies and complete data analysis. However, the utility of the information gained from these studies already is apparent as a guide to the management of the Lakeshore's natural resources. There is reason to be optimistic that former residential sites eventually will blend in with their surrounding natural communities.

Hiebert is a botanist and Chief of the Science staff at Indiana Dunes NL.

Tetons Sponsor Resource Training

By William Supernaugh

A Bootstrap Program – that is the best description of Grand Teton National Park's "Orientation to Natural Resources Management" held April 26-28, 1983. The 24-hour course is a fresh approach to meeting a specific park's objectives and training needs. While modeled in part after Albright Training Center's 40-hour course, "Natural Resource Management – Midlevel," course coordinator John Daugherty modified the agenda to conform to the resource management program of Grand Teton. The 35 attendees were representative of the park staff in general – coming as they did from maintenance, protection, interpretation, and administration.

The impetus for the training course arose during early 1982 while the park staff was grappling with the evolving Resource Management Plan. As Project statements were developed, the authors detected a sense of unsureness regarding interdivisional responsibility for carrying out various portions of the plan. The whys and hows of backcountry and river management, wildlife control programs, restoration of acquired land, and similar specific programs were not always understood by members of the staff who were not directly involved with a particular endeavor. Supt. Jack Stark and Asst. Supt. Bill Schenk endorsed the proposed training course as a means of building a parkwide understanding of their resource management objectives, an awareness of administrative and legal constraints on management alternatives, and a greater familiarity with the nitty-gritty details of many of the monitoring, management, and research activities being carried on within the park.

The three-day course gave park employees an opportunity to learn of the evolution of natural resource management within the Park Service as presented by Yellowstone Supt. Bob Barbee; the planning process and resource management responsibilities were explained by Denny Galvin, Denver Service; NEPA and complementary environmental protection laws and regulations were covered by Bill Supernaugh, WASO. A panel discussion of public involvement responsibilities and strategies in developing support for resource programs leaned heavily on the past experiences of Superintendents Stark and Barbee.

Regional Chief Scientist Jim Reid covered the Significant Resource Problem (SRP) submissions and the role of research in managing park resources. Teton Resource Specialist Bob Woods, along with park biologists Bill Barmore and Pete Hayden, addressed specific projects included within the park's draft plan, thus giving a better understanding of what was needed in the way of personnel and logistical support, maintenance requirements, potential user conflicts, items of local concern, and alternative ways to solve problems – including those which were considered and rejected.

Additional coverage included human use and occupation of Jackson Hole, status of the grizzly bear, and an introduction to the ecology of the area.

I was greatly encouraged to see a class of such diverse background focus on the resource management theme, as each member of the staff viewed the program from the perspective of his/her job. Open discussions among Division Chiefs can only help clarify the role and responsibility each may have for implementing or supporting part of an integrated program. The apparent value of such a course is that it meets the basic "need-to-know" requirement of employees working in a medium to large park with scattered work sites and duty stations and having a fairly complex resource management operation. Secondly, communication ladders and bridges become established, permitting freer information transfer up and down the chain of command as well as back and forth among divisions. Lastly, there was strong evidence of improved "team building" with staff members coming together to lend their talents, interests and job skills to the development and implementation of a park-wide resource management effort.

Persons interested in developing a similar course for their park are encouraged to contact John Daugherty or the Training Committee at Grand Teton National Park.

Supernaugh is a wildlife biologist with the Biological Resources Division, WASO.

Cooperative Regional Projects Described

A proposal to use Biosphere Reserves as the focus of integrated projects on a regional ecological scale to demonstrate solutions to conservation and resource management problems was made to the First International Biosphere Reserve Congress, held in September in the USSR. The paper, entitled "Cooperative Regional Demonstration Projects: Environmental Education in Practice," was delivered by Vernon C. (Tommy) Gilbert, Regional Representative for Environmental Training and Management in Africa (ETMA), P. O. Box 67839, Nairobi, Kenya.

Gilbert pointed to two Man and the Biosphere (MAB) projects that have influenced development of the Cooperative Regional Demonstration Project (CRDP) approach – the Biosphere Reserves at La Michilia and Mapimi in Durango, Mexico. There, under the leadership of Dr. Gonzalo Halffter and his colleagues in the Institute of Ecology in Mexico, scientists, politicians, and local people work together to improve conservation of natural resources of the region and at the same time raise the economic and social level of people living in and around the reserves.

Gilbert quotes Dr. Halffter: "It is not Utopian to believe that new strategies for ecological development can spring from the Reserves: on the contrary, this is an objective of no less importance than the conservation of the germ plasm."

The situation in Kenya was characterized by Gilbert as "increasing, horrifying, long-term loss of natural resources for short-term returns" and one that was likely to get worse unless there was "concerted national action organized and expressed right down to the users of the country's resource base."

Gilbert's last position with the National Park Service before retiring in 1981 was NSP/AID Environmental Project Manager. Before accepting the African assignment, he served a term as Director of the International Science and Technology Institute in Washington, D.C.

regional highlights

North Atlantic Region

John Portnoy, our regional Research Biologist, has been reassigned to the Planning Division, Cape Cod National Seashore, as part of the regional realignment process.

We have successfully established a coastally-oriented Cooperative Research Unit at Rutgers University, New Brunswick, N.J. This major component of our three-region (NAR, MAR, SER) Barrier Island initiative, has been funded through the Significant Resource Problem (SRP) process. The flexibility of the Cooperative Research Unit approach plus a negotiated matching fund ratio of 1:1 makes this an exciting opportunity for solving management problems in the coastal parks of our three Regions. NAR Chief Scientist P.A. Buckley has been assigned as Director of that Unit and will leave Boston this fall to take up those duties at Rutgers.

Southeast Region

The South Florida Research Center at Everglades NP announces the following list of publications, available through the National Technical Information Service, U.S. Dept. of Commerce, 5285 Port Royal Rd., Springfield, VA 22161:

SFRC-83/01 **Status of the Eastern Indigo Snake in Southern Florida National Parks and Vicinity** by Todd Steiner, Oron L. Bass, Jr., and James A. Kushlan;

SFRC-83/02 **Population Structure, Food Habits, and Spawning Activity of Gray Snapper,** *Lutjanus grieseus,* **in Everglades National Park** by Edward S. Rutherford, Edith B. Thue, and David G. Buker;

SFRC-83/03 **Age and Growth of Four Everglades Fishes Using Otolith Techniques** by P. William Haake and John Mark Dean.

For more information, call Jessie Brundige at 350-4653.

* * *

Two new reports have been added to the Research/Resources Management Series published by the Southeast Regional Office. They are:

R/RM Report SER-64: **Impacts and Influences on the Great Smoky Mountains National Park: An Annotated Bibliography with a Discussion and Review of Selected Findings, Recommendations, and Conclusions** by David E. Carpenter. This 245-page document describes and provides references to works containing information about external impacts and influences on Great Smoky Mountains. Subjects covered include development in the southern Appalachian region, demographic changes, federal lands management, highways and road development, timber cutting, oil and gas exploration and development, and air and water pollution. Copies of this report can be obtained through Stan Canter or the Uplands Field Research Laboratory at Great Smoky Mountains National Park, Gatlinburg, Tennessee 37738.

R/RM Report SER-65: **Coastal Erosion at Cape Hatteras: A Lighthouse in Danger** by Lorance D. Lisle and Robert Dolan, University of Virginia. This report analyzes records and surveys of the shoreline position of Cape Hatteras dating back to 1852, and predicts a 2005 A.D. shoreline position approximately 100 meters *west* of the Cape Hatteras lighthouse, based on the results of the University of Virginia's COAST computer analysis program. Copies are available through the Southeast Regional Office, 75 Spring Street S.W., Atlanta, Georgia 30303.

* * *

In an article focusing on colonial water birds in U.S. National Parks, James A. Kushlan of the South Florida Research Center at Everglades NP suggests that ecosystem management in reserves cannot, alone, protect populations – that "a regional strategy is imperative."

The article, which appeared in *Environmental Management,* Vol. 7, No. 3, starts from the fact that "reserves seldom encompass complete ecosystems" and suggests that "the varying management strategies found within the array of existing and potential reserves must be the foundation for the conservation of some special species." He concludes that "because happenstance should not dictate the future of colonial water bird populations, region-by-region management plans that specify the role of each management area and assign goals may be useful."

* * *

Southeast Regional Director Bob Baker and other Regional officials heard a presentation entitled, "Acid Rain: Its Causes and Consequences in the Environment," given by Dr. Ellis B. Cowling in the Regional Office on Aug. 23. Cowling, Associate Dean for Research, School of Forest Resources at North Carolina State University, and Chairman of the United States' National Atmospheric Deposition Program (NADP), reported that readings taken during the past few years show acid rain affects every state east of the Mississippi River. Areas most sensitive, he said, include the southern Appalachian region where Great Smoky Mountains National Park is located.

He commended the NPS for its cooperation and continuing acid rain research efforts. "One of the greatest strengths of the National Park Service, in comparison to some of the other agencies within the NADP program, is that it has people on the ground who care," said Cowling.

Western Region

Exciting research findings are issuing from a University of California-Berkeley Museum of Paleontology study in Petrified Forest NP. This study, now in its third season, has uncovered more than 20 new species of late Triassic thecodonts and early Jurassic dinosaurs. Dr. Kevin Padian is the principal investigator of this independently funded project. One new species, *Anamanasuchus rectori,* has been named after Supt. Roger Rector, who has been very supportive of the UC-Berkeley project. Dr. Padian is preparing a large NSF grant proposal in an attempt to expand the study into a major research effort over the next three years.

* * *

Dr. Chuck Stone, Research Scientist at Hawaii Volcanoes NP and Dr. Michael Scott, Team Leader of the USFWS Hawaiian Forest Bird Survey Team, have announced a symposium on Protection and Management of Terrestrial Hawaiian Ecosystems, to be held at Hawaii Volcanoes National Park June 12-13, 1984.

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Dr. Reginald R. Barrett, Wildlife Professor in the University of California, Berkeley Department of Forestry and Resource Management recently completed a seven month sabbatical in Hawaii Volcanoes National Park working with the park staff on the feral pig problem.

Dr. William Halvorson, Dr. Christine Schonewald-Cox and Jonathan Bayless officially transferred from WASO to the Western Region Natural Science Program rolls on July 31, 1983. Dr. Halvorson will be duty stationed at Channel Islands NP and will move soon to California. Dr. Schonewald-Cox and Bayless will be duty stationed at the University of California, Davis CPSU and will move to California in May, 1984.

* * *

Reprints now are available for three articles by Charles van Riper III that have appeared within the past year in *Condor,* the *Wilson Bulletin,* and *The Auk.* From *Condor* (84:117-119) comes "Within-Territory Division of Foraging Space by Male and Female Amakihi (Loxops virens)," by Alan C. Kamil and van Riper; from the *Wilson Bulletin* (94:4, 463-467) comes "Censuses and Breeding Observations of the Birds on Kohala Mountain, Hawaii," by van Riper; and from *The Auk* (99:667-674) comes "Temperature Regulation in Two Endangered Hawaiian Honeycreepers: The Palila (Psittirostra bailleui) and the Laysan Finch (Psittirostra cantans)," by Wesley W. Weathers and van Riper.

Van Riper is leader of the NPS/CPSU at Wickson Hall, University of California, Davis, CA 95616.

* * *

Four Western Region natural scientists, Denny Fenn, Gary Fellers, Charles van Riper and Gary Davis, recently joined with Denver Service Center, Western Archeological and Conservation Center and Channel Islands NP staff in a special Interdisciplinary Science Team pulse on Santa Rosa and Santa Cruz Islands to gather data in support of the planning effort at Channel Islands. Doug Cornell, DSC planning team leader for Channel Islands, coordinated the pulse effort.

* * *

David J. Parsons, research scientist at Sequoia/Kings Canyon NPS, is either the sole or the contributing author of four papers published recently on park-related subjects. Significant inaccuracies in the reporting of backcountry use permit data and their effect on management decisions are discussed in "Wilderness Permit Accuracy: Differences between Reported and Actual Use." The article appeared in *Environmental Management,* Vol. 6, No. 4, and was co-authored by Thomas J. Stohlgren, also of NPS, and James M. Kraushaar of the University of Vermont School of Business.

The Proceedings of *Symposium on Dynamics and Management of Mediterranean-Type Ecosystems,* published as General Technical Report PSW-58 by the SW Forest and Range Experiment Station, USFS, contains the following papers: "Fire Management and Vegetation Effects in Mediterranean-Type Ecosystems: A Summary and Synthesis," by Parsons; "Post-fire Recovery of Chamise Chaparral in Sequoia NP," by Gail A. Baker, Philip W. Rundel, and Parsons; and "Using Stem Basal Area to Determine Biomass and Stand Structure in Chamise Chaparral," by T.J. Stohlgren, N.L. Stephenson, Parsons, and P.W. Rundel.

* * *

Technical Report No. 13, *Levels of Selected Micronutrients in Soils and Vegetation and Dietary Implications for Tule Elk at Point Reyes National Seashore,* is available now from the University of California, Davis, CPSU 95616, according to Charles van Riper III, Unit Leader (916) 752-7119. Authors are M. Akeson, Research Assistant; L.D. Whittig, soil morphologist; R.G. Burau, soil chemist; V.V. Rendig, soil chemist, and R.D. Meyer, specialist.

The investigation was conducted to provide further insight into the suspected dietary nutrient imbalance

Hacking Runs Gamut of Peregrine Perils

By Jonathan B. Jarvis

Planning for the 1983 manipulation of the endangered peregrine falcons at Crater Lake NP began much as it had in the previous two years, (*Park Science* Vol. 2, No. 4). A cooperative effort by the Park, the Oregon Department of Fish and Wildlife (ODFW), and the Predatory Bird Research Group (PBRG) of Santa Cruz, Calif., established a site observer in March at a station near the historic aerie.

Anticipating the return of the nesting pair of peregrines, plans were made to replace the eggs with fledglings as had been done the past two years. Logistical support for the site observer, Randy Wilson, was only slightly hampered by a record snow accumulation of 21 feet.

The first bird to arrive at the aerie was a male, identified from markings as the nesting male of past years. For 30 days he wailed from the vicinity of the ledge. In late April, a female peregrine arrived, but the color markings and a leg band indicated she was not the nesting female of past years. She was at least a two-year-old adult, and quite possibly one of the two females fledged at the aerie in 1981. Since the nesting female of past years was thought to be an older bird, her failure to return was interpreted as indicating she had not survived the winter migration.

Disaster Strikes

Park staff spirits soared as courtship and prey exchanges were observed between the male and the new female. However, after just one week of courtship, disaster struck. The male failed to return from a hunting trip, presumably having fallen prey to accidental death or to intentional shooting by man.

For days the female wailed from the ledge, calling for her mate to bring food. Seven days after the male had disappeared, a new peregrine, thought to be an immature (one-year-old) male, arrived at the aerie. The female and this new immature began interaction and bonding behavior.

Soon thereafter, an egg was laid on the ledge, but since no copulation had been observed, the egg was thought to be unfertilized – probably laid as the result of the intense courtship activity. This conclusion was verified by the lack of interest and incubation by the female as she intensified the courtship and bonding with the immature male.

While the bonding raised new hopes for a viable nesting pair next year, hopes for a 1983 success were dashed. The immature male and the mature female would not be capable of producing a successful nesting this year.

Alternatives Considered

Park and ODFW personnel met to determine the alternatives for saving Oregon's only known peregrine nest. Wilson reported he had now seen a total of three banded peregrines in the aerie vicinity; an adult female, an immature female, and an immature male. This indicated that the previous years' manipulations were at least a 75 percent success, with the return of three out of four birds.

It was noted that with the loss of the adult male, the Park had a cumulative shortage of male peregrines for future nestings. The best alternative suggested was a "hacking" operation – a falconer's term for the imprinting and releasing of birds into an area. With this procedure, the Park population could be augmented with young male birds.

The aerie operation thus far had expended most of the Park's programmed funding for the peregrines, so to support the hacking operation, Park staff turned to the private sector. Proposals to Weyerhaeuser Company and to Recreational Equipment, Inc. produced $500.00 for helicopter support and $550.00 of camping equipment respectively. ODFW and the Park pooled money to purchase the peregrines from the PBRG in Santa Cruz and Park staff organized to provide logistical support to a remote location.

With the assistance of a USFS helicopter a "hack" site was located that provided reasonable accessibility, freedom from predators and distance from the historic aerie to prevent territorial conflicts with the returning immatures. The area was surveyed for the presence of great horned owls, a natural threat to peregrines, and found to be free.

Hack Box Flown In

On June 30, a 4' x 4' x 6' hack box was flown to the site and cabled to a ledge within the Crater Lake caldera. Three days later, two male and one female peregrines were flown from California to Chiloquin, Oregon. They were then driven to a helisport on the Park boundary and flown via helicopter to the site. Placed in the cage-fronted "hack" box, the three birds got their first breathtaking view from 1,000 feet above the Lake surface.

On the cliff edge 500 feet above the hack box, a camp was set up for hack site observer Randy Wilson. Wilson's duties included observing and recording the peregrines' progress, as well as scrambling down a skree slope before dawn each morning to provide the peregrines with a daily quotient of three quail each.

The quail, provided by ODFW, were cleaned and frozen and proved to be a major logistical problem of the operation. To prevent spoilage in the remote location, Wilson could store only a week's supply by burying a cooler in the snow. By the end of the "hacking," the peregrines had eaten over 400 quail!

One week after the peregrines were placed in the hack box, they were banded, fitted with leg mounted radio transmitters and released to the ledge. On July 11, all three tested their wings with the first flight. Until they developed their aerobatic skills, they were now the most vulnerable to predation by golden eagles and great horned owls. Only one day after release, Wilson observed an immature golden eagle attempt to catch the female peregrine.

Stress Produces Lethargy

Although the eagle attack was unsuccessful, its stress effect on the female was enough to produce lethargy, making the bird increasingly vulnerable to any repeat attempt by the eagle. For several days, Wilson and an assistant were able to fend off the eagle by shouting and rapid movements as it approached, but the eagle became increasingly accustomed to their actions and it was feared the female would be lost.

Acting on advice from the PBRG, Park rangers set up a vigil over the hack site, armed with blank-loaded shotguns that would fire a load noise to frighten the eagle. Fortunately, the two male peregrines developed their flying skills rapidly and eventually chased the eagle away.

Though flying well, the peregrines still were entirely dependent on the daily quotient of quail. Therefore, Park staff was concerned when the quail began disappearing soon after they were left on the ledge. A live trap brought to the ledge caught an immature pine marten the first night. It was transported 15 miles away to another area of the Park and released. The problem was not solved until three more pine martens were live trapped from the ledge and transported to other parts of the Park for release.

During the remainder of the operation, the peregrines ranged further each day from the security of the hack site. Reports came in of them being seen many miles from the ledge as they explored their new territory. In mid-August, they began returning with full crops and showed less interest in the provided quail.

Finally, on August 29, the park closed the hack site and discontinued feeding, confident that the three could fend for themselves. With luck, they will return in coming years to reestablish Oregon's only known nesting pair of these magnificent birds.

Jarvis is the Resource Management Trainee at Crater Lake NP.

Regional Highlights (Continued)

affecting the tule elk at Tomales Point, Point Reyes NS. Most importantly, copper levels in plant species and in soils were found to be low. Dietary imbalance for tule elk and other ungulates may be closely related to stress associated with grazing animal density, it was concluded. Five management recommendations are included in the report.

Pacific Northwest Region

A 65-page report, covering the second of a three-year experimental management program and titled *Mountain Goat Ecology and Management Investigations at Olympic National Park,* is now in publication form. Its authors, J. Aho, D. Houston, B. Moorhead, E. Schreiner, and R. Starr are all NPS employees. The third report, covering this year's experimental management program, will complete the study of Olympic NP goats and their capacity as an exotic species to alter pristine ecological relationships, and should contribute substantially to the ecological information on mountain goats – one of the least known ungulates of North America.

* * *

Gary E. Machlis, CPSU Sociology Project Leader at the University of Idaho and Donald R. Field, CPSU Sociology Project Leader at Oregon State University are editors of a book soon to be published by Oregon State Press (publication date Spring 1984). The tentative title is *On Interpretation: Sociology for the Communication of Natural and Cultural History.* The theme of the book is the application of sociology to interpretation. The volume is a collection of readings from over 10 years of research on selected clientele groups for whom interpreters provide natural and cultural history programs.

* * *

Donald R. Field, senior scientist (sociologist) and former Chief Scientist of the PNR, now at the Oregon State University NPS/CPSU, has received the 1983 Theodore and Franklin Roosevelt award for excellence in recreation and park research from the National Recreation and Park Association. The award was presented on October 2 by Harry G. Haskell, Jr., chairman of the NRPA board of trustees, at the NRPS Congress in Kansas City, MO.

Action Plan For Aquatic Research At Voyageurs NP

By Larry W. Kallemeyn

Approximately 85,000 acres of Voyageurs National Park's 219,000 total acreage is covered by water; over 95 percent of the water area is occupied by Lake Kabetogama and those portions of Rainy, Namakan, and Sand Point Lakes that lie within the park. In addition to the four main lakes, there are 26 smaller lakes, ranging in size from 20 to 740 acres. Small impoundments created by beaver dams also are abundant.

Most activities in the park center on the large lakes; recreational fishing is the principal visitor activity. Approximately 800,000 personhours are expended on the fishery annually with walleye, northern pike, sauger, and smallmouth bass being the principal species harvested.

Resources Issues

Regulated lake levels and acid precipitation have been identified as resource problems in the park's Resource Management Plan. Lake levels in the large lakes in Voyageurs NP are controlled by a dam at the outlet of Rainy Lake and by two dams on the outlet of Namakan Reservoir that control the water level in Namakan, Kabetogama, and Sand Point Lakes. Because portions of all the lakes except Kabetogama lie in Canada, the dams and lake levels are regulated by the International Joint Commission (IJC). From 1909 to 1980 the average annual water level fluctuation in Rainy Lake was 3.6 feet; on the other lakes it was 9.3 feet. Estimated "natural" fluctuations for this same period would have averaged 6.7 feet for Rainy Lake and 6.4 feet for Namakan Reservoir. Thus it appears the present method of using larger than normal fluctuations on the Reservior to maintain artificially low fluctuations on Rainy Lake could be having an adverse impact on the aquatic ecosystem.

Due to the low buffering capacity of the park waters, acid precipitation, which has been documented in the park, definitely has the potential for an adverse affect on the park's flora and fauna. Alkalinity readings in most of the park lakes are less than 20 mg/liter, which indicate the lakes have a limited capacity for neutralizing the acids that enter from the atmosphere.

The recreational use of the fishery resource was not specifically addressed when the Resource Management Plan was written in 1981. However, results of creel censuses conducted in 1977 and 1978 by the Minnesota Department of Natural Resources and in 1981 by Voyageurs NP personnel have shown that the fishery is intensive enough to have a significant impact on the fish community. The fishery is concentrated on the large species such as the walleye and northern pike, and the selective removal of these key predators probably is having an additional indirect influence on the other members of the fish community.

Aquatic Research Program

Research relating to these issues conducted prior to 1983 was restricted by a lack of funds and manpower. During the winter of 1982-83 an aquatic research Action Plan was developed and added to the Management Plan. It called for addressing simultaneously the three resource issues. For each of the broad areas of investigation, specific research elements were identified and it was decided whether Voyageurs NP researchers or contractors would do the work. This plan was used to obtain additional funding from the Midwest Region's Science office and the NPS Significant Resource Problems program.

The investigation dealing with the impact of water regulation has five research elements (1) a study of the hydrology of Namakan Reservoir and Rainy Lake and analysis of the impact of fluctuating water levels on (2) the littoral biota, including the vegetation and benthic organisms, (3) the fish community with special emphasis on the walleye and northern pike, (4) shore and marsh nesting birds, and (5) beaver and muskrat colonies.

The hydrology study is being conducted by the NPS Water Resources Field Support Lab; the CPSUs at Michigan Technological University and the University of Tucson are doing the benthos, beaver and muskrat, and bird studies. The littoral vegetation work is contracted to the University of Minnesota, Duluth. Research personnel from Voyageurs NP are carrying out the fishery study and coordinating the other work involved. Technical support for portions of the fisheries investigation is being provided by the Minnesota Department of Natural Resources.

If the studies show that the current water management program is having an adverse impact, the research approach should help the Park Service devise useful recommendations to the IJC for alternative regulatory systems. Should the IJC then make some change, the data collected in these studies will serve as baseline information against which we can evaluate the new regulatory system's impact.

The emphasis with regard to acid precipitation has been to encourage work by other agencies, since the park lacks equipment or facilities for conducting detailed studies in that area. Completed work includes a water quality and zooplankton study funded by the NPS Midwest Region's Science Office, and a water quality and precipitation chemistry study conducted by EPA. Currently the USGS and Minnesota Pollution Control Agency are monitoring water quality and precipitation chemistry in the park. The NPS/CPSU at Michigan Technological University in FY 1984 will begin monitoring a small watershed in the park for conducting a time-trend analysis of stream discharge and pH. Park personnel's involvement in the acid rain program consists of assisting these other agencies in monitoring some basic limnological parameters, e.g., water temperature, pH, dissolved oxygen, conductivity, alkalinity, transparency, and zooplankton composition and abundance.

Because of the potential impact of the recreational fishery on the fish community as well as its importance to park vistors, a program to collect and analyze fish harvest data was begun in the spring of FY 1983. The program's principal objective is to estimate accurately the annual harvest and fishing pressure and to obtain growth and mortality estimates for the various fish species. Through a cooperative agreement, funding is being supplied to the Minnesota Department of Natural Resources to measure fishing pressure and harvest on the four major lakes in the park. In addition, park personnel are testing an aerial census as another means of monitoring fishing pressure. They also are testing a postal creel card as a means of measuring fishing harvest and pressure on the park's 26 similar lakes.

The various studies being conducted in this program complement each other in that data collected in one study can be used to good advantage by researchers conducting another study. This is particularly true of the data that are being collected in the studies dealing with the impact of the water management on the fish community and the recreational fishery. When completed the results of the program should provide a broad spectrum of information resource personnel can use in managing the park's aquatic resource.

Kallemeyn is a aquatic research biologist at Voyageurs NP.

The National Park Service Loses a Friend

By Russell Dickenson
Director, National Park Service

Dr. A. Starker Leopold, a friend and advisor to the National Park Service for many years, holds a special place in our memories. The most notable and timeless, perhaps, of his contributions was the 1963 report, *Study of Wildlife Problems in the National Parks,* written while he served as chairman of the Special Advisory Board on Wildlife Management under Interior Secretary Stewart L. Udall.

This study later became generally known as the Leopold Report, providing recommendations that have guided development of Service policy and wildlife management for the ensuing 20 years.

Dr. Leopold continued advising the Service through participation in the Natural Sciences Advisory Committee, established in 1964 and destined to figure importantly in subsequent NPS resource policies and programs. While on the University of California faculty, Dr. Leopold found time to serve a year (in 1967 and 1968) as Chief Scientist of the National Park Service, because, he said, "I wanted to help get the research program off the ground."

After he resigned from this post he continued to serve in various capacities including member of the Advisory Board on National Parks, Historic Sites, Building and Monuments (now known as the National Park System Advisory Board), contributor of information to the *Report of the Committee on Yellowstone Grizzlies* (1974) prepared by the National Academy of Sciences, and as vice-chairman of the Secretary's Advisory Committee from 1972 to 1976. He served with Dr. Durward Allen as a sub-committee of two to produce two 1977 reports: *A Review of National Park Service Bear Management Programs,* and a *Review and Recommendations Relative to the National Park Service Natural Science Programs,* both of which served as policy documents.

More recently, Dr. Leopold served as a member of a panel of experts to write the assessment of the role of science and technology in managing natural resources in parks, prepared by the National Academy of Sciences in 1980.

In all, the NPS has been the proud beneficiary of the thoughts and energies of one of the most renowned naturalists our country has produced. It is with deepest sadness that I make my last farewell to Dr. Leopold, long time friend of our Nation's parks and their natural resources.

Wauer Gives Paper In West Germany

Roland H. Wauer, assistant superintendent at Great Smoky Mountains NP, attended a 10-day International Working Conference: New Directions for Conservation of Parks, June 5-15 in West Germany, where he delivered a paper on the evolution of resource management in National Parks of the U.S. He also discussed two projects of the NPS/CPSU at the University of Idaho: an international survey of threats to parks, sent to 135 countries and garnering 70 percent response, and preparation of a new State of the Parks survey form plus software for conceptual models of impacts on park systems.

Preliminary results from the international threats survey appeared in the Summer issue of PARKS magazine (Vol. 8 No. 1, pp. 14-17), authored by David L. Tichnell, Gary E. Machlis, and James R. Fazio. (PARKS is published by the NPS International Affairs office, Washington, D.C. 20240).

Considerable interest was expressed among the international delegates and Wauer agreed to send the survey forms to all participants so that each of their countries could take part.

A full report on the trip by Wauer appears in the Summer issue of the George Wright Society's FORUM (George Wright Society, PO Box 65, Hancock, MI 49930), together with the 12 recommendations that grew out of the conference.

Jean Packard, editor of PARKS, has elected to publish the paper on interpretation at Luneburger Heide Nature Park in West Germany. It was given by Gaby Kube, the park's chief of interpretation.

Anadromous Fish in Olympic NP Described in Houston Report

Anadromous Fish in Olympic National Park: A Status Report, by Douglas B. Houston, is a 71-page review of the distribution and abundance of salmon and trout populations in the only natural area administered by the NPS outside of Alaska to have substantial numbers of native anadromous salmonids as part of the park fauna.

Because most of these populations are harvested in commercial and sport fisheries outside park boundaries and because recreational fishing is permitted in park waters, this segment of the park's fauna is subject to management by other Federal and State agencies and by several Indian tribes.

The nature and extent of the conflicts with the park's primary purpose of preserving and restoring natural ecological processes are discussed in the report, and management strategies are considered.

The report is available from Olympic NP, 600 E. Park Ave., Port Angeles, WA 98362.

'The Year of the Books' On the Indiana Dunes

By Dale B. Engquist, *Superintendent Indiana Dunes National Lakeshore*

The struggle to preserve the Indiana Dunes began well before the turn of the 20th Century and culminated in 1966 with the creation of an Indiana Dunes National Lakeshore. The classic struggle between conflicting land use values – between the forces of economic development and preservation – continues today, 60 years after creation of the Indiana Dunes State Park and almost 20 years after the National Lakeshore was born.

To understand the Dunes today and to manage its resources one must understand its past, not only its natural history but its human and political history as well.

While voluminous literature on the Dunes exists, 1983 has turned out to be the year of new books. A theologian has written *Sacred Sands,* two longtime residents of the dunes have authored *Duel for the Dunes,* and the Eastern National Park and Monument Association has published *The Indiana Dunes.* I highly recommend all three. The lessons to be learned from this park's history can serve us all well in meeting the challenges of present day park management.

J. Ronald Engel's book, *Sacred Sands, the Struggle for Community in the Indiana Dunes,* was released this spring (Wesleyan University Press, $22.95). Kay Franklin and Norma Schaeffer's book *Duel for the Dunes, Land Use Conflict on the Shores of Lake Michigan,* will be published soon (University of Illinois Press, $18.95). Both books concern the long, often bitterly fought, battle that has pitted preservationists against industry, Illinois against Indiana, and very often the people against their own elected representatives. Both books chronicle the struggle's long and significant cast of characters – Stephen Mather, poet Carl Sandburg, ecologist Henry Cowles, landscape architect Jens Jensen, Hull House's Jane Addams, former Illinois Sen. Paul H. Douglas, and many more.

The books do not, however, duplicate each other. Dr. Engel writes from the viewpoint of the philosopher and theologian. The dunes preservation movement is treated as part of the Midwest's Progressive movement, as a ". . . battleground in the struggle for social justice and environmental preservation." He concentrates on the early years – the artists, poets, scientists, social reformers, and thinkers. His book explains why so many people have fought for so long a period and with such devotion for their dunes. For them, the dunes are a sacred symbol; the save-the-dunes movement is a laic religion.

Kay Franklin and Norma Schaeffer, both residents of the town of Beverly Shores, now surrounded by the National Lakeshore, are less philosophical, more pragmatic. Fuller treatment is given to politicians and bureaucrats. The book takes a closer look at the history of the dunes since authorization of the Lakeshore, including its present management, conflicts over further expansion, and NPS proposals for planning and development.

Although the first NPS Director, Stephen Mather, was intensely involved in movements to establish a Sand Dunes National Park, the victories of preservation were won by the people. Indeed, the National Park Service and the Department of the Interior are treated in this book as "reluctant allies" in the struggle. We who like to think always of ourselves as wearing unblemished white hats may cringe somewhat at this characterization, but it is not without foundation.

The Indiana Dunes (Eastern Acorn Press, $3.95), written by the Lakeshore's chief interpreter, Larry Waldron, with photographs by former interpreter Robert Daum, sets forth the benefits of the preservation victories. The land, the lake, the plants, the dunes and bogs – all are described and illustrated. The book concentrates on natural history, showing why the dunes are often referred to as the birthplace of ecology in North America and how, in its present day land forms, one finds the history of continental glaciation better exemplified than anywhere else.

Yet even this book, with its accent on natural history, cannot ignore the human factor. The people's relation to the land, part and parcel of the natural history story, is summarized in the chapter on "People," introduced by a 1958 picture of Sen. Paul H. Douglas, campaigning from the front seat of a jeep to Save the Dunes.

Renewable Resource Inventories Conference Held In Corvallis

More than 300 natural resource management people from a dozen countries attended a conference Aug. 15-19 in Renewable Resource Inventories for Monitoring Changes and Trends at the Oregon State University campus in Corvallis, Oregon.

Five NPS attendees were Lillian Rummel, National Capital Parks, East, Washington, D.C.; John Miller, Grand Canyon; Jon Jarvis, Crater Lake; Gary Davis, Channel Islands; and Gary Vequist, Glacier Bay.

The conference was sponsored by nine agencies, societies, and foundations, in cooperation with the United Nations' Food and Agricultural Organization, the U.S. Forest Service, and OSU. Papers will be published by January 1984, and will be available through the OSU School of Forestry, Corvallis, OR 97331.

Cumberland Island Fire Effects Study

By Kathryn Davison

Over the last three decades the natural role of fire has become increasingly important in the national parks. Studies of vegetation and wildlife responses to fire have guided fire policies away from total suppression towards natural fire research and management. Activity has centered in large western parks, however, and the effects of fire on many types of park ecosystems remain unstudied.

The need for more information is especially urgent in the Southeastern National Seashores, located on sandy barrier islands where the annual rainfall is sufficient for the growth of dense vegetation, but the summer is usually dry, punctuated by violent thunderstorms. The abundance of dry fuel and high lightning frequency have made fire a significant part of the evolution and ecology of the coastal vegetation. A large body of literature exists concerning the various plant communities of the mainland Coastal Plain, but little research has dealt with fire management of barrier islands or national seashores. Since barrier islands have some unique plant communities and have vegetation patterns unlike those of the mainland, establishing adequate management for National Seashores requires further analysis of their fire ecology.

The South-Cut Fire, which occurred in July of 1981 on Cumberland Island National Seashore, provided an excellent opportunity to document plant survivorship and regrowth after a natural fire on a barrier island. There had not been a fire on this part of the Island for at least 15 years so that fuel loadings were high; 1981 was the last of four dry years, which had reduced considerably the water level of the freshwater marshes. The lightning-ignited fire swept over 1,700 acres, but was largely restricted to four community types: oak scrub, pine scrub, mature pine, and freshwater marsh. Major boundaries of the fire formed along the edges of mature hardwood forests where penetration was limited to the shrub understory and litter (Fig. 1 and 2). Biologists from the NPS Cooperative unit at the University of Georgia presently are comparing these five communities and their responses to this major burn in order more fully to understand the role of fire in the ecology of Cumberland Island.

Burn Study Begun

The Georgia Co-op began a study of the burn in December of 1981. Plots for tree data were laid out in the five major community types. Three levels of fire exposure were studied by maximum scorch height: ground (0-0.5m), shrub (0.5-3m) and crown (+3m). Herb, woody sprout and seedling regrowth were measured by percent cover and stem counts in transects along one side of the plots. The sites were revisited in the spring, summer and autumn for herb and shrub regrowth measurements. Comparison plots in unburned communities were sampled where possible. A large percent of the oak scrub on the Island has burned in the last five years and all of the pine scrub burned in the 1981 fire, thus for pond pine communities unburned comparison sites are not available on the Island. The results of the study have not yet been analyzed, but some general observations have been made. The following is a description of each of the major community types and some notes about their responses to the fire.

The mature hardwood forest is of particular interest because it was here that the fire stopped. This forest has a closed canopy of 20-25 meters inside of which a more humid microenvironment is enclosed. Litter dries out less rapidly here than in the more open oak scrub forest. Live oak, *Quercus virginiana* is the most common tree of both the mature hardwood and the more fire prone oak scrub forests. Other canopy species of the mature forest include: sweet bay, *Magnolia virginiana,* red bay, *Persia borbonia,* cabbage palm, *Sabel palmetto,* black gum, *Nyssa sylvatica,* holly, *Ilex opaca,* and red maple, *Acer rubrum.* The shrubby understory is often dominated by saw palmetto, *Serenoa repens* which can form a continuous layer under the oaks. Small trees of live oak, red bay, wax myrtle, *Myrica cerifera,* sparkleberry, *Vaccinium arboreum,* and staggerbush, *Lyonia ferruginea* are scattered in a distinct understory. There is little herb cover excepting isolated patches of braken fern and panic grass.

Overstory Trees Survived

The overstory trees, with the exception of maple and holly have thick bark and survived the fire very well. Where the fire entered the forest it was carried mainly by the saw palmetto through the understory, and most of the smaller trees were killed. However, all of the species that lost individuals to the fire are represented in the regrowth. Seedlings of maple, holly, wax myrtle and red bay have been found in areas where the species had existed previously. The strongest form of regrowth in terms of numbers and percent cover has been root and rhizome sprouting. Saw palmetto survived the fire very well. Most of the leaves were consumed, but the large rhizomes were well insulated and quickly replaced the lost foliage. Live oak, red bay, staggerbush, and wax myrtle have gained much height and ground cover over the last year through root sprouts. No new tree species have appeared and as yet, none have been lost in the areas studied. There is some change in the age distribution of individuals for this community, but little to no change in species composition.

The oak scrub is a forest type which grows in relatively sterile, well drained sands in upland sites. The canopy is open and low, 10-15 meters. Three oaks form the majority of the canopy with live oak being the most common, followed by myrtle oak, *Q. myrtifolia,* and Chapman's oak, *Q. chapmanii.* Other canopy species include: American olive, *Osmanthus americana,* red bay, staggerbush, and scattered slash and pond pines. A less distinct understory than in the mature hardwood forest consists of a dense growth of staggerbush, sparkleberry, saw palmetto, gallberry *Ilex glabra* and dwarf *Vaccinium myrsinites* blueberry; the open nature of the canopy allows the litter to dry rapidly, and the less distinct boundaries between the overstory and the understory present a relatively continuous vertical arrangement of fuel. Fire can be carried easily into the canopy.

Possible Futures

The fact that most of the oak scrub on the Island has burned within the last five years, and that this same area on the northern end burned about 25 years ago to approximately the same boundaries suggests that this community is a pyric disclimax, and is being maintained by fires of natural origin. In the absence of killing crown fires, the oaks may eventually form a closed canopy and the community could then succeed to a more mature forest. However, the sterile soils allow only slow growth of the trees. The time needed for trees to grow large enough to form a closed canopy is usually much longer than the time between fires, due to the climate and the accumulation of fuels.

The mature pine community is characterized by even-aged stands dominated by one of three pines: loblolly, *Pinus taeda,* slash, *P. elliottii* or longleaf, *P. palustris.* These may be mixed with live oaks. The canopy is high (22-28m) and partially open. Saw palmetto is common, but not dense. Much of the ground cover is grasses and other herbs.

The response to the fire in this community varied greatly with fire severity. Most of the areas experienced no crown fire. In this case, the larger pines survived and the community was little changed. However, in one area near the edge of the salt marsh high winds brought flames into the canopy of a stand of loblolly pines. All of the trees were killed. The regrowth in this area is primarily herbaceous. The saw palmetto is resprouting here as it has everywhere else it occurs. A few seedlings of pine, wax myrtle and winged sumac *Rhus copalina* have been found, but they are not abundant, as most of the ground is covered with fallen trees and lush herb growth.

Pond Pine Regrowth Variable

The pine scrub or pocosin community is a swampy forest where pond pine, *Pinus serotina,* is the most common tree. The understory is much the same as in the oak scrub but, with little to no oak component except on the drier sites. Pine scrub grades into swampy marsh on the wetter sites where marsh herbs are more common than the shrubs, and into oak scrub on the drier sites that have a very small amount of herb cover.

All the pond pine on the north end of the Island was involved in the fire; the majority experienced severe crown fire. Those pines that did survive have sprouted epicormically* to replace needles lost to the blaze. The serotinous** cones held on the trees opened in the heat; and many seedlings have been found, especially on the wetter sites.

Regrowth of pond pine has been variable. Healthy root sprouts are growing in the drier sites among the sprouts of saw palmetto, gallberry, heaths and oaks. Pine seedlings in these areas have not survived well,

**Growing from a dormant bud exposed to light and air.*

***Occurring in the latter, drier part of the summer.*

being shaded out by the dense sprouts.

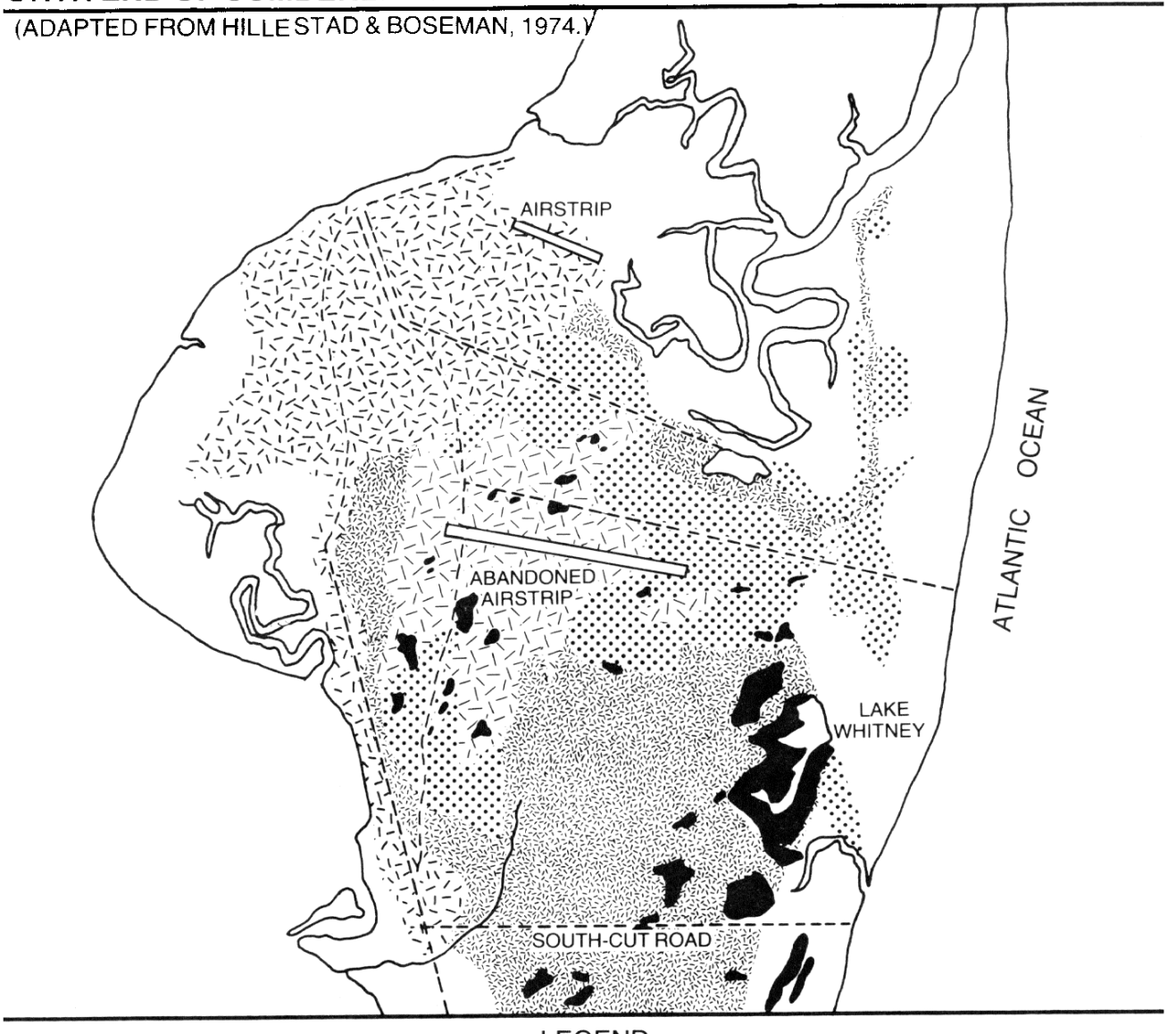
On the wetter sites, hardwoods and saw palmetto have not grown back as densely. Here, the root sprouts of pond pine died a few months after they came up, but many healthy seedlings were found. It should be noted that the root sprouts of staggerbush, fetterbush, *Lyonia lucida,* gallberry, blueberries, and especially saw palmetto flowered and fruited much more heavily inside the burn than outside, and were attended by a host of pollinating insects. This was particularly apparent in the oak and pine scrubs.

Freshwater Marshes Bounce Back

During the last days of the fire, the northern end of the sweet-water marsh complex caught and burned southward to South-Cut Road which effectively blocked its spread. *Spartina bakerii,* a hummocked cordgrass, is the most common species of these marshes, forming a nearly continuous band through the sweet-water complex. Due to the dry conditions the grasses carried a hot blaze over the marshes. The surrounding trees generally did not survive, and most of the above-ground vegetation in the marsh was killed. However, the grasses, shrubs and forbs all

FIGURE 1. PLANT COMMUNITY DISTRIBUTION ON THE NORTH END OF CUMBERLAND ISLAND NATIONAL SEASHORE.

(ADAPTED FROM HILLESTAD & BOSEMAN, 1974.)



Cumberland Island (Continued)

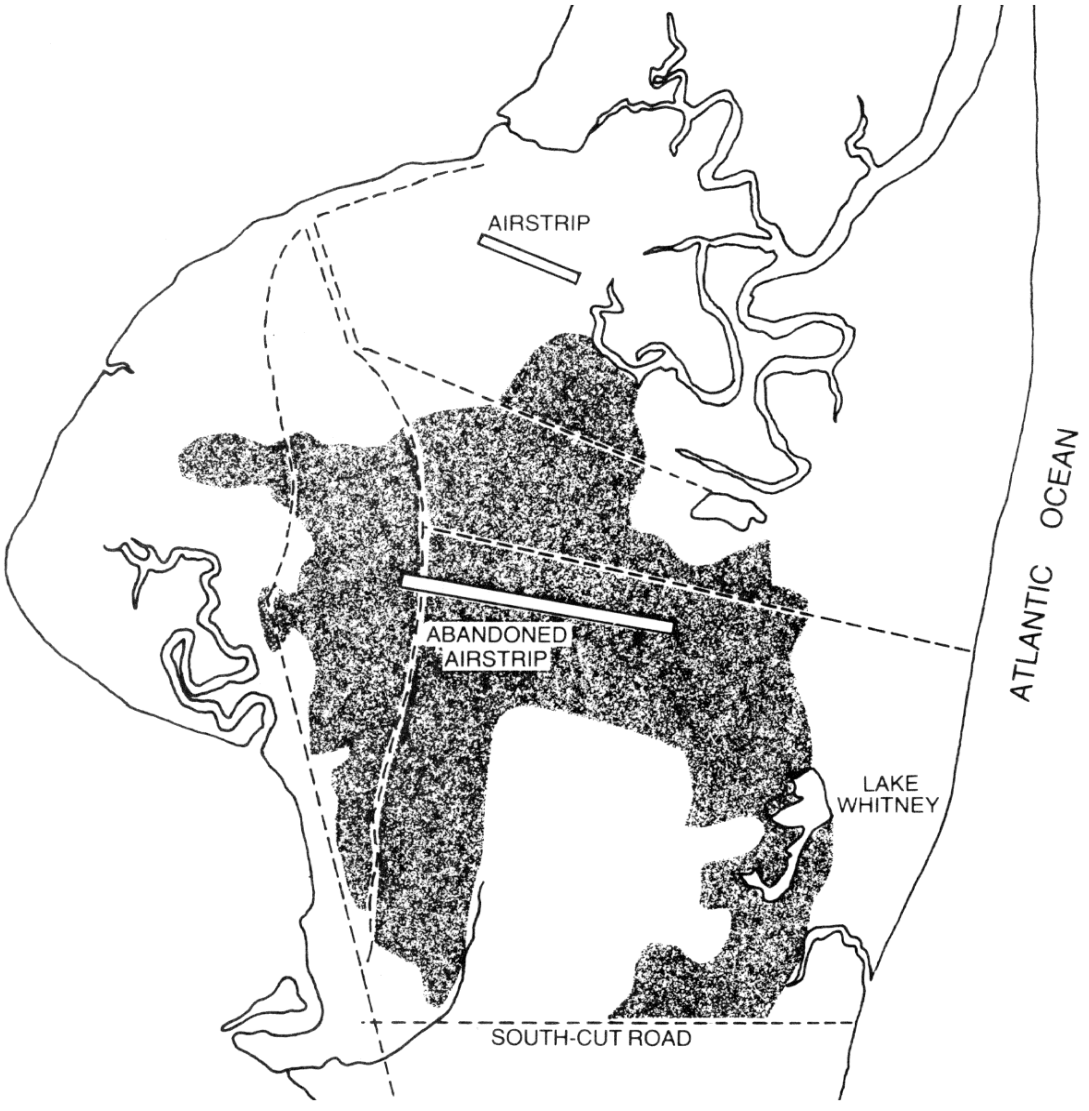
have grown back from the old root systems. The grazers (horse and deer) seem to prefer the burned over grasses to those in unburned areas. Grasses in identical marshes on either side of South-Cut Road are cropped down to six inches on the burned side and not significantly grazed on the unburned side. The freshwater marshes have replaced the biomass lost to the fire more rapidly than any other community in the study and in terms of percent cover may have benefited from the fire.

These preliminary observations indicate first that natural fire is an important ecological factor on Cumberland Island, and at least 15 percent of the upland vegetation of the island is subject to natural fire on a 15 to 30 year rotation. The island has some vegetation types, such as pine and oak scrub, that develop high fuel loadings. The marsh and scrub communities of the island generally are fire tolerant, however, while even a hot fire has difficulty burning into the more fire sensitive but less flammable live oak forest.

Fire is important to ecosystem structure and function on the island and requires a sophisticated management planning. In this case, some of the problems encountered in western parks where natural fire plays an important role, can be avoided by a resources management program which permits "management fire" and anticipates the development of high fuel loadings.

Davison is a graduate student in the University of Georgia Department of Botany, working with NPS Research Scientist Sue Power Bratton.

FIGURE 2. BOUNDARY OF THE SOUTH-CUT FIRE ON CUMBERLAND ISLAND NATIONAL SEASHORE, 1981



Smoke and Visibility In Washington State

By Shirley Clark

The Clean Air Act Amendments of 1977 set forth a national visibility goal – to prevent future and to remedy existing impairment of visibility in class I areas due to man-made pollution. Three years later, EPA promulgated Visibility Regulations which required states to revise State Implementation Plans (SIPS) for visibility.

The State of Washington had adopted a Smoke Management Plan in the early '70s to deal with health and welfare effects of forest burning. The primary goal of the plan was to keep smoke out of the urban, heavily populated areas, so burns were conducted under wind and weather conditions that forced smoke into the mountainous areas of the state – where the class I areas are located!

State officials believed that smoke from slash burning was affecting visibility throughout the state. After the visibility regulations were finalized, the State was eager to set up a monitoring program. Cooperation between the State and NPS resulted in visibility monitoring in the three class I areas managed by NPS. Photography, particulate monitoring, nephelometer measurements, and visual observations have indicated that smoke from slash burning is affecting visibility in class I areas.

The State held an informational meeting prior to drafting a Visibility SIP. This gave a chance for proponents of both visibility and burning to air their concerns about the plan and its approach. After release of the draft plan, public hearings were held and generally supportive comments were received.

The plan included a tighter scheduling of burning on weekends between July 1 and Labor Day weekend within 60 miles of a class I area. NPS had requested that time period to be emphasized initially because Mount Rainier, North Cascades, and Olympic National Parks receive 50% of annual visitation during that time and entering visitation on weekend days is over twice that on weekdays. A 60-mile buffer area around the three class I areas managed by NPS and the five class I areas managed by USFS encompasses most of western Washington. The restrictions went into effect on July 1, and burning was not allowed on visibility important (according to the weather forecast) weekend days between July 1 and Labor Day weekend within 60 miles of a class I area.

The plan also included a goal by forest managers to reduce total emissions generated by prescribed burning in western Washington 35 percent below current levels by 1990. Ways proposed to achieve this goal include refinement of burning techniques and increased utilization of wood residue.

The plan is viewed by NPS as a good first step toward improving visibility in Mount Rainier, North Cascades, and Olympic National Parks. It appears that a reasonable compromise has been reached among the conflicting interests which the plan covers. NPS will continue to cooperate with the state on monitoring activities as the plan is implemented to document whether or not visibility improves.

Clark is Air and Water Quality Coordinator for the Pacific Northwestern Region, NPS.

superintendent's corner

Editor's Note: The Superintendent's Corner this time is filled by Daniel J. (Jim) Tobin, Jr., who was superintendent of Mount Rainier NP in April 1976, when he delivered these remarks to the third annual Science/Management Conference of the NPS/Pacific Northwest Region, at Klamath Falls, OR. Tobin is now Regional Director of the Pacific Northwest Region, NPS.

A Superintendent's Expectations of Science and Scientists

By Daniel J. (Jim) Tobin, Jr.

Perhaps we should place this in perspective as my personal interest in, and/or reason for, utilizing natural science research at Mount Rainier National Park. First and primarily, I view it as a management tool needed to provide information, techniques or systems to manage the natural resources. More simply stated, I am looking for a problem solver.

This means a problem must be identified by management and then in cooperation with a scientist, defined in language that is mutually understood. Following definition of the problem comes a negotiated understanding of:

1. Does the problem warrant study, i.e., are there existing studies and recommended problem solutions?
2. If the study is warranted:
   a. for how long
   b. at what cost?
   c. by whom?
   d. what will be the end product?

These elements are probably understood by all, but I will add a little clarification.

A. How long should a study run? This is extremely important as the problems may not permit an "all the time in the world approach."

B. At what cost? A simple matter of budget and money to pay bills. Our most recent experience has been that money is in short supply throughout the National Park Service. As a consequence, competition for available funds is keen and a theme of the day is "trade off." This means if I must do research, what can I leave undone to pay the bill?

C. By whom? I am interested in placing my research with a scientist of integrity, with good standing in the professional community. He must be willing to stand by his conclusions should they generate controversy and must understand that he may be subject to management's call should expert testimony be required in matters of litigation.

D What will be the end product? The answer to this is very much the WHAT I expect of science and scientists. There should be a written report identifying the problem studied; the method or methods of study utilized; results of the study; conclusions; and recommended management actions.

I am not interested in a treatise written in professional terms prepared solely for publication in scientific journals. The resultant professional criticism is a welcome by-product, but my needs are for lay language, illustrations and recommendations that show me how to implement them.

Please note that I said *recommendations*; that is what I mean. In management there is a frequent need to explore several solutions to a problem and to give consideration to political realities, both in-service and out-of-service. In such an arena I prefer receiving a display of possible solutions arrayed in a best to least desirable format with a brief rationale for each one.

Now, what do I expect from scientists as they work within the Park? I expect scientists to be cooperative guests when they come to the Park to pursue their study. They are expected to comply with the rules and regulations to the fullest practicable extent. Should their study require taking of specimens or engaging in other activities outside the realm of usual public use, the where and how must be arranged with management. I feel researchers within the Park should exchange information among themselves as to what their study is; where and how it will be conducted. We are expending public monies. As members of the public we are all entitled to the best possible return on the dollar. There isn't room for duplication of effort.

This approach may not please some of you, I realize. I have talked with research scientists across the country during the past year and am well aware that there are scientists dedicated to the proposition that pure research is to satisfy man's curiosity. But, directed research designed and intended to solve a problem is an ethical compromise. These researchers have aptly illustrated that undirected research does, on occasion, add knowledge of Park resources and provide potential for

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Superintendent's Corner (Continued)

application to management strategy. Operating in today's economic crunch, however, precludes such research in my Park and, I believe, anywhere within the National Park System.

All of the foregoing has been intended to say a science program in a park must be a program that serves the needs of management. In conclusion, I would like to present a couple of ideas picked up as we task-forced the science issue last summer.

1. Regional Offices have a responsibility to annually review and evaluate both on-going and proposed research to determine the quality of research, qualifications of researchers, and to assure that research results are being applied within management programs.
2. The Regional Science Program should include provisions for extension work assistance to parks. This should take the form of diagnostic service for current problems and also helping the park predict problem areas.
3. The National Park Service must establish a program wherein its scientific personnel are provided advanced training and retraining. I personally feel such a program is necessary to maintain professional skills and to enhance National Park Service credibility within the academic world.

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In The Next Issue

"Golden Gate Team Approach To Resource Problems" by Judd A. Howell; "On-going Research and Monitoring at Redwoods" (the first of a two-part article) by Bob Bellows.

NOTICE

The Spring 1984 issue of *Park Science* (deadline Feb. 15, 1984) will be devoted to the topic "Information Management and Natural Resources in the National Park Service." It will focus on park and regional computer applications in natural resource management and research. Those interested in submitting articles or just brief descriptions of their projects should contact Anne Frondorf, Biological Resources Division, National Park Service, Dept. of the Interior, Washington, D.C. 20240, FTS 343-8127.