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10-Year Study of Crater Lake Underscores Need For Long-term Monitoring Program

Editor's Note: After looking over the Crater Lake Limnological Studies Final Report (NPS/PNRO/NRTR-93/03), the Editor of Lake and Reservoir Management, Roger W. Bachmann, wrote to Gary Larson, the study's Principal Investigator, proposing use of the Report as the basis for a special collection of papers in the journal. Bachmann stated that "in keeping with the purpose of the journal" he would "like to see the work related to management as well." No date for the journal publication has been set, but the 730-page Report itself, edited by Larson, C. David McIntire, and Ruth W. Jacobs, is available from the Technical Information Center, Denver Service Center, PO Box 25287, Denver, CO 80225-0287; (303)969-2130.

By Gary Larson

Limnological studies of Crater Lake were initiated by the NPS in 1982 in response to an apparent decline in lake clarity and possible changes in characteristics of the algal community. In the fall of 1982 Congress passed Public Law 97-250, which authorized and directed the Secretary of the Interior to conduct a 10-year limnological study of Crater Lake and to implement immediately such actions as may be necessary to retain the lake's natural pristine water quality.

Crater Lake from the top of Watchman Peak, looking at Llao Rock. (PHOTO BY DAVE MCINTIRE)

The broad project goals adopted for the study were to:

1. develop a limnological base to be used for comparisons of future conditions of the lake;
2. develop a better understanding of physical, chemical, and biological components of the lake system;
3. develop a long-term monitoring program;
4. determine if the lake had experienced recent changes, and if changes were present and human-related; and
5. identify the causes and recommend ways of mitigating the changes.

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PARK SCIENCE

NATIONAL PARK SERVICE

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

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Editorial

These are heady days of change throughout the National Park System...exciting, promising, and nervous. The Park Service is responding with the predictable mix of enthusiasm, hope, and anxiety.

Whole systems are among the toughest things in the world to change. When they do begin to alter, they "self design," in spite of the best intentions of those who are most instrumental in setting the process in motion. Hence the watchful waiting with which the Service (a "whole system" in its own right) watches as the rock-solid boulder begins to move. How will it travel? Once in motion, can it be guided? And where will it settle until the next set of circumstances again sets it in motion?

The changes now underway have been heralded for years. Mostly, the trumpets have sounded on deaf ears. But this issue of *Park Science* reflects almost the entire rainbow of a new dawn—from the Gary Williams article on I&M and the Gary Machlis piece on Extended GAP Analysis to the philosophic musings of Dave Haskell about the "why" of the NPS mission and the thoughtful letter to the editor from the Alaska contingency.

The words of Interior Secretary Bruce Babbitt, in reply to questions from the Hon. Robert S. Walker (R-PA) as quoted below, are a reassuring answer to the cloud of question marks that hang over the Park Service. They speak clearly of a strong hand at the helm of change and a warning to the encrusted "old ways" that a fresh and bracing wind is blowing.

Question: (from the Hon. Robert S. Walker (R-PA)) How will the National Biological Survey balance the need for scientific integrity with the need for relevance to natural resource managers of the science being conducted by the NBS?

Answer: (from Interior Secretary Bruce Babbitt) Scientific integrity and responsiveness to natural resource manager needs are not necessarily opposites that need to be "balanced." Scientific integrity entails credible procedures for the collection, analysis, and interpretation of data. Existing research projects that are transferring to NBS will continue according to their study plans. The needs of bureaus within Interior will continue to be met.

NBS will strengthen the overall support for bureaus by increasing the visibility of

science; by combining research and inventory activities in a single organization; and by ensuring consistent approaches across bureaus, so that information can more readily be shared. The information transfer capability will make technical and scientific information more available in non-technical terms to provide information to managers.

Bureaus will continue to identify and rank their science needs, and will be actively involved in setting the NBS agenda and budget. This will occur at the headquarters level through the intra-departmental Policy Council, but also will happen in the field, as NBS managers and scientists interact on a day-to-day basis with client bureau staff.

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NPS Inventory and Monitoring Program Emerges From I&M Task Force

By Gary Williams

Editor's Note: Following is the first of three articles by Gary Williams, I&M Program Coordinator in the NPS Washington Office, dealing with development and implementation of a Systemwide I&M Program. In this issue, we begin with Inventory Status; the Spring issue will cover Monitoring; the Summer issue will deal with how the Program will interact with the National Biological Survey.

In 1989, the NPS Associate Director for Natural Resources appointed a special Servicewide Task Force and charged it with developing a workable plan for implementing I&M on a programmatic basis throughout the entire National Park System.

The group's development effort built on the 1987 "Evison Report," and it recommended a two-phase approach. During the first 10 years (Phase I) the focus was to: (1) prepare the parks for long-term monitoring, and (2) develop the expertise and experience to design and implement effective natural resource monitoring programs in individual park units; for Phase II, the long-term monitoring was to be extended to all natural resource parks in the NPS and continued in perpetuity.

NPS-75, a Servicewide policy guideline for designing and implementing I&M programs in park units, was published in 1992. The Servicewide I&M Program Coordinator will work directly with a National Technical Advisory Committee established to assist in program development and oversight and with all 10 Regional I&M Coordinators. The park units containing significant quantities of natural resources have been identified, and collectively they represent the NPS "I&M System."

Five Program Goals will guide Phase I of the Servicewide Program:

(1) Natural Resource Inventories (see Table 1); (2) Ecosystem Monitoring; (3) Planning and Management Technology; (4) Program Integration; and (5) Partnerships and Cooperation.

Status of Natural Resource Inventories

The acquisition of the natural resource data sets described in Table 1 for approximately 250 I&M park units can best be accomplished through implementation of a well-coordinated, systemwide data collection initiative. By such an undertaking, as opposed to requesting each individual park to obtain its own data, the Service can better insure that the inventory will satisfy a number of important criteria. For example, the

information collected at the very least should contain the "core" set of data needed to deal with park planning and management. In a similar manner, the data collection effort must address the issues of long-term data compatibility and integrity. Baseline data must be collected and maintained in accordance with clearly defined protocols and quality assurance standards.

Cost effectiveness is another major consideration in data acquisition. To reduce costs, the Service will consider clustering park units to achieve economies of scale. Costs may also be minimized by negotiating agreements with sister Federal agencies. Thus, Phase I natural resource inventory will be conducted as a Washington Office initiative with strong regional and park oversight and priority setting.

(Note: This section provided by Dr. Sue Glenn)

Species Lists/Biodiversity

A major inventory effort in FY 1993 was completion of the NPFAUNA.PC databases compiled by U/CA under the direction of Dr. James Quinn. These databases contain

checklists of mammal, bird, fish, herb, and plant species found in approximately 190 NPS units. Documentation of this information also is included and the Federal Status of each species has been updated.

All nomenclatural differences in species names among parks and regions were standardized; some of the databases were changed to reflect comments received from international review of the system. The data then were sent back to the regions for a final review before the data is distributed within and outside the NPS in FY 1994.

Through distribution of these data sets, the Service anticipates that other agencies and individuals with additional relevant knowledge of species occurrences in parks will come forward and make that information available. This may include biologists who have seen species in parks that do not appear in the database, as well as museums and plant herbaria with specimens to add to the database. Distribution of these lists also may encourage biologists to assist the parks in special inventories. Although the databases

Continued on page 4

Table 1. Recommended minimal data standards for Inventory and Monitoring Park Units.

1. Bibliography of manuscripts, old maps and other historical information related to science and resource management. This information must be park specific.
2. Compilation of existing species lists. Should include ALL species lists available and an estimate of their quality.
3. Field inventory of species (plant and animal) of special concern.
4. Listing of Threatened and Endangered endemic or non-natives species.
5. Status and distribution of species and abiotic features of special concern.
6. Current (<= 5 years old) maps for:
 - Vegetation
 - Watershed boundaries
 - Topography (DLG and DEM preferable)
 - Hydrography (from topographic maps)
 - NPS Park Management Zones and Special Designations (e.g. Landmarks, RNA, etc.)
7. Location and Classification of:
 - Streams
 - Wetlands
 - Lakes
 - Groundwater
8. Basic Precipitation and Meteorological Data
9. Basic water chemistry factors for selected water bodies. Factors should include:
 - Alkalinity
 - Conductivity
 - PH
 - Dissolved Oxygen
10. Location of existing nearby ambient air quality monitoring stations
11. Atmospheric particulates
 - CA
 - MG
12. Visibility

will reflect only currently compiled information and are not meant to reflect a complete species inventory, they should be useful in planning future cost-effective species inventories.

(Note: This section provided by Drs. Dave Graber and Bill Halvorson)

Vegetation Mapping

Beginning in 1994, NPS and the National Biological Survey (NBS) will begin developing vegetation maps for approximately 235 NPS units and environs in the conterminous U.S. (Alaskan units will be mapped through a separate funding effort.) Contracting partners in the current multi-million dollar endeavor are the Environmental Systems Research Institute (ESRI), and a team of subcontractors including The Nature Conservancy (TNC).

Development of a vegetation/land cover map is one of the first critical needs for park management. Vegetation is considered a "fundamental" data layer for wildland stewards because, like terrain and hydrography, it is central to characterizing a landscape and is the driving variable for so much else, such as wildlife, fire dynamics, and even the movement of carbon and nitrogen through ecosystems.

The classification system proposed by the contractors (Table 2) is becoming a standard among land management agencies worldwide... a hierarchical system based on dominant plant physiognomy (morphology and phenology) at higher levels, and floristics—the dominant species—the lowest, "series" level. Thus an open stand of Douglas-fir (*Pseudotsuga menziesii*) would be classified as a terrestrial "Evergreen Needle-leaved Woodland with Rounded Crowns," Douglas-fir series. This system, adapted by TNC from an international classification that permits comparisons at different levels, already is in use by the USFWS Gap Analysis Program.

The vegetation mapping contract was developed to get the approximately 235 natural resource park units mapped at the series level and to provide information urgently needed by the NPS Washington Office and by a growing list of regional to international land management and conservation efforts. Not only can this information answer questions such as "How much short perennial bunchgrass is protected by the NP System?" it also can be integrated with data collected on other land ownerships to provide continent-scale information that can track such global phenomena as pollution effects or response to climate change.

Table 2. Proposed classification scheme for the National Park Service vegetation mapping project.

A. PHYSIOGNOMY

System: Terrestrial/Aquatic – (hydrological regime)

Class: Woodland – (spacing and height of dominant form)

Subclass: Evergreen Woodland – (morphological & Phenological similarity)

Group: Temperate Evergreen Needle-leaved – (climate, latitude, growth form, leaf form)

Formation: Evergreen Needle-leaved Woodland with Rounded Crowns – (mappable units)

B. FLORISTICS

Series (or Cover Type): Doug Fir Woodland – (dominant species)

Community (or Association) – (subdominant or associated species with similar ecological processes)

The mapping effort also will provide information at the park unit level and the tools to pursue more detailed questions. Mapping will be done at the series (dominant species) level with (1) a minimum mapping unit of 0.5 ha, and (2) precise registration to the USGS 1:24000 map series, making certain that at least 80 percent of the mapped units are classified and drawn accurately. The maps, with their detailed vegetation structure information, will give parks an excellent reference point for monitoring change caused by such disturbance factors as fire, insects, drought, disease, or weather; for analyzing wildlife habitat; and for determining site suitability for management activities.

Data will be provided foremost in the form of GRASS-format GIS files. Analog maps at 1:24000 scale, the aerial color photography used for type delineation, narrative descriptions of each vegetation class, and detailed information from field plots used in characterization.

The quality of the classification and mapping efforts will be increased by cooperation of park and regional office NPS staff and by the availability of related thematic data (such as geology, soils, or terrain). NPS staff should provide information and their own experiences for the process.

The NPS recommended to the NBS that the first parks to be mapped be in the midwest grassland park areas. It is expected that this first mapping and classification effort will require adjustments as the work proceeds. Input from many quarters at these early stages will ensure that the products will be usable and can easily be coordinated with other land management activities.

For additional information or comments about the vegetation mapping initiative, contact Mike Story at (303) 969-2619 or leave a message on cc:mail.

(Note: This section provided by Dean Tucker and Gary Rosenlieb)

Water Resources Data

A cooperative endeavor initiated in 1993 by the NPS Servicewide I&M Program and the NPS Water Resources Division (WRD), the NPS Baseline Water Quality Inventory and Analysis Project is a three year effort designed to characterize baseline water quality at all units of the NP System containing significant natural resources.

Specific objectives are to (1) retrieve water quality and related data from the EPA's STORET and other database systems; (2) develop a complete inventory of all retrieved data; (3) produce descriptive statistics and appropriate box and whiskers and time series plots of the water quality data to characterize annual, seasonal, and period of record central tendencies and trends; (4) compare park water quality data with relevant EPA national water quality criteria on a station-by-station basis; and (5) reformat the water quality and other related data for use with the park-based Water Quality Data Management System (currently under development in the WRD) and other appropriate analytical tools.

Every park unit participating will receive a detailed analog report and several hydrographic digital databases, including all water quality parameter data, 1:100,000 scale hydrography, surface-water quality monitoring station locations, stream gage locations, National Point Discharge Elimination System permit locations, and drinking water intake locations.

The results of this effort are intended to enable park resource managers and the WRD to compare and contrast water quality data collected as part of ongoing I&M programs with historical water quality trends and to design better park-based water quality I&M programs. One component of this project is

to demonstrate how the digital databases and analog report can be used to determine where additional baseline water quality monitoring is needed. The park water quality databases produced by this effort will lay the groundwork for allowing regions and the WRD to generate regional and national assessments of the status of park water quality.

Completing the work will take approximately three years. Parks will be completed in the priority order established by regional water resource coordinators and the Servicewide I&M Program. Servicewide review and comment already has been obtained on the draft Baseline Water Quality Inventory and Analysis for Rock Creek Park and revisions are being made. Once the new procedures are finalized, production of Baseline Water Quality Inventory and Analysis reports for all participating parks will commence.

For additional information or comments, contact Dean Tucker at (303) 225-3516, Gary Rosenlieb at (303) 225-3518, or leave a message for either on cc:mail.

Digital Cartographic Data

Digital cartographic products are being obtained through a 50:50 cost-sharing agreement with the USGS and will provide several of the basic data layers needed for park-based GIS. Standard products available under this cooperative agreement are topographic maps, digital line graphs, digital elevation models, and digital orthophoto products.

The cost share program benefits both NPS and USGS. In addition to obtaining important spatial data sets needed to support park management, research, and planning, the effort will accelerate population of the National Digital Cartographic Data Base, and enhance support for OMB Circular A-16, Coordination of Surveying, Mapping, and Related Spatial Data Activities.

In total, approximately \$1.07 million of Servicewide I&M funds were made available in 1993 to acquire cartographic data sets for approximately 40 park units in 9 NPS Regions.

For additional information or comments about acquisition of digital cartographic products, contact Leslie Manfull at (303) 969-2964 or leave a message on cc:mail.

Prototype Programs Selected

During May 1993, the NPS Washington Office issued a Call for Proposals from which it could select competitively Prototype Monitoring Programs for the seven biogeographic associations (biomes) not currently represented in the NPS Servicewide I&M Program.

During the period of Nov. 2-5, 1993, an Interagency Evaluation Panel consisting of individuals from both the Servicewide I&M Advisory Committee and the NBS met in Denver to evaluate the submittals

and develop implementation recommendations. The proposals selected and their corresponding biogeographic association are indicated below. These units will be added to the current Prototype Monitoring Programs in Denali NP (Arctic/Subarctic), Channel Islands NP (Pacific Coast), Shenandoah NP (Deciduous Forest), and Great Smoky Mountains NP (Deciduous Forest) to complete the Phase I Servicewide Prototype Monitoring Program Network.

Biogeographic Association NPS Units

- | | |
|--|--|
| I. Atlantic/Gulf Coast Cape Cod NS | VI. Grasslands/Prairies Great Plains |
| II. Caves Mammoth Cave NP | Prairie Cluster: |
| III. Coniferous Forest Olympic NP | * Effigy Mounds NM |
| IV. Lakes and Rivers North Cascades NP | * Homestead NM |
| V. Arid Lands Northern Colorado Plateau Cluster: | * Scotts Bluff NM |
| * Arches NM | * Agate Fossil Beds NM |
| * Canyonlands NP | * Wilson's Creek NB |
| * Capitol Reef NP | VII. Tropical/Subtropical Virgin Islands Cluster |
| * Dinosaur NM | * Virgin Islands NP |
| * Natural Bridges NM | * Buck Island Reef NM |
| | * Dry Tortugas NP |

NBS Signs Contract with Nature Conservancy

In what he called "the first of many cooperative agreements that NBS will make with the private sector," Interior Secretary Bruce Babbitt on Dec. 6, 1993, signed the Memorandum of Understanding with The Nature Conservancy (TNC) as a framework for future cooperative activities. Under the agreement, a working group will be formed to explore establishing a National Heritage Data Center in the National Biological Survey; ways to work with Natural Heritage Programs generally; and to discuss exchanging resources to improve the technical capabilities of both organizations.

The agreement also identifies several short term projects for further development, including TNC support in completion of NBS's first Status and Trends Report; completion of a national classification system for ecosystems; and initiation of joint development and testing of methods and protocols for the field and for data handling.

Vail Work Plan Reinvented

The good work begun at Vail, under the headings of Park Use and Enjoyment, Organizational Renewal, Resources Stewardship, and Environmental Leadership, are being "tweaked into a slightly different framework"—one that fits better the NPS administrative set-up and its areas of emphasis.

The new working groups will be called Resources Stewardship, Education, Partnerships, and Careers. The Careers Council, chaired by A/D Joe Gorrell, held its first meeting in September, by phone, and its second, "in person," meeting in Omaha, identifying its charter and establishing its priorities. The Council is guided by an Oversight Committee made up of NPS Deputy Director John Reynolds, R/D John Cook and A/D Ed Davis. Reynolds attended the Omaha meeting and charged the Council with developing "a comprehensive human resources management strategy for the NPS—a strategy that is fully responsive to the needs of the Service and that engenders a 'cradle to grave' concept of employee caring and employee support."

Reynolds stressed "a critical point:" The changes in name and shifts in priority "do not mean that we intend to lose a scrap of work or a bit of energy from processes already underway." NPS employees from across the Service are encouraged to volunteer for membership on the various committees responsible for affecting change.

Gap Analysis and National Parks: Adding the Socioeconomic Dimension

By Gary E. Machlis, Deborah J. Forester and J.E. McKendry

Editor's Note: The Oct. 16, 1993 issue of Science News (pp 248-251) features an article by Elizabeth Pennisi, "Filling in the Gaps: Computer Mapping Finds Unprotected Species." The cover is a computer model of the state of Idaho, captioned "Mapping Biodiversity." It makes an informative companion piece to the article below.

The conservation of biodiversity is an issue of growing concern to park managers, for the global system of protected areas is an important means of conserving biodiversity *in situ*. Four percent of the world's land area is protected in over 5,000 individual areas covering nearly 530 million ha (WRI 1990). In the US, national parks include a diversity of gene pools, populations, species, communities and ecosystems. The National Park Service (NPS) manages a *de facto* biodiversity reserve system, albeit incomplete.

Yet, national parks and the biodiversity they contain face threats from a variety of human actions (Machlis and Tichnell 1985; NRC 1992). Increased attention to the biodiversity values of parks is necessary in the face of human activity (such as economic development) and ecological challenges. Successful strategies will require 1) ecosystem-scale management that extends beyond park boundaries and involves other agencies and landowners, 2) better understanding of hu-

man actions that impact biodiversity, and 3) analytical techniques and practical tools for making land management decisions. One such technique is *gap analysis*.

Gap Analysis: A Brief Description

In order to identify underprotected yet critical areas of biodiversity, gap analysis uses geographic information systems (GIS) to map biodiversity and the location of protected areas. Elements of biodiversity including vegetation types and vertebrate species distributions are entered into the GIS; species richness maps are derived from these data. The resulting maps are overlaid with protection status such as national parks, wilderness areas, state parks and so forth. Locations with important biodiversity values and low protection status (the specific criteria can be adjusted) represent "gaps" in biodiversity conservation (see Scott et al. 1993 for a detailed description).

Gap analysis in its general form has been used in various situations, including USFS wilderness areas, tribal lands, Australian national parks, the Hawaiian Islands, California, Costa Rica, Ecuador and certain African protected areas (McKendry and Machlis 1992). A gap analysis program is now underway in 32 states in the US. It is anticipated that all states will be completed by 2009, and

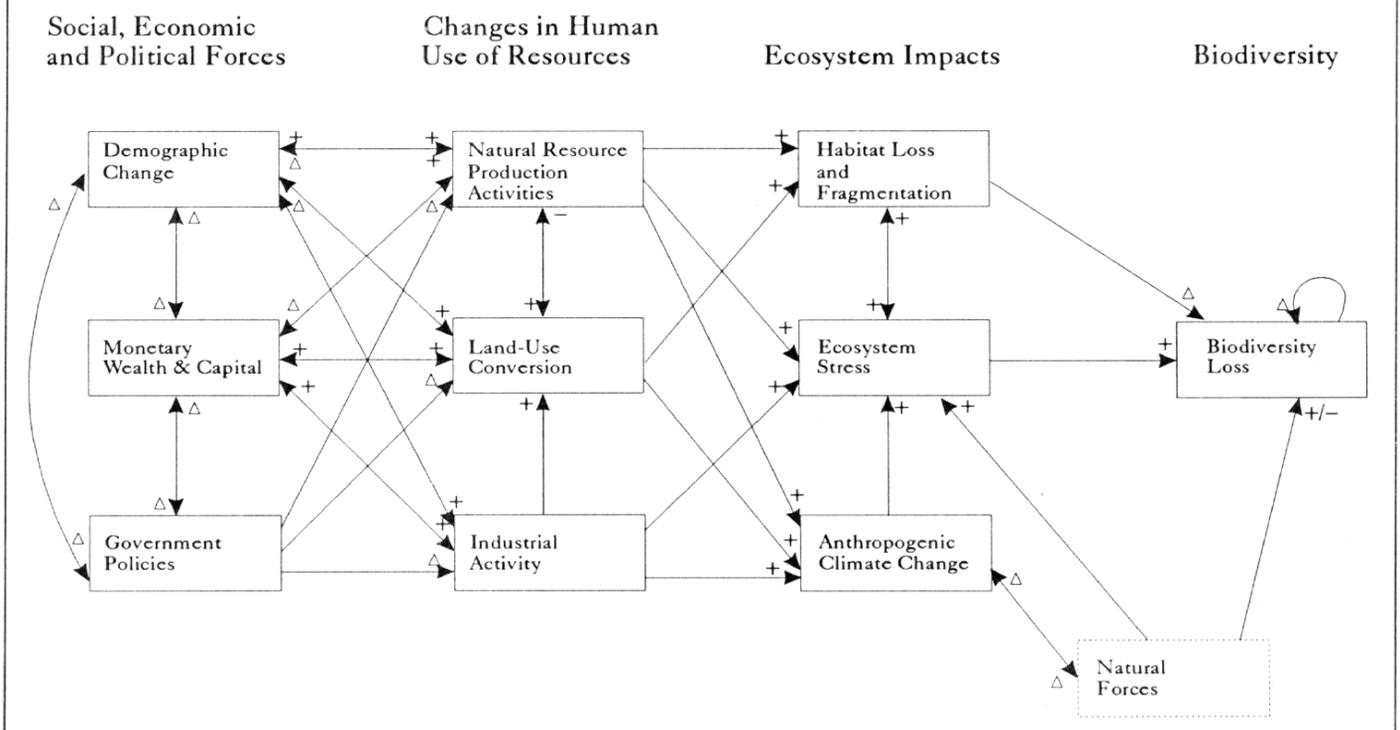
plans are being made to integrate state gap analyses into a national assessment (Scott et al. 1991). Gap analysis is likely to be an important component of the National Biological Survey.

Adding the Socioeconomic Dimension

Since human actions may increase the vulnerability of gap locations to future biodiversity loss, the University of Idaho's Cooperative Park Studies Unit (UI CPSU) Sociology Project has begun research extending gap analysis to include socioeconomic factors. A model was developed that identifies the major paths by which human actions impact biodiversity (see Fig. 1; for a detailed description see Machlis and Forester, forthcoming). Social, economic and political factors are considered the driving force behind changes in how people use resources. Changing resource use leads to impacts on ecosystems, some of which may result in biodiversity loss.

Extending the gap analysis technique to include socioeconomic factors is relatively simple. Socioeconomic zones of influence are delineated around each biodiversity gap location. Based upon the model, indicators of human action are collected and entered into the GIS database (see Table 1 for examples). Related indicators are combined into

Figure 1. A Working Model of Human Impacts on Biodiversity.



indices, again based upon the model. Finally, an index of vulnerability is created, and each gap location is given a relative index score. The results are displayed in map form; the maps may be useful to managers, landowners, resource agencies, advocacy groups and interested citizens (for a description, see McKendry and Machlis 1993).

The Idaho Pilot Project

The potential of adding a socioeconomic dimension to gap analysis was tested through a recently completed pilot project in Idaho. The research was funded by the NPS and the State of Idaho; the UI CPSU Sociology Project, the Idaho Cooperative Fish and Wildlife Research Unit, and the Clark University Graduate School of Geography were cooperators on the project.

Native vertebrate species richness (excluding fish) was used as the basis for the biological analysis. Data for the state were aggregated by 635 km² hexagons developed for the EPA's Environmental Monitoring and Assessment Program. Gap locations were determined using a specific algorithm, or mathematical procedure. The hexagon with the highest number of species was identified, followed by the hexagon that added the highest number of species not already in the first hexagon. This procedure continued until all native vertebrate species were included in the set of hexagons. The result was the minimum number of hexagons containing all native vertebrate species in the state. Five hexagons were selected for further analysis. Together, the selected hexagons contained approximately 95% of all native vertebrates in Idaho.

Each of the five hexagons was identified as a "gap location," i.e., potentially important to biodiversity in Idaho. A map of these gap locations was overlaid with a map of protected area status in Idaho; areas were defined as having "complete" or "partial" protection based on The Nature Conservancy classification system (see Map 1, page 8). None of the hexagons are totally protected, though small portions of protected areas are present in several of the gap locations. (In the on-going gap analysis program, other biological criteria and more sophisticated algorithms are being developed to identify areas of important biodiversity. The techniques are evolving rapidly, as scientists gain more experience in gap analysis.)

Socioeconomic indicators similar to those listed in Table 1 were collected for the counties surrounding each gap location. Data were entered into the GIS database; dBase IV, pcArc/Info, and IDRISI were used as software for the analysis. Four indices were constructed and mapped: socioeconomic change, government policies, land development and ownership complexity. Map 2,

page 9 (both maps are black and white conversions of their color originals) shows the results for socioeconomic change; the lower the index score, the lower the predicted level of future population and income growth. The four indices were then combined into an overall index of vulnerability. Based on the analysis, the gap locations were ranked as to their relative vulnerability to future biodiversity loss.

The results are presented in map form, with explanatory text. GIS and graphic design software used to produce the final maps included pcArc/Info, IDRISI, CorelDraw! and Micrografx Picture Publisher. A prototype atlas, *Idaho: An Atlas of Biodiversity* (Machlis et al. 1993) was prepared.

Next Effort: Puget Sound Gap Analysis

The UI CPSU Sociology Project has begun an effort to apply what was learned in the Idaho pilot project to the Puget Sound region of Washington. The research is supported by both the NPS (Pacific Northwest Region) and the EPA (Division of Strategic Planning and Management). The USFWS Washington Cooperative Fish and Wildlife Research Unit is a cooperator.

The Puget Sound study offers the opportunity to improve the integration of socioeconomic factors into the gap analysis technique. It allows for working at a different scale (ecoregion rather than state), and Puget Sound is a large, rapidly growing metropolitan area adjacent to several national parks. Additional socioeconomic indicators will be employed. Different presentation possibilities, including an interactive atlas on CD-ROM, are being explored. An advisory committee is being established, and will help assure the results are useful to managers and decision-makers.

Applications to National Park Management

While the technique needs further development, extending gap analysis to include socioeconomic factors could prove beneficial to national park managers and others interested in biodiversity conservation. Several potential uses are illustrated below:

- Gap analysis can help identify locations vulnerable to biodiversity loss. For example,

locations where human population growth is leading to rapid land-use conversion and habitat fragmentation can be identified. Importantly, the results could identify areas (1) high in biodiversity values, (2) vulnerable to biodiversity loss, and (3) not in national parks, yet which may impact the parks. South Florida and Puget Sound are examples of regions where such an effort may have merit.

- Once gap locations and their vulnerabilities have been identified, long-term monitoring can answer such questions as: Are critical socioeconomic trends continuing? Have actions been taken to reverse those trends contributing to biodiversity loss? What indirect impacts might be resulting from human activity in or near the gap locations? Monitoring critical socioeconomic trends and landscape changes can (1) provide an "early warning system," (2) help clarify management challenges, and (3) suggest potential actions. Such monitoring for the Greater Yellowstone Ecosystem, or along the US-Mexico border may be useful.

- Threats adjacent to parks could be treated as significant factors influencing biodiversity within parks. Increased biodiversity loss outside of national parks may signal increased concern for protection within parks. Park boundaries are permeable, and effective biodiversity conservation demands examining and understanding processes in the wider landscape of which protected areas are part. For example, the technique could prove critical to buffer zone and corridor planning; the North Cascades National Park Complex and certain historic battlefields (which may also preserve significant biodiversity values) might be appropriate sites.

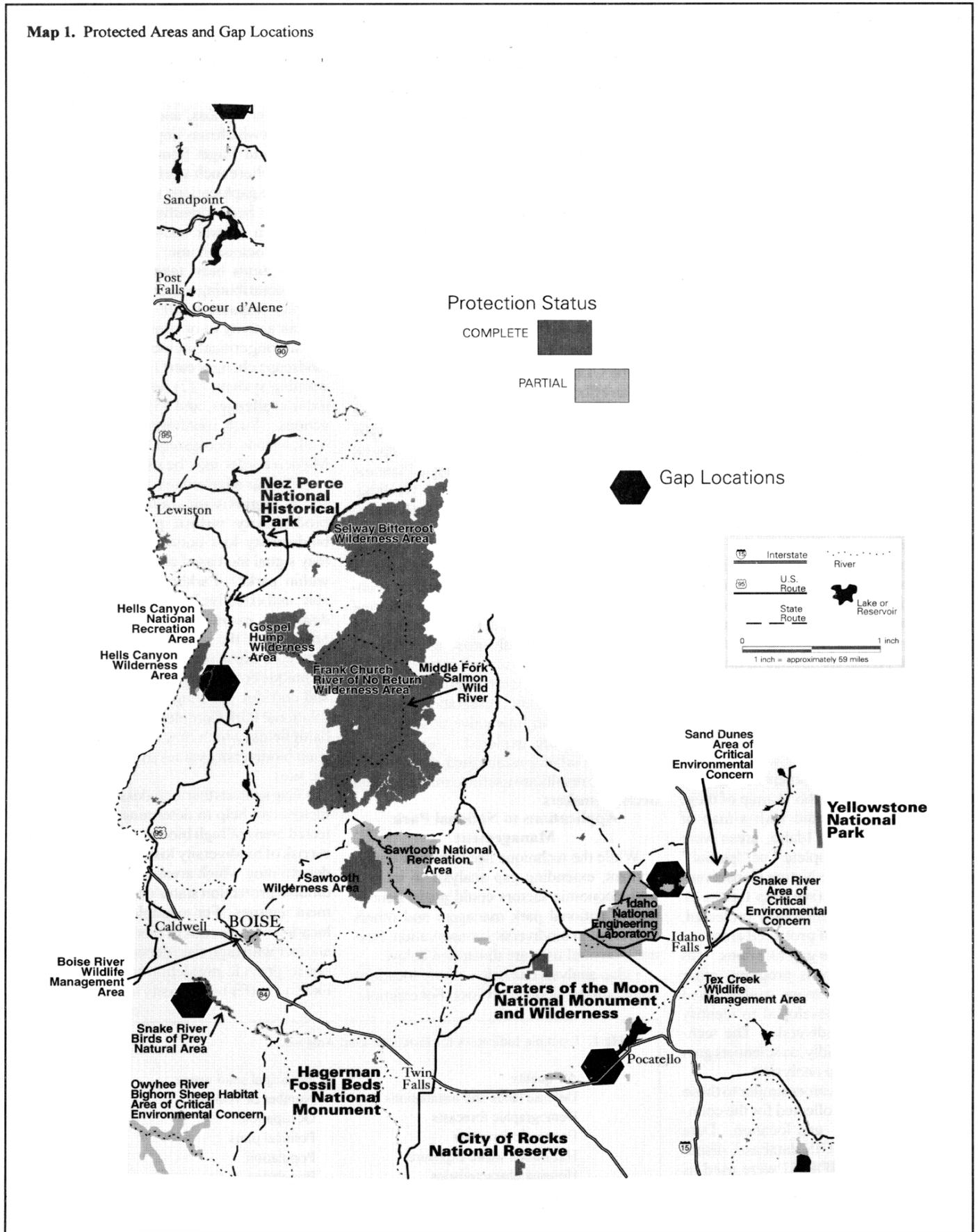
- Gap analysis that includes socioeconomic factors can help to determine which unprotected areas of high biodiversity are at greatest risk of biodiversity loss. This can assist in determining which areas to consider for additional protection status or revised management regimes. For example, given one gap location with low risk of biodiversity loss and another with high risk, decision-makers may opt to provide protection to the area most likely to suffer biodiversity loss. In addition,

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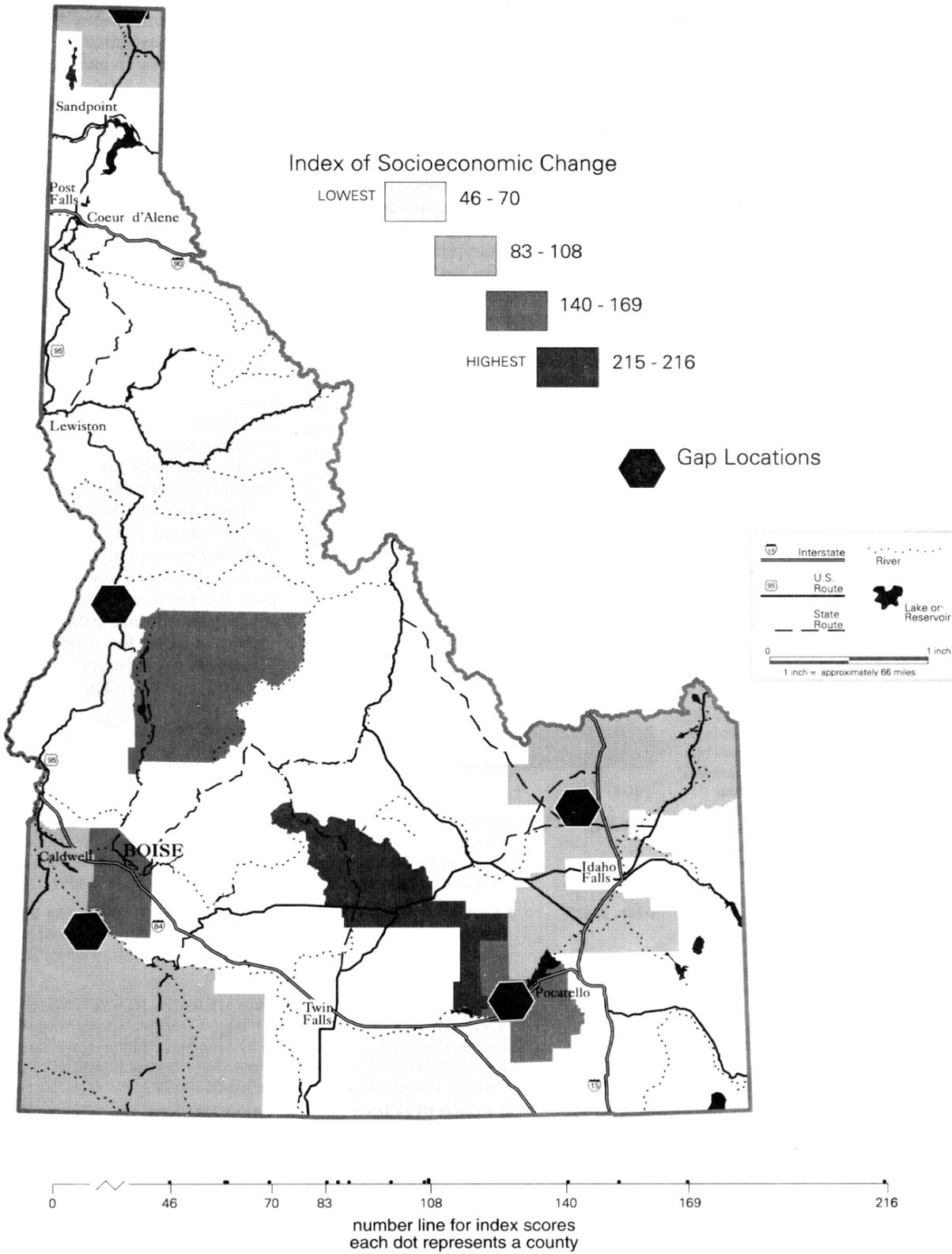
Table 1. Example Indicators for Extended Gap Analysis.

Air quality	Municipal solid waste
Defense lands and installations	Number of vehicles
Demographic forecasts	Occupation
Economic forecasts	Political units
Hazardous waste exposure	Population
Housing characteristics	Population and economic projections
Labor force projections	Population density
Land use regulations	Real estate transactions
Location of manufacturing	Residential construction

Map 1. Protected Areas and Gap Locations



Map 2. Socioeconomic Change and Gap Locations



gap analysis can help identify areas where careful development may minimally harm biodiversity values. Such information may be useful to non-governmental organizations with land acquisition programs, federal and state agencies, and private developers.

Conclusion

Gap analysis is evolving rapidly, and numerous state databases are being constructed. The technique likely will become an important conservation planning tool. Gap analysis can provide a systematic source of information for scientific analysis, professional management, and public dialogue. All are necessary for successful ecosystem management and the conservation of biodiversity. Extending gap analysis to include socioeconomic factors will further increase its usefulness and application. While much work remains before the technique is fully operational, park managers may soon benefit from its use.

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Watchable Wildlife Conference Shows Strength in Diversity

By Napier Shelton

The most exciting thing about the Watchable Wildlife program—its pulling together of people from many sectors of American life—was once again evident at the program's second national conference, held at Corpus Christi in November 1993. Besides managers and interpreters from numerous public agencies and conservation organizations, there were representatives from municipal offices, chambers of commerce, ecotourism, the military, universities, corporations, and the media—as participants. All were interested in how wildlife watching can lead to understanding, conservation, and ultimately the maintenance of biodiversity.

Some also were interested in the economic benefits. For instance, several staff members from Texas ranches, where cattle and abundant wildlife coexist, came to explain or find out how to make money from wildlife watching. (Bird tours regularly visit the King Ranch, where 434 species of birds have been seen—as many or more than in most states.) Participants also learned how corporations increasingly are contributing to wildlife habitat enhancement, thereby achieving better community relations, often a better bottom line, and heightened employee involvement.

The ethics of wildlife viewing received a lot of attention this year. How close should you get to wildlife? When is it OK to play

tapes to attract birds? Where should we draw the line between the benefits of wildlife viewing and stress on animals? These questions need more research and continuous awareness.

Three NPS presenters (including one "defector" to the NBS) shared Park Service experience. Judd Howell from Golden Gate described the benefits to both park and people as volunteers assisted with raptor banding and vertebrate surveys. Ray Skiles explained how Big Bend attempts to prevent too-close encounters of people with mountain lions and black bears, under the NPS land management ethic. John Miller talked about birds and sea turtles on Padre Island.

The Park Service had nine attendees at the conference—up from six last year but still a disappointingly small number. The NPS has a lot to contribute to the Watchable Wildlife program, especially its interpretive/educational experience, and a lot to gain from working with the many groups involved.

Gary Graham, John Herron, and numerous colleagues from the Texas Parks and Wildlife Department and elsewhere are to be congratulated for a well-run, highly informative, friendly conference that made good strides toward bringing the public and private sectors together for wildlife conservation. Next year's conference will be held in Burlington, VT, in October. Y'all come!

Meetings of Interest

1994

- Feb. 23-25** 2nd SYMPOSIUM ON SOCIAL ASPECTS AND RECREATION RESEARCH, at San Diego, CA; hosted by USFS Pacific SW Research Station, BLM, and the Social Aspects of Resource Management Institute at CA State Polytech U, Pomona. Contact Lisa Maggiore, (909) 869-4591
- Mar. 23-25** 5 YEARS AFTER THE EXXON VALDEZ OIL SPILL, An International Conference on Prevention, Response, and Oversight; sponsored by the Alaska Sea Grant College Program, U/AK, Fairbanks. Contact Brenda Baxter, U/AK, Fairbanks, 99775-5040; (907) 474-7086.
- May 4-6** 1994 GEOLOGIC SOCIETY OF AMERICA, ROCKY MOUNTAIN SECTION MEETING, Durango, CO; Papers from a platform session on NPS Paleontological Research, chaired by Vincent L. Santucci, will be published in a symposium volume. Contact Santucci at Petrified Forest NP, PO Box 2266, Petrified Forest, AZ 86028; (602) 524-6228 x227.
- May 16-18** SECOND INTERNATIONAL CONFERENCE ON SCIENCE AND MANAGEMENT OF PROTECTED AREAS, at Dalhousie U, Halifax, Nova Scotia; contact: Neil Munro, Parks Canada, Historic Properties, Upper Water St., Halifax, N.S., CANADA B3J 1S9, FAX (902) 426-7012.
- June 7-10** FIFTH INTERNATIONAL SYMPOSIUM ON SOCIETY AND RESOURCE MANAGEMENT, CO/State/U, Fort Collins, CO. Michael J. Manfredo, program chair, has called for papers by Nov. 1, 1993, to Manfredo, Human Dimensions in Natural Resources Unit, CO/State/U, Fort Collins, CO 80523.
- Aug. 28-Sept. 2** 6th ANNUAL INTERAGENCY WILDERNESS CONFERENCE, tentatively scheduled for Santa Fe or Albuquerque, NM.

Getting a Handle on Visitor Carrying Capacity – A Pilot Project at Arches National Park

By Marilyn Hof, Jim Hammett, Michael Rees, Jane Belnap, Noel Poe, Dave Lime, and Bob Manning

Annual visitation to national park areas is now counted in the hundreds of millions. In the decade of the 1970s visitation increased by 30 percent; in the 1980s it rose 35 percent. If this trend continues, national park areas can expect a demand for an additional 60-90 million recreation visits by the year 2000. This presents the National Park Service with a huge challenge — maintaining the integrity of park resources and visitors' experiences.

In the past, the question of how much public use is appropriate in a national park has been framed in terms of "carrying capacity." This term/concept has come both from within the Park Service and from Congress — the 1978 General Authorities Act requires each park's general management plan to include "identification of and implementation commitments for visitor carrying capacities for all areas of the unit." Although Park Service management policies and planning guidelines acknowledge this responsibility, there has been little direction or agreement on a methodology for how to identify a park's carrying capacity. Indeed, there has not even been an agency-wide agreement on the meaning of the term "carrying capacity."

For the past several years NPS planners at the Denver Service Center and consultants at University of Minnesota and the University of Vermont CPSUs have been developing a process intended to help park planners and managers address visitor carrying capacity. The rest of this article summarizes this process, called the Visitor Experience and Resource Protection (VERP) process as well as discusses a pilot project at Arches NP.

The VERP Process

VERP defines carrying capacity as: *the type and level of visitor use that can be accommodated while sustaining the desired resource and social conditions that complement the purposes of the park units and their management objectives.*

In other words, the VERP process interprets carrying capacity not so much as a prescription of numbers of people, but as a prescription of desired ecological and social conditions. Measures of the *appropriate conditions* replace the measurements of *maximum sustainable use* that are often used to measure other types of carrying capacities (e.g., range capacity for domestic ungulates, wildlife habitat [Dassmann 1964]).

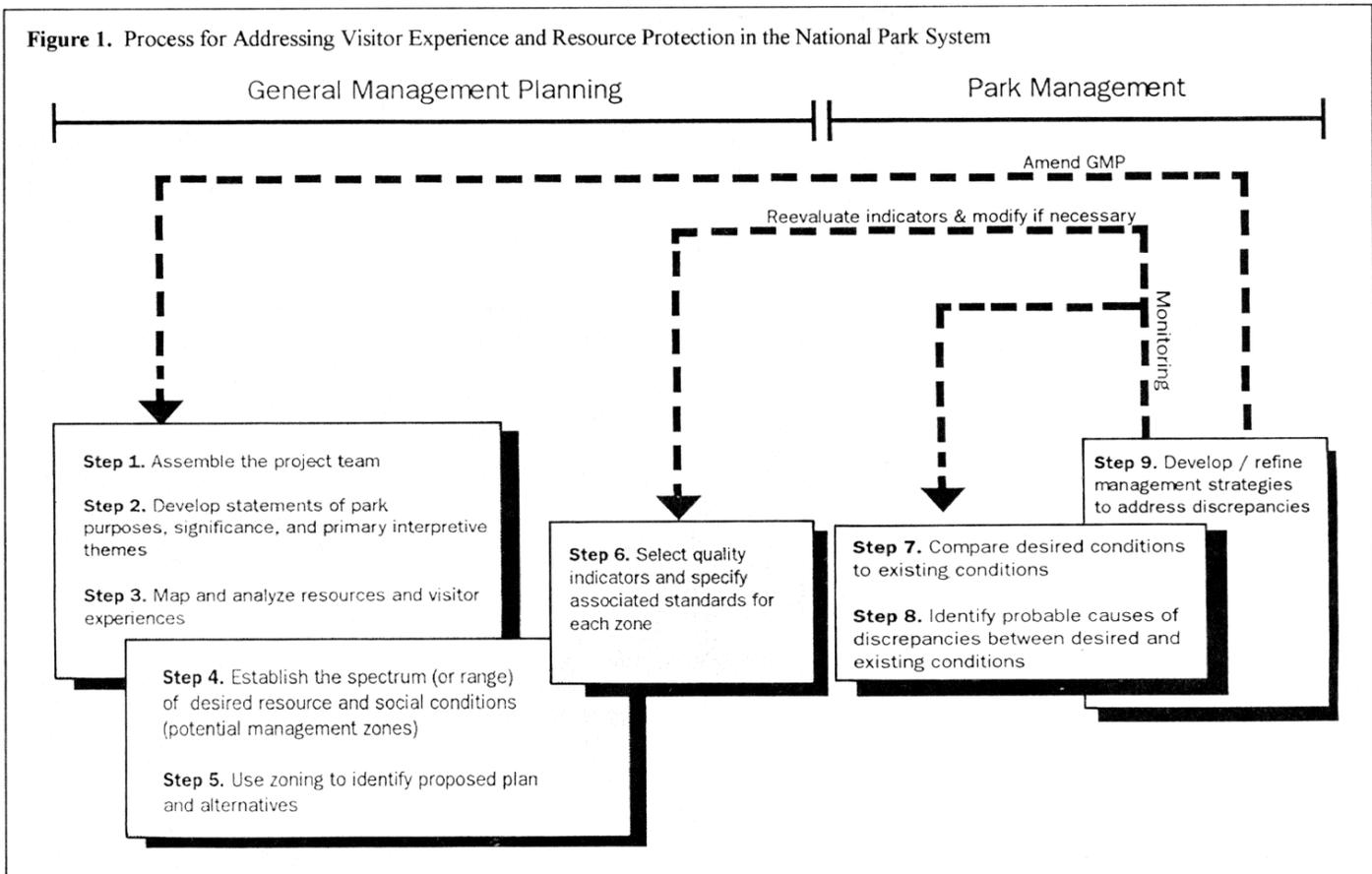
As conceived, the process will identify and document the kinds and levels of use that are appropriate, as well as where and when such uses should occur. The prescriptions, coupled with a monitoring program, will give park managers the information and the rationale needed to make sound decisions about visitor use, and gain the public and agency support needed to implement those decisions.

As shown in Figure 1, the VERP process consists of nine steps. The first six steps are requirements of general park planning, and ideally should be part of each park's general management plan. The later steps in the process require annual review and adjustment, and are accomplished through park operations and management activities.

The VERP process is based on many of the same elements and underlying logic included in the U.S. Forest Service's limits of acceptable change (LAC) and the National Parks and Conservation Association's visitor impact management (VIM) methodologies (Graefe, et al 1990; Lime and Stankey 1971). The primary difference between

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Figure 1. Process for Addressing Visitor Experience and Resource Protection in the National Park System



Computer generated photographs showing three levels of social impact.

VERP and these other processes is that VERP is intended to be used in all areas of a park, both frontcountry and backcountry whereas LAC and VIM have primarily been used in wilderness settings.

A major premise of these methodologies and VERP is that management goals, which are qualitative in nature, must be translated to *measurable* management objectives through the use of *indicators and standards*. Measurable indicators will be selected for monitoring key aspects of the visitor experience and resources, then standards will be assigned based upon management goals. When standards are exceeded, land managers must take action to get an indicator back within its defined standard. In a complex park, the park will also be zoned to reflect management goals for different areas. Then, specific indicators and standards would be selected for each zone.

Indicators are divided into two types: *biological/physical indicators*—those indicators that measure impacts to the biological or physical resources of a park; and *social indicators*—those indicators that measure impacts on park visitors that are caused by interactions with other visitors or with park or concession employees.

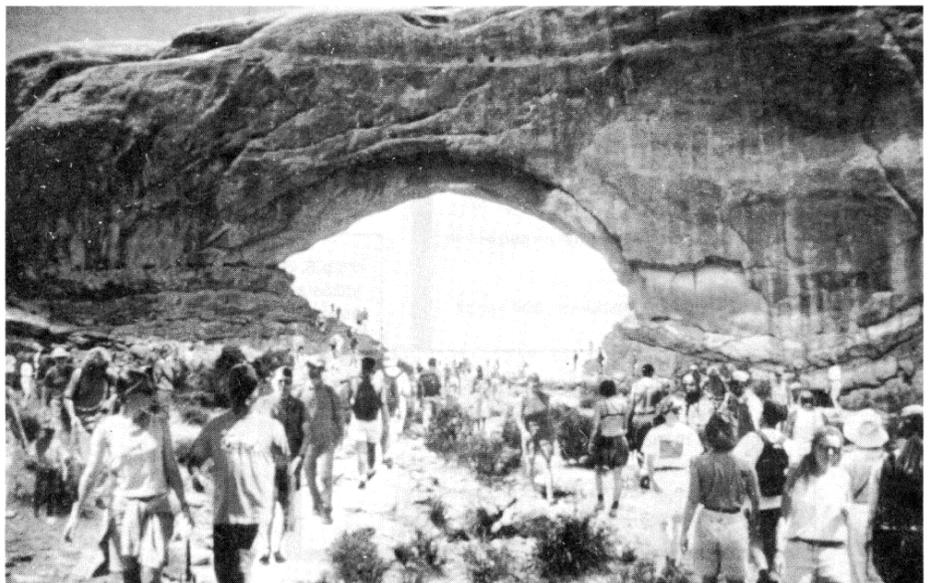
The underlying logic of indicators is easy to understand; however determining what standard to apply to different parts of the park is not so easy. It requires research, considerable thought, and considerable bravery on the part of managers! Since VERP is driven by indicators and standards, a considerable amount of effort has to be spent determining them.

VERP at Arches National Park

The VERP process is being pilot-tested at Arches NP. The purpose of this test application is to refine the VERP process and to provide a model for application to the National Park System. The process is currently between steps 5 and 6. The park has been zoned and the zones have been qualitatively described. The next step is the selection of corresponding indicators and standards. Below we describe research in progress by the authors aimed at defining these.

Research to Select Biological Indicators

During the past two summers, researchers have been evaluating potential indicators that might be used to measure impacts to park resources from visitor use. Nineteen indicators were evaluated in different habitats along trail corridors with high, moderate, and low use levels. Most of the potential indicators were discarded for a variety of reasons: they



were too difficult to measure, too costly, correlated poorly with changes in visitor use, too dependent on environmental variables such as rainfall, too slow to recover once impacts were reduced, or were not useable in different habitats.

However, three indicators showing considerable promise were selected:

cryptobiotic soil crust condition. This crust, which forms atop nearly all soils on the Colorado Plateau, is very important for nutrient cycling; it is very sensitive to visitor use; is easy to measure and quantify visually; and is indicative of overall ecosystem health.

soil compaction. Despite their sandy nature, soils of the Colorado Plateau are compactable, which adversely affects water uptake, nutrient cycling, and plant germination and growth. Again, this is a very easy indicator to measure and soils here recover from compaction fairly quickly once causal factors are removed.

formation of social trails. This indicator is an effective measure of off-trail use and indicates how much of an area away from designated trails is being trampled by visitors.

In addition to the above first tier indicators, which will be monitored on a weekly or monthly basis, a set of second tier indicators will be measured on a 5-year cycle. These indicators include cover and frequency of vascular plants by species, elemental tissue analysis of dominant plants, cover and frequency of ground cover (litter, cyanobacteria, mosses and lichens), soil characteristics (organic matter, bulk density, porosity, etc.). The purpose of these indicators is to measure more directly the ecosystem health, and also to check the validity and utility of the first tier indicators.

Research to Select Social Indicators

The social carrying capacity research program at Arches was approached in two phases. Phase I was conducted in the summer of 1992 and aimed at identifying potential social indicators (Manning et al. 1993). Personal interviews were conducted with 112 visitors throughout the park. In addition, 10 focus group sessions were held with park visitors, park staff and local community residents.

Phase I research was qualitative in nature; its purpose was simply to explore for potential indicator variables. Additional research, phase II, was needed to become more quantitative by asking respondents to rate the relative importance of these potential indicators. This required a larger and more representative sample. It also required some inno-

vative sampling techniques based on image capture technology (Nassauer 1990, Chenoweth 1990, Pitt 1990, Lime 1990). Base photographs of park sites were taken and these images were then modified with computer software to present a range of impact conditions. A set of 16 photographs was developed for each attraction site and trail presenting a wide-ranging number of visitors present. An analogous set of photographs was developed for a range of environmental impacts caused by off-trail hiking. Respondents rated the acceptability of each photograph.

Data from the second phase of the research program are now being analyzed. Our expectation is that we will be able to identify the most important indicators of quality for each potential zone within the park and will be able to suggest visitor-based standards for at least some of these indicator variables. A program of monitoring will then be needed that focuses on these indicator variables. When monitoring indicates that standards of quality have been reached or exceeded, then carrying capacity will have been reached or exceeded as well.

Hof, Hammett, and Rees are planners at the Denver Service Center; Behnap is a research ecologist with NBS at Moab, Utah; Poe is the

superintendent of Arches N.P.; Lime is a professor and researcher at the University of Minnesota; Manning is a professor and researcher at the University of Vermont.

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Jacksonville Science Conference Proceedings Now Available

Proceedings of the 7th Conference on Research and Resource Management in Parks and on Public Lands, held in Jacksonville, FL Nov. 16-20, 1992, are now available in a single 479-page (softbound) volume for "probably under \$20." In addition to all the papers, summaries of the sessions, and a list of poster presentations, the book contains a Preface by William E. Brown, an Introduction to the Conference by Jean Matthews, and Gaylord Nelson's conference closing address.

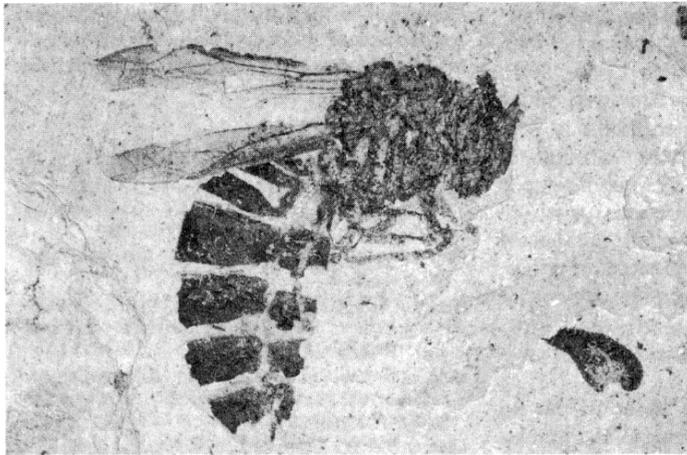
Orders will be invoiced and may be made by writing the George Wright Society, P.O. Box 65, Hancock, MI 49930-0065, by calling (906) 487-9722, or by FAX (906) 487-9405.

Battling Bees Here

An article in the latest *Inside Bajada* by Gloria Maender of the NPS CPSU at U/AZ reports the arrival in at least four NPS sites in Texas of swarms of Africanized honey bees (AHB)—the kind that was introduced into Brazil from South Africa in 1956. In addition to describing the swarms at Big Bend NP, Amistad NRA, Padre Islands National Seashore, and San Antonio Missions NHP, the article describes measures that at-risk NPS units should be taking:

- Become aware of the type of habitats within the park area where honey bees now nest and monitor the bee population.
- Use pheromone-baited swarm traps to monitor feral bees. USDA Agricultural Research Service traps are durable, inconspicuous, and popular with bees.
- Establish and maintain contact with local State Agriculture Department personnel responsible for AHB monitoring and information.
- Establish working relations with federal or UA honey bee research scientists.
- Train at least two personnel in handling of swarm traps and emergency procedures.
- Develop handouts for park visitors, calling on University extension services.

Creepy-Crawlys of Florissant's Eocene Time



By William A. Dexter

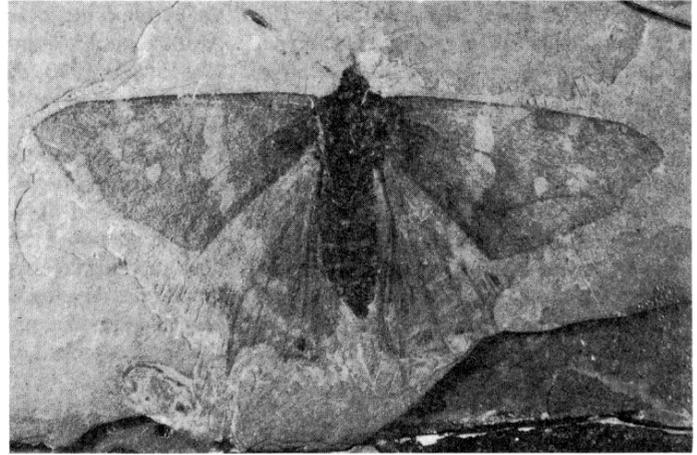
Did you know that today every fifth living thing in our world is a beetle?!

It is estimated that over one million species of insects are alive today. It is very possible that millions more remain to be identified. Add the number of extinct insect species and the total becomes astronomical. Insects were, and are, the most successful organisms ever to have lived on earth. With the exception of microscopic organisms, insects far outnumber all other living things combined.

Four insect orders have been around for more than 300 million years. Insect fossil parts have been found in Cambrian rock nearly 600 million years old! Fifteen insect orders had developed by 200 million years ago, at the time of the initial stages of Pangea, when continental drift started and the dinosaurs first appeared. Most major insect groups were established during Carboniferous times—the time of the coal age forests. Some Carboniferous dragon flies attained wing spans of over 30 inches; cockroaches grew to 12 inches in length.

Thirty-five million years ago, an overwhelming number of insect species flourished around and about ancient Lake Florissant, site of the present day Florissant Fossil Beds National Monument in Colorado. It is estimated that as many as 75 percent of all modern insect genera were present when the Florissant Fossil shale beds were laid down. Although there are representatives of modern genera and families at Florissant, all the individual species that lived in the Florissant area during Eocene times now are extinct.

Two of the most abundant insect orders prevailed during ancient Florissant times. One group includes the bees, wasps, and ants; the other includes the beetles. Snout



Right: Ancient wasp (*Paleovespa Florissantia*) probably resembling a modern day bald-faced hornet. This carbon imprint is some thirty-five million years old.

(PHOTO BY WALT SAEUGER)

Left: Fossil butterfly (*Prodryas persephone scudder*), unique in the world, was carefully preserved for about thirty-five million years.

(PHOTO BY F.M. CARPENTER)

beetles (weevils) and ground beetles are the most common beetle types found as fossils in the Florissant Lake deposits.

The great diversity of insects represents an astounding success story and rapid evolution. Why are insects so successful? Why were insects so numerous in and about Florissant's ancient lake?

We might look for answers first in the unique overall appearance that insects share in general. They all possess a chitinous exoskeleton or hard outer body parts. This body support system provides armor-like protection. Another unique property is that 99 percent of all insects have wings, which aid them in their pursuit of survival. Their relatively small size makes them unobtrusive. Their ability to hide under vegetation and rocks helps to promote their preservation, protection, and further success. Short developmental stages allow for rapid regeneration, fast adaptation rates, and thus an increased survival duration.

Insects in general have a variety of feeding habits. Some eat vegetation. Others are predacious or parasitic and feed on other animals. A few insects even devour one another, (probably not one of their survival skills).

Insects have a multitude of lifestyles, variously termed incomplete and complete metamorphosis. Grasshoppers, crickets, and roaches have incomplete life histories. This means that when they hatch from eggs, the

young appear as miniature versions of adults. Complete metamorphosis occurs where the young develop by dramatic "leaps and bounds," not in a gradual manner and by means of various larval stages.

Some insects within the same species have different life forms. Ants, for example, have workers, queens, and winged members—the latter being sexually active and searching for mates; other forms of ants are sexless. Beetles, such as weevils and scavengers, are known to have foraged about the most productive areas of ancient Florissant Lake, hence would be more easily trapped by volcanic ash and dust. The variety of life cycles in the insect world increases their overall competitiveness and provides for successful life histories.

Those in subterranean habitats would have had little contact with poisonous volcanic gasses, such as methane and cyanide. All these various conditions collectively reflect the successful nature of insect behavior and ecology.

The insect story of the ancient Lake itself is a dramatic one. Insect fossils retrieved from the lake bed shales represent over 1,100 species, 19 orders, and 146 families. More insect varieties than from any other fossil formation in the world are found in these multi-layered shale beds.

Visitors to the Florissant Fossil Beds National Monument can read the fossil evidence, revealing a chapter of ancient life trapped in the paper thin pages of time—an epoch some 30 million years before the onset of humanity. To visit Florissant and then consult the yellow pages under "exterminators," is to realize that insects continue to make one of the strongest of Life's bids to "inherit the earth."

Dexter is Staff Paleontologist at Florissant Fossil Beds NM, Florissant, CO.

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Information Crossfile

Frequent, abrupt changes in the climate of Earth have been the rule over the past 250,000 years, according to climate specialists' analysis of ice extracted from the full depth of the Greenland ice sheet.

Walter Sullivan of the *New York Times* wrote in mid-July that the "astonishing" findings suggest that the period of stable climate in which human civilization has flourished may be unusual and that the present climate may get either warmer or colder much more quickly than had been believed—"in spans of decades or even less."

J.W.C. White of the Institute of Arctic and Alpine Research at U/CO noted that whereas adaptation—the peaceful shifting of food-growing areas, coastal populations, etc.—seemed possible if change meant a few degrees in a century, the new studies indicate change of as much as 18 degrees in a couple of decades. The new results, reported in *Nature*, unexpectedly showed abrupt climate changes in inter-glacial as well as in glacial periods. The *Nature* article authors had no explanation for the rapid shifts, nor for the "mystery" of why the climate of the last 8,000 to 10,000 years has been "strangely stable."

* * *

Merck, Sharp and Dohme, the pharmaceutical company, has agreed to pay Costa Rica \$1 million plus royalties from products developed as part of the on-going hunt for new chemicals in nature that may prove useful to human beings. The \$1 million is being applied by Costa Rica toward its conservation effort, and represents industry's acknowledgement that helping to preserve biodiversity is a wise investment.

Thomas Eisner, Shurman Professor of Biology at Cornell Institute for Research in Chemical Ecology and a member of the National Academy of Sciences, was quoted in the July 6, 1993 issue of the *Oregonian* as having proposed creation of a Biotic Exploration Fund of about \$250 million (the approximate cost of bringing a single pharmaceutical drug to market) to receive contributions from industrial and governmental sources. The fund would then help finance biodiversity institutes in developing nations and help create partnerships between those nations and industry. The donors would recover their investments from the new products developed; the developing nations would acquire the resources needed for conservation.

Only a tiny fraction of the millions of species of animals, plants and microorganisms on Earth have been tested for useful chemicals, Eisner said, "but the shelf of

natural molecules is fast disappearing... being cut down, eroded away, lost to urbanization..."

* * *

Norman Myers, an environmental consultant in Headington, Oxford, UK, and a senior fellow of the World Wildlife Fund, US, is the author of an article titled *The Question of Linkages in Environment and Development* in *BioScience*, 43:5,302-310.

The article, based on an extended policy background for the secretariat of the UN Conference on Environment and Development, analyzes the character and prevalence of linkages, illustrates linkages through instances from several spheres of human activity, and concludes by considering the sorts of policy initiatives that would enable us to deal with linkages in a manner and on a scale to reflect the challenge they represent.

He describes our world view as "traditionally grounded in a practice of splitting it up into manageable components" that consider linkages as "an incidental factor too complex to be reflected (operationalized) through institutional responses," and concludes: "We will respond to linkages either by reactions of sufficient scope and character, or by salvage measures in a world impoverished by our disregard for linkages. Linkages will eventually be addressed, whether by design or by default."

* * *

Revelstoke, a community in the Columbia Mountains of interior British Columbia (and near Glacier NP), has developed a "vision statement," described by Jenny Feick and Dr. Albert Einsiedel, Jr. in *Research Links* (Spring 1993), Vol. 1, No. 1 of the Canadian Park Service, Western Region's Forum for Cultural and Social Studies. The authors question *Revelstoke's Vision: Will It Help Achieve Sustainable Development?* and describe the evidence supporting the notion that goals have a motivating effect on behavior.

Revelstoke has experienced a boom and bust economy based on resource exploitation of the Columbia River, its neighboring forests, and major transportation corridor. Community residents decided they wanted to shape their destiny rather than be subjected to the whims of transient developers and government. In 1992 an interdisciplinary team prepared a vision statement and in February 1993 the Revelstoke citizens voted to purchase the tree farm license north of Revelstoke "to gain local control of forest management, thus taking a first step toward making their vision a reality." Their stated goal is "achieving sustainable growth by

balancing environmental, social, and economic values within a local, regional and global context."

* * *

From Cliff Martinka, NPS Senior Research Scientist at Glacier NP, comes word of a new book, **Parks, Peaks, and People**, compiled and edited by Lawrence S. Hamilton, Daniel P. Bauer, and Helen F. Takeuchi and produced by the East-West Center with assistance from the Woodlands Mountain Institute, the U.S. NPS, and IUCN's Commission on NPs and Protected Areas.

The book is an outstanding collection of papers arising from an international consultation on protected areas in mountain environments, held in Hawaii Volcanoes NP Oct. 26-Nov. 2, 1991. The book is available from East-West Center, Program on Environment, 1777 East-West Road, Honolulu, HI 96848. The cost is \$5, and Martinka notes: "A good value nowadays."

* * *

The Pacific Northwest Region's Resource Management newsletter recently highlighted, from the 11/30/92 issue of *U.S. News and World Report*, a paragraph that deserves repetition. It appeared as part of a review of *The Diversity of Life*, by E.O. Wilson.

"A vital reason to protect biodiversity is to preserve the ecosystems that we depend on to enrich the soil, modify the climate, even create the air we breathe. Turning over a stump, Wilson pointed out the profusion of small and obscure life forms—a metallic blue beetle, a centipede, mites, a crane fly, slugs galore, and a riot of orange, white, and yellow fungi, topped by green and eggplant hued colonies of algae. These, he said, are the organisms that 'hold the world steady.'"

* * *

Henri Grassino-Mayer, a researcher from U/AZ, is working on his PhD studying trees at El Malpais National Monument in New Mexico and developing a tree ring chronology and climatic history of the area. A recent presentation at El Malpais by Grassino-Mayer for an audience of people from NPS, BLM, USFS, and Los Amigos del Malpais (an organization of volunteers who assist on park projects) was written up by J.D. Meisner and appeared in the *Cibola County Beacon* (Aug. 4, 1993) of Grants, New Mexico. Grassino-Mayer told his listeners that grazing, fire suppression, and logging showed up in his studies as having a solid impact on the natural record of fire and climate. His studies have provided what he called "the deepest fire

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history ever obtained in the southwest" and showed that many trees had survived 20 to 30 fires in their lifetimes.

* * *

For an arresting evocation of landscape in the form of words, see Gary Dwyer's description of the three landscapes that have been "most influential/important" to him in his work. The piece appears on page 169 of **Landscape Journal** (Fall 1993), and Dwyer's No. 1 choice is a National Park System site—which shall be nameless here, so as not to spoil the punch line at the end of Dwyer's astounding word picture.

For contrast, read Carol Franklin/Andropogon's essay (following Dwyer's) on the Russel Wright Garden of Woodland Paths, Garrison, NY... "an expression of the American landscape as opposed to imposing a European vision on it." She calls it "an ecological garden" because, as she says, Wright asked the question "What is this place?" and then brought the skills and the sensitivity of a designer to the task of discovering and dramatizing the patterns and processes of this landscape.

* * *

"They came, they multiplied, they conquered" is the opening of a **Science News** report (Vol. 144, p.20) on zebra mussels. These hitchhikers entered the Great Lakes in the ballast tanks of a transoceanic cargo ship and triggered one of the most disastrous ecological invasions in recent U.S. history. But they were only the first of many such invaders reaching saltwater ports, inland waterways, and marine estuaries "on a vast and largely unnoticed scale," says marine ecologist James T. Carlton of Williams College in Williamstown, MA.

Carlton (whose complete article appeared in the July 2, 1993 **Science**) studied the ballast water of 159 ships in Coos Bay, OR—ships that hailed from 25 Japanese ports—and found 367 different marine species, including shrimps, sea anemones, jellyfish, snails, clams, fish, flatworms, and a variety of microscopic life forms. These "invaders" are rarely noticed until, like the zebra mussel, they become a major nuisance. John Chapman, marine biologist at Oregon State University's Hatfield Marine Science Center in Newport, OR, calls it a lottery. "We can speculate," says Chapman, "but there are no data."

* * *

Biological Diversity: Conserving the Earth's Wild Wealth is the title of a poster-sized brochure produced by the NPS's Wildlife and Vegetation Division in Washington,

DC, and the Harpers Ferry Center in West Virginia. The attractive, colorful design focuses on the history and diversity of the planet's life forms, as found and studied in World Heritage sites and Biosphere Reserves. Interspersed with maps and photos, the text describes the evolution of our present finely woven fabric of life and suggests that its current unraveling can "harm human civilization too, by foreclosing opportunities for spiritual, intellectual, social, and economic development."

* * *

"Some basic ideas about ecology are changing. A change in theory may end up profoundly changing the physical world." With that provocative subtitle, Steve Packard's *Restoring Oak Ecosystems* in the Summer 1993 issue of **Restoration & Management Notes**, tackles the emerging debate about the nature of ecosystems and of Nature itself.

"Conservation biology, natural areas management, and restoration ecology are emerging disciplines that have been generating new definitions, information, understandings, goals and values," he says in opening. He then summarizes the elements of earlier conventional wisdom and proceeds to try to "untangle some of the interrelated ideas" they involve. The 11-page article covers Natural vs. Artificial Succession, the Power of Definitions, and the Setting of Management Priorities, all within the context of Midwestern tallgrass savanna restoration.

* * *

Worth sharing (in the context of restoration) is this quotation from **The New Republic**, Dec. 28, 1992, carried inside the cover of the Summer 1993 **Restoration & Management Notes**:

"Break a vase, and the love that reassembles the fragments is stronger than that love that took its symmetry for granted when it was whole."

* * *

For readers interested in Old-growth forests of Eastern North America, the April 1993 **Natural Areas Journal** carries an article by Gregory J. Nowacki (U.S.F.S., P.O. Box 21628, Juneau, AK 99802-1628) and Paul A. Trianosky (Duke University School of the Environment, Durham, NC 27708) that gives 749 literature citations, listed alphabetically by author. Numbered citations are cross-referenced with broadly defined forest types and selected old-growth sites.

* * *

The New York State Parks Agency's **Fostering Environmental Stewardship Plan**, undertaken in response to Governor Cuomo's 1990 State of the State directive, presents a 10-year stewardship action plan that would strengthen preservation and maintenance efforts on behalf of the State Park System, and also would dovetail with recommendations in the 1984 *NPCA Adjacent Land Survey: No Park Is an Island*. The National Park and Conservation Association report stated that "Unless all levels of government mount a concerted effort to deal with adjacent land problems in a coordinated manner, the NPS mandate will be completely undermined."

New York State Parks Agency Commissioner Orin Lehman noted that "other state park agencies and the National Park Service are looking introspectively and recommitting to their stewardship responsibilities."

Copies of the 81-page report and its 37 pages of appendices, plus a 16-page executive summary, may be requested from Thomas L. Cobb, NYS Office of Parks, Recreation and Historic Preservation, Bldg. 1, Nelson A. Rockefeller Empire State Plaza, Albany, NY 12238. The summary was presented by Dr. Dobb at the 5th Annual Northeastern Recreation Research Symposium at Saratoga Spa State Park, Saratoga Springs, NY, April 18-20, 1993.

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Pilobolus Ecology: Fungal forests, fecal ecosystems, and the wild ride of lungworm larvae. This is the intriguing title of an article by K. Michael Foes in the Spring 1993 issue of **Yellowstone Science** (Vol. 1, No. 3), complete with photos, charts, and maps. Also carried in the Spring 1993 issue is an interview with Pete Feigley, project coordinator/zoologist and a staff botanist, on the new Greater Yellowstone Conservation Data Center—a Natural Heritage Program funded by The Nature Conservancy with logistical support from the NPS. The project's aim is to inventory and monitor a wide variety of species in greater Yellowstone in order to improve understanding of the status and trends in ecosystem health.

* * *

Resource Management Notes, the Florida Dept. of Natural Resource quarterly newsletter, noted in its July 1993 issue a new program to help address the conservation and management needs of neotropical migrants that occur in Florida. The state's Game and Fresh Water Fish Commission's research, survey, and educational activities

will focus on breeding species suffering widespread declines, key habitats that support rare breeding species, and migration counts in many coastal areas.

These activities will be undertaken in cooperation with the Partners in Flight program, a nationwide effort being promoted by several federal agencies, including the National Park Service.

* * *

From Giovanni Puggioni, Natural Resource Officer for the B.C. Ministry of Environment, Lands, and Parks, comes a copy of **A Protected Areas Strategy for British Columbia** and a 1-square-yard poster/foldout of maps/artwork/text. The Strategy describes the policies and process necessary to protect 12 percent of the Province on a representative basis.

Copies of the 40-page Strategy publication and the associated poster/brochure may be had by contacting Puggioni at the Ministry, 2nd flr, 800 Johnson St., Victoria, BC, Canada; V8V 1X4; (604)387-5002.

* * *

Environmental Concern Inc.'s **Wetland Journal**, (Vol. 5, No. 2) introduces a new feature into the journal: The DOs and DON'Ts of Wetland Planning. The correct procedures associated with planned wetlands that will assist and often assure the success of such work will be listed under DOs. The errors associated with planned wetlands that will jeopardize the success of, and often cause the failure of, such work will be listed under DON'Ts. Contributors to this Restoration Techniques feature will be acknowledged, according to Dr. Edgar W. Garbisch, president of the publication's environmental concern staff.

* * *

PEER: A Publication of Public Employees for Environmental Responsibility, began publication (Vol. 1, No. 1) in Summer 1993. Billing itself editorially as "a new voice for environmental ethics," the publication received national press coverage. Its first issue carried news of a new organization formed by employees of the Bureau of Reclamation in Denver—REOEI (Reclamation Employee Organization for Ethics and Integrity), and a white paper written by employees of the DL's Bureau of Land Management (BLM). The white paper is entitled *Grazing report: Gross BLM Mismanagement Cited*, and is available from PEER, 810 First St., N.E., Suite 680, Washington, DC 20002; (202)408-0041.

* * *

An article entitled *NPWS—licenced to kill!* in the **Australian Ranger** (Spring 1993) by Lorraine Donne, describes a new and successful line of attack by environmentalists against logging activities in New South Wales. Under the National Parks and Wildlife Act there, it is illegal to "take or kill" fauna without permission (licence) from the National Parks and Wildlife Service (NPWS). The court found that the forestry activities in northern NSW's Chaelundi State Forest fell within this definition and were both a direct and indirect threat to endangered fauna in the forest.

As a result, the Endangered Fauna/Interim Protection (EFIP) Act of 1991 and the Environmental Planning and Assessment Act of 1979 (EPA Act) were amended. A significant change is expansion of the definition of "take or kill" to include "hunt, shoot, poison, net, snare, spear, pursue, capture, disturb, lure, or injure..." and also includes "...significant modification of the habitat of the fauna likely to affect its essential behavioural patterns." (All spellings reflect British style).

* * *

Nature Conservancy, TNC's bi-monthly publication, devotes its Ecology Forum in the November/December 1993 issue to "Florida's Plumbing Problems," and contains a beautifully illustrated look by Greg Breining at America's once-vast savanna: "The Case of the Missing Ecosystem," where did it go and can we bring it back?

* * *

More than 5,000 miles of beach were scoured in 1992 by some 160,000 volunteers as part of an international litter removal program coordinated by the Center for Marine Conservation (CMC) in Washington, DC. Trash brigades in the U.S. and 32 other countries retrieved 5,328,000 pieces of debris, 58.8 percent of which was plastic (including styrofoam).

This depressing item is carried in the October 9, 1993 issue of **Science News**, page 235. The CMC survey points out that fishing paraphernalia (monofilament line, floats, and lures), while it accounts for only 1 percent of the retrieved litter, kills more marine wildlife than any other category of beach debris.

* * *

The upcoming "Pacific Salmon & Their Ecosystems" conference in Seattle, WA, Jan. 10-12, 1994 will look at the status of Pacific Northwest salmonids, regional trends, salmon policies and politics, technological solutions (cost effective restoration), and institutional solutions (effective long-term

planning and management). One of the sessions is titled "Managing Resources with Incomplete Information: Making the Best of a Bad Situation"—surely an excessive redundancy!

The Portland **Oregonian**, editorializing on the salmon situation in the Nov. 21, 1993 paper, describes the "scientific consensus" for salmon recovery, beyond fishing restrictions: aggressive state and federal crackdown on salmon habitat destroyers—the logging, grazing, and mining practices that strip streambanks of vegetation and destroy spawning beds.

"Even more than freedom from fishermen's hooks or nets," the *Oregonian* editors wrote, "wild salmon need homes to return to."

* * *

Jack Ward Thomas, newly appointed Chief of the U.S. Forest Service, delivered his inaugural speech as chief to an overflow crowd at Oregon State University on Nov. 18, 1993... a speech that at least one reporter, covering it for the **Oregonian**, found to be "in an academic way, profound."

What Thomas talked about was the role of science in decision-making. "The public," he said, "should not expect too much from scientists because science is a *method*." He took aim at "professional gladiators" on both sides of the old-growth forest conflict—people who aren't interested in collaboration but are only in the fight to win. He understands that such people are a part of the political system, but they're not part of the approach Thomas sees evolving in the management of public lands. He characterizes this new approach as "an attempt to preserve biodiversity through ecosystem management at the landscape scale," with people an integral part of that landscape.

* * *

Wire service reports and work by the **Oregonian** staff describe how researchers at U/WA have cloned the insect juvenile hormone receptor—the cellular gateway that controls metamorphosis in caterpillars and butterflies. The receptor is the docking point in each insect cell for juvenile hormone, a protein substance that prevents the caterpillar from entering the pupal stage until its body has grown sufficiently. The insect matures only when the hormone is absent.

Hormone-based pesticides offer a way to control targeted bugs without hurting other creatures. Lynn Riddiford, a U/WA zoology professor who led the research, said the description of the receptor's biology will give the pesticide industry a road map for

Continued on page 22

Information Crossfile

designing dummy proteins that plug into cells of caterpillars, blocking the insect's natural hormone from the binding site and allowing premature metamorphosis.

* * *

The status and prospects for success of the Endangered Species Act (ESA) is the subject of an article in the Policy Forum section of **Science**, Nov. 12, 1993, pp 976-7. Four authors, two from U/ID, one from the USFWS unit there, and a research biologist for USFWS in Alaska, attempted to assess the validity of recent criticisms regarding the level of protection provided by the ESA and the recovery process.

They found that recovery plans all too often "manage for extinction" rather than for survival. "We need to be more realistic in setting biologically defensible recovery goals," they stated. If suitable habitat is severely limited, then habitat restoration should be included as a necessary component of recovery efforts.

They also pointed out that the ESA requirement that species should be recovered within their ecosystems "often may not be done." They propose "initiating an aggressive, proactive effort to save species while they are still common, viable parts of their self-sustaining natural ecosystems." An important step in that direction, they conclude, would be to ensure that a minimum of three viable representatives of each vegetation cover type are preserved in each ecoregion in which they occur.

* * *

A discussion of "sustainable use of renewable resources" in the Policy Forum section of **Science**, Nov. 5, 1993, pp 828-9, starts with the definition of sustainable use (as published in **Our Common Future**, Oxford Univ. Press, by the World Commission on Environment and Development): It is defined as use that "meets the needs of the present without compromising the ability of future generations to meet their own needs."

From there, five distinguished authors, (whose scientific expertise is mainly in fisheries), found that the challenges to sustainable use in the area of fisheries management are not insurmountable. "To meet these challenges," they write, "we must address fundamental economic biases against sustainability, particularly in open-access management regimes; continue the development and application of methods that directly integrate sources of uncertainty into scientific advice; and learn from past management failures and successes."

Their conclusion is that "Sustainable development is achievable if scientific advice based on biological, social, and economic considerations is an integral part of the development of policies for renewable resource use."

* * *

The Cowbird Peril: A Resource Management Problem and an Interpretive Story is the title of a 33-page paper, written and distributed to selected NP sites and personnel by Richard L. Cunningham, NPS Western Region's Chief of Interpretation.

Cunningham notes that the National Park Service is a signatory agency to the Migratory Bird Conservation Program (also known as Partners in Flight). In spite of the fact that migratory birds are an important part of the biological diversity of the National Park System and a resource the NPS is committed to conserve, too little is understood about one of the major threats—brood parasitism by cowbirds.

Three species of the cowbird now reside in the United States, and Cunningham has addressed his paper to NPS interpreters and resource management specialists to inform and educate park staffs and the public about the cowbird menace and methods for combatting it.

The paper while still in draft form prompted the Western Regional Office to prepare and submit an NRPP Proposal (WR-N-02, Neotropical Migratory Bird Population Management: Parasitic Cowbird Removal).

For copies of the paper or further information, contact Cunningham at (415) 744-3910.

* * *

The Oct. 15, 1993 issue of **Science** describes (on p 410-412) a 5000 year record of extreme floods and climate change in southwestern U.S. The regional paleoflood chronology, based on flood deposits from 19 rivers in Arizona and Utah, shows the largest floods in the region cluster into distinct time intervals that coincide with periods of cool, moist climate and frequent El Nino events.

* * *

Fire History and Climate Change in Giant Sequoia Groves, by Thomas W. Swetnam of the U/AZ Laboratory of Tree-Ring Research, describes how fire scars in giant sequoia (*Sequoiadendron giganteum*) were used to reconstruct the spatial and temporal pattern of surface fires that burned episodically through five groves in the past 2,000 years. Regionally synchronous fire histories demonstrate the importance of climate in maintaining nonequilibrium conditions. The article appears in pp 885-9 of **Science**, Nov. 5, 1993.

Thirteen New Titles Available

From Donna O'Leary comes word of 13 new titles, obtainable by writing to her:

**Publications Coordinator
National Park Service
Natural Resources Publication Office
P.O. Box 25287 (WASO-NRPO)
Denver, CO 80225-0287**

1. Ecological effects of the Lawn Lake flood of 1982, Rocky Mountain National Park. Henry E. McCutchen, Raymond Herrmann, and David R. Stevens, editors. NRS-93/21
2. Demography of grizzly bears in relation to hunting and mining development in northwestern Alaska. W.B. Ballard, L.A. Ayres, D.J. Reed, S.G. Fancy, and Kate Faulkner. NRS-93/23
3. Proceedings of fourth conference on research in California's national parks. Stephen D. Veirs, Jr., Thomas J. Stohlgren, Christine Schonewald-Cox, editors. NRTP-93/9
4. Proceedings of first biennial conference on research in Colorado Plateau national parks. Peter Rowlands, Charles van Ripper, III, and Mark Sogge, editors. NRTP-93/10
5. National Park Service paleontological research abstract volume. Vincent L. Santucci, editor. NRTR-93/11
6. Proceedings of fourth western black bear workshop. Jeffrey A. Keay, editor. NRTR-31/12
7. Proceedings of the Seventh Annual GRASS Users Conference, 1992. Gary W. Waggoner, editor. NRTR-93-13
8. Handbook for ranking exotic plants for management and control. Ronald D. Hiebert and James Stubbendieck. NRR-93/08
9. Permit application guidance for new air pollution sources. John Bunyak. NRR-93/09
10. 1992 highlights of natural resources management. Lissa Fox, editor. NRR-93/10
11. The Pacific Northwest Region resource database project: a synthesis. R. Gerald Wright. NRR-93/11
12. Problems and practices in backcountry recreation management: a survey of National Park Service managers. Jeffrey Marion, Joseph Roggenbuck, and Robert Manning. NRR-93-12
13. 1992 annual science reports
Data sorted by region and park: NRSR-93/08
Data sorted by field of study: NRSR-93/09

Letters

To the Editor:

This is a plea: **Don't Bury Resource Management!**

In the 1970s, several parks, including Sequoia/Kings Canyon and Yosemite, organized independent resource management programs. Management review reports over the past decade, from State of the Parks (1980) to the Vail Agenda (1992), have stated an urgent need for more and better trained NPS natural resource managers and better program focus. The Natural Resource Management Trainee Program was begun in 1983 in response to the identified need to increase the number of professional natural resource managers and to upgrade the effectiveness of NPS resource management.

Professional Parity – Protection/emergency services have become so complex that just sustaining full performance level skills and maintaining quality standards has become an arduous task for rangers. Rather than pursue a futile attempt to require rangers to do everything, the time has come to embrace the concept of professional parity between rangers and resource managers.

Certainly more individuals are needed who possess the knowledge and who are provided the time to contribute significantly to resource management activities. It is imperative that a corps of individuals is dedicated fulltime to resource management functions—to provide program direction, development, operation, and evaluation. Just as technical requirements for ranger profi-

ciency have increased, so too has the need for educated, technically proficient and experienced resource managers to accomplish *scientifically valid* resource management.

Scientific Credibility—High-quality data are important for many management decisions and are *critical* to support controversial ones. Since the park ranger series has no science education requirements, its ranks lack scientific credibility. Such credibility is necessary for the NPS to participate effectively in complex resource management conflicts—especially when dealing with resource managers and scientists from other agencies, institutions, and private industry.

Science information is often too technical for managers to interpret alone, and the management implications may be unclear. The Vail Agenda stated, "Managers have little training and experience to learn the uses and needs of research outputs." Acceptance by management of the value of research results can go a long way toward promoting manager-scientist cooperation.

Partners in Park Management – Complex social, political, environmental, and ecological considerations warrant *interdisciplinary consultation*. The natural resource management component deserves Divisional status and presence at Divisional Chief meetings so that specific ecological implications of management actions can be communicated. The separation of professional resource management disciplines from decision making is unconscionable. The integration of natural resource information into park management decisions often depends on the manner in which it is communicated to park managers, and on the level at which such input occurs. It is high time to accept and recognize natural resource professionals as full partners in providing the National Park Service with *science-based* management.

Everyone who works in a national park unit contributes, either directly or indirectly, to resource management. Rangers who are better educated in science will be able to contribute more. But program development, guidance, and evaluation must be provided by individuals educated and experienced in science and resource management and dedicated fulltime to those tasks.

Resource management is a *science*.

Gary Vequist
Brad Cella
Susan Mills
Ross Kavanagh
NPS Alaska Regional Office
Anchorage, AK 99503

To the Editor:

This letter is a response to *Campfires and Firewood: A Global Perspective* by Dick Cunningham (Fall 1993, p.32). I had a chance to read this paper earlier, as Chief of Interpretation and Education at Big Thicket National Preserve. Undoubtedly many would agree that the information presented in this paper is interesting and very well researched. I do feel, however, that a major piece of the deforestation equation is curiously missing—the growth rate of Human Population.

Deforestation is directly related to population growth. In the Worldwatch Institute publication *Vigil Signs—1993*, some of the countries Mr. Cunningham mentions show strong population growth. Interestingly, the growth in non-industrialized countries is causing a decline in their populations' wellbeing. Latin America is second only to Africa as the fastest growing population area in the world. Guatemala and Honduras are seeing a 3 percent growth rate annually.

A recommended read for those wanting a calmly argued historical perspective on population expansion, natural resources extraction and exhaustion, and the human outcome, please read **A Green History of the World, the Environment, and the Collapse of Great Civilizations**, by Clive Ponting, 1991.

If I hear "Ranger, throw another log on the fire," I will respond with "That reminds me... I have some facts of history I want to share with you... something we humans need to be frequently reminded of..."

Respectfully,

Bob Valen
60 Candlelight Lane
Lumberton, TX 77656

In the next issue . . .

➤ Three articles on reveg: from Olympic NP (by Ed Schreiner), from Glacier NP (by Kristin Vanderbilt), and from Grand Teton NP (by Redente, Cotts and Schiller)

➤ "Ash Yellows and Defoliating Insects in Zion NP" by W.A. Sinclair, et al

➤ David Ek's "Notes From China"

➤ "Beaver Recolonization at Indiana Dunes NL" by Eddie Childers

➤ "How to Prepare Veg Overlays" (as done at Harpers Ferry) by Collins et al

➤ "Trail Conditions and Management Practices in NPS" by Jeff Marion

➤ ...and much, much more. Although, as readers may have noticed, some of this is tentative.

Regional Highlights

Western Region

Two recently published Technical Reports are available from NPS/CPSU at U/AZ: Technical Report NPS/WRUA/NRTR-93/01, **Case study of research, monitoring, and management programs associated with the saguaro cactus (*Carnegiea gigantea*) at Saguaro National Monument, Arizona**, by Joseph R. McAuliffe; and Technical Report NPS/WRUA/NRTR-93-09, **Review of the Air Quality Biological Effects Research Program, Saguaro National Monument, Arizona**, by Saguaro National Monument Air Quality Biological Effects Research Review Panel. To obtain copies write to NPS/CPSU/UA, 125 Biological Sciences East, The University of Arizona, Tucson, AZ 85721, or call 602-670-6885.

Water Resources Division

A revision to the NPS Floodplain Guidelines was formally adopted by the National Park Service. The new guideline maintains the policy of protecting life, property, and natural floodplain resource values by avoiding use of floodplains whenever possible. The principal changes in the new guideline are separation of Floodplain and Wetlands guidance and delegation of Statement-of-Findings approval from the Director to the Regional Director.

Additionally, the revised guideline is intended to be more concise and procedurally efficient than the previous guideline.

* * *

WRD staff traveled to Hagerman Fossil Beds National Monument in the Pacific Northwest Region to take part in a meeting of the Erosion Task Force. The Task Force is addressing the problem of continuing landslides that threaten fossil beds at the Monument. There was unanimous agreement that the landslides are caused by a buildup of the water table in perched aquifers caused by leakage from irrigation practices on the bench above the river. An article on this project will appear in a later issue of **Park Science**.

* * *

For a summary of programs, activity areas, and accomplishments involving the Water Resources Division in 1992, the **1992 Annual Report** of the Division is available from Judy Rouse, (303) 225-3502.

Pacific Northwest Region

The Regional headquarters have been moved, as of December 1993, to the following address: 909 First Ave., Seattle, WA 98104-1060; the telephone number has been changed to (206) 220-4798.

* * *

"Distribution and Status of the Fisher (*Martes pennanti*) in Washington" is the title of an article in **Northwestern Naturalist** (73:69-79) by Wildlife Ecologist Doug Houston (at Olympic NP) and Keith B. Aubry, USFS Pacific Northwest Research Station at Olympia, WA. The fisher is a marten-like animal almost twice the size of the marten.

Aubry and Houston determined the current distribution of fishers in Washington using sighting and trapping records and found their occurrence west of the Cascade crest to be strongly skewed toward low to mid-elevations. The animal still occurs in the Cascade Range and Olympic Mountains and in portions of the Okanogan Highlands, but apparently it is very rare. They predict that available habitat for fishers would be enhanced by minimizing forest fragmentation, maintaining high forest-floor structural diversity, preserving snags and live trees with dead tops, and protecting swamps and other forested wetlands.

Alaska Region

The 3rd Glacier Bay Science Symposium, "Creating Glacier Bay's Research Role Within Park, Regional and Global Contexts--a Plan for Action," was held in September 1993 at Glacier Bay NP and Preserve (GLBA) headquarters in Bartlett Cove. The conference was dedicated to the memory of Richard Goldthwait, one of the pioneer glaciologists to work in the bay, and was jointly sponsored by GLBA, Friends of Glacier Bay, and Northern Illinois University.

Dr. Daniel Engstrom of the U/MN chaired the meetings. More than 130 attended, including scientists, members of the local community, and representatives from the new National Biological Survey (NBS). A series of technical sessions covered all aspects of research within the park—geology and glaciology, terrestrial and marine succession, and various species accounts, both botanical and zoological.

Five workshops, with participation from all attendees, brainstormed a vision for the future of science at Glacier Bay. The hoped-for result will be an action plan to help guide the park's science program as the NBS is created and as resource issues continue to face the park. Symposium proceedings will be published in 1994.

* * *

Larry Whalon has been selected as new Chief of Resources for Northwest Alaska parks (Cape Krusenstern National Monument, Kobuk Valley NP, and Noatak National Preserve). Whalon comes from the Bu-

reau of Land Management, where he was a Natural Resource Specialist/Botanist. He holds a master's degree in botany (rare plants) from U/WY.

Mary Beth Moss has been named new Chief of Resource Management for Glacier Bay NP and Preserve. She comes from the USFS's Oregon Dunes NRA, where she was a Resource Management Specialist.

* * *

A panel of park and regional natural resource staff, appointed by the Regional Director, is evaluating the existing AK Region natural resource program and alternatives for its redesign. A professional outside facilitator, who has worked with several natural resource agencies, is guiding the process. The panel is focused on the natural resource functions needed for the *region*, as opposed to narrow subject areas. The intent is to develop an organization that provides management with strong science and natural resource information for use in their everyday decision making.

Southeast Region

From Bob Hickman, Resource Management Specialist at SERO, comes a 3-page single-spaced listing of the research scientists and employees who are transferring from the SE Region of NPS to the National Biological Survey (NBS). The detailed listing expresses appreciation and recognition for their contributions to the Region and the heartfelt hope for a continuing close relationship with the NPS. "They have been," he says, "and we hope will continue to be 'highlights' in the Southeast Region.

Hickman's submission is evidence of thorough research into the expertise and accomplishments of each of the fond-farewellers. Here, regrettably, we have space only to list their names:

Joseph D. Clark, Stephen Cofer-Shabica, D. Martin Fleming, Gary Y. Hendrix, William F. Loftus, Stephen C. Nodvin, Francis P. Noe, Charles R. Parker, John D. Peine, Michael B. Robblee, William B. Robertson, Jr., Caroline S. Rogers, Theodore R. Simons, James R. Snyder, Michael A. Soukup—all scientists. Also transferring to NBS are Michael Kunze, Janet Rock, Virginia Garrison, Ellen Gorman, Linda Grober, Holly Belles, and Marlena Hovorka. All will be missed and are wished well.

* * *

A recently published report from the Region is B. R. Johnson's **Mitigation of Visitor Impacts on High Montane Rare Plant Habitat**: An integrated strategy of design,

Regional Highlights

interpretation, and restoration at Craggy Gardens, Blue Ridge Parkway. NPS/SERBLRI/NRTR-93/07.

S. P. Bratton and S. Miller have had accepted for publication a report on **Historic Field Systems and the Structure of Maritime Oak Forests, Cumberland Island National Seashore, GA.**

Mid-Atlantic Region

For several years, Shenandoah NP has undertaken to control exotic brown trout populations in four park streams. More than two decades ago, exotic brown trout were introduced into the lower reaches of these streams outside the park boundary. Under an agreement with the VA Dept. of Game and Inland Fisheries (DGIF), the stocking of non-native trout in waters continuous with park waters was discontinued in 1985. The primary method of control is intensive electroshocking of known brown trout habitat in the park, and removal of browns during low water periods in late summer.

Despite five years of intensive efforts, significant populations persist; their range continues to expand upstream. In 1993, several hybrid brown/brook trout (tiger trout) were captured, indicating a new threat to the genetic purity of the native trout populations of isolated park streams.

* * *

A recovery plan for the Shenandoah salamander is in the final stages of development. No substantial change in park management appears to be required in order to implement this plan. The recovery strategy will be to protect the habitat from human disturbance. Some minor restrictions concerning trail maintenance and fireline construction may be necessary.

* * *

Shenandoah NP's Natural Resources and Science Chief David Haskell attended the final 1933 meeting of Virginia State Science Advisory Board for Air Pollution. Final reports from the committees on Adverse Impacts, Pollution Prevention, and Risk Assessment were presented and discussed. Also discussed were progress of the park's Air Quality Management Plan and the NPS Eastern Region's Air Quality Plan.

* * *

Concerns about excessive white-tailed deer populations in Shenandoah NP's eastern park units continue to be studied. Park resource management staff have been involved in a cooperative effort with the Virginia DGIF to assess deer health throughout the state. Analysis of parasites and fat storage from six park

deer indicated the deer were in good health this summer, despite observations that deer habitat condition has been degrading for the past decade.

The reason for the good current health of these sample deer seems to be the recent increase in understory vegetation in response to gypsy moth-induced tree mortality. This sudden increase in forage may be improving deer health and thus increasing birth rates and the deer population in general. Concerns are that widespread tree mortality in the park could lead to a deer population explosion.

* * *

Colonial National Historical Park, working with VA Institute of Marine Science, has begun a parkwide urban groundwater impact study. Wells have been installed at 21 locations and first quarter samples are being analyzed. Quarterly sampling will include inorganics and organics over a 1-year period. Final results and available data will be analyzed and recommendations made for long-term monitoring and management.

Under a challenge cost share cooperative agreement with NC/State/U, the park is developing automated GIS applications dealing with wildfire analysis and planning, and wildlife observations. Also, fire management unit values-at-risk maps are being finalized using the GIS and integrating cultural, natural, and infrastructure information.

The park has contracted with the VA Division of Natural Heritage to prepare a detailed monitoring plan for the different natural heritage occurrences and habitats identified in a recent survey. This will include both state and federally listed species.

* * *

Michele Batcheller of PA/State/U has been hired as the wildlife biologist responsible for researching and developing the DEIS for white-tailed deer management at Gettysburg National Military Park/Eisenhower National Historic Site. Four chapters already are completed.

Gettysburg NMP/Eisenhower NHS has begun to inventory all its fauna. The research is being conducted by PA/State/U students Greg Keller, Ian Harrell, and Ron Rohrback under direction of Dr. Richard Yahner, wildlife management professor. Historical fauna research reports, park maps, and wildlife observation records have been investigated and field work began in Spring 1993. The study is expected to take several years. Although no state or federal rare, threatened, or endangered fauna species have been discovered within the parks, some species not previously known to occur here have been documented.

Piping Plover Protection Wins Cape Cod NS Worldwide Recognition

Cape Cod National Seashore recently gained international recognition for outstanding efforts to protect piping plovers, a federally listed species under the Endangered Species Act (ESA). In September 1993, the Western Hemisphere Shorebird Reserve Network (WHSRN) named Cape Cod NS to its Piping Plover Registry, making Cape Cod one of 13 sites in the U.S. and Canada approved as part of the Network.

The piping plover is a small shorebird that nests and feeds along sandy beaches. It has suffered greatly from increased development and recreational use of beaches on the Atlantic Coast since World War II, and habitat loss in the Northern Great Plains and Great Lakes regions. Despite its listing under the U.S. ESA in 1986, the bird has not shown strong signs of recovery. A 1991 survey by the USFWS Piping Plover Recovery Team came up with only 5,482 adult birds in an exhaustive search of 10 countries.

The WHSRN initiated the Piping Plover Registry to highlight the critically important roles played by individuals, public agencies, and non-profit groups who work to protect this bird. The Registry also will help facilitate information exchanges among sites working to improve conservation efforts.

Cape Cod NS has registered success in protecting piping plovers on the Seashore's beaches by working to minimize disturbance of nesting birds, conducting public education programs, and fencing nests from predators. Nesting success is closely monitored.

Beyond the Mission: An Essay On NPS Management

By David A. Haskell

The mission of the National Park Service, as stated by the 1916 Organic Act, has been the focal point of debate and discussion both within the NPS and by agency supporters and critics for several decades. The list of reports and commentary that have been prepared over the past thirty years in particular, repeatedly refer to the "dual mission of the NPS". Discussions have even referred to the Organic Act as being impossibly schizophrenic, a statement of mission that requires the agency to pursue two diametrically opposing goals; To protect park resources, and to provide for public enjoyment. The most recent public mention of this duality of mission can be found in the opening paragraph of the National Research Council Report, *Science in the National Parks* where the dual mission is referred to as "a losing battle". One would think that if a crest was designed for the agency the central feature would be a two headed eagle, a bird that sees all but can never get off the ground.

Presenting the NPS mission in a seemingly new, different, or novel light has been the hallmark of several NPS Directors since the stalwart leadership style of George Hartzog brought the agency the "Parks for People" program. We even momentarily set aside the NPS arrowhead in favor of the Parkscape triangle tie tac and the beloved buffalo gave way to the design of the century, the "You're in good hands with the NPS" badge. Many remember the day when the NPS badge was stripped away from all employees except those with law enforcement authority. We have had some interesting times, all in the name of clarifying the NPS mission.

Perhaps the most intensive mission analysis since the drafting of the Organic Act took place during the National Park Service 75th Anniversary Conference held in Vail Colorado, now known affectionately as the Vail Conference. The report that grew out of this landmark event, "National Parks for the 21st Century" (The Vail Agenda), brought an intense focus on professionalizing the NPS workforce. There was a particularly strong focus on improving the agency's capability to provide a science based resource management program. The message from and to the attendees was clear. In his closing remarks Director Ridenour emphatically stated that the very resources for which the parks were created were at serious risk and that we could no longer allow this to continue. In his words he stated that from now on, if we are to err, we are to err on the side of the resource. The order was clear, we were to protect the resources at all cost.

From the Organic Act of 1916 to the Leopold Report in 1963, and on to the NRC report on Science in the National Parks in 1992, there is general agreement that resource stewardship is the NPS mission. Passive protection can no longer be counted on to assure the continuation of resource integrity in this rapidly changing world.

We can finally put our minds at ease, the dual mission has been reduced to a single mission, resource stewardship, the eagle with the single head can now fly. These recent events have put the minds of many NPS employees at ease, or have they? Is this a complete picture or is something still missing here? What about the last word of the agency title, the National Park **Service**? What about the fact that the NPS is an agency funded by tax dollars in a democratic society where the government is expected to serve the needs of the public? In a manner of thinking, the American people created the parks for their use and enjoyment. Many fallen governments have failed to recognize the stark reality that what the people giveth, the people can taketh away. Governments that are not responsive to the people are eventually replaced. It is easy to lose sight of the fact that the existence of each national park is only one piece of legislation away from being voted out of existence! Does this realization change the mission? I think not, but it should cause us to look beyond the mission and ask ourselves the big question; WHY?

There must be something to consider beyond the mission of the National Park Service. **We must have not only have a mission, there must be a purpose.** When we think of what the NPS is all about, it may be easier to think in terms of both mission and purpose. The mission is what we do, the purpose is why we do it. In war, the mission is to win the battle, to win the war, but the purpose is to bring about peace. The battles are the action. Some of the action is not pleasant but it has to be done. Peace is the human value that is derived from all of the effort and sacrifice. What is achieved is cherished because it has a cost and a great value. In a way this is analogous to the preservation of the natural and cultural heritage of our people.

In the mission and purpose paradigm, the NPS mission is to preserve the natural condition of the national parks, the cultural resources and values of the historic, military, and cultural parks, and the recreational values of the national seashores, lakeshores, rivers, and recreation areas. In most cases, the values to be protected are identified in the enabling legislation for each unit. The purpose for doing so may not be quite so self-evident. Understanding the purpose is not just a philosophical exercise; it is essential to maintaining a focus on how we manage national parks. In order to stay on track in the complex world of today and into the near future, we have continually to ask ourselves, WHY? Answering the why question often produces the most useful rationale for making difficult management decisions. Let's examine the purpose behind the mission.

In the simplest general terms, WHY we engage in the NPS mission is that the National Park Service is a public service agency of the U.S. Government. The Congress has stated via several pieces of legislation that they want the parks to be aggressively managed so that the resources are protected from significant damage. This enlightened public perspective was most eloquently stated in the 1970 Administration of the National Park Service Act (16 USC 1a-1-1c), "These areas, though distinct in character, are united through their inter-related purposes and resources into one National Park System as cumulative expressions of a single national heritage... Individually and collectively, these areas derive increased national dignity and recognition of their superb environmental quality through their inclusion jointly in one national park system preserved and managed for the benefit and inspiration of all the people of the United States". This message was again reaffirmed with similar language in the 1978 Redwoods Act (16 USC 1a-1). This wording describes the public value to be achieved in managing the National Park System. It speaks well to the WHY question, it helps to define the PURPOSE, at least from the legislative perspective.

Early American philosophers and students of the natural world such as Henry Thoreau and John Muir expressed the more passionate view that some of the natural world, as created by a force greater than ourselves, must be maintained in pristine condition. In these places humans would have a place to go where the mind and soul would not be bombarded with the sights and sounds of human activity. These would be places where the forces of nature reign supreme, and as mortals we must acknowledge our place in an order that is not dominated by man. When

the crazy world spins out of balance these are the places where we go to keep things in perspective. There are many people among us today who believe this to be an important part of the WHY question.

Perhaps a more mainstream public perspective that contributes to our understanding of the NPS PURPOSE is the realization and appreciation that preserving the variety of natural American landscapes, complete with their full complement of flora and fauna (the ecosystem) is important to maintaining our sense of national identity. Superimposed upon these landscapes is the story of the founding and growth of our nation that is being preserved as national historic parks, cultural parks, battlefields, and other sites that provide the window into our past. In the management of most units of the national park system it is impossible to separate the human history from the natural history. The relationship of the land to the American identity has been most profoundly exemplified by the culture and beliefs of the native Americans, who have perhaps, more than any other segment of the public, mourned the loss of the native American landscape. The national parks and federal Wilderness Areas

will soon be all that remains of America not dominated by the works of human beings. They will indeed be not only the last of the great places, they will be the **only** great places. This is WHY their integrity can not be compromised.

Unfortunately not all segments of the public feel strongly about these values. A common trait among people of all nations is to be most concerned about today. Somebody else can plan for tomorrow. In democratic societies the people tend to delegate planning for tomorrow to their elected governments. In the early days of American democracy the first governments were charged with looking after the general public good. Government remains today as the constitutionally designated representative of the people, and thus must assume a great measure of responsibility for the future of the people. Imperfect as we may find government at times, there is no other group on the horizon that even seeks to fulfill that awesome responsibility. There is, therefore, no more fundamental purpose for the National Park Service, as a government agency, then to assume responsibility for the long-term preservation of the natural and cultural heritage of the nation.

These several facets of the NPS PURPOSE provide the strongest rationale for not allowing short-term public interests to compromise the effective long-term management and preservation of the parks. When faced with difficult mission-related decisions that pit the short-term interests and demands of certain segments of the public against the long-term stewardship mission of the agency, it may be more fruitful to present a defense based on PURPOSE rather than relying solely on a statement of mission. Even in the absence of Congressional or special interest public pressure it may often be less troubling for park managers to ask the WHY question that will reveal the PURPOSE which will be served. The view that is provided when mission is seen in conflict with purpose tends to give us a cross-eyed vision of our task. The use of mission and purpose **together**, in a focused way, could conceivably provide us with a new, stereopticon picture—one that would cast positive light from both directions and more clearly show us the way to good management decisions.

Haskell is the Natural Resources and Science Chief for Shenandoah NP.

Haskell Explores NPS "Commitment" in FORUM Essay

"Is the NPS Ready for Science?" is the question asked by David Haskell in a provocative essay appearing this month in the George Wright Society's FORUM. Haskell cites the shelved reports so ably discussed by Jonathan Jarvis in the Summer 1993 issue of *Park Science* (Vol. 13, No. 3, pp 6,7, and 10), and proposes one way to effect a change in the NPS science and stewardship paradigm.

Despite the plethora of reports and recommendations, Haskell states, the **will to change** has been notably lacking to date. He hails the recent line-up of favorable aspects for supporting ecologically and scientifically sound park stewardship, terming it "an astrological

window," and adds: "This may be the only time in the history of NPS that the Service itself is the only obstacle to accomplishing this shift."

Haskell describes "the worries of a lot of park managers" at the transfer of all the biological science research personnel stationed in parks, CPSUs and central offices to the National Biological Survey. He muses on the fact that these Research Grade Evaluation (RGE) personnel have been relied on heavily by superintendents, because the resource management specialists ("although many of them are skilled and dedicated") are spread so thin that "they rarely have the time to address the

larger strategic resource management needs of the parks." In addition, they can aspire to no more than a GS-11 grade and "very little training and career development has been offered to enhance the basic skills they have brought to the job."

The question now, Haskell says, is why—considering the repeated recommendations of past review commissions—the Service didn't start decades ago the process of building a scientifically credible resource management program carried out by park biologists and other "applied scientists." He cites "substantial institutional inertia (euphemistically termed 'tradition') as perhaps the major obstacle to any meaningful change in the fundamental management strategy.

Haskell first asks "Is the NPS ready to adopt a resource stewardship paradigm based on science, that looks to the future and insures the ecological integrity of the parks?" and then presents some of the key recommendations that have been made to date—carefully arranged as "stepstones" to the preferred new paradigm.

The essay in its entirety appears in the GWS's FORUM, Vol. 10, No. 4, due out in December/January.

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An ecosystem approach was used to develop the program. Conceptual models of the lake ecosystem were developed and used to guide research and analyses. Studies included quantity and chemistry of precipitation, lake level fluctuations, solar radiation, chemistry of intra-caldera springs, lake clarity, lake color, lake chemistry, particle flux, chlorophyll, primary production, phytoplankton, zooplankton, bottom fauna and flora, and fish. An extensive data base was assembled for each aspect of the study.

A Study in Complexity

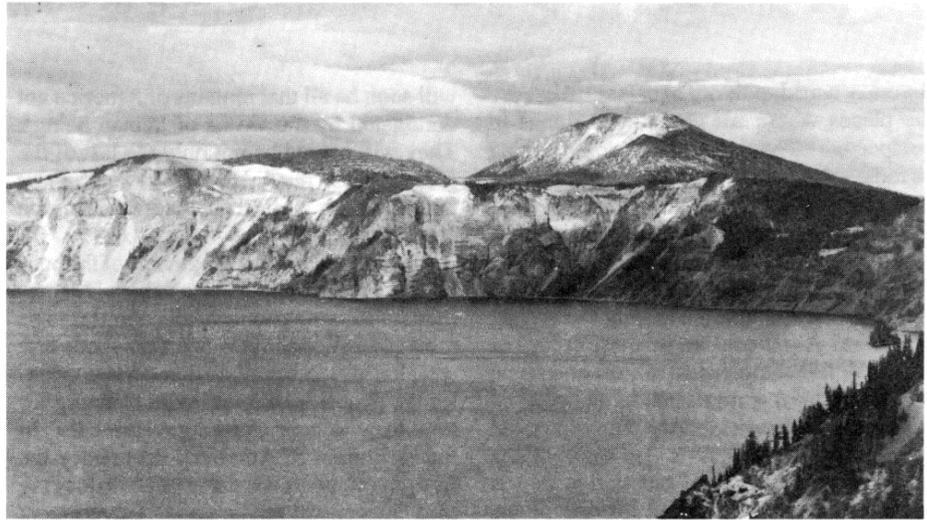
Crater Lake was found to be a complex, dynamic, and oligotrophic (nutrient-poor) system. The volume of the lake responded quickly to changes in precipitation because the basin has no surface outlet. Water leaves the lake through seepage and evaporation. Although the lake level normally fluctuates about 0.5 m annually, the lake surface dropped about 3 m in elevation between 1984 and 1992. The lake was relatively high in dissolved salts, total alkalinity, and conductivity; pH ranged between 7 and 8. Hydrothermal fluids from the lake bottom contributed to the relatively high salt content of the lake. Phosphorus and nitrate were low in concentration, although the concentration of the latter increased substantially below a depth of 200 m. On an annual basis, atmospheric bulk deposition accounted for about 90 percent of the nitrogen and 30 percent of the phosphorus input to the lake. Recycling of nutrients was important to the internal nutrient budget of the lake.

Wind-driven circulation mixed the lake in winter and spring to a depth of about 200 m. Some deep-water mixing was indicated by high concentrations of dissolved oxygen at the lake bottom. The lake was thermally stratified in summer and fall. The interface between the warmed surface waters and the cold waters of the deep lake was at a depth of about 80 m.

Secchi disk clarity was in the high-20-m to mid-30-m range. The depth of 1 percent of the incident surface light generally was between 80 and 100 m. Seasonal changes in Secchi disk readings and the depth of 1 percent incident light were observed. In summer, a layer of near-surface turbidity was associated with changes in Secchi disk clarity. Lake color measurements indicated that the near-surface water was very blue.

Wide Ranging Water Chemistry

Water chemistry of the caldera inlet springs exhibited a wide range of chemical concentrations and total ionic compositions over short distances around the lake's perimeter. Calcium, magnesium, and sodium were the



Crater Lake from the west rim, looking east to Mt. Scott with Phantom Ship at lower right. (PHOTO BY DAVE MCINTIRE)

major cations; bicarbonate was the major anion. Contribution of nitrates to the lake from the springs was studied specifically because of concerns about a sewage drain field for visitor facilities located just outside the caldera wall. One spring located on the caldera wall near the drain field system exhibited relatively high nitrate concentrations but contributed less than 1 percent of the total annual input of new nitrate into the lake. Although an analysis of the water chemistry of the spring could not confirm the source of the nitrates, the drain field was removed in 1991 as a precautionary measure.

Chlorophyll, phytoplankton, and zooplankton were distributed uniformly in winter and spring from the lake surface to the depth of mixing (maximum depth about 200 m), and maximum primary production occurred between 40 and 60 m. A deep-water chlorophyll maximum developed between 100 and 140 in summer and fall, and maximum primary production typically occurred between 40 and 80 m. About 96 percent of total primary production was associated with nutrients recycled in the euphotic zone. A sparse but complex phytoplankton community partitioned the water column to a depth of 200 m. A high density of phytoplankton typically developed in the warm near-surface waters. Cyclic seasonal and annual changes in chlorophyll, primary production, and phytoplankton density were observed. Periods of upwelling of nutrient-rich waters from the deep lake were thought to influence lake productivity.

In summer and fall the zooplankton community, which was comprised of 8 rotifer species and 2 species of crustaceans, partitioned the water column to a depth of 200 m. Zooplankton abundance in the upper 20 m of the water column was very low. Highest densities of zooplankton were located in the

depth interval of 80 to 180 m. Closely related or competing species were found in different portions of the water column. The largest crustacean species was cyclic in abundance, and its abundance was related to lake productivity and fish predation. When it was abundant, rotifer abundances declined, and changes in the distribution of the other crustacean species were observed.

Trout and Salmon Persist

Two species of fish, rainbow trout and kokanee salmon, still persist in the lake. Both species were stocked many years ago, continued to reproduce in the lake, and had long-term effects on the lake system. Kokanee salmon mostly were pelagic and fed primarily on crustacean zooplankton and small-bodied bottom fauna. Abundance of kokanee was cyclic owing to the numerical dominance of one year class. Rainbow trout were found along the littoral zone of the lake and fed on terrestrial insects at the lake surface, large-bodied bottom fauna, and kokanee.

Benthic macroinvertebrate richness was moderate in Crater Lake and comparable to the richness found in other large, cold, oligotrophic lakes in the northern hemisphere. Densities of epibenthic macroinvertebrates on rocky substrates in the littoral zone were relatively high. Most taxa in the littoral zone were types common to streams and rivers in montane areas of western North America. Snails were common to a depth of 100 m. Oligochaeta worms and chironomid midges were common in the deep lake.

A new species of aquatic mite, *Algophagopsis* sp., was found in the lake. Crater Lake remains the only known locale for this species. The mite was abundant on rock surfaces in association with aquatic

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Water Quality Litigation: An Update From the Everglades

By Michael Soukup

Nutrient enrichment of the Everglades by the Everglades Agricultural Area (EAA) had been reported by scientists since the 1970s. In 1988, the acting U.S. Attorney in Miami filed suit against the State on behalf of Everglades NP and Loxahatchee National Wildlife Refuge to compel enforcement of State water quality law. The Settlement Agreement reached between the State and Federal governments in 1991 obligated the State to construct wetlands in the EAA and to force the primarily sugar cane growers to reduce the phosphorus in their runoff by 25 percent.

When the State sought to effect this Agreement through implementation of a Surface Water Improvement and Management (SWIM) Plan (under the State SWIM Act), the agriculture industry filed more than 30 legal and administrative suits to block implementation. After six months of intensive preparation for trials set to begin in mid-1993, all parties agreed to enter into mediation. Mediation began in January 1993 and is still in progress.

The process began on two levels: Policy and Technical. Technical representatives from all parties met for several months to hammer out a consensus plan; the Technical Mediation Group went further than the SWIM

Plan in attacking the water quality issue, including greater protection for the Miccosukee Tribal Lands and Lake Okeechobee, and added additional constructed wetland treatment capacity for Lake Okeechobee and C-51 (a suburban basin) water as a first step in restoring Everglades hydroperiods to pre-drainage levels. The new plan costs roughly \$465 million in today's dollars (of which roughly \$200 million covers the hydroperiod benefits.)

The Policy level group, with direct involvement of DOI Asst. Secretaries Frampton and Cohen, reached a financial agreement in July. The industry would pay \$233 million over 20 years while increasing their on-farm reductions of phosphorus runoff gradually to 45 percent (or pay up to \$322 million). This led to an announcement by DOI Secretary Babbitt and the other potential signatories of a Statement of Principles on July 13, 1993.

The Statement was not well received by environmentalists, largely due to a perception that the sugar industry was not paying its fair share, (their payments were not indexed for inflation, etc.), and some public lands in the EAA were to be used for cleaning Lake Okeechobee waters.

Since July, intense negotiations have attempted to produce a detailed agreement that includes some accommodation of the environmental position plus all the difficult issues not addressed in the broad Statement of Principles. Negotiations have been difficult, partly because the agriculture industry remains unwilling to admit in the agreement that there is a problem or that they are the cause. This posture preserves their rights to challenge the agreement if additional clean-up expense is necessary.

A good probability exists that a Phase II effort will be necessary to get down to threshold levels for phosphorus when such levels are experimentally determined. The exact level of phosphorus necessary to maintain the Everglades as it originally evolved, and the effectiveness of the proposed constructed wetlands, are important areas of research during the first 10 years of any eventual agreement.

The construction and operation of over 40,000 acres of wetland for low level phosphorus removal never before has been attempted. As with all Everglades projects, the problems and their solutions are grand in scale, and the potential reward for restoring and preserving the system is equally so.

Soukup is Director of the NPS/CPSU at FL International Univ.

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lichen and *Nostoc* in the main lake, on filamentous algae in Emerald pool located on Wizard Island, and on the deep-water moss, *Drepanocladus aduncus*, with the deepest collection from 118 m.

Beds of macrophytes were found on some of the sand-gravel benches around the perimeter of the lake. *Drepanocladus aduncus* was present in dense beds in the lake in the depth interval of 30 to 120 m. Several species of diatoms were associated with the moss. Periphyton was collected from many sites around the lake margin, as well as from depths of 120 m or more.

Comparisons of limnological data collected prior to the study with data collected during the study did not reveal any major long-term changes in the near-surface water quality of the lake. Hydrothermal inputs were responsible for the stable concentrations of dissolved salts through time. The analysis of Secchi disk records collected between two time intervals, 1913-1969 and 1978-1991, suggested that the data sets were fairly comparable. However, this finding was insufficient to dismiss summarily the possibility of subtle long-term change to the lake. Changes in nutrient input from the

atmosphere and potential local sources of nutrients may have some long-term roles to play in the productivity and clarity of Crater Lake.

Variability Factors Elusive

It remained difficult to separate the natural variability of the Secchi disk readings from any changes that may have resulted from human-related activities. Disk readings in the range of 39-40 m, which were recorded in August of 1937 and 1969, were not repeated in readings taken in August from 1978 through 1991. However, readings of 37 and 39 m were recorded in July of 1985 and June of 1988, respectively. The absence of extremely deep Secchi disk readings during this study may have been a sign of change, but a 33.5 m reading in August 1954, the only bona-fide August Secchi disk reading between 1937 and the late 1960s, illustrated the problem of separating the natural dynamics of lake clarity from any long-term decreases in clarity.

In general, the Crater Lake ecosystem was extremely responsive and sensitive to environmental change and was judged to be pristine, except for the consequences of fish introductions. The study documented many of the components and processes important

to lake clarity and the lake system as a whole. Knowledge of the relative importance of these components and processes was high in many instances, although the level of knowledge of any one of the complex features tended to be low to moderate.

The study also identified many questions needing further study. Long-term change could not be fully evaluated because very little historical data were available to compare with the detailed data base assembled during this study. The situation underscored the need for a long-term monitoring program to evaluate future change against the benchmark set in the 10-year study. Global climate change, air pollution, on-site auto and boat use, and non-native fish present the greatest potential human-related threats to the pristine nature of Crater Lake.

Additional studies would refine knowledge of the components and dynamic processes of the lake system as well as help to separate changing lake conditions caused by natural phenomena from those caused by human-related activities.

Larson is an Aquatic Ecologist with the National Biological Survey, stationed at the Oregon State University NPS/CPSU.

A recent assessment of U.S. biosphere reserve regional programs by Sarah Bishop of Partners for Parks gives a good picture of how the biosphere reserve concept is faring. In general, most of the programs are showing results and appear to be growing, as participants gradually learn how to work together for mutual benefit and the regional good. As might be expected, however, the degrees of success vary widely.

The oldest regional program, that of the **Southern Appalachian Man and the Biosphere Cooperative** (SAMAB), which includes Great Smoky Mountains NP, probably has advanced the farthest. With about 10 federal, state, and private partners, and the SAMAB Foundation for fund-raising, the Cooperative has published a strategic planning process for tourist-based communities, acts as a regional clearinghouse for information on environmental education programs, and conducts many other research and education activities.

SAMAB enjoys the growing confidence of the public and increasing cooperation among members. "Tensions and suspicions have faded as SAMAB members learn more about one another's agencies and their missions and goals," according to Bishop. She finds the major problem to be a reluctance of regional and national agency administrators to support SAMAB efforts—support that is needed to supplement the thus-far modest fund-raising by the SAMAB Foundation.

The **Mammoth Cave Area Biosphere Reserve** in Kentucky consists of Mammoth Cave NP (core) and the groundwater recharge area that surrounds it (zone of cooperation). The Mammoth Cave Area BR Cooperative coordinates the BR program. It was established as an adjunct to the Natural Resources Planning Council of the Barren River Area Development District (BRADD). BRADD serves as the biosphere reserve secretariat. The basic issue is achieving sustainable development within the zone of cooperation that improves the economic and cultural well-being of local people while protecting core area values—especially the quality of groundwater, which is critical for cave biota.

Measures to achieve these goals are progressing, thanks to the nurturing of local trust. "Public acceptance was due in part to the early efforts of the park and BRADD to focus the BR program on meeting the needs of the surrounding community... and then assess the benefits to the park... In a region where the federal presence is viewed with suspicion [the park superintendent] has as-

sumed the role of one who is willing to help solve the problems of others as the route to protecting park values."

The **Sonoran Desert Biosphere Reserve** in Arizona presently consists only of Organ Pipe Cactus National Monument, but the possibilities for a regional MAB program, including adjacent parts of Mexico, are growing. Concerns about the drawdown of groundwater for agricultural development in Mexico, the effects of changing U.S.-Mexico trade relationships, maintaining the traditional dry-land farming and ranching practices of indigenous people, and other issues are drawing people on both sides of the border together.

Two developments in 1993 have boosted the process. The Sonoran Desert Alliance, with a board of directors consisting of four residents each from Mexico, the Tohono O'odham tribe, and the U.S., was formed to promote cooperation in improving the economic, cultural, and environmental health of the region. Mexico has established a large biosphere reserve with three core areas in northwest Sonora. Carlos Nagel, President of Friends of ProNatura, and Superintendent Harold Smith and the staff of Organ Pipe Cactus NM have played large roles in the ongoing development of the Sonoran Desert BR.

Many U.S. BRs were established as parts of clusters of areas that had differing missions. A need now with many of these BR clusters is to develop more coordination and cooperation among the member units. The **Glacier Area biosphere reserves**—Glacier NP, Coram Experimental Forest, and Waterton Lakes NP in Alberta—have separately developed BR programs that strengthen their relationship with adjoining land owners, but a regional BR program linking all three is not presently on the horizon.

Glacier NP has become involved in the Flathead Basin Commission to address regional water quality issues, and Waterton Lakes NP continues its modestly-funded BR program with its Alberta neighbors. Similarly, the **Chihuahuan Desert biosphere reserves** mostly go their own ways. Big Bend NP emphasizes research on sustainable conservation; the Jornada Experimental Range in southern New Mexico conducts range research; the Mapimi BR in northern Mexico focuses on studies of ecologically sustainable ways local people can use their desert environment more productively.

The Chihuahuan Desert Biosphere Technical Group, an informal consortium of scientists, educators, public lands managers, and interested private land owners, hopes to

gain international support for the formation of a regional BR in the Chihuahuan Desert that will include the three existing BRs as well as other federal, state, and private entities. The **Central California Coast BR**, with its 13 member units, makes a greater effort at cooperative action, but not surprisingly encounters caution when an agency is asked to view its role more broadly than its basic mission. The CCCBR has been most successful with its research and education projects. Shared management concerns have been more difficult to identify and address.

The **Virgin Islands Biosphere Reserve** presently consists only of Virgin Islands NP. It "has conducted a remarkable research, monitoring, and resource management training program that will contribute most significantly to a broader based BR program when it is put in place." The challenge here is to bring other entities besides the park into the program and focus it more on ecologically sound economic development.

Perhaps the most unwieldy BR assessed by Bishop is the **Champlain-Adirondack Biosphere Reserve**. Development of this 3,990,000-ha BR is currently stalled, largely because of political and cultural differences between Vermont and New York, and concern of many Adirondack residents about infringement on property rights. Meanwhile, some BR goals are being addressed through the federally supported Lake Champlain Basin Program, which deals mainly with water quality issues.

The greatest need among U.S. biosphere reserve programs, as Bishop (and her informants) see it, is for workable administrative structures and increased funding for administration and projects. Her reports were to be used as background for developing a BR action plan at the U.S. Biosphere Reserve Action Plan Workshop in December 1993.

Napier Shelton
NPS Washington Office

High Tech Meets Old Bones: Accurate Location of Fossil Resources at Hagerman Fossil Beds

By Chris Force

Bob Willhite, Hagerman's Chief Ranger, takes a sighting using the laser transit to pinpoint accurately the fossil site.



A dilemma paleontologists and archaeologists have long faced is how to identify accurately but discretely a site's location. The staff at Hagerman Fossil Beds National Monument has found a high tech answer.

Hagerman Fossil Beds NM is located in south-central Idaho on the bluffs of the Snake River west of the town of Hagerman. These 500 foot bluffs, composed of the Glens Ferry Formation sediments, produce a wide variety of fossils (over 100 species including vertebrates, invertebrates and plants) of Pliocene age. The sediments within the monument represent a floodplain environment composed of river channel sands, overbank clays and silts, highly organic pond deposits, volcanic ashes and basalt flows. These sediments are easily eroded and contain localized concentrations of small vertebrate fossils, as well as sites with larger mammal remains.

Although this area has been known throughout the world as rich in fossils since its scientific discovery in 1929, it did not receive status as a National Monument until 1988. From 1929-1988 several academic institutions collected fossils on what is now the Monument. Today we know of over 300 recorded fossil localities identified by these various institutions.

The Monument needs a completed baseline inventory to identify the exact location of these fossil sites. This baseline information will provide the framework for the development of the legislatively mandated research program at the Monument, and for its developing resource management plan and general management plan. Knowing the precise location of sites helps in planning for visitor access by indicating where to locate trails and facilities, and how to minimize the impact to the fossil resource. To document these sites, the NPS staff and volunteers are using the latest available technology, a Global Positioning System (GPS) and a laser transit.

The Global Positioning System was developed by the military to determine the location of military vehicles or units on the earth's

surface. It utilizes satellites that send signals to a back-pack receiver, which computes the exact location. Using a special, high-precision Global Positioning System, surveyors from the Bureau of Land Management and NPS staff established a grid of 60 reference points throughout the Monument that are accurate within several centimeters.

A laser transit, the Criterion produced by Laser Technology Incorporated of Englewood, CO, is used to accurately survey each fossil site. It works by firing a laser beam at a mirror prism on a height-adjustable pole, and measures the reflected beam of light. A computer within the transit calculates the horizontal distance, azimuth, slope distance, percent slope, and inclination from the transit to the prism. Although the laser is designed to be hand-held, it is mounted on a tripod to capitalize on its precision limits.

Because readings can be done quickly, three replications are taken of each measurement to detect operator error. A limiting factor of the instrument is that directions are based on a magnetic azimuth. For this reason, staff has developed procedures focusing

on distances and triangulation. By sighting at the fossil locality and two of the GPS reference points, the exact position of the fossil locality is computed using trigonometric calculations. By this process, the fossil site is located in space horizontally and vertically with a margin of error in tenths of feet. The fossil locality does not have to be physically marked, thus protecting the site's integrity.

Each site is given a unique identifier and a permanent locality code, and will be entered into a GIS system along with pertinent associated data such as species present, number of specimens, and sediment type. Such an accurate baseline inventory will allow us to discover possible patterns in site locations throughout the monument. Analysis of these patterns may help explain how these fossil concentrations formed.

The hand-held attribute of this laser will save substantial time when it comes time to relocate any documented site. It has a navigation function that uses as coordinates the closest reference points, and audibly tells the operator when the instrument is sighted on the fossil locality. The operator can then direct a field crew person to the exact location.

During the course of the baseline inventory for known fossil sites, numerous new sites have been found as well as significant individual specimens. One example is the most complete *Borophagus* (hyena-like dog) known from Hagerman. It's a lower jaw that contains the canine, fourth premolar and first molar. Also discovered were several new mastodon localities and a sandstone concretion with a high concentration of frog bones. It is not yet known how many individuals are represented in this concretion, but at least two species of frogs are present.

High tech measurements, such as those possible using this system, will play a major role in managing and scientifically evaluating the fossil resources at Hagerman Fossil Beds NM.

Force is a Museum Technician at Hagerman Fossil Beds NM

NAS Report Cites Urgent Need for National Biological Survey

The National Research Council, National Academy of Sciences, report, "A Biological Survey for the Nation," was released in early October. It proposed that the National Biological Survey provide leadership for a program that pulls together public and private organizations for gathering information to prevent costly environmental confrontations over the nation's plant and animal life. The federal government spends about \$1 billion each year on environmental biology research, but the committee found "significant gaps" in the efforts of current national research programs.

"The National Academy of Sciences report underscores the urgent need for an agency within the Department of the Interior to provide leadership in the life sciences area; that agency is the National Biological Survey," said Interior Secretary Bruce Babbitt. "The report wisely focuses on establishing true partnerships and on the need to support and expand relationships with existing biological research organizations."

The report recommends that the many public and private entities involved in current

research on biological resources should work together under the auspices of a new organization, the National Partnership for Biological Survey, to provide comprehensive information that will be useful for decision-makers at all levels of government and outside government.

"The NAS report will be extremely valuable to the National Biological Survey. The National Academy's support for a federal partnership with states, universities, and private organizations will ensure that the new agency becomes a truly collaborative effort," said George Frampton, Assistant Secretary for Fish and Wildlife and Parks, who also will oversee the NBS.

Although somewhat philosophically similar to current NBS implementation efforts, a number of the recommendations contained in the report are much broader in scope than can be covered by existing fiscal and personnel resources of the NBS. The recommendations of the NAS are still under review by Department of the Interior and NBS officials.

CRM Special Issue Highlights 'Tradition'

A special 64-page issue of the Cultural Resource Management bulletin, **CRM** (Vol. 16, 1993) contains articles many of which were prepared for two symposia dealing with traditional cultural properties, held at the 58th Annual Meeting of the Society for American Archaeology in St. Louis, MO in April 1993.

All the papers from the symposium titled "Take Me To Your Leaders: Archeologists and Consultation with Native American and Other Traditional Communities," are introduced by Lynne Sebastian and commented on in the concluding article by Thomas F. King, co-author of National Register Bulletin

38, *Guidelines for Evaluating and Documenting Traditional Cultural Properties*.

The papers by Patricia Parker and by Sally Thompson Greiser and T. Weber Greiser were prepared for a symposium called "Vanishing Spaces: Native American Sacred Places," organized by Thompson Greiser. Several papers prepared specially for this issue are included.

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