PARK SCIENCE

A RESOURCE MANAGEMENT BULLETIN

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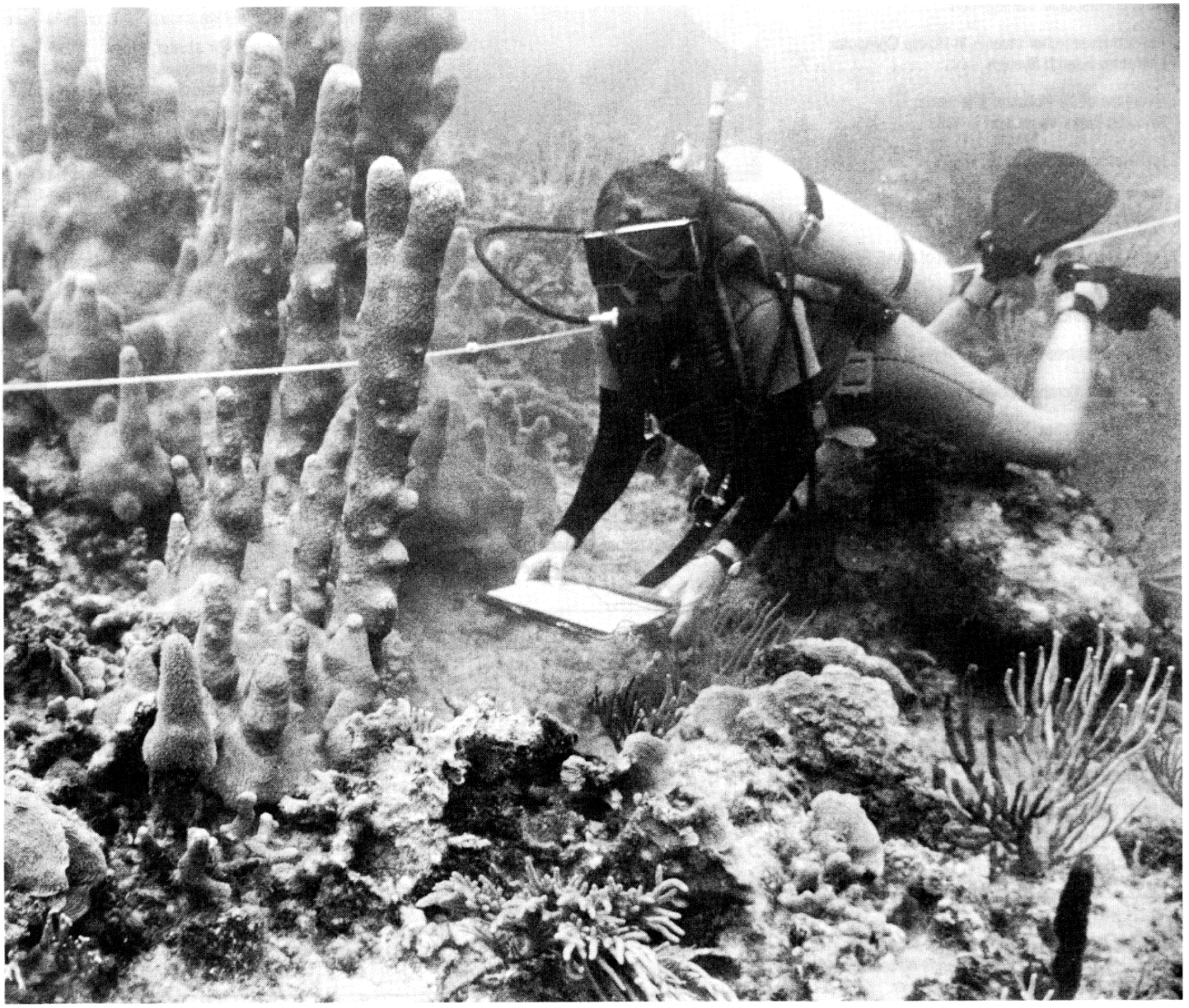

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SUMMER 1985

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

In This Issue

Cover Photo:
Establishing long-term monitoring sites on the St. John Reef in the U.S. Virgin Islands National Park is the task of the scuba diver on the cover.

Guest Editorial

By William Penn Mott, Jr., Director
National Park Service

It is a real pleasure for me to have the opportunity to share some of my thoughts on natural resources with readers of *Park Science*. I feel that the wise management of natural resources is almost synonymous with public expectations of the National Park Service. My interest in and commitment for natural resources has been an integral part of my 50 year career as a park professional. As we move forward together as a team, I will need your help, advice, and counsel so that we can build on the excellence that has already been achieved by the Service. Some of the areas that I feel we should focus on initially are:

Develop a long-range plan or strategy to better protect our natural resources.

It is absolutely essential for us to develop broad, new concepts for better protection of our resources for future generations. The directions that we gain from these concepts should ultimately be viewed as the "hallmark" of contemporary thought concerning resource protection. It should be the very best that we can do. I expect us to involve the best minds both within the Service and outside to produce in a highly professional manner, the concepts that will give focus to our management decisions and provide guidance for expanding our research efforts to meet critical needs.

Effectively share our understanding of critical resource issues with our public(s).

Obviously, we don't know all the answers to solve the critical resource issues we face, but we have an obligation to share what we do know. On many complex natural resource issues, such as acid deposition, critical habitat loss, and endangered species management, we can present these concerns in a context of public understanding. A public that understands, and shares its understanding with our elected officials, is a powerful force.

Seek a better balance between people management and resource management.

We have areas, in my judgment, that may be out of balance. It seems that we unintentionally ignore the public in some areas and we err in others by ignoring the resource. I feel this lack of balance often creates issues that put the Service in adversary roles with some segments of the public. In carrying this out, I will review closely our management philosophies for balanced visitor use and resource protection. Research will have to provide the information to determine this balance.

In the months ahead, I hope to meet personally with many of you in an effort to better understand the critical natural resource issues we face. Together we can put into motion an agenda that will build on the outstanding traditions of the Service and, at the same time, incorporate new visions of parks and our continued commitment to resource protection.

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Research and Resource Management Program at Virgin Islands National Park/Biosphere Reserve

By Caroline Rogers and Vonnie S. Zullo

The Research/Resource Management Program in Virgin Island National Park focuses on watershed management and Biosphere Reserve activities. Most of the projects are being carried out under the Virgin Island Resource Management Cooperative (VIRMC), a cooperative venture in research and resource management which began in 1982. The Cooperative consists of the National Park Service and 13 other members, including territorial and federal government agencies, private research and educational institutions based in the U.S. Virgin Islands, British Virgin Islands and Puerto Rico. This Cooperative attempts to bring together local expertise to work towards the solution of resource management problems.

Projects conducted in 1984 emphasized gathering of baseline information on the major benthic communities in the waters off St. John and Buck Island Reef National Monument. Maps were produced, along with qualitative descriptions of the coral reefs, sea grass beds, mangroves and algal plains; collections were made of the common species in these communities. Fish and shellfish populations were studied through visual censuses and analysis of landing statistics from local fishermen. A long-term monitoring program was established to assess the extent of damage attributable to anchoring in seagrass beds.

Several ongoing projects involve an interdisciplinary approach to watershed management in three bays off St. John. In the last five years, runoff into the marine environment during periods of heavy rainfall appears to have increased substantially because of careless development on St. John. In some cases, the development causes significant losses of upland vegetation and the increased runoff can accelerate beach erosion, resulting in degradation of associated reef systems.

This year, biologists, botanists, geologists, resource managers, and historians are working together to develop an overview of the interaction of terrestrial and marine ecosystems, specifically the past and present impact of land clearing on nearshore marine ecosystems in Reef Bay, Fish Bay, and Hawksnest Bay. These bays are subject to different degrees of development. Reef and Fish Bays are both on the south shore of St. John. Reef Bay is within Virgin Islands NP and not subject to any development pressure. Construction of roads and houses in the Fish Bay watershed are threatening coral reefs and other marine ecosystems inside the park boundary. A new clinic was built on the steep slopes above Hawksnest Bay, on the north shore of St. John, creating the possibility of accelerated runoff and possible detrimental consequences for the reefs and seagrass beds in the bay.

Research Biologist Caroline Rogers and Biological Technician Vonnie Zullo are gathering quantitative baseline data on the reefs in these three bays and establishing permanent study sites as part of a long-term monitoring program. Using a variety of different methods, they are quantifying the amount of living coral cover on several reef zones. Long-time residents of St. John believe the islands reefs are deteriorating, but the lack of prior quantitative baseline data makes it difficult to be certain.

Rafe Boulon, from the local Division of Fish and Wildlife, is studying the fish, lobsters, and conchs within the three bays. His objective is to develop suitable management strategies after determining the population trends for these fisheries resources.

Dr. Dennis Hubbard, a geologist from the West Indies Laboratory on St. Croix, is studying the past and present effects of terrigenous runoff on the coral reefs. His study includes analysis of coral growth rings to determine if there is evidence of decreased growth rates that correlate with periods of land clearing and increased erosion when the island was cleared for sugar cane and cotton production.

George Tyson, a historian from St. Thomas, is studying the patterns of land use in the three selected watersheds from the 1700s to the present. Most of the vegetation on St. John has been influenced by man. Numerous old plantation ruins and elaborate mountainside terracing attest to this fact. In the 18th century, European planters and African laborers operated a large plantation system geared to the production of sugar and cotton. After 1850, the plantation system died out and there was a period of small scale, diversified agriculture, forestry and fishing.

From 1950 to the present, accelerated economic growth and immigration has occurred, together with intensification of pressure on land and marine resources of the Virgin Islands NP, established in 1956. His study will help to determine the impact of human manipulation (e.g., clearing of land for cultivation, charcoal production, raising of livestock) on the natural vegetation and soils of the island.

John Matuszak from the College of the Virgin Islands Cooperative Extension Service is working with scientists from the New York Botanical Garden to establish permanent plots, measuring from 0.5-1.0 hectare, in the forests of Hawksnest, Reef and Fish Bays of St. John for long-term monitoring study of succession of natural and introduced vegetation. Species identification and standard forestry measurements of dbh and height are recorded for trees greater than 5 cm dbh. It is important to note that the vegetation of St. John within Virgin Island NP is unique in that there are no similar protected areas elsewhere in the Caribbean – no other areas where forests have been allowed to recover after extensive clearing.

The feral donkeys that roam over St. John may have a significant impact on the island's vegetation, altering normal successional patterns. Rebecca Rudman, a graduate student at Cornell University, is working with Dr. Dave Nellis from the local Division of Fish and Wildlife to determine the feeding habits of the donkeys and to make recommendations for feral donkey managment on the island.

Virgin Islands NP was designated a Biosphere Reserve in 1976, with a formal dedication in 1983. Unlike Biosphere Reserves in the continental United States, the Virgin Island Biosphere Reserve is in a region with mostly developing countries. Biosphere Reserve activities are being formulated with the goal of increasing public awareness of resource management issues. To be effective a Biosphere Reserve should serve as a center of training and education and should integrate local people into all phases of management.

One of this year's projects is the preparation of a report which will outline the major concepts necessary to manage and develop a Biosphere Reserve on St. John. Principal Investigator Allen Putney from the Eastern Caribbean Natural Area Management Program will base his report on information obtained through workshops and informal discussions with St. John residents and Virgin Islands NP employees. Useful information on such issues as the conflicts among the different groups of people who use the natural resources within the park will be valuable in forming Virgin Islands Biosphere Reserve management guidelines.

A videotape on the Virgin Islands Biosphere Reserve prepared by Island Resources Foundation is near completion. The film is based on a Biosphere Reserve workshop in May 1983, when people from many Caribbean islands met to discuss the role of Biosphere Reserves in the conservation of terrestrial and marine resources. The tape will be widely distributed for viewing throughout the Caribbean.

Local residents are involved in current projects within Virgin Islands Biosphere Reserve. Presentation of the goals and results of these projects will take place through the Virgin Islands NP Environmental Studies Program with the local school system and through a series of seminars to be held after completion of the Virgin Islands Biosphere Reserve Resource Management Station conference building later this year.

Rogers is Research Biologist and Zullo is a Biological Technician at Virgin Islands NP.

***Virgin Islands National Park** is seen here with the British Virgin Islands in the background.*

Arid Land Reclamation Research in Glen Canyon

By Jim Holland and Dennis Schramm

Glen Canyon National Recreation Area (GLCA) is one of five national recreation areas in the National Park System where the enabling legislation authorized continued federal mineral leasing. Since its establishment in 1972, no new leases have been issued; however, many oil and gas lease applications are awaiting National Park Service review and several valid existing oil and gas leases issued prior to 1972 remain. In addition, the Combined Hydrocarbon Leasing Act of 1981 provided for conversion of existing oil and gas leases to combined hydrocarbon leases within special tar sand areas (STSA) identified in the act. The Tar Sand Triangle, partially within GLCA, is one of these STSA's.

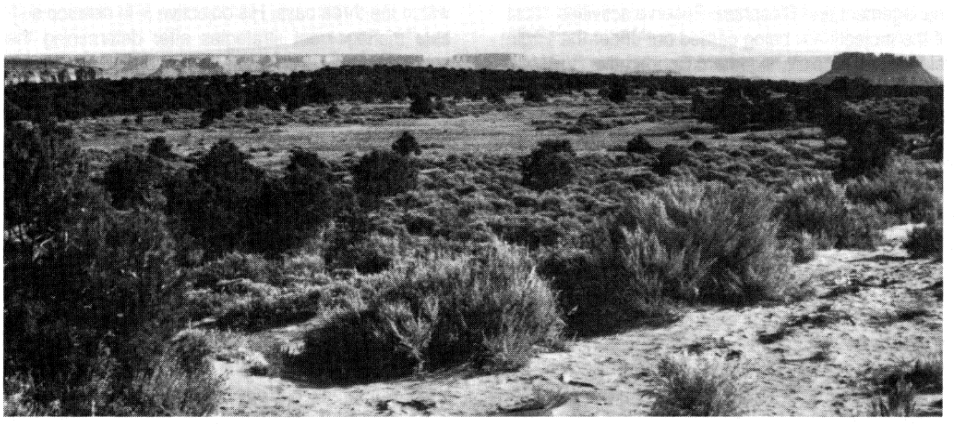
Before a lease can be issued, the NPS must make a finding that development of the lease will not result in significant adverse effects on the resources of the park. An important element of this "significance" determination is an assessment of the reclamation potential of the affected land.

During the recent review of tar sand lease conversion proposals at GLCA, conflicting statements emerged concerning the area's reclamation potential. Estimates of complete recovery of disturbed lands varied from 5 to 100 years. Some even questioned the feasibility of any reclamation in the arid lands of the Tar Sand Triangle. These concerns raised fundamental questions in the review of all mineral development proposals, prompting the Service to investigate the potential for reclaiming disturbed lands to predisturbance conditions.

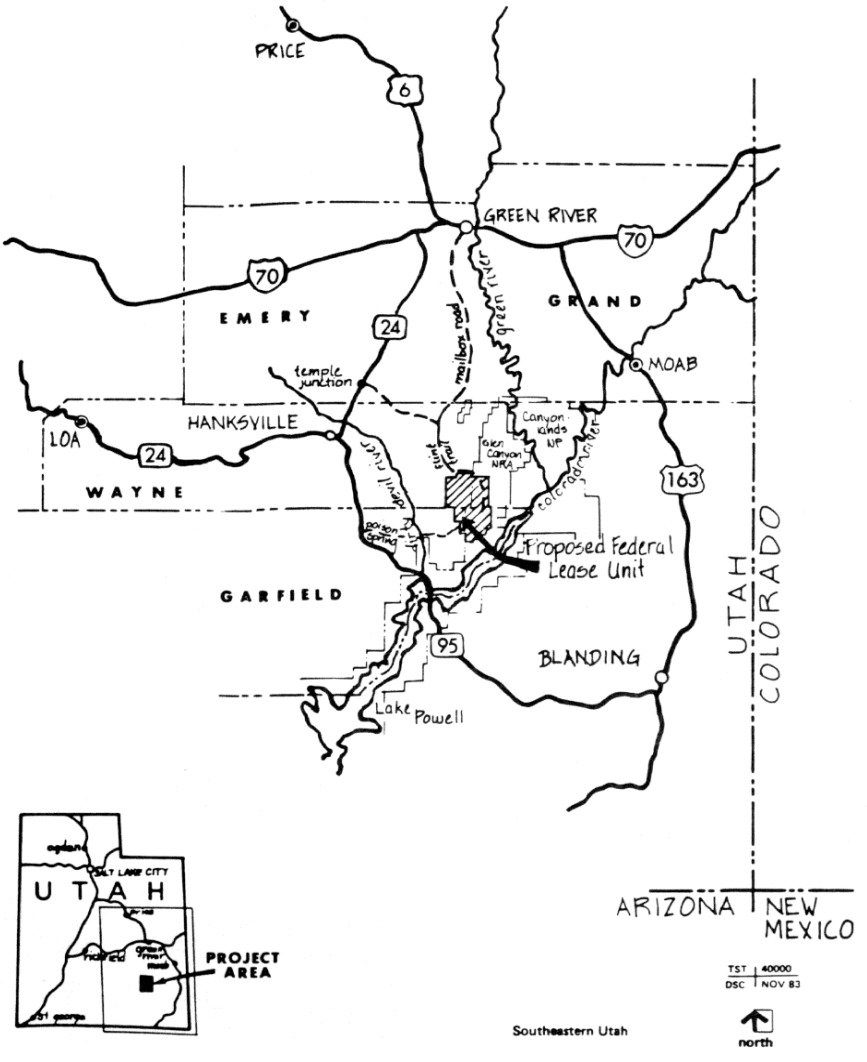
In 1984, faced with potentially 22,000 acres of tar sand development and 160,000 acres of pending oil and gas lease offers, Glen Canyon requested the support of the Washington Office – Energy, Mining and Minerals Division, in investigating reclamation potential of lands disturbed by mineral activity. Of primary concern were the pinyon-juniper woodlands and sagebrush shrublands in the Tar Sand Triangle, located within the Orange Cliffs portion of the GLCA, just west of Canyonlands NP. (see regional map).

A research proposal was developed by the authors to determine reclamation potential in the Orange Cliffs, using only native plant species without irrigation. The primary objective was to test the effectiveness of various reclamation treatments on establishment of native plants from seed and transplant survival. Results will be used to develop reclamation prescriptions for returning an area to predisturbance conditions and to develop appropriate bonding levels for proposed operations. Experience and information gained in this project also will be incorporated into Service-wide reclamation guidelines and standards currently being developed by the Energy, Mining and Minerals Division.

The project consists of four integrated phases: (1) reviewing recent arid land reclamation literature, (2) preparing a reclamation research plan for four disturbed sites in the Tar Sand Triangle, (3) implementing the plan and (4) preparing a field monitoring manual that outlines monitoring procedures and statistical analysis methods for evaluating the success of various reclamation treatments.



Pinyon-juniper woodlands *and sagebrush shrublands typical of the area surrounding the research sites.*



NPS contracted with Thorne Ecological Institute of Boulder, Colo., to do the literature review, develop the plan and prepare a research monitoring manual. Field implementation of the reclamation plan was conducted by Thorne and three subcontractors.

The Environment

The Orange Cliffs are located on the Colorado Plateau, in south-central Utah, northwest of the Colorado River (see map), an area of flat-topped mesas, vertical cliffs, and deep canyons resulting from differential erosion of geologic strata. Mesa tops vary from 6774 ft. to 7866 ft. and are composed of reddish-brown Wingate sandstone capped by Kayenta formation (a buff brown, coarse sandstone with minor shale and limestone interbeds). Navajo sandstone, characterized by large-scale, tangential cross-bedding, overlies the Kayenta and outcrops occasionally in the project area.

The semi-arid environment retards weathering of the sandstone parent material, so soils are formed and deposited chiefly by wind and water erosion. Soils on the mesa tops were formed from wind deposited sands and are generally quite shallow (less than 50 cm). Soils of the Orange Cliffs are composed primarily of shallow Mellenthin series, which are loamy Calciorthids that support pinyon-juniper woodlands. A small percentage of the mesa top is covered with deeper 115-180 cm) Begay soils – coarse-loamy Camborthids, typically supporting sagebrush and grassland vegetation.

Cryptogamic soil crusts are found on all soil types in the project area. These crusts are composed of nitrogen-fixing bacteria, algae, fungi, mosses and lichens that bind soil particles into lumpy, blackish crusts, resistant to wind and water erosion.

The semi-arid environment of the area is modified locally by topography and elevation and soil characteristics. Three-year averages (1982-1983) for precipitation and temperature at the Hans Flat Ranger Station reflect the climate of the project area. Average annual precipitation for the three year period was 30 cm, with 10 percent falling in March and 62 percent in July through November. Approximately half of the annual precipitation falls as snow. The driest portion of the year occurs from December through February, averaging only 3.2 cm. Lowest average mean minimum temperatures of 22°F occur in December and January. Average mean maximum temperatures in the summer months range from 80°F to 85°F.

Native vegetation on the mesa tops consists primarily of pinyon-juniper woodland and big sagebrush-blue grama shrublands. Table 1 lists the primary native species found in these communities that were utilized in this study.

Site Selection

Fifteen oil and gas and uranium core hole drilling pads and several access roads were examined for potential use in the reclamation research. The drilling pads are from mineral exploration activities which predate the GLCA act. Most of the drilling sites are approximately 1 acre in size and were scraped to level the pad and remove native vegetation. Prior to our reclamation effort the disturbed drill sites were typically vegetated with a sparse mixture of native pioneer species including: rabbitbrush, snakeweed, globemallow, yellow bee plant, lobeleaf groundsel, and fineleaf hymenopappus. Non-native species such as Russian thistle and pigweed were present on the disturbed pads in small numbers.

Three drilling pads and a section of access road eventually selected for use in the research project provided a sample of typical soil and vegetation types. All site locations are within 5 miles of the Hans Flat Ranger Station, minimizing travel and simplifying implementation and monitoring.

Experimental Design

Establishment of reclamation research plots on the disturbed sites began in the fall of 1984 with removal of existing vegetation, redistribution of berms and grading to approximate surrounding topography. The drilling pads and road section were then cross-ripped to a depth of 40-60 cm. Attempts at smoothing the surface after ripping by pulling an I-beam behind the bulldozer were not entirely successful; a harrow pulled behind a pickup completed the job.

Experimental sites were established on a small portion of the ripped area after surface preparation. Experimental study plots (3m x 3m) were located within fenced exclosures; the area outside the fence was seeded and harrowed. The experimental sites were fenced with 5-strand barbed wire and chicken wire to exclude cattle and rabbits. Exclosures on the abandoned drilling pads are one-half acre each and the access road exclosure is one-quarter acre.

Three-meter-square study plots, separated by half-meter wide walking paths, were established in a grid pattern within the fenced exclosures. In all, 180 study plots were established on the 4 research sites, representing ten replications of each combination of experimental treatments.

Surface preparation, fencing, seeding, and transplanting of containerized seedlings were completed in November 1984 in a two-week period. Spring transplanting was conducted in April 1985.

Reclamation treatments selected for experimentation were based on results of the literature review and include the following: **seeding/planting methods** – drill seeding, broadcast seeding, and hand planting of containerized plants were tested; **seeding rates** – drill seeding and broadcast seeding were each tested at two different rates; **mulching** – the use of sterile straw mulch, juniper slash and no mulch were tested; **water retention** – the use of hand-dug furrows for

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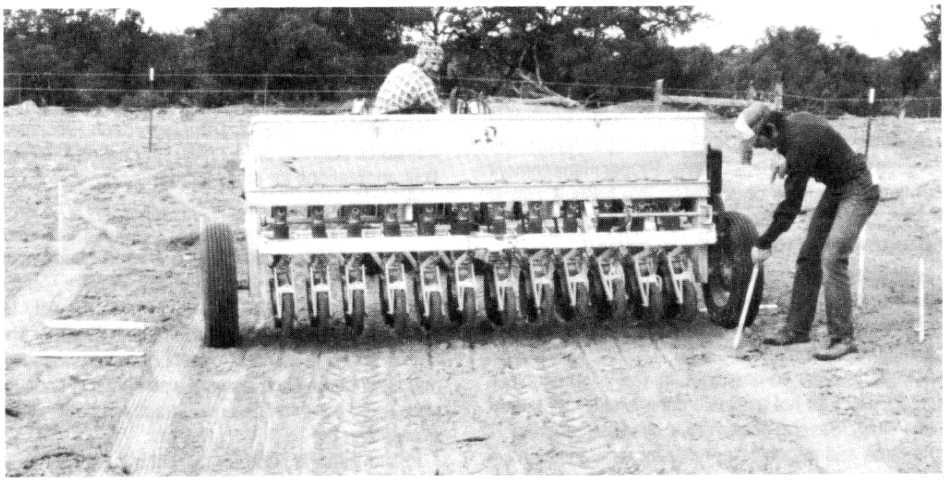

Drill seeder *being used to seed a study plot. Glen Canyon National Recreation Area.*

Table 1: Native species used in reclamation research at Glen Canyon National Recreation Area

Scientific Name	Common Name	Transplanted	Seeded
Shrubs/Perennial Herbs			
Artemisia tridentata	big sagebrush	•	•
Ephedra viridis	green mormon tea	•	•
Atriplex canescens	fourwing saltbush	•	•
Amelanchier utahensis	Utah serviceberry	•	
Cercocarpus montanus	true mountain mahogany	•	•
Sphaeralcea coccinea	scarlet globemallow	•	•
Cowania mexicana	cliffrose	•	•
Ceratoides lanata	winterfat	•	•
Trees			
Pinus edulis	pinyon pine	•	•
Grasses			
Bouteloua gracilis	blue grama	•	•
Hilaria jamesii	galleta grass	•	•
Oryzopsis hymenoides	indian ricegrass	•	•
Sporobolus cryptandrus	sand dropseed	•	•

AID/NPS Cooperative Program in Natural Resource Management

By Joanne Michalovic

In 1979, the National Park Service, Office of International Affairs, entered into a cooperative agreement with the U.S. Agency for International Development (AID) – a government donor organization providing financial assistance and expertise to developing countries in such areas as food, agriculture, forestry, science, and technology. The AID/NPS cooperative program focuses on transferring information to lesser developed counties (LDCs) on how to integrate natural resource management concerns into the development process.

The National Park Service was selected to participate in this program because it has had long experience in managing a wide variety of habitats, takes an ecosystem approach to management, has many links with experts in the environmental fields, and strives to balance development with environmental protection. The project is funded through the AID Office of Science and Technology in Washington.

The growing populations of most developing countries are using up their renewable natural resources at unprecedented rates. Proper management of these resources on a sustainable basis is critical to the long-term economic and social well-being of these nations. For the most part though, developing countries do not have the internal, infra-structural capability or support to plan, fund, and execute projects designed to manage natural resources. In attempting to satisfy their immediate needs for food, fuel, and shelter, the long-term consequences of resource degradation frequently are overlooked. The result too often is deforestation, desertification and soil erosion, silted-up reservoirs, water pollution, saline soils, pesticide-resistent insects, and loss of valuable species of flora and fauna. The aim of the project is to assist LDC's to improve their capability to conserve and manage their natural resources and environment.

The AID/NPS cooperative program consists of a six phase project activity, and concentrates on three bio-geographic regions – coastal zones, arid and semi-arid lands, and the humid tropics. Phases I through IV of the project, currently nearing completion, deal with production and dissemination of information. Over the past five years, AID and the NPS have engaged some 200 scientists and international experts to develop publications that will enable host country personnel to integrate natural resource concerns as an equally-weighed element with social, economic, and institutional factors in development strategies and project planning. Each document translates scientific or technical information into practical applications for development.

The first of these AID/NPS publications is an informative quarterly – the "Natural Resource Technical Bulletin" (NRTB), which is prepared in cooperation with the Sierra Club International Earthcare Center, with special assistance from the Yale University Library of Forestry and Environmental Studies. The NRTB covers a different aspect of natural resource management in each issue. It also contains book reviews, and an annotated bibliography of publications available in the field.

In line with the need for current information about natural resource management, three generic AID/NPS documents were produced. They review regional development planning experience, methods for conducting natural resource inventories and environmental baseline studies, and approaches to developing internal administrative and support infrastructures. In addition, specific publications were produced for each of the three bio-geographical areas and include case studies, review papers, development guidelines, and project design aids.

Most recently, the project entered Phases V and VI of implementation. Phase V, the design and implementation phase of training, is intended to train host country personnel, from universities or government, who have the capability to train others – a training-of-trainers concept. This phase envisions the transformation of information, methodologies, and technologies developed under Phases I through IV of the project into course materials to be used in three workshops on planning and managing natural resources – in coastal areas, in arid and semi-arid lands, and in the humid tropics.

The first of the three workshops – "Training of Trainers in Coastal Zone Management" – was held in Bangkok, Thailand in March. It was hosted by the Faculty of Environment and Resource Studies of Mahidol University. This faculty was chosen because of its integrated approach to resource management issues, its energetic and enthusiastic staff, and the recognition of it as Thailand's leading environmental and research center.

The workshop goals were to (1) stimulate coastal zone management and planning in as many LDCs as practicable; (2) have the participants develop training curricula at the workshop that incorporated an integrated systems approach to managing coastal zones; (3) facilitate establishing a coastal zone management network of trainers, government officials, and donors; (4) introduce coastal resource management issues into schools of law, business, and public administration; and (5) increase the number of natural resource management courses at the university level and insure they are designed and taught in an inter-disciplinary, integrated manner.

Fifteen participants from Indonesia, Thailand, Sri Lanka, Kenya, and Mozambique spent three weeks intensively studying the major elements of coastal area management planning – resource uses, planning and information management, legal context, institu-

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accumulating moisture versus no furrows was tested on the transplant plots; **planting season** – planting of containerized seedlings in spring versus fall was tested on the transplant plots.

Utah juniper, co-dominant in the pinyon-juniper woodland, was not available commercially for use in this study. Several other native species, common in the area and possibly desirable for reintroduction on disturbed sites, are not normally available through commercial suppliers. Species notable in this group include roundleaf buffaloberry, narrowleaf yucca, sandhill muhly, single-leaf ash, and Torrey's ephedra.

Two experimental plots also were established to evaluate the potential recovery of cryptogamic soil crusts common in the area. Soil crusts containing cryptogams were collected nearby and spread over the surface of the study plots. The cryptogams then were mixed with the soil to a depth of 5 cm and raked smooth. The plots will be monitored for recovery of soil crusts and compared to control plots where no soil crusts were added. The crusts appear to be a significant component of an undisturbed native site and re-establishment of them would be desirable.

Monitoring of the study plots will be done annually in July after maximum leaf expansion and prior to seed development. Biennial sampling will occur after the first two years, for approximately eight more years. One square meter of each study plot will be sampled in 10 randomly selected subplots (0.1 m^2 each).

Monitoring results should be available near the end of each calendar year following the data collection and analysis. Results can be obtained by contacting Jim Holland at (602) 645-2471. Limited copies of the final reclamation plan are available from Dennis Schramm at FTS 776-8780 or (303) 236-8780.

Holland is a resource management specialist at GLCA, Utah-Arizona; Schramm is an ecologist with the Environmental Assessment Branch of the NPS Washington Office, Energy, Mining and Minerals Division (Denver Field Unit).

***Portion of one research site** showing three transplant study plots. Foreground and background plots demonstrate furrowing used for moisture retention.*

tions and administrative arrangements, economic context, and social context.

A week long field exercise to Songkhla and Phuket in southern Thailand demonstrated many of the principles and techniques by utilizing an actual development proposal on the coast as a case study. Each participant was from either a university or a government training center, and was expected to institute training curricula developed at the workshop upon returning home.

Participants had received instructions prior to the workshop from high level government decision-makers in their respective countries on the target audiences toward which their training programs were to be directed. This helped to define specific country training priorities and built commitment to support the training courses developed by the workshop participants.

Similar workshops are planned for arid and semi-arid land management in June at the University of Zimbabwe in Harare, and for management of humid tropic resources in November at a presently undetermined institution in Latin America.

Workshops and training, however, accomplish little unless implementation and institutionalization of the knowledge is transferred to a benefitting audience. Phase VI of the AID/NPS cooperative program does just that. Follow-up activities are planned with the three host country institutions after the workshops to assist them in institutionalizing the training by incorporating the training materials within their curricula.

Currently, the NPS is continuing its work with the Faculty of Environment and Resource Studies at Mahidol University, helping them design and sponsor their own coastal zone management training-of-trainers course for Thai participants. The target for this proposed training is teacher training college students, who eventually will be teaching courses at the high school level. At this level, the training and dissemination of coastal zone management information will have a high multiplier effect, perhaps a ratio of 1:50 per year. Influencing students at the high school level will help instill a conservation ethic in a segment of the population that soon will be entering universities and choosing professions and careers. Since there are 23 coastal provinces in Thailand, each with at least one teacher training college, the amplifying effects could be enormous.

This short course will serve as a model and a pilot. The experience and data gained from it will be passed on regionally, to assist other Southeast Asian nations in establishing their own training programs, and to participants from the first world-wide training-of-trainers course held at Mahidol in March. This will help in establishing and maintaining a network of professionals concerned with coastal zone management issues.

In addition, the development of a Thai language textbook (presently non-existent) for university students, on coastal zone management will be forthcoming as a result of follow-up activities between the NPS and Mahidol University. Again, similar types of follow-up activities are planned for the institutions hosting the arid and semi-arid lands and the humid tropics workshops in designing training strategies for their countries.

Further information on NPS/AID publications, on workshop substance, or on follow-up activities can be obtained by writing the National Park Service, Office of Internal Affairs, P.O. Box 37127, Washington, D.C. 20013-7127, or by calling (202) 343-7063.

Michalovic is an International Cooperation Specialist with the International Affairs Office in Washington, D.C.

Computer Corner

Harried Researcher Invents In-House Computer Literature Search System

By Douglas A. Wilcox

A major problem for research scientists in any organization is keeping current with the literature. Even when access problems can be solved by personal journal subscriptions, Current Contents, computer literature searches, reprint requests, and Inter-Library Loan, another major problem still exists – keeping track of personal literature files. When faced with 7-8 linear feet of reprints shelved in my bookcase in 8-10 subject categories and a number of journal manuscripts to prepare, I decided that some kind of action was necessary. The logical solution appeared to be an in-house computer literature search system.

The solution to my problem cast a larger shadow of apprehension than the work in all the manuscripts combined. I decided that help was needed beyond the bio-tech and clerical time available. Fortunately, I had the assistance of Gail Gorka, an experienced VIP who had been working on data collection for me for two years. To acquire more assistance, I wrote a VIP position description and prepared a news release for several local newspapers, advertising for volunteers trained in biological sciences or with computer and clerical skills. Within two weeks I had 13 prospective volunteers to select from. My choices included Terry Albrecht for clerical work and Linda Lewis, Sandy Townsend, and Fran Reigle for reviewing papers.

After some orientation, a discussion of alternative approaches to the problem, and a couple of trial runs, we devised a system that has worked well. Initially, I established a 5-digit, alphanumeric labeling system for the reprints in my collection. The first two digits are letters that designate a subject category for the papers; the last three digits are numbers that allow a capacity of 999 papers in each category. I then formatted a standard FORTRAN coding sheet to provide columns for the labeling code and five 14-letter keywords on each line. Data entry would thus be facilitated once the papers were categorized and keywords assigned. Many of the categories had been long-established in my files, some were beginning to form substantially thick folders and needed to be split further, and some new categories were dictated by new research projects. At present, I am up to 49 subject categories.

To begin the keywording process, I would review 6-8 papers in each category and formulate as many keywords as were necessary. The keywords could range from simple terms (Succession, Zonation), to genus names *(Sphagnum, Scirpus),* to more complex abbreviated terms (WaterLevFluct, FenHydrology). Usually after reviewing 5-6 papers in each category, I would not need to add very many additional keywords. All keywords were kept on a master list to avoid creation of synonymous keywords and to keep spellings and abbreviations consistent. The remainder of the papers in a selected category were then given to Gail, Linda, Sandy, or Fran. After reviewing the papers and keywords I had worked on to get a feel for the category, the VIP would finish the category, adding new keywords if needed. The labeling codes and citations were listed for each paper and the keywords were recorded on the data sheets following the codes. I then briefly reviewed each paper and changed or added any keywords I felt necessary.

The final steps in the process were handled by Terry, who entered the data into an IBM-PC using the PFS File software. The citations were typed onto 3x5 cards along with label codes and placed alphabetically by subject category into card files.

If I wish to search my literature for papers dealing with a certain subject matter, the appropriate keywords can be selected from the alphabetized master list printed out by the computer. When the keywords are entered back into the computer, the result is a printout of the label codes for any reprints to which those keywords have been assigned. The reprints can then be easily extracted from my files. An additional refinement in the system, which has not been undertaken yet, is to enter all of the citations into the computer.

Adaptations or revisions of the system I use may be more useful to other researchers. The advantages I see in my system relate to ease of data entry and ready access to the appropriate reprints. By sorting and storing the reprints by subject categories, I can readily take an entire file home when working on a research proposal or manuscript dealing with the subject. Assigning of keywords is also greatly facilitated by dealing with groups of similar papers. I like having ready access to the citations in my card file, but a computer listing would greatly facilitate manuscript preparation. I found the VIP mechanism to be a fruitful means of getting a lot done in a fairly short period of time (3-4 months). Much of the credit goes to Gail for continually keeping things organized and doing the lion's share of keywording.

Despite my overall satisfaction with the system, it is not without frustrations. There are certain subject categories that only I can assign keywords for, either because the papers are too general or too technical. In both cases, I'm the only one who knows why I'm interested in the paper. Finding time to work on these files can be difficult, as was trying to keep ahead of the VIPs during our initial big effort. The incredible number of keywords now in the system (well over 250) can create confusion also, as can papers that don't fit into any subject category.

By far, the biggest frustration is trying to keep up with the incoming literature. Reprints come filtering in at a fairly regular rate, but if any outside computer literature search is done, I can suddenly be deluged by dozens of papers from Inter-Library Loan. Since my VIP team has been dismantled, biotech Michelle Mueggler and I must tackle the incoming literature ourselves, and I am looking at a forbidding stack of unfinished work even as I write these words. I must say, however, that there is a sense of security in having a good handle on the tools that are part of how I do my job. When I think of how frightening a pile of 1615 unorganized reprints would be, I can only recommend that everyone work out an in-house system similar to mine.

Wilcox is a research aquatic ecologist at Indiana Dunes National Lakeshore.

Overview of Air Pollution Effects On National Parks Vegetation in 1985

By James P. Bennett
NPS Air Quality Division

Known Air Pollution Effects on Vegetation in National Parks – 1985

Park	Pollutant	Vegetation Effects
Acadia NP	Ozone (Four exceedances of NAAQS* in 1983 & 1984; the maximum hourly average during these years has been 0.14 ppm.)	Over 95% of 300 eastern white pine trees studied in 1984 showed some slight injury. Almost 30% of the injury was 20% foliar damage or greater. The injury appears to be correlated with decreased width of tree rings, i.e. growth.
Shenandoah NP	Ozone (No exceedances of NAAQS since 1980. However, maximum hourly averages during summers reach as high as 0.12 ppm; monthly means are increasing by .003 ppm.)	Widespread foliar injury in 1982 & 1984 on white pine, tulip poplar, black locust, wild grape, clematis and milkweed. Injury on the most sensitive species (milkweek) occurred on 90% of the plants observed each year. About 8% of the least sensitive species (black locust) were injured. The injury appears to be correlated with decreased productivity and plant diversity. Tree mortality is abnormally high.
Shenandoah NP	Sulfur oxides and heavy metals (Levels of SO_2 are about 20% of the 3 hour NAAQS and 30% of the 24 hour NAAQS.)	Elevated concentrations of sulfur and lead are found in lichens. At some sites, the concentrations are above the normal range for lichens from unpolluted areas. Such concentrations have been associated with lichen decline and food web effects in other studies.
Great Smoky Mountains NP	Ozone (Data collected by TVA show numerous exceedances of NAAQS; however, latest data collected by Tennessee show attainment of NAAQS.)	Between 25-30% of eastern white pine trees show injury. Preliminary evidence indicates that sensitive genotypes may be disappearing and that growth is decreasing.
Saguaro NM	Ozone (No exceedances of NAAQS since 1982; hourly average has reached .110 ppm during the summer.)	Almost all of 225 ponderosa pine trees studied in 1984 showed some injury, with the average foliar injury being almost 12%. Some slight injury was also observed on oak and walnut trees.
Sequoia NP	Ozone (The maximum hourly average during the summer has consistently exceed or equalled NAAQS since 1981.)	Over one-third (36%) of 540 ponderosa pine trees studied periodically since 1980 show moderate to severe injury. Injury is also common on oak trees. Foliar symptoms, like ozone injury observed in laboratory studies, have been recently observed on giant sequoia seedlings in the park.
Santa Monica Mountains NRA	Ozone and Sulfur Dioxide (Summer 1984 ozone levels exceeded NAAQS on numerous occasions with the highest hourly average being 0.22 ppm.)	Air pollution injury averaged 40% of all injury on 7 species. The injury has been related to reduced biomass production and subsequent soil destabilization and fire fuel loading. In portions of the park lichens are no longer found, indicating long-term exposures to SO_2.
Indiana Dunes NL	Ozone and Sulfur Dioxide (Numerous exceedances of ozone NAAQS in recent years; highest O_3 hourly average recorded has been 0.16 ppm; SO_2 concentrations are 73%, 64% & 47% of 3 hour, 24 hour, and annual NAAQS.)	Foliar injury is common on 16 species studied in 1984 including white and jack pines. Injury is greater on juveniles than adults. Growth of jack pine juveniles and white pine adults is reduced in areas highest in ozone. Lichens are also no longer found here, indicating long-term exposures to SO_2.
Cuyahoga Valley NRA, Saratoga NHP & Acadia NP	Ozone	In a common fumigation exposure study, injury on quaking aspen genotypes from these parks was significantly less than injury on aspen genotypes from Voyageurs & Isle Royale NPs, indicating that sensitive genotypes are absent and that the species gene pool is affected.

*National Ambient Air Quality Standards (NAAQS):
Ozone: 0.12 ppm/1 hour/1 day
Sulfur Dioxide: 0.50 ppm/3 hour; 0.14 ppm/24 hour; 0.03 ppm/annual average
All reported values are from NPS monitors physically located in National Parks.

Four years ago I initiated the Biological Effects Program for the Air Quality Division by starting a number of projects for detecting effects (*Park Science* 2: 10). Enough time has passed since the program's inception to begin summarizing some of the findings. The accompanying table summarizes known biological effects from field studies in about 10 national park units, and biomonitoring results in many more parks. The three columns name the parks containing the effects, the pollutants causing the effects and recent observed concentrations, and the effects themselves.

Observing effects of pollutants on plants accomplished two purposes: biomonitoring of the presence of pollutants, and translating this into actual biological effects. Most air pollutants cause specific types of foliar injury which can be diagnosed in the field . . . the types of spots on the leaves can tell you which pollutants were present and which caused the injury. Thus, identification of these spots is one means of monitoring the presence of pollutants.

In addition, however, the injury itself is a biological effect. The pollutants were present at concentrations high enough to affect cells in obvious ways. For example, ozone concentrations above 0.08 ppm cause a dark purple stippling on the top surfaces of leaves. Each stipple, or spot, is actually a dead cell. If enough of this type of injury occurs, it usually means that less obvious but more serious effects also are taking place. Such effects include growth reductions, premature leaf abscission, reduced flowering, decreased fruit weights, and more. These are the types of effects described in one part of the table, while biomonitoring results appear in the other part.

It is clear from the table that the worst effects in the national parks are the results of elevated levels of ozone. This pollutant is widespread in the eastern U.S. and California. Our milkweed survey indicates that ozone is present in at least 20 parks in the eastern U.S. at concentrations above the foliar injury threshold for this species (about 0.06 ppm). The same might be said for California since ponderosa pine also is sensitive to ozone at about this concentration.

The next important air pollutant in the national parks from the point of view of biological effects is actually a whole class of pollutants – the heavy metals. Elevated levels of lead are common in organisms in several parks, probably due to the lead in automobile emissions.

This table only summarizes what is known about existing effects found in field studies on terrestrial vegetation from gaseous and particulate air pollutants, and specifically excludes terrestrial and aquatic effects from acidic precipitation. The effects of acid rain on high-elevation eastern forests is greatly talked about today, but very little is actually known about it. Many studies are underway in several eastern parks to establish clear cause and effect relationships for acid raid.

The worst effects are not found in the parks that are designated Class I under the Clean Air Act. Instead, Indiana Dunes and Santa Monica Mountains, both Class II parks, show severe effects but have a lesser degree of protection under the act. They do indicate, however, that severe effects could occur in

research notes

Editor's Note: *Beginning with this issue,* Park Science *will be devoting a specially designated space to research projects contemplated or recently underway. The new section, entitled* ***Research Notes,*** *was suggested by Editorial Board Member Gary Davis in the interest of promoting better communication among scientists about research that is in the planning stage or still is being conducted.*

Davis proposes that ***Research Notes*** *might also make available space for those who wish to propose a research topic or who are asking for assistance in obtaining ideas, methods, literature, study sites, or whatever, for a particular project. For instance, Davis and William L. Halvorson, a research biologist at Channel Islands National Park, are considering writing a review article about long-term research in National Parks and would be interested in receiving information for such an article. Readers able to shed light, furnish answers, or otherwise respond to the information given or requested in the* ***Research Notes*** *space would respond directly to the individual who placed the Note. In this way, information asked, offered, given, and received will get fastest and widest circulation.*

Erosion on Santa Barbara Island

Erosion is a serious problem on Santa Barbara Island, the smallest 260 hectares (or 642 acres) of the Channel Islands off the coast of southern California. For approximately 80 years prior to its becoming part of Channel Islands National Monument in 1938, the island was heavily impaced by sheep, goats, rabbits, cats, farming (including plowing and burning) and the introduction of exotic plant species. Since 1980 when Channel Islands National Park was created, the NPS has been conducting an extensive inventory and monitoring program.

One aspect of the research/management program is a study of the erosion on Santa Barbara Island; its causes and feasible cures. Because of past land-use practices, the island vegetation is now primarily an exotic-species dominated grassland and interspersed with patches of shrubs, both native and exotic. These patches vary in size and density throughout the island, but both aspects are increasing now that the grazers have been removed from the island (rabbits were present until 1981). The erosion apparently was caused by a combination of the change from native vegetation cover to exotic species brought about by farming, and the burrowing rabbits, that caused further reductions of plant covering on the soil.

The island soils are primarily heavy clay vertisols and mollisols, which exhibit fairly strong shrink-swell characteristics. Burrowing and denuding of the area served to increase the soil's tendency toward tunnel erosion. The result has been an extensive pattern of gullies with occasional patches (up to 2.7 hectares or 6.6 acres) of sheet erosion where the top soil has been completely removed.

This study is a joint effort on the part of Bill Halvorson (Channel Islands NP), Denny Fenn (CPSU, Texas A&M), and Lynn Whittig (UC-Davis). It includes analyses of the specific characteristics of the soil and of vegetation, and germination and growth experiments using indiginous seeds. The concern is that the Park be able to amend the soil by changing nutrient content, structure, and/or organic matter content as needed, and that a ground cover of native species be restored, all without introducing any new gene pools to the island. Understanding the soil-vegetation interrelationships will greatly enhance our ability to solve the erosion problem, and also will aid in our attempts to restore to the greatest extent possible, the native plant and animal communities of the island.

CONTACT: Gary Davis, Channel Islands NP, 1901 Spinnaker Dr., Ventura, CA 93001.

Dudleya traskiae

Channel Islands National Park currently is studying what appears to be a success story involving the Endangered Species Act. The Santa Barbara Island live-forever, *Dudleya traskiae* (Rose) Moran, is a succulent, perennial plant whose natural distribution is limited to Santa Barbara Island. It was listed as Endangered by the U.S. Fish and Wildlife Service (USFWS) in April 1978 (FR 43 17916). This status was deemed appropriate based on the fact that the past land-use practices, including farming, burning, and introduction of rabbits, had reduced the presence of *Dudleya traskiae* to such an extent that in 1970 it was thought to be extinct in the wild; however, it was rediscovered in 1975 as one population of a few individuals.

The NPS, meanwhile, had initiated an intensive effort to irradicate the rabbits, which were the primary cause of the near demise of a number of native plant species on the island. Complete removal of the rabbits was accomplished in 1981. Following that, Park personnel conducted surveys for the live-forever in 1982, 1983, and 1984. These surveys indicated a trend of increasing numbers and range for the species, which is still restricted to rocky sea and canyon bluffs of moderate to vertical slope.

In late 1984, while the USFWS's recovery plan was undergoing final review, a study of the population dynamics and habitat requirements of *Dudleya traskiae* was initiated by Bill Halvorson and Ronilee Fowler of Channel Islands. Support for the study has come from the USFWS and the State of California Dept. of Fish and Game's Endangered Species Program in the form of botanists giving their time in consultation and in partial funding of the research. The study will map populations and individuals, record habitat characteristics, and determine population dynamics for this species.

This information was not available for inclusion in the recovery plan and therefore will be essential to the carrying out of the plan's objective to restore the Santa Barbara Island live-forever to 95 percent of the suitable potential habitat with vigorous and self-sustaining populations. Though it appears to be expanding again, the successful long-term management of this extremely rare species requires the completion of this coordinated, jointly-funded research effort. Upon completion we're hoping to show not only successful recovery of an endangered species, but a successful venture into three-way interagency cooperation.

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the Class I parks if pollutant concentrations are allowed to reach the levels found in INDU and SOMO.

Our most important study is that mentioned in the last entry in the "effects" table. This study compares the sensitivities of different genotypes of the same hardwood tree species from many different eastern parks. Evidence being analyzed indicates that the genotypes from the more polluted parks are less sensitive than those from more pristine parks. This indicates that selection is favoring tolerant genotypes and that sensitive ones are being removed from the existing populations. This is extremely important for natural resource managers in the parks to know because it indicates that the natural gene pools are being diminished. Thus, fitness of species is lowered; the whole fabric of natural ecosystems can unravel should this continue.

Biomonitoring

The following parks are either exhibiting elevated concentrations of the indicated elements in biosphere organisms or components, or frequent foliar injury from gaseous pollutants. The ecological significance of this is unknown but it does indicate anthropogenic influences are presented.

Park	Pollutant	Biosphere Organism or Component
20 Eastern Parks	Ozone	Common milkweed: foliar injury.
Hampton NHS Gettysburg NMP Fredericksburg/ Spotsylvania NMP Petersburg NB	Ozone	Black cherry, white ash, wild grape, sassafras, tulip poplar, dogwood, milkweed, witchhazel, redbud, white pine, Austrian pine: foliar injury.
Isle Royale NP Theodore Roosevelt NP Everglades NP Shenandoah NP Great Smoky Mountains NP	Sulfur	Lichens: abnormally high concentrations.
Shenandoah NP	Lead	Lichens: abnormally high concentrations.
Great Smoky Mountains NP	Lead	Leaf litter: abnormally high concentrations.
Big Thicket NP	Sulfur, heavy metals	Spanish moss: abnormally high concentrations.
Mt. Rainier NP	Arsenic	Subalpine fir foliage: abnormally high concentrations.
Great Smoky Mountains NP	Heavy metals	Red spruce: abnormally high concentrations in tree rings.

Tansy Flea Beetle Wins Ragwort Sweepstakes At Redwood NP

By Lorraine J. Holden

Most national parks have their share of exotic plant problems and Redwood National Park is no exception. Homestead plants (cypress, Monterey pine), introduced exotics (Klamath weed, tansy ragwort, scotch broom) and escaped ornamentals (Cotoneaster, Pampas grass) are just some of Redwood's concerns. Control programs can include mechanical, chemical, or biological methods.

Mechanical control, such as plowing, burning or pulling can be labor intensive, expensive and impractical in remote areas. Chemical control (herbicides) is discouraged by political, financial, and botanical considerations. Biological control, when available, offers a cost-effective, ecologically precise, self-sustaining method for controlling exotic weeds.

At Redwood NP, tremendous success has been achieved with a biological control program for tansy ragwort *(Senecio jacobaeae)* using the tansy flea beetle *(Longitarsus jacobaeae)*.

Tansy ragwort is a showy yellow-flowered member of the Aster family. It is an extremely aggressive biennial weed, outcompeting native and naturalized vegetation on open prairies. It also contains toxic alkaloids which cause liver damage and death in horses, cattle and other livestock.

A native to the dunes of Holland, the weed first appeared in Northern California near Smith River in 1930. It spread slowly at first, but by 1965 it had invaded over 3½ million acres of rangeland in Southern Oregon and Northern California. The problem had reached such a proportion by 1978 that Del Norte County made active control mandatory. Landowners were required to mow a 150 foot strip of ragwort-infested land bordering any road.

The main area of infestation within Redwood NP was on Endert's Beach, a 300 acre disturbed coastal prairie three miles south of Crescent City, Calif. Endert's Beach is a popular day use area and clearly visible from Crescent City. Sporadic hand pulling began in 1977. In 1980, the Park implemented an experimental control program, which included burning, plowing, discing and pulling as possible techniques. The Park recognized, however that biological control probably would yield the best long term results.

In 1982, as a Natural Resources graduate student at nearby Humboldt State University with an undergraduate background in entomology, I became involved in the project as part of my Master's thesis. USDA entomologists had been working on a biological control program for tansy ragwort for several years. By 1965, three insects had been identified, tested and reared in USDA control laboratories. Specialists had gone back to tansy ragwort's native home and inventoried the natural pests that had held the plant in check. Of these, only the insects that caused severe damage to the weedy plant were chosen, and of those, only the ones which were host-specific could be used.

The winners in this selection were the cinnabar moth, the tansy seedfly and the tansy flea beetle. All of these were introduced into the park by USDA biologists with the cooperation and guidance of the Del Norte County Farm Advisor, Murph Westing. He had the insight to design a feasible release program, directing releases of the tansy flea beetle along the base of the hillslopes above open pastures.

The cinnabar moth is an attractive charcoal and crimson day-flying moth in the Arctiid family. The moth lays her eggs on the underside of the tansy leaves, up to 100 in a clutch, and the larvae feed on the leaves, often until the plant is entirely defoliated. However, the larvae pupate in mid-September, and in a coastal climate the ragwort has sufficient time to resprout, reflower and set more seed, continuing its cycle. Consequently, cinnabar moths have been ineffective in controlling tansy ragwort in coastal areas. They are more successful in drier eastern Oregon.

***Biological Technician Bonnie Griffith** deftly wields the Dieter vacuum machine, used to collect the tiny, fast-moving tansy flea beetle.*

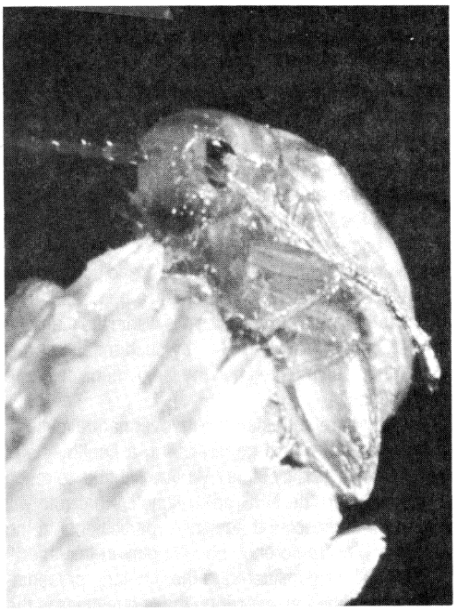
The tansy seedfly hasn't lived up to its promise yet in Northern California. It was released in May of 1980, and it may require up to nine years to develop a population large enough to show any effect.

The real hero (or heroine) of the story is the tansy flea beetle. This tiny (8 mm) golden creature of the Chrysomelid family is responsible for overwhelming reduction in ragwort. A small colony was brought to Del Norte County in 1974 but didn't seem to become established. In 1978, another colony was brought to Endert's Beach, where the beetles thrived.

This little beetle lays her eggs in clutches of twos and threes at the base of the ragwort plant in October. The eggs hatch and the larvae bore into the roots and leaf bases, feeding inside the plant throughout the winter. In early spring, they emerge and pupate quickly, becoming adults and feeding on the outside of the plant for most of the summer.

The colony site on Endert's Beach was so successful that it became the nursery colony for other park areas, much of Del Norte County and even for Oregon. Collecting these tiny, fast-jumping creatures required special equipment, namely a Deiter vacuum machine, which literally sucks up the beetles from the plants. The beetles were then transferred to paper bags and taken to new pastures. In order to have enough beetles to establish a colony, about 500 to 750 individuals were collected for each new site. In 1982, Del Norte County agricultural technicians and

***The author,** all five feet six inches of her, barely tops the tansy ragwort – the aggressive biennial plant that is affectionately referred to at Redwood National Park as "that nasty weed."*



***Tiny, golden, and deadly** to tansy ragwort is this 8 mm flea beetle, whose larvae bore into roots and leaf bases and feed all winter inside the plants.*

Redwood NP biological technicians collected enough beetles for 66 new releases; in 1983 there were over 300 releases. That's 225,000 beetles!!

Quantifying the effect the beetles were having on the plants was very important in designing a continuing control program. Sixteen permanent plots were established in the prairie in the fall of 1982 and reinventoried regularly. The population density of the beetles was measured by collecting plants from these plots and counting the numbers of larvae within the stems. This beetle population intensity (larvae per centimeter of ragwort leaf) and the reduction in percent cover of ragwort had a high correlation. The permanent plots also represented different combinations of treatments: mowing, burning, and cinnabar moth density. An analysis of interraction effects showed the beetles to be the primary cause for this dramatic reduction.

These vegetation plots showed that native and naturalized plants of the prairies have increased as the ragwort decreased. Due to the effectiveness of the tansy flea beetles, the county discontinued enforcement of the ordinance and the park gradually phased out costly manual control efforts.

This year, there are only a few beetle-ridden patches of ragwort along the beach, and only about a half dozen sites within the whole county. As the ragwort declines, the beetles die off. We hope a few beetles survive in the remaining isolated patches of ragwort. In this way, we can still have a small population of beetles to track with the tansy population. Total eradication may not be feasible, but we hope to keep this plant pest at tolerable levels.

Like chemical and mechanical control, bological control must be applied with knowledge and caution, and monitoring is essential to keep track of the environmental pulse. It must also be remembered that biological control may require years to show visible results. Because it is a delicate fine-tuning of the ecosystem, it operates within the parameters of the environment – at nature's pace. Faith and patience are prerequisites for a successful management program. Biological control can offer a cost effective, ecologically sound, self-sustaining method for exotic plant control.

Besides its use against tansy ragwort, biological control is being investigated for Scotch broom, French broom, Canada thistle and other exotics. It's a methodology well worth looking into.

Holden is a Biological Technician on the Redwood NP staff.

Cookbook for Biological Control of Exotic Plants

1. SELECT AN ENTREE

Define your park's ecological assets and identify the potential threats from exotic plants. Protection of coastal prairies, second growth forests or shrub communities may be some choices.

2. GATHER THE INGREDIENTS

Prepare an annotated list of the outstanding exotic plants. Rate each species on its pest status: toxic, aggressive, competitive, etc. Estimate the infested acreage and sketch a rough map of locations. Include a brief botanical biography, noting each plant's reproduction mode, requirements and general phenology.

3. ARRANGE THEM ON THE COUNTER

Arrange this list by priority based on your Park's policies and needs.

4. LOOK UP THE STANDARD REICPE

Use the NPS Computerized Literature Search service to augment your list and add new information. Concentrate on the top five species and limit the search to the last five or ten years.

5. CONSULT OTHER COOKBOOKS

Contact and develop open communication with all sources working on biological control. Typical sources include: local universities, federal, state and county agricultural departments, farm advisers, US Forest Service, Native Plant Societies, and other regional research centers.

Many of these contact will have a file of unpublished studies pertinent to your project. Often, they are looking for undisturbed sites to conduct biological control studies, and your park might become the beneficiary of their research at *no cost!*

6. PRE HEAT OVEN TO ENERGY EFFICIENT TEMPERATURE

Select and implement the most promising biological control program. Your contacts should help you obtain the necessary insect agents. Set up permanent plots and controls, measure the plant and insect populations regularly, treat some areas mechanically and/or chemically, and keep the biotechs busy monitoring the results.

7. BAKE THREE YEARS

Engender a patient optimistic attitude. Allow at least three years before a final evaluation. Keep in mind that biocontrol, once established, is a long term, self-sustaining, nearly cost free program.

8. SERVE TO EVERYONE

Share. Keep open communication with those local groups and agencies. Post a note on the NPS Bulletin Board Service. Publish your studies in appropriate journals, maybe even an article in *Park Science!!*

Managing for Uncertainty Subject of AAAS Panel

"How Can Science be Used More Effectively to Manage National Park Resources?" was the title of the Conservation Foundation panel held on May 28 in Los Angeles as part of the weeklong annual meeting of the AAAS. Following is the abstract of the presentation made by Panelist Dave Graber, research scientist at Sequoia/Kings Canyon NPs.

"As wild ecosystems are progressively compromised by a variety of human activities such as mining, grazing, logging, recreation, and settlement, what is left become increasingly valuable as laboratories of natural ecological processes. The wilderness of our large national parks will assume this role to an ever greater extent. The integrity of the parks themselves, however, is threatened by pollution, the pressures of increasing visitation, and the parks' growing ecological isolation and resultant island effects. Internally, what once appeared to be straightforward relationships among organisms and their environments now appear to be far more complex.

"Management of natural resources in natural parks has begun to respond with a heightened awareness of this uncertainty. To satisfy their growing function as biosphere reserves, parks will be managed less for the preservation of a desired biotic landscape than for unimpeded interaction of native ecosystem processes and structural elements. This will call, where possible, for the correction or mitigation of anthropogenic factors. Such management will tax the knowledge of the scientific community, but it offers in return a particularly rewarding set of study areas. The National Park Service, for its part, faces the challenge of integrating its emerging scientific function with traditional recreational and aesthetic values."

Abstracts of the remarks of Yellowstone Supt. Bob Barbee will be carried in the Fall issue; those of NPS Research Scientist John Dennis appeared in the Spring issue.

Jamaica Bay Task Force Proves Area Isn't 'Strictly for Birds'

By John T. Tanacredi

The Jamaica Bay Task Force – a joint venture of the National Park Service, the New York State Department of Environmental Conservation and the New York City Department of Environmental Protection – is concrete evidence that more than a Proceedings can spring from a Conference. The Task Force, now a going concern, is the offspring of the June 1984 Jamaica Bay Environmental Conference, held at Queens College, City of New York – a conference prompted by concern for Jamaica Bay as a prime example of the Hudson-Raritan ecosystem and the human interactions and efforts that have gone into its revitalization.

A cooperative activity of the National Park Service, the New York State Department of Environmental Conservation, and the New York City Department of Environmental Protection, and several private and non-profit organizations, the Task Force is focusing on immediate studies and decisions, and on the development of a long range comprehensive strategy for the Bay. It was established at the suggestion of Congressman Joseph P. Addabbo.

Jamaica Bay had been a recurring example in the writings of the late Dr. Rene Dubos, and so it was fitting that Dr. William Eblen – the present director of the Dubos Center in New York City – provided the conference's keynote address. His opening remarks led directly into an all-day set of sessions that featured speakers from both the private and public sectors, explored problems and implications of urban ecosystem revitalization, and sought means of fostering dialogue among various levels of government, the scientific community, and local citizen groups affected by activities in and around Jamaica Bay.

It has been 32 years since then Commissioner of the NYC Parks Department Robert Moses declared, "Jamaica Bay is strictly for the birds," and with these words requested and received the first significant budget of $55,000 for the establishment and operation of the Jamaica Bay Wildlife Refuge. From the end of 1953 through 1954, some 1½ million culms of beachgrass were planted, along with a variety of small trees, shrubs, and bushes for land birds. By the end of 1954, more than 100 species of birds and their nesting areas were observed by Refuge visitors.

In the three decades since its establishment, the Refuge has seen:

- the number of bird species expand to 327;
- the inclusion of a majority of Jamaica Bay within the NPS System;
- the creation of salt marsh areas along the periphery of the Bay;
- the improvement of water quality;
- the upgrading of major wastewater treatment systems;
- an increased interest in research and use of the Bay as an environmental laboratory; and
- recreational fishing at one of its highest levels in years.

On the negative side, must be noted the contribution of hazardous materials and debris, the expansion of a major airport runway into the Bay, the creation of two landfills, and chemical pollution that has necessitated restrictions on the consumption of certain fish species.

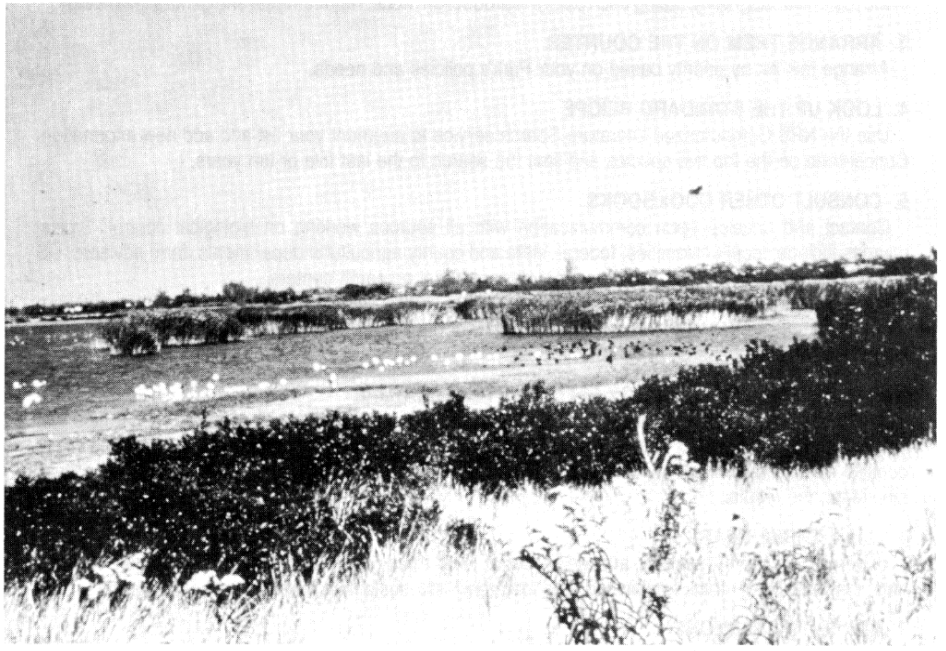
One's sense, then, of how things are developing has to be a mixed bag of emotions . . . surprise at the productivity, tenacity, and survival of a wide range of species, and frustration over the inability to remove or discontinue the chronic disposal of synthetic and biological pollutants. These two conflicting impressions were the genesis of the major theme for the Jamaica Bay Environmental Conference: "The problems and implications of urban ecosystem revitalization."

National Parks have been described recently in terms of their interrelationship with those areas that immediately surround them. The principles of island biogeography have been used in describing parks, inasmuch as a park's isolation will cause effects in the trends of organism recruitment across the park's boundaries. If Jamaica Bay really *were* "strictly for the birds," few problems would exist. The Bay is directly under the administrative pathway for bird migration (the Atlantic Flyway) and so long as we continue to provide a wide diversity of habitat we have no problem attracting bird life.

Jamaica Bay, however, is "for the people" as well . . . not just in mere provision of "recreational space," but – as the Second World Conference on National Parks suggested in 1972 – as places "where visitors are allowed to enter, under special conditions, for inspirational, educative, and recreative purposes." The NPS, further, must accomplish this within the mandate of the Organic Act of 1916 – "by such means as will leave them unimpaired for the enjoyment of future generations."

Thus, we are entrusted to turn over natural/cultural resources to the next generation in a healthy state. But what is a healthy state? What will it take to reach this goal? Can the NPS do it alone? What role will each of the associated agencies (participants in the Jamaica Bay Conference panels) play in this effort? The objectives considered in the day-long presentations were aimed at answering these questions in the light of past history and present conditions.

The NPS has a unique opportunity in Jamaica Bay



New York City skyline *looms in background over Jamaica Bay Wildlife Refuge (above). Abundant waterbird populations seem to find the city no threat as they make use of the Refuge's West Pond (below). Photo by B. Vaughn.*

to reverse – in many instances to revitalize – those natural systems that have been degraded or stressed by the urban environment. This can often be accomplished purely by regulatory restrictions. However, the Park Service must do more than merely bring the park ideals out of the "countryside" and into the urban milieu; it must actively pursue opportunities to work cooperatively toward the regeneration of abused natural resources and toward building in people a receptivity for the natural environment. We must do what Dr. Dubos called "help urban people move progressively and with increasing understanding from the completely humanized world into the wilderness."

This is a tall order. Legislative requirements, public expectations, and managerial concepts of recreational uses cover a wide range of perceptions. Recreation (both "passive" and "active") is one of the largest and fastest growing economic forces in the United States. Such activities as fishing and wildlife observation are, of course, totally dependent on their being a resource – the flora and fauna of the park's ecosystem. Other recreational activities will then compete for such uses in areas like Jamaica Bay.

Because of the impacts associated with its proximity to the New York metropolitan area. Jamaica Bay may require some manipulation of the altered natural systems before allowing nature to take its course. The basic premise to such activities is to mimic natural conditions by providing an atmosphere conducive to increasing habitat diversity. The goal is to increase the level of species diversity until it approaches, and in some respects surpasses, historical levels.

The kindling necessary for the successful igniting of dialogue is information. Trial and error does not work when it comes to the Park Service's primary responsibility – protection of the resource for future generations. The "reasonable freedom" of which the 1963 Leopold Report spoke with relation to allowing natural processes such as fire, insect outbreaks and so forth to operate within national parks, generally means so long as no species or biotic community is exposed to the possibility of extinction; no unacceptable losses to other resources are anticipated, and there is no threat to human safety.

The Interior Department's Management Policies have recognized the need to determine the attributes and constraints of all land within the park system and to classify the resources accordingly. Management objectives for natural resource management are applied to all units of the National Park System regardless of their administrative designation (i.e., National Parks, National Seashores, National Recreation Areas, etc.). Due to urgently needed open spaces in the United States, particularly near metropolitan areas, recreation areas such as Gateway NRA, while created for use by the general public, also were envisioned to be "free from exploitative practices for the protection of wildlife and their habitat." The continued attention to reduction of pollution loads to Jamaica Bay, will allow natural processes to return the natural system to historically higher levels of "quality." Dr. Dubos in an interview by the USEPA in 1978 noted that "an ecosystem that has been changed can be brought back to a good condition if you help nature to function with the natural repair systems that exist."

It has been NPS policy to restore to its natural condition ecosystems that have undergone major European settler induced changes. How closely the natural condition is approximated depends upon existing knowledge or information of that condition and to what degree the biological and physical processes molding that system presently can simulate or regenerate pre-settlement conditions. For example, an approximately acre sized site at the Jamaica Bay Wildlife Refuge, threatened by erosion, was replanted and stabilized by placing marsh grass along the intertidal zone. The bottom line however, should be the maintenance of naturally functioning ecosystems with commensurate reductions in pollution loads so as to allow the recruitment and increase of natural biological productivity and diversity levels.

Jamaica Bay provides the largest and in some cases the last open space for many species of wild plant and animal life remaining in metropolitan New York. We should be striving to reverse the trends of hundreds of "little decisions" that have added up over the years to a loss of habitat in and around the Bay. Practically one-third of the area associated with the coastal outwash plain of Queens and Brooklyn has been filled since the mid 1700s. The tyranny of small decisions, or "nickel-dime ecology" as I call it, provides for expedient decision-making based on paltry ecological information, but does not allow for long-range planning and conscious conservation.

The pressures on the Bay are many – housing development, dredging, wetlands filling, sewage effluents, oil pollution, noise pollution, and recreation, to name only a few. Because the bulk of the Bay now is included within the boundaries of the NPS Refuge, future impacts may be controlled. However, considerable areas around the Bay are not within the managerial boundaries, and their preservation as natural buffers against continuous urban pressures is essential.

Proceedings of the Jamaica Bay Conference are slated for August 1985 publication. They can be had by writing to Natural Resource Management Specialist, Gateway National Recreation Area, Brooklyn NY 11234. For more information on the Task Force and its activities, contact Tanacredi at FTS 665-3796.

Tanacredi is National Resource Management Specialist at Gateway National Recreation Area.

G'Day Mate! An International VIP Pays a Visit

Few field biologists in the National Park Service have escaped the ravages of the uninvited "outside expert" who blows through a park freely offering advice and "answers" to questions that he doesn't begin to understand. Occasionally, in truly pleasant contrast, an individual may pass through the park who does indeed possess great breadth of experience matched by keen intellect. These encounters are especially cherished by biologists in remote areas – who otherwise windup talking biology to themselves. Dr. Graeme Caughley, Senior Principal Research Scientist, CSIRO, Division of Wildlife Research, Australia, epitomizes this useful professional consultant. His field experience and intellect are coupled with sharp wit and penetrating insight. Caughley is known for outstanding work on the population dynamics and ecology of large mammals. [Much of this is referenced in *Analysis of Vertebrate Populations,* G. Caughley. 1977. John Wiley & Sons. His most recent book, *The Deer Wars* – the story of deer in New Zealand (1983. Heinemann Publishers) provides a very different perspective on the effects of deer on the ecology of New Zealand.]

Dr. Caughley spent about two weeks during February 1985 consulting with biologists at Olympic, Glacier, and Yellowstone National Parks. The trip was coordinated through the NPS Office of International Affairs and sponsored by IUCN as part of an International VIP program.

The subjects covered at Olympic ranged from discussions of the dynamics of mountain goat populations, through the practicality of aerial goat capture, to the design for an aerial census of elk in the rain forests of the park. Doug Houston reports that he and his colleagues at Olympic found the experience stimulating and useful. "In fact, we all experienced some sort of intellectual withdrawal symptoms after the visit. It's been a long time since we have answered so many hard questions or been challenged to look at the same problem from so many perspectives," Houston reports.

From Olympic, Caughley went on to Glacier NP, where he discussed "mostly bears" with Research Biologist Cliff Martinka and then to Yellowstone to talk bison population dynamics with Research Biologist Mary Meagher. On the way, he managed to present two population dynamics seminars for wildlife students at the University of Montana and at Montana State University. In Bozeman, he consulted with Dick Knight, team leader for the Interagency Grizzly Bear Study Team.

"Graeme is such a delight to us field science types," Meagher said after Caughley's visit. "We were telling him about the complaints we get over erosion and other impacts from so-called overpopulation of elk up on the Northern range. Graeme's reply to all this was that those people are talking theology and we're talking science, and until they can present their arguments backed by data, we should simply treat their objections with the scientific dignity they deserve."

Riparian Conference Covers Wide Range

More than 400 riparian enthusiasts attended the First North American Riparian Conference in Tucson, Arizona, April 16 to 18, 1985. Twenty-two plenary, technical, and special sessions addressed a wide variety of riparian concerns ranging from riparian ecology to legal and institutional needs, from research to administration, and from grazing to urban planning. More than 100 papers were presented by scientists, managers, and policymakers from the United States, Mexico, Nigeria, Pakistan, and Syria.

The conference was organized by the Riparian/Wetlands Committee and the School of Renewable Natural Resources, University of Arizona, and co-sponsored by more than 20 scientific and resource management organizations from the United States and Mexico. NPS science personnel involved in organizing the conference were Dr. R. Roy Johnson, technical chairman; Dr. A. Heaton Underhill, Fisheries Section chairman; Doug Duncan, biologist; Lupe P. Hendrickson, administrative clerk; and Elaine Johnson-Duncan, VIP – all associated with the CPSU/UA. Technical papers by NPS personnel were presented by: Bryan T. Brown and R.R. Johnson, CPSU/UA, Donald R. Field and Marty Lee, CPSU/OSU, D. Foster, Lawrence E. Stevens and Gwendolyn L. Waring, John R. Thomas, and Peter L. Warren and L. Susan Anderson.

In addition to scheduled conference sessions, ancillary meetings included a workshop on drafting model riparian legislation, led by Dr. Jon Kusler, and a meeting of MAB-8 (Biosphere Reserves) officials and associated researchers led by Dr. Roger Soles, Executive Director, State Department and Dr. William Gregg, NPS, WASO, and Co-chairman of MAB-8, and attended by NPS scientists, Drs. Christine Schonewald-Cox and R. Roy Johnson.

regional highlights

Pacific Northwest

Douglas Houston, NPS Regional research biologist, was the chief scientific consultant for the elk information that went into the AAAS's recently aired Nova program. Houston, stationed at Olympic NP, is the author of *The Northern Yellowstone Elk: Ecology and Management,* published in 1982 by Macmillan Publishing Co., Inc.

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Since it will undoubtedly be the last error Research Biologist James K. Agee ever makes, it seems fitting to share the limerick Agee submitted after *Park Science* awarded him "the back of our editorial hand" for misleading information about the opposite direction of the sash on one of the English Royal Marines in a historic photo of English Camp on San Juan Island *(Park Science,* Spring 1985, p. 22):

"I accept the back of your hand
For the backward sash of the man.
They dress to the letter.
I should have known better.
No different drummers marched in *that* band."

* * *

People, Human Behavior and Water-Based Recreation: A Working Bibliography, is the title of a 46-page guide to the behavioral research that has been done on water based recreation. It is available as CPSU/OSU 85-5 from the Cooperative Park Studies Unit, School of Forestry, Oregon State University, Corvallis, OR 97331. Authors are Kristen S. Martinson, OSU research assistant in recreation resource management, and Donald R. Field, NPS senior scientist with the OSU/CPSU. Topic areas include user characteristics and behavior, places and resource settings, user preferences, crowding and carrying capacity, management of water resources and activity opportunities, and economic and non-enonomic analysis.

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The Organization and the Employee in an Era of Change, by Donald R. Field and Gary E. Machlis, (of the Oregon State University CPSU and the University of Idaho CPSU respectively), defines the issues facing the National Park Service and its employees as they were developed by more than 125 NPS employees from all levels of the Service at 19 issue workshops held over a 15-month period. The issues, even when combined and organized into 20 main topic areas, still total 418, the largest number (67) related to administration and budget. The study is available as CPSU/OSU 85-4 from NPS/CPSUs at Oregon State University and the Universities of Washington and Idaho.

National Capital Region

A Natural Resources Conference is scheduled for Sept. 11-13, 1985, at Catoctin Mountain Park, near Thurmont, MD. A variety of presentations will be given on natural resource topics in NCR. Contact Dr. William Anderson at FTS 426-6660 or Keith Langdon, at (301) 293-9536.

Southeast Region

Susan P. Bratton, NPS research scientist and adjunct research biologist in the University of Georgia Institute of Ecology, is the recipient of the first certificate in environmental ethics ever awarded at the University of Georgia. Bratton, who is a cooperative unit coordinator with NPS and has worked for the Service for 10 years, holds a bachelor's degree in biology from Barnard College at Columbia University, a master's degree in religion from the University of Georgia, and a doctorate in ecology from Cornell University.

The certificate was given by the recently established faculty of environmental ethics, formed at the university to encourage contacts between faculty and students in the biological sciences and the humanities and social sciences. The environmental ethics program focuses on value issues as they relate to the natural environment.

Bratton has taught environmental ethics at the Au-Sable Environmental Institute in Mancelona, Mich., and has published two articles in the professional journal *Environmental Ethics.*

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Florida Power and Light Co. (FP&L) has agreed to spend $200,000 over the next three years for air quality research in NPS areas of South Florida. The work began in November 1984, under a Memorandum of Understanding. John Morehead, Everglades NP Superintendent, said, "It seems almost an anti-climax after all the work that has gone into it."

The idea was broached more than a year ago, when FP&L approached Jim Bennett, NPS ecologist with the Air Quality Division in Denver, about the possibility of FP&L funding joint research. Subsequent discussions and negotiations culminated in the agreement. Under its terms, NPS also is committing $230,000 for a total of eight projects. The work will be accomplished through Air Quality contracts with recognized research units and will include studies of slash pines, epiphytes (including lichens, mosses, orchids, and bromeliads) and climatology in Big Cypress National Preserve and Everglades and Biscayne National Parks.

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From Ted Simons, research biologist at Gulf Islands National Seashore, comes the following list of citations for his recently published work on the Hawaiian Dark-rumped Petrel. In addition, Simons has a summary article on his Petrel research at Haleakala NP slated for a forthcoming issue of *Park Science.*

Simons, T.R. 1983. Biology and conservation of the endangered Hawaiian Dark-rumped Petrel *(Pterodroma phaeopygia sandwichensis).* National Park Service, Cooperative Park Studies Unit, College of Forest Resources, University of Washington, Seattle, Washington. CPSU/UW 83-2, 311 p.

Simons, T.R. 1984. A population model of the endangered Hawaiian Dark-rumped Petrel. J. Wildl. Manage. 48: 1065-1076.

Simons, T.R. 1985. Biology and behavior of the endangered Hawaiian Dark-rumped Petrel. Condor 87: 229-245.

Simons, T.R. and G.C. Whittow. 1984. Energetics of growth in the Dark-rumped Petrel. Chapter 8 *in:* Seabird Energetics, G.C. Whittow, ed., Plenum, New York.

Whittow, G.C., T.R. Simons, and T.N. Pettit. 1984. Water loss from the eggs of a tropical seabird *(Pterodroma phaeopygia)* at high altitude. Comp. Biochem. and Physio. 78: 537-540.

Western Region

Dr. Bruce Kilgore has been selected as the Chief, Division of Natural Resources and Research, Western Region. Kilgore reported for duty on June 10, and is responsible for the Region's recently merged natural science and resource management programs. He will be returning to the NPS after 3½ years with the Intermountain Forest and Range Experiment Station, Missoula, Mont., where he was in charge of determining effects of fire and fire exclusion on natural ecosystems and of synthesizing information on fire effects and fire behavior. Prior to November, 1981, Kilgore served as the Associate Regional Director for Resource Management and Planning, Western Region.

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The California Air Resources Board has approved funding for eight studies to be carried out in Sequoia National Park: Vegetation process studies, fish and amphibian studies, hydrologic mass balance, paleolimnology of Emerald Lake (diatoms), particulate monitoring, nitric acid and ammonia in the air, atmospheric tracer experiments, and aerosol transport.

David Parsons and David Graber, research scientists with Sequoia and Kings Canyon NPs, provided interviews to various newspapers regarding acid rain in the west; Graber authored an article for the *Los Angeles Times* on the subject, and Parsons appeared on NBC Nightly News and KMPH-TV Visalia to discuss California's acid rain problems.

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Santa Monica Mountains National Recreation Area continues its outstanding public information program with a 16-page calendar, Springtime in the Santa Monica Mountains and Seashore. Fifteen co-sponsors are listed, together with the National Park Service, for the April through June activities. Descriptions are fairly detailed and in each case a "contact" is given, with phone number, for more information. Activities requiring fees are marked with an "F" and those requiring reservations, with an "R." Degree of strenuousness, appropriate apparel, information content, and group leaders are indicated.

WASO

The following publications are available on a limited basis upon request from Joanne Michalovic of the International Affairs Office in Washington, D.C. They have been produced under the AID/NPS Cooperative Natural Resource Management Program described elsewhere in this issue.

Natural Resource Technical Bulletin – a quarterly.

Integrated regional development planning: Guidelines and case studies from OAS experience; Organization of American States (1984).

Resource inventory and baseline study methods for developing countries; American Association for the Advancement of Science (1984).

Legal, regulatory, and institutional aspects of environment and natural resource management in developing countries; International Institute for Environment and Development (IIED) (1981).

Legal, regulatory, and institutional aspects . . . a case study of Venezuela, IIED (1981). (Also available as case studies of Ghana, Malaysia, and Sudan, all 1981.)

Institutional arrangements for management of coastal resources; Research Planning Institute (1984).

Coastal resources management guidelines, Research Planning Institute (1984).

Arid and semi-arid lands: Sustainable use and management in developing countries; Winrock International (1985).

Guidelines for development of arid and semi-arid lands; Winrock International (1985).

Ecological aspects of development in the humid tropics; National Academy of Sciences (1982).

Guidelines for development in the humid tropics; Winrock International (1985).

National resource trends in East Africa; Clark University (1984).

The value of conserving genetic resources; NPS (1984).

Other: Marine parks and protected areas: A guide for planners and managers; International Union for the Conservation of Nature and Natural Resources (1984).

Midwest

The first day of the May 14-17 Midwest Superintendents' Zone Meeting in Manhattan, Kan., was devoted to a session on the results of prairie research conducted in parks in the Midwest Region. The meeting included Superintendents from Effigy Mounds National Monument, Fort Larned, National Historic Site, George Washington Carver National Monument, Herbert Hoover National Historic Site, Homestead National Monument, Pipestone National Monument, Scotts Bluff National Monument, and Wilson's Creek National Battlefield as well as the Regional Director and other Region staff. Gary Willson, Science Division, Midwest Regional Office coordinated presentations given by Dr. James Stubbendieck, Professor of Range Ecology, University of Nebraska-Lincoln; Dr. Don Becker, U.S. Army Corps of Engineers, Omaha; and Dr. Jim Jackson, Professor, Missouri Southern State College, Joplin. Dr. Lloyd C. Hulbert, Director, Konza Prairie Research Natural Area, led an afternoon tour of the Konza Prairie.

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The Midwest Region held its second annual Science Business Meeting on June 13-15, at the Wilder Forest Conference Center, Marine on St. Croix, Minn. Twelve NPS scientists from the Midwest Region attended. Invited speakers included Charles Carlson, Regional Contracting Office, who discussed science research contracting and John Reed, Biological Resources, WASO, who commented on future science funding. The conference concluded with a field trip to Saint Croix National Scenic Riverway.

information crossfile

From Jim Larson, PNR Chief Scientist, comes word of two recent articles in the ***Wildlife Society Bulletin*** having to do with the capturing of desert mule deer, white-tailed deer, and mountain sheep with a net-gun (13:71-73, 1985) and a comparison of drive nets and darting for capture of desert bighorn sheep (13:73-76, 1985).

The net-gun methodology is described by Paul Krausman, John Hevert, and Leonard Ordway, all of the University of Arizona, Tucson. The net-gun, fired from a helicopter, was found to be an expensive capture technique, but "comparable to costs of remote drug delivery using helicopters."

The drive net/darting comparison, by J. William Bates, Jr., James W. Bates, and James G. Guymon, all of the Utah Division of Wildlife Resources, found the use of drive nets as significantly reducing bighorn sheep mortality compared to darting.

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From Jim Kushlan comes word of a new Harper & Row publication, ***The Herons Handbook,*** authored by Kushlan and James Hancock, president of the British Trust for Ornithology.

Kushlan, who is now an associate professor of biology at East Texas State University and adjunct associate professor of biology at the University of Miami in Florida, until recently was an NPS research scientist based at Everglades NP.

The Herons Handbook is 288 pages, contains 66 color plates, 18 line drawings, 61 maps, and an index, is $9\frac{1}{4}' \times 6''$ in handbook format, and contains an introduction by Roger Tory Peterson. This book on herons and bitterns is an authoritative summary of what is currently known about this worldwide family of wading birds – the result of extensive studies carried out over many years on both sides of the Atlantic.

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Gypsy moths may harbor the seeds of their own destruction, according to a BioBrief in ***BioScience*** (Vol. 35, No. 4, p. 260). The destroyers take the form of latent viruses – discovered by researchers at the Boyce Thompson Institute for Plant Research (BTI) and Cornell University. The scientists were working with the Northeast gypsy moths – once flourishing as a population, but decimated after a shortage of red oak forced them to feed off pine and poplar. The dead larvae were found to be loaded with viruses – "more than 1 trillion virus particles per insect." The working hypothesis is that the insects were stressed by the forced change in diet, which roused the latent viruses from dormancy. If so, the projected strategy would involve purposely stressing the pests to activate a virus that destroys them. Insect Virologist H. Alan Wood of BTI notes that latent viruses may be more easily manipulated and thus more effective than viruses previously tested as insect population controls.

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"A Reinterpretation of National Park Legislation" by John Lemons and Dean Stout appeared in the Fall 1984 issue (Vol. 15, No. 1, pp. 41-65) of ***Environmental Law*** (Northwestern School of Law of Lewis and Clark College). The authors reviewed the legislative history behind the 1916 Organic Act and analyzed specific enabling legislation for Yosemite, Sequoia and Yellowstone. In applying these laws to the preservation *versus* use dilemma, the authors provide an interpretation that strongly supports the preservation of park resources. They conclude that the most basic fiduciary duties of NPS are to reduce development and promote the preservation of resources.

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Northwest Woodlands is the title of a new quarterly magazine, replacing the news publications of the Oregon Small Woodlands Assn. and the Washington Farm Forestry Assn. Vol. 1, No. 1, April 1985, carries a story on development of "the sterile insect technique" for controlling gypsy moth infestations. To date, the technique has been used successfully to eliminate two isolated infestations, and demonstration projects are planned for additional sites this year. The quarterly is published at 4033 S.W. Canyon Road, Portland, OR 97221 and is edited by Merle S. Lowden.

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From Jim Agee at the NPS/CPSU at University of Washington comes word of the ***Bibliography of Repeat Photography for Evaluating Landscape Change,*** by Barry Rogers, Harold Malde, and Raymond Turner – a 1984 publication of the University of Utah Press. Repeat photography has been a valuable way to assess landscape change over time (e.g. Doug Houston's ***The Northern Yellowstone Elk***.) The authors have compiled known contributions to the subject in this 179-page volume; however, it is difficult, Agee says, to assess how complete the bibliography is. The introduction has a fine section on purposes, reliability, and methods of repeat photography, and the book is well-indexed. ISBN #0-87840-239-3. Loan copy is available from the Pacific Northwest Region's library.

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An international guide to range scientists, range research projects, university and college range curricula, and range experiment stations is slated for publication this spring at the University of Idaho, Moscow, ID 83843. The directory listings, by country for Australia, Canada, Mexico, and the U.S., will list range scientists by name, address, and specialty area, and will include addresses of international range organizations, consulting firms, equipment suppliers, and manufacturers of scientific equipment. Also listed will be research in progress in range and applied ecology.

Other nations than those noted above will fall into a broad international listing.

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Ranger is the new name of the official publication put out by the Association of National Park Rangers. Formerly ***Newsletter,*** the quarterly is now a self-cover magazine, with Bill Halainen of Minute Man NHP continuing as editor. The quality of the contributions, from articles to letters-to-the-editor, reflects the broad range of concerns and interests and the high caliber of the men and women who make up NPS ranger ranks. Published by Concord Press in Framingham, Mass., ***Ranger*** columns are open to opinion on all subject matter pertaining to park conditions and man-

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agement. Prospective contributors should contact the editor before submitting manuscripts. Address Editor Halainen at RFD #2, 41 North Great Road, Lincoln, MA 01773.

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In a dateline article out of Corvallis, Ore., in late January, Philip Shabecoff of the ***New York Times*** News Service describes the growing body of scientific research that now indicates acid rain is developing into a national problem – "not simply a matter of concern to New England and New York's Adirondack Mountains."

The story covers the activities of NAPAP (the National Acid Precipitation Assessment Program, with a budget of nearly $60 million this year and involving 13 different departments and agencies) and within this context it includes references to work by National Park Service scientists. Answers about the causes and effects of acid rain and other pollutants "are starting to be found," Shabecoff states, "and a good number of them are emerging from the Environmental Protection Agency's research laboratory here in the Willamette Valley, a continent away from the acidified lakes of the Adirondacks."

As a result of direct experiments plus mathematical models based on "the flood of data from around the country," scientists and technicians are now "able to describe some of the chemical and biological processes that take place." The article includes a look at the intense debate raging over possible effects of acid rain on human health and over what should be done with relation to all the newly acquired information and insights.

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Additional scientific articles dealing recently with acid precipitation include one on "Acid Tolerance in Amphibians," by Benjamin A. Pierce (Dept. of Biology, Baylor University, Waco, TX 76798) in the April 1985 issue of ***BioScience,*** and "Acid Precipitation: Natural Versus Anthropogenic Components," by James Galloway and Mark Hawley, (University of Virginia Dept. of Environmental Sciences), and Gene Likens (NY Botanical Garden's Institute of Ecosystem Studies, Millbrook, NY 12545) in the Nov. 16, 1984 issue of ***Science.***

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Coastal Barrier Resources System: A Draft Report To Congress, dated April 1985, has gone out from the Interior Office of the Secretary for review. The public comment period will end on July 15, 1985, following which time the Secretary of the Interior will develop his recommendations to the Congress regarding the Coastal Barrier Resources System (CBRS) described in the Draft Report. The System consists of a network of 186 units along the Atlantic and Gulf of Mexico coasts, within which most Federal expenditures no longer are available to promote growth of development. The Coastal Barrier Resources Act of 1982 requires that recommendations be included in the final report. The recommendations will be developed in consultation with the Governors of the affected coastal states. It also requires the Department to allow for and take into consideration public comment.

Comments regarding the Draft Report should be sent to the Coastal Barriers Study Group, NPS, PO Box 37127, U.S. Dept. of the Interior, Washington, DC 20013-7127.

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The latest in a series of USFS publications on the influence of forest and rangeland management on anadromous fish habitat in western North America is now available through the Pacific Northwest Forest and Range Experiment Station, Multnomah Bldg., 319 S.W. Pine, P.O. Box 3890, Portland, OR 97208. The new publication, GTR-PNW-178, is titled ***Influences of Recreation,*** by Roger Clark, Dave Gibbons, and Gilbert Pauley. The report describes the interrelations between recreation and fisheries. Recreational issues affecting either the supply of habitat for anadromous fish production and use, or the demand for the fisheries also are discussed. Opportunities for research are outlined.

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Science News, in its April 13, 1985 issue, carries a story about the suspected nitrogen culprit in the unexpectedly heavy frost damage sustained by the mountain forests of Vermont during the 1983-84 winter, when thousands of red spruce and other trees "didn't show the winter hardiness that they would normally show."

Botanist Hubert W. Vogelmann of the University of Vermont, hypothesizes that an oversupply of nitrogen, deposited as ammonium or nitrate ions carried by windblown dust and by rain or snow, may have exacerbated frost damage not only in Vermont but in forests around the world. Sources are as diverse as heavily fertilized fields, feedlots, motor vehicles, and power plants.

The theory is that plant cells, heavily fertilized by nitrogen, continue to grow late into the year. The elongated, thin-walled cells that result cannot cope when caught by severe winter weather. Robert I. Bruck, a forest pathologist at North Carolina State University, has showed there was enough nitrogen in a simulated rain solution he and his colleagues used, to "perturb" the symbiotic relationships between fungus and root . . . influencing the way trees take in water, phosphorus, and other nutrients. Attention now appears to be shifting away from sulfur compounds – an early worry for trees and forest ecosystems – to the damaging effects of such other pollutants as ozone, combined with the effects of excess nitrogen, acidification, mobilization of metals like lead and aluminum, and the deposition of various organic, potentially growth-altering compounds that may number in the hundreds.

"These forests are being hammered by all of them," said Vogelmann.

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Science News for March 30, 1985 (Vol. 127, No. 13), carries word of the finding by the President's Council on Environmental Quality that data from networks monitoring U.S. environmental quality are "not very good."

A Washington-based consultant, Richard M. Dowd, formerly an assistant administrator of EPA, participated in a recently completed study by CEQ, analyzing "how to remedy deficiencies in data on the health of the environment and challenges to that health."

At a news briefing in late March, A. Alan Hill, CEQ chairman, pledged that he would work with other federal agencies to see that the report's long list of recommendations is implemented. The recommendations were distilled from the findings of four expert panels on human health impacts, geochemical and hydrological processes, ecosystems, and environmental monitoring and assessment.

A key concern was monitoring. The study found that for many environmental indicators, little or no monitoring data exist. Panelists also worried that most data come from short-term experiments that "probably do not reflect the real and complex biochemical and physical ways an ecosystem would respond to stress. Recommendations include the inventorying of all federal monitoring programs and the identifying of specially sensitive species (such as bees, worms, or lichens) as early-warning sentinels of hazards.

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"Problems with the Press: Who's Responsible?" appears in the March 1985 ***BioScience*** (Vol. 35, No. 3). Based on Rae Goodell's 1984 keynote address to the Council of Biology Editors, the article is a thoughtful look at the pressures on scientists to deal with the information needs of society and at the attitudes of scientists faced with this need.

Goodell is with the Writing Program, Massachusetts Institute of Technology. Her thesis is that communicating with the press is becoming an obligation for scientists and that "the burden is generally not a welcome one." She examines the reasons, and finds that lack of time, lack of clearcut standards for scientists in press encounters, and lack of predictable results in what appears from the pens of journalists are the three major causes for the distaste most scientists feel about interaction with the press.

Goodell's own conclusions, after a lengthy survey of current scientific writings and programming, are perhaps presented in the words of two science writers she quotes. Paul Ehrlich sees communicating with the public as a part of each scientist's responsibility, and calls it "tithing to society." Douglas Hofstadter, in a lecture for an MIT series on Political Issues and the Science Writer, said: "It seems to me that people who are going to be involved in writing about science, in doing science, in teaching science, do owe a certain debt to society to emphasize what they believe is truly important."

Fellowships and awards are proliferating in the strictly scientific world now, recognizing excellence in popular science writing and broadcasting. Universities are strengthening their own coverage of science within the schools and are setting up specialized courses for scientists in public information writing. Goodell sees the entire field of public/science interaction as alive and stirring with change.

Grizzly/Wolf Technical Workshop

The 10th Anniversary meeting of the Grizzly/Wolf Technical Workshop will be held July 24-26 on the west boundary of Glacier NP. The outdoor setting for the open-air workshops, along the scenic North Fork of the Flathead River, encourages frank exchange among many who might otherwise not have an opportunity to meet.

The workshops each year have attracted an ever-widening circle of professionals – researchers, managers, and others from various agencies and private organizations – in an informal atmosphere for trading information and discussing issues.

This year's agenda includes panel discussions on legal questions involving grizzly bears and wolves, the role of control programs in wolf recovery, and conflicts between grizzly and wilderness management. Sessions on grizzly and wolf research updates will make current results available to managers for immediate applications. Kate Kendall, at Glacier NP Science Center, is the contact.

MEETINGS OF INTEREST

1985

July 23-26, NATIONAL WILDERNESS RESEARCH CONFERENCE, at Colorado State University, Fort Collins. Contact, National Wilderness Research Conference, College of Forestry and Natural Resources, Colorado State University, Fort Collins, CO 80523.

July 24-26, GRIZZLY/WOLF TECHNICAL WORKSHOP, open-air workshops held on the North Fork of the Flathead River. Contact, Kate Kendall, Science Center, Glacier NP, West Glacier, MT 59936.

Nov. 18-22, MANAGING PEOPLE IN PARKS AND FORESTS, Oregon State University, Corvallis, OR 97331. Contact, Donald R. Field, OSU-CPSU.

1986

May 12-16, FIRST NATIONAL SYMPOSIUM ON SOCIAL SCIENCE IN RESOURCE MANAGEMENT, co-sponsored by NPS, USFS, and OSU Coll. of Forestry, Dept. of Resource Recreation Management. Theme: "People, Parks and Forests." Contact, Donald R. Field, OSU/CPSU, Oregon State University, Corvallis 97331.

July 13-20, CONFERENCE ON RESEARCH IN THE NATIONAL PARKS, co-sponsored by the George Wright Society and the National Park Service, at Fort Collins, CO. Theme: "Interrelationships of Man and His Environment." Co-chairmen: Ray Herrmann for natural resources; Calvin Cummings for cultural resources. Contact Hermann, Room 107-C Natural Resources, Colorado State University, Fort Collins, CO 80523.

Oct. 25-28, CALIFORNIA CHANNEL ISLANDS SYMPOSIUM, Santa Barbara, CA. Contact Gary E. Davis, Channel Islands NP, 1901 Spinnaker Dr., Ventura, CA 93003.

Early October (no firm dates yet), CONFERENCE ON FOSSIL RESOURCES, at Dinosaur National Monument. (See story this page.)

See also ***Meetings of Interest*** *in previous issues of* ***Park Science.***

Managing People in Parks

A short course on "Managing People in Parks and Forests" has been rescheduled for Nov. 18-22, 1985, according to Workshop Director Donald R. Field, senior scientist with the NPS Cooperative Park Studies Unit at Oregon State University, Corvallis.

The workshop, to be held on the OSU campus, is about how to manage people in recreation settings and the use of social science statistics in the decision-making process. Discussion of contemporary issues in recreation will provide the foundation for participants to look ahead and plan for the '90s. Data management systems to be reviewed include those available for microcomputers.

Instruction will be by lectures, small group assignments, and panel discussion from experts in social science research and senior managers from federal and state land management agencies. Course fee is $250.

Channel Islands Symposium

A California Channel Islands Symposium will be held in Santa Barbara on Oct. 25-28, 1986, according to Channel Islands NP research scientist Gary E. Davis, who is a member of the symposium steering committee. The symposium is the third in a series that began in 1965 and continued in 1978.

The Southern California Academy of Sciences is organizing the meeting with assistance from a number of other organizations. The steering committee is chaired by F. G. Hochberg, Santa Barbara Museum of Natural History, and in addition to Davis, includes Ronald J. Dow, U.S. Navy; Robert Given, University of Southern California; Robert Hansen, The Nature Conservancy; Ralph Philbrick, Santa Barbara Botanic Garden; and Dennis M. Power, Santa Barbara Museum of Natural History.

First NPS Conference on Fossil Resources

The first NPS Conference on Fossil Resources in the National Park System will be held in October 1986 at Dinosaur National Monument, Utah. This 40-hour conference will *not* be a meeting of paleontologists, but rather will serve as an interface between the scientific community and managers and interpreters. Topics will include legal protection of fossils, threats to fossils (both human and non-human) and how to mitigate them, addressing fossils in a Natural Resources Management Plan, basic data necessary for the successful management of fossils in the field, how to use outside researchers to develop and implement a management program, fossils as museum objects, interpreting fossils and ancient environments, training seasonals, and technical expertise and facilities available within the Service.

The conference is an outgrowth of concerns about this resource service-wide (see Superintendent's Corner, *Park Science*, Fall 1984 5(1):9). "We firmly believe that such a meeting is long overdue, and it will be a major step towards upgrading our care of this fragile and valuable resource," said Dinosaur NM Superintendent Joe Kennedy.

Interested parties seeking additional information should contact Dan Chure, Park Paleontologist, Dinosaur National Monument, P.O. Box 128, Jensen, Utah 84035, (801) 789-2115.

mab notes

By William P. Gregg, Jr.
NPS Coordinator of the
Man and the Biosphere Program

The Conservation Data Base (CDB) is a computerized geographic information system (GIS) planned by MAB and being implemented cooperatively by the National Park Service, the Geological Survey, and Florida State University. When operational, the system will be capable of generating a wide variety of relatively small-scale resource maps and related statistical analysis "on demand" for a wide range of conservation purposes.

Incentive for the project came from MAB's Project Directorate on Biosphere Reserves. The Directorate is responsible for convening interdisciplinary panels to recommend sites for nomination as biosphere reserves, in particular biogeographic regions. Each panel must delineate the boundaries of a biogeographic region; as well as locate, describe, compare and evaluate a large number of candidate sites within that region. The work requires maps, map overlays, and tabular displays of data on site characteristics derived from maps.

Because manual preparation of such material is time consuming and costly, the Directorate, in its FY1984-85 plan called for development of an automated GIS to provide maps and tabular information tailored to the needs of particular panels. The system would be based on digitization of small-scale maps showing natural resource classifications, climatological and other environmental variables, natural and cultural features, protected areas and special designations (like natural landmarks, biosphere reserves, and research natural areas), and other information needed by the selection panels.

As planning got underway, it became obvious that CDB's capability to generate maps and analyses for user-specified regions of the U.S. would have applications far surpassing the immediate needs of MAB . . . in policy analysis, regional planning, design of protected area systems, impact assessment, forecasting, and providing information to special interests and the public. The considerable potential engendered enthusiasm among the participants.

The Geological Survey is providing 1:2,000,000 regional base maps digitized for the National Atlas. These maps allow for display, singly or in combination, of political boundaries to the county level, roads, railroads, major streams and water bodies, and urban areas. USGS is also providing mylar copies for use in digitizing selected National Atlas and other small-scale maps, and plans to assist in the actual digitizing where possible.

The Florida Resources and Environmental Analysis Center at FSU, with limited funding from NPS, has begun digitizing national resource classifications in accordance with NPS priorities, for use on Intergraph, a state-of-the-art software package for computer mapping. The university is integrating the regional map files into a national base map for the CDB, and is working on expanding the analytical capabilities of Intergraph by integrating it with SAGIS, the powerful geographic information system software package used by our NPS cartography unit in Denver (see Winter '82, Winter '83, and Spring '84 issues of *Park*

Continued on next page

Book Reviews

Larry D. Harris. 1984. The fragmented forest, Island biogeographic theory and the preservation of biotic diversity. Univ. Chicago Press, Chicago and London, xviii, 211 p. With foreword by Kenton R. Miller.

As years pass our commercial forest lands have become ever more simplified and monotonous. Decades of timber harvest have brought about forest conversion to plantation-like monocultures or young successional stands, one after another without break. Adjacent cutting blocks seldom present any forest older than about 100 years. As remnants of older forests become ever more constricted and isolated, Professor Harris has produced this needed and timely book. He and colleagues, who contributed to several of the 11 chapters, present managers with an appealing alternative, which proposes continuance of "non-declining even flow" timber for consumption while systematically maintaining a high level of wildlife diversity.

To accommodate both commodity and diversity from our forests in the future means, however, that we must begin *now* to plan for all stages of forest succession, up to and including old-growth, in tomorrow's landscape. In Dr. Harris's words "the thrust of this work is not directed at a system of nature preserves, but rather a forest management strategy that depends heavily upon, and in turn conserves, the unique character of old-growth ecosystems."

And what is so special about old-growth forest? Notwithstanding its intrinsic qualities of beauty and appeal to many people, without provision for old-growth maintenance we cannot assure an acceptable level of wildlife diversity over the forested landscapes. We must plan for diversity before it is too late.

Arguments for maintaining old-growth or late successional forests are not new. In a paper in *Science* in 1969 ecologist E.P. Odum looked at both "production" (or early successional communities) and "diversity" (later successional communities) ecosystems, and reasoned that an intelligent society would plan to accommodate both in the regional landscape. But are we doing this? Dr. Harris proposes that large areas of preservation (such as National Parks and Wilderness) and equally large areas of unmitigated production landscapes (such as commercial forest lands) will not do the job. We can do much better by mixing up smaller units of both protection and harvest areas so that all stages of forest succession will be adequately juxtaposed in the local landscape.

To be sure, the best designs for mixing forest successional stages in the local landscape must consider the size and location of these indispensible larger preserves. Harris and colleagues show how this can be done by applying theories of island biogeography to one of the last and fast disappearing areas of old-growth forest in the U.S. – the commercial forest lands of the Willamette National Forest in Oregon. Several chapters are devoted to describing the history, old-growth character, and animal community characteristics of these truly impressive Cascadian forests. Should the reader become enamoured of old-growth forest for its own sake, Harris reminds us (p. 109), "There is no old-growth issue save for the desire and objective of maintaining biotic diversity."

Chapter 6 is a review of pertinent elements of island biogeography theory. Harris describes the insularization of old-growth forest ecosystems brought about by conventional forest harvest practices. This leads to local faunal extinctions or adverse isolation effects on remnant populations.

The key to management strategy is then stated: "To the degree that old-growth ecosystems can be surrounded, even partially, by similar habitat, the island analogy and its portents do not apply."

Chapters 8-10 are the heart of the book. Island biogeography applied at a whole forest level is like fitting the pieces of a puzzle together. What are the total acreage requirements for maintaining viable populations of different animal species? How many "islands" should there be? What about their size or assortment of sizes? How far apart? What about their connectivity (or severity of the barrier to movement between adjacent islands)? What are the crucial qualities of the islands themselves: should they merely be old-growth stands or "long-rotation" islands defined as "a management unit consisting of a current old-growth stand and several surrounding adjacent stands managed on a 320-year rotation?"

The key management strategy, stated above, favors long rotation islands in the face of present risks and future uncertainties concerning wildlife. Chapter 10 applies the theory to the Willamette National Forest Oak Ridge district. The chapter is altogether too brief. The importance of riparian drainage patterns is indicated as a basis for fitting the pieces of the puzzle. But I would like to see several of the alternatives discussed in Chapters 8 and 9 displayed, and their tradeoffs discussed. This is what forest managers have to do in preparing their Plans and Environmental Impact Statements.

I applaud this book and its author and collaborators. The concepts surely can be applied to other regions with different qualities of old growth forest and forest harvest practices. Even Park and Wilderness managers can take note. Too much old-growth in absence of disturbances that create younger stands also can lower diversity. And what happens on the boundaries of these preserves will determine the long term health within. We do not want megazoos only, but sustainable ecosystems.

Forest managers should not look upon Professor Harris's book as a cookie cutter approach to forest diversity. Forests outside the Pacific Northwest can be similarly analysed with different emergent patterns and tradeoffs. The old days of "Everything-Everywhere" as the timber harvest addage has it, is no longer a feasible approach. Harris has shown how timber managers can join with wildlife biologists, ecologists, and planners and publics of varying persuasions and professions to produce a pleasing, harmonious forested landscape in the best sense of environmental quality and multiple use.

William H. Moir, Ecologist
USDA Forest Service, Southwestern Region

* * *

Stephen Herrero. 1985. Bear Attacks: Their causes and avoidance. Nick Lyons Books, 31 West 21st St., New York, NY 10010. $14.95

Many of our large wilderness parks support populations of grizzly and black bears. Maintaining these splendid creatures in a wild state – as free as possible from the influence of man – while at the same time providing for human safety, is a difficult challenge for resource managers. This new book should be required reading for park rangers and managers.

Herrero analyzes 414 interactions between people and black or grizzly bears, including 357 incidents involving injury or aggression from the bear. Interactions are classed as "sudden encounters," "provoked attacks," and "predation." This is a difficult data base to work from because, in many cases, the detailed circumstances leading up to an attack are unknown. Herrero recognizes these limitations. He offers circumspect generalizations where appropriate, and rightfully avoids them elsewhere.

Herrero uses this information, along with information on bear social behavior, food habits, and physiology, to show how to minimize people/bear conflict. The book deals with sensitive issues, such as possible vulnerability of menstruating women to bear predation, in a forthright manner. Some readers may be offended by the detailed accounts of individual attacks, which could allay or exacerbate the nightmares of the "bear-phobic." Nevertheless, Herrero uses these accounts effectively to document attack situations and to point out how they might have been avoided.

This book is much more than the title suggests. Herrero produces some thoughtful observations on bear management in parks as well as a sensitive rationale for maintaining populations of wild bears.

Douglas B. Houston, Research Biologist
National Park Service, Pacific Northwest Region

MAB Notes

Continued from previous page

Science). The merger would enable the Denver unit to access CDB directly for in-house applications.

Finally, the MAB Secretariat at the State Department is funding a comprehensive inventory of U.S. reserves 5000 acres or larger. The two-year project, which will begin with a pilot study in the Eastern Deciduous Forest region this summer, involves classification of protected areas according to management objectives and existing vegetation, an analysis of gaps in the U.S. protected area system, and the formatting of the survey information for entry into the CDB.

Together, these cooperative MAB activities should give us an important new tool for mapping resource information at the state, regional, or national level. As the data base becomes operational, we will publish information on its capabilities in *Park Science.*

Brown Pelican Nesting Stages Comeback at Santa Barbara Island

Expansion of California brown pelican nesting to Santa Barbara Island in the Channel Islands National Park is reported by the park's research scientist, Gary E. Davis. An endangered species, the California brown pelican has nested only occasionally on Santa Barbara Island during the past 100 years and never in the high numbers seen this year, Davis reports.

Historical information on sea bird nesting in the park was compiled during design of a long-term population dynamics monitoring protocol. The summary shown here, drawn primarily from that design study, shows pelican nesting activity in the park since 1884. In January 1985, Davis advises, pelicans began building nests on Signal peak, the highest point on Santa Barbara Island. They nested on both the steep sea cliffs along the southwestern flank of the peak and in the gently rolling swale on the north slope in low bushes of seashore bight. By mid-March the colony consisted of 600 to 800 active nests, with two or three chicks from one to nine weeks of age in nearly every nest. Adult pelicans still in breeding plumage on empty nests suggested that the colony would grow even more before the nesting season was over.

The park also contains the only consistently active California brown pelican colony in the United States – located on Anacapa Island. In the late 1960s and early 1970s, DDT concentrations in pelican prey reduced reproduction in the American population to disastrously low levels. In 1970 the entire population fledged only a single bird. With removal of the major sources of DDT, the pelicans began to recover. By early 1980s they were fledging more than 1,000 young a year.

Unusual oceanographic conditions associated with the El Nino event of 1983-84 apparently disrupted the pelican food web, Davis said, and productivity fell to less than 600 birds in 1984. The Anacapa colony is active again this year, but activity there started several weeks after the new colony on Santa Barbara Island. Monitoring of nesting attempts and fledging success will continue as part of the park's long-term natural resource monitoring program.

"It looks," said Davis, "as though the California brown pelican is making a successful comeback in Southern California, and that provides a somewhat unusual opportunity to investigate the ecological and genetic dynamics of a rapidly expanding population of large, long-lived animals."

A summary of California brown pelican nesting activity in Channel Island National Park, California.*

	NUMBER OF PELICAN NESTS			
Year	Anacapa Island	Santa Barbara Island	Santa Cruz Island Scorpion Rock	San Miguel/ Prince Island
1884	present	NS†	NS	NS
1887	NS	NS	none	NS
1895	NS	NS	none	NS
1897	NS	none	NS	NS
1898	present	NS	NS	NS
1909	NS	several	NS	NS
1910	500	NS	NS	5
1911	200	25	NS	NS
1912	200	several hundred	NS	none
1914	1000+	NS	NS	NS
1916	1500	NS	NS	NS
1917	2000	NS	NS	NS
1920	5000+	NS	NS	NS
1922	100's	NS	NS	NS
1927	2500±	NS	NS	present
1928	500	NS	NS	NS
1929	present	NS	NS	NS
1930	200	NS	NS	100's
1935	2000	NS	NS	NS
1936	2000	NS	NS	NS
1939	2000+	30	NS	200
1940	2000+	NS		NS
1941	2000+	NS		
1962	500			
1963	100-1000			
1964	100-1000	present		
1967	present	present		
1968	present	none		none
1969	750	NS		NS
1970	552	NS		
1971	540	NS	NS	
1972	149	none	112	
1973	247	NS		
1974	311	none	105	
1975	212	none	80	none
1976	417		none	none
1977	76			none
1978	210			NS
1979	1258			
1980	2147	97		
1981	2946	none	none	none
1982	1862	none	NS	NS
1983	1856	21	NS	NS
1984	628	none	NS	NS

*The primary source of this information was – Hunt, G.L. Jr., and T. Ingram, 1982: Summary of the historical data base for selected species of marine birds in Channel Islands National Park. Report to the National Park Service on CX 8000-1-0035. 75 p.

No records of pelican nesting on Santa Rosa Island were found, observations made in 1975-77 found no nesting in that period.

†NS = No samples taken/no observations recorded.

In the Next Issue

"Developing Guidelines for Revegetating Highly Acid Minespoil in the Big South Fork National River and Recreation Area," by Ed Buchner, Michael Rickard, and Sam Kunkle; "Limits of Acceptable Change: A Framework for Assessing Carrying Capacity," by Jeffrey Marion, David Cole, and David Reynolds; "Impacts of a Proposed Nuclear Waste Facility on the Night Sky in Canyonlands NP," by Don Henderson; and "Research Networking at Gateway," by John Tanacredi.

Barn Owls Coming Back To Gateway

By Robert P. Cook

The barn owl *(Tyto alba pratincola)* is a declining raptor species, long ago "blue listed" by the National Audubon Society and recently listed as a "species of special concern" by the New York State Department of Environmental Conservation. Loss of habitat in general, as well as loss of specific nesting habitat have been major factors in this species' decline.

At Gateway's Jamaica Bay Unit, the barn owl was known to occur, and presumed to be nesting in abandoned buildings both within and adjacent to the park. Recognizing the potential of the nearly 5,000 acres of suitable habitat that existed within the Jamaica Bay Unit, New York naturalist Peter Post suggested the placing of barn owl nest boxes. Since the habitat in question was man-made, and since it lay within the Jamaica Bay Wildlife Refuge, this suggestion was consistent with management goals to restore and maximize the diversity of native wildlife. Using a prototype nest box developed and donated by Len Soucy of the Raptor Trust, staff and volunteers of Jamaica Bay Wildlife Refuge began in 1980 a program of erecting and monitoring nest boxes throughout Jamaica Bay.

Success required an interval during which local owls could find the boxes and take up residence. This part of the project took two years, but once the owls caught on, the occupancy rate and total number of owls produced has increased annually (Table 1). Fledged barn owls generally disperse from their natal area, but apparently some have remained local, taking up residence in unoccupied boxes and thereby increasing the occupancy rate.

Banding of the young began in 1983, and in 1984 both young and adult females were banded. It is expected that, in time, some incubating females captured will have been banded as young in a nearby box. To date, two band recoveries have been made. One was of a bird banded as a nestling and recaptured by owl banders in Cape May, N.J. approximately 125 miles further south. The second recovery was that of a young bird dead at nearby JFK Airport.

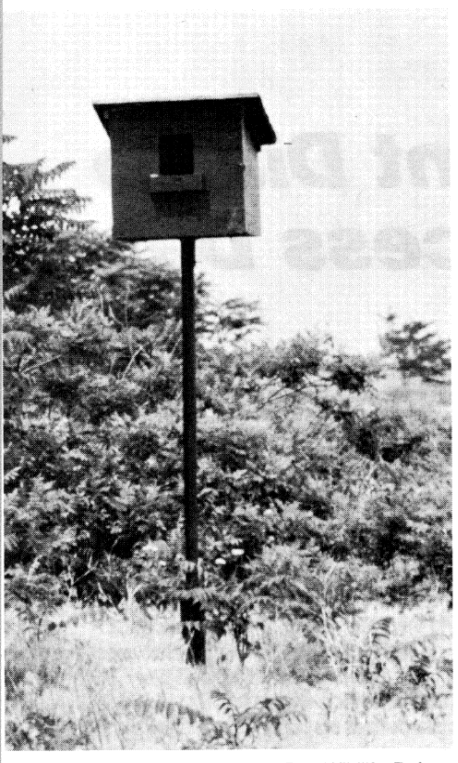
Barn owl food studies have demonstrated that the species composition of prey items varies seasonally and according to prey availability. Pellet material for prey analysis was collected from nest boxes in late summer, follow fledging of young. The bulk of this material is presumably pellets produced by the young, but these boxes also are used as roosts year-round, and winter pellets of adults undoubtedly were present. Despite these limitations, prey item analysis provides some interesting insights into the Jamaica Bay barn owls. Typical of Northeastern barn owls, meadow voles constitute the predominant prey item by numbers (Table 2). However, the occurrence of Norway rat, in numbers and particularly by percent weight, is much higher than elsewhere in the Northeast. This is due to the large naturalized rat population which occurs throughout the islands and periphery of Jamaica Bay, and the paucity of other potential prey species such as moles and shrews. In this case, the increased incidence of Norway rat supports the general perception of barn owls as opportunistic feeders.

The present outlook seems very encouraging. It is hoped that the Jamaica Bay barn owl population will form a nucleus which will help bolster a singificant population within the Park and throughout the Tri-State area, reversing the decline.

Volunteers and staff of Jamaica Bay Wildlife Refuge, particularly Mary Hake, Clive Pinnock, Don Riepe, Chris Rose, and Russell Trieller, made this program possible.

Cook is a Natural Resource Management Specialist trainee with the NPS North Atlantic Region.

Banded baby barn owl *– a nestling from one of the Jamaica Bay barn owl boxes, is held here by Bob Cook, NPS Natural Resource Management Specialist trainee with the North Atlantic Region. Photo by D. Riepe.*



***Barn owl nest box** in Jamaica Bay Wildlife Refuge is one of many erected at Jamaica Bay Wildlife Refuge, beginning in 1980. Photo by D. Riepe.*

Space Technology Aids Biologists in Tracking Elk

By Ron Shay

Products of the space program are helping Oregon biologists plot the movements of 25 elk in southwestern Oregon.

Last winter, 24 cow elk and one spike bull were fitted with radio collars in the traditional fashion, utilizing tranquilizer guns and drugs. Usually, after the elk are thus equipped with the small radio transmitters, they are tracked by biologists on foot, horseback, in a vehicle, or trying to mark map locations while flying over the area.

However, things have gone space-age with this bunch of animals according to Larry Conn, Oregon Department of Fish and Wildlife (ODFW) district biologist for the area. The project is being carried out in conjunction with the Umpqua National Forest which is providing aircraft and electronic equipment.

Spin-off products of the space program are used in creating the miniaturized radio transmitters that are attached to the collars put around the necks of the elk. The use of solid state electronics has made it possible to create radios that will take the abuse that comes with hanging around the neck of an elk going through the brush. Additionally, the actual transmitter only weighs about half a pound; even with the addition of batteries and protective materials it does not create a burden on the animal.

In the past, Conn and his assistant, Steve Denney, would have spent many hours tracking the signals of the various animals and plotting them on maps. This is still done when detailed movement of animals is wanted. However, with the herd of 25, ODFW and the Umpqua Forest want to try to determine general movements and use of various types of plant cover.

The Landsat satellites orbiting several hundred miles above the earth have provided the base for this type of study. As the satellite passes over, it senses the different colors it sees on the earth and translates the information into electronic data. The data are transmitted back to earth, then interpreted and made into maps showing the various types of plant growth covering the area. The satellites can break the cover types down into units that are about 80 yards square.

The biologists are concerned about three main kinds of plant life utilized by the elk. Vegetation that provides food for the foraging animals is obviously one important type. Hiding cover is another plant type; the third consists of larger growth, such as timber that provides thermal cover. Basically, this latter type of area gives the animals shelter from the weather during extremely hot periods or during cold spells. It is possible to determine the different cover types from the images created with Landsat.

Then another recent electronic innovation enters the scene. Mariners have been using LORAN or Long Range Aids to Navigation for a number of years. This gives the person equipped with the necessary gear a set of numbers that virtually puts an "X" on the map indicating his location. Since the system is based on radio signals sent out by specialized transmitting towers, it can be used over land as well as the water.

And, a number of years ago, a Japanese gentleman invented a very directional radio receiving antenna called a Yagi antenna. Put all of these pieces of wizardry together and you have "elk monitoring a la 1985."

The radio transmitter collars were put in place last winter. On a weekly basis in the months of November through April, an aircraft equipped with a LORAN system, and radio receiver with the directional Yagi antenna, flew the area where the elk were hanging out. As the elk were located, their location was recorded with the LORAN gear. The location information, which had been recorded on a map that correlates with LORAN fixes, was then transferred to the LANDSAT image and made it possible to plot the movements of the animals through the various types of cover. And what is provided is not simply group coverage, since each of the animals has a distinctive signal from its transmitter so that individual movements can be plotted.

One flight each month will be made during May and June; then the job of correlating the information with the cover maps will be attempted. Previous studies in other parts of the state have shown that big game animals need a mix of the various types of cover. The concept is proven: the work being done on the Umpqua National Forest will add to the overall knowledge about Roosevelt elk and give specific information about the herds of southwestern Oregon. Information is being collected more readily using modern technology, but still needs the interpretation of trained human senses.

*Shay is editor of **Oregon Wildlife,** bimonthly publication of the Oregon Dept. of Fish and Wildlife.*

Table 1. Summary of Barn Owl Nest Box Productivity, Jamaica Bay Wildlife Refuge

	1980	1981	1982	1983	1984
Number of boxes in place	3	8	9	10	10
Number of active nest boxes	0	0	2	4	6
Occupancy rate	0	0	22%	40%	60%
*Productivity	0	0	8	14 + 4 eggs	26
*Productivity/active box	0	0	4.0	4.5	43

*Productivity is the number of young and/or eggs produced. While not every egg results in a fledged bird, logistical constraints and a desire to minimize disturbance prevents following closely the fate of all young. Therefore, any calculation which includes eggs are probably higher than the actual number of birds that survived and fledged.

Table 2. Prey items of Jamaica Bay Barn Owls.
Based on analysis of pellet material from three nest boxes, collected 9/27/83.

Prey Species	# Individuals	% Frequency	% by weight
Meadow Vole *(Microtus pennsylvanica)*	1156	73.0	43.2
White-footed Mouse *(Peromyscus leucopus)*	8	0.5	0.3
Muskrat *(Ondatra zibethica)*	1		
House Mouse *(Mus musculus)*	23	1.5	0.6
Norway Rat *(Rattus norvegicus)*	373	23.5	54.5
Avian*	24	1.5	1.4
Total	1585	100	100

*Avian remains were not always identifiable to species. Those species found include Starling *(Sturnus vulgaris)*, Common Flicker *(Colaptes avratus)*, and unidentified sparrow *(Fringillidae or Ploecidae)*. Anecdotally, remains of a Kestrel *(Falco sparverius)* were found in a box not included in the above analysis.

**based on average live weight of prey species obtained from literature sources.

Raptor Banding at Point Diablo Supplies Trapping Success Data

By Judd A. Howell and Williston Shor

Point Diablo hawk lookout was described by Binford (1979) as a major site for west coast raptor observation. During the fall of 1983 the National Park Service supported a program for trapping and banding migrating diurnal raptors in the Marin Headlands District of Golden Gate National Recreation Area. In 29 partial days during 1983, 41 individuals of 4 raptor species were captured, banded and released. Trap success was about 35 percent for hawks attracted by lure. In 110 days during 1984, 207 individuals of 6 raptor species were captured.

Introduction

In 1973 fifteen hawk migration observatories existed in the continental United States (HMANA 1974). The sixteenth was located in Ontario, Canada. All the observatories were east of the Mississippi River. Hawks observed in migration numbered in the thousands, varying from approximately 2,000 to 500,000 per station. Several stations were active in capturing and banding migrating hawks, including Cape May, N.J., Hawk Ridge, Minn., and Whitefish Point, Mich. Thiollay (1980) reported 262,000 hawks during spring migration along the east coast of Mexico.

The first reports from the west coast at Point Diablo, Calif. (De Sante and Remsen 1973) described briefly Binford's (1979) 29 days of observation, recording 4034 individuals of 14 species. Eighteen species of diurnal raptors were recorded from 1972 to 1977 including one endangered species, the peregrine falcon. Unusual sitings from Point Diablo were reported in subsequent years such as the wing marked Swainson's hawk from Richland, Wash. (Stallcup, DeSante and Greenberg 1975, Stallcup and Winter 1976, and Winter and Erickson 1977). After Binford's (1979) report no systematic counts were conducted at Point Diablo, Calif., until 1982 (Evans, Erickson and Le Valley 1982 and Faust pers. comm.).

Raptor banding activities along coastal California have been limited primarily to local population studies. Bloom (pers comm.) reported tentative patterns of migration based on his banding efforts during the 1970s and early 1980s. Red-tailed hawks banded in southwestern California dispersed northward while red-tailed hawks banded in northeastern California moved south. Two American kestrels flew from eastern and southeastern California to west central and southwestern Mexico. Bloom also reported that two peregrine falcons moved from northwestern California to northwestern Mexico, and one peregrine flew to the Napa Valley north of San Francisco Bay. Other raptor observatories and a single banding station began in Montana, Utah and Nevada, respectively, during the early 1980s (Tilly 1981, Hoffman 1984, and Hoffman and Potts 1984).

Little is known about the origin or destination of the raptors that use the Point Diablo flyway. The importance of establishing a banding station there was recognized by the National Park Service and received public review and support (Howell 1982). The main goal of the banding station is to establish primary data on dispersal and migration routes of diurnal raptors along coastal California. Secondary goals include, but are not limited to, environmental education and interpretation, natural resource protection, and evaluation of human impacts.

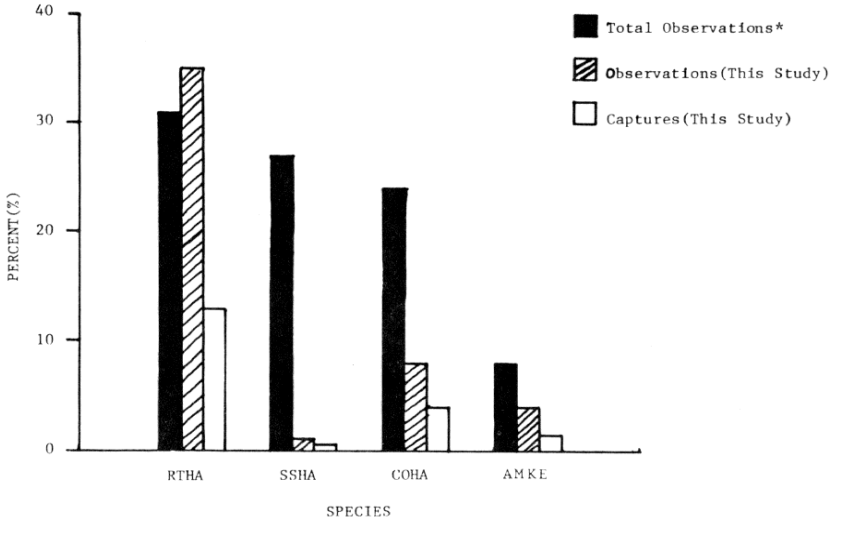
Methods

Point Diablo is located at the southern tip of the Marin peninsula, Marin County, Calif. The peninsula is bounded on the east by San Francisco and San Pablo Bays, on the west by the Pacific Ocean and on the south by the Golden Gate, a one mile wide channel that connects San Francisco Bay with the Pacific Ocean. The coastal mountains of California run parallel with the shore. Onshore breezes along the coastal ridges form updrafts, which are used by migrating raptors as they move south in the fall. The Marin peninsula forms a large funnel that guides migrating birds to its tip, where they concentrate. In this area, the Marin Headlands, they tend to stop before crossing the water barrier of the Golden Gate.

In late September 1983 two banders began trapping diurnal raptors at Point Diablo (Battery 129 or Hawk Hill) in the Marin Headlands. Battery 129 is a popular vista point as well as raptor observatory. Because of visitor interference, the banding effort was moved to Cross Hill (Slacker Hill) 1.2 km northeast of Battery 129. Trapping for 1983 was conducted from Sept. 24, 1983, to Jan. 2, 1984. Raptors were captured, measured, weighed, sexed when possible, banded with serially numbered leg bands and released.

Trapping was conducted 2 to 4 days each week for 3 to 6 hours per day. Three trap types were used in various combinations: a) 1 to 3 dho-gazza traps, b) 2 to 4 bal-chatri traps and c) 1 bow net. A lure bird, attached with flying harness and line to a pole and controlled from blinds up the hill, was used to attract

Figure 1. Relative Frequencies of Four Raptor Species Observed* and Captured in 1983 at Pt. Diablo Hawk Lookout, Golden Gate National Recreation Area, California.



*Data courtesy of Carter Faust, Marin Audubon Society

raptors. When raptors approached, the lure bird was allowed to escape into a shelter. A pocket tape recorder was used to record species, observations, behavior, weather and captures.

Nine volunteers contributed 319 hours of work during 1983, building blinds, and animal cages, trapping, and banding. NPS field staff and maintenance personnel contributed additional time, materials, and support.

Trapping for 1984 was conducted from Sept. 4 to Dec. 31, 1984. Forty-nine volunteers operated the station, 7 days a week, except during inclement weather, when they trapped along the road using bal-chatris. The major change in trapping methodology for 1984 was to rely almost exclusively on 2-bow nets. The volunteer raptor banding program for 1984 was designed to provide a full time banding station during the fall migration at Cross Hill (Slacker Hill).

Sixty-five volunteers, age 18 or older, were recruited from local universities and conservation groups. They were trained, in cooperation with the San Francisco Zoological Society's Raptor Conservation Program, in five, 3-hour sessions covering raptor identification, biology of migration, Federal and State laws, capture and handling techniques, banding, NPS policy and volunteer etiquette. In addition, each volunteer spent a day in the field to become familiar with the site. In mid-June 1984, each volunteer who had successfully completed the course was certified with a banding station sub-permit.

Results

In 29 days, totaling 129 hours of trapping during 1983, 41 individuals of 4 raptor species were captured: Red-tailed hawk (RTHA) *Butco jamaicensis,* Cooper's hawk (COHA) *Accipiter cooperii,* Sharp-skinned hawk (SSHA) *Accipiter striatus* and American kestrel (AMKE) *Falco sparverius.* Four additional species were observed in 1983 but not captured: Northern harrier (NOHA) *Circus cyaneus,* merlin (MELI) *Falco columbarius,* Golden eagle (GOEA) *Aquila chrysaetos* and Black-shouldered kite (BSKI) *Elanus caeruleus.*

In 110 days, totaling over 700 hours trapping during 1984, 207 individuals of 6 raptor species were captured: 158 Red-tailed hawks, 33 Cooper's hawks, 2 Sharp-skinned hawks, 9 American kestrels, 4 Northern harriers and 1 goshawk *Accipeter gentilis* In 1984 four additional species were attracted to the traps: prairie falcon, *Falco mexicanus,* peregine falcon *Falco peregrinus,* Red-shouldered hawk, *Buteo lineatus* and Broad-winged hawk, *Buteo platypteus.*

Table 1 presents the total 1983 observations of each species, the number attracted to the bait, and number captured. These data are approximate because complete records were not kept for all days. In addition these initial data were used to evaluate trapping success and should not be used to establish trends. Of 114 individuals attracted to the trapping area in 1983, 35 percent were captured.

A total of 268 trap hours was accumulated in 1983. Table 2 presents the capture rates for each trap type. The bal-chatri traps were used in two locations, on Cross Hill and in Rodeo Valley along the road. The dho-gazzas and bow net were used only on Cross Hill.

Carter Faust (pers. comm.) observed 3,249 raptors in 65 days of observations at Battery 129 during 1983 and saw 10,551 raptors in over 100 days of observation during 1984. Fig. 1 presents the relative frequencies of the 4 species that were captured in 1983 during this study, compared with the relative frequencies of Faust's 1983 observations. The frequency distribution for 1984 is very similar to Fig. 1, illustrating an underrepresentation of accipiters in the sample. Our first band recovery for the 1983 trapping season came from a Cooper's hawk banded in September 1983 and shot near Mexicali, Mexico Jan. 14, 1984.

The 1984 volunteers logged 1,160 hours of training, 480 hours of site establishment and 2054.5 hours of banding. This amounts to approximately 1.8 work years or $27,778.

Discussion

In general, for the first year a 35 percent trap success seemed good, although proportionately fewer Sharp-shinned and Cooper's hawks were attracted and captured both in 1983 and 1984. The bow net was the most efficient trap while dho-gazzas produced moderate results.

Three major changes in methodology need to be implemented for future trapping. First, trapping for Cooper's and Sharp-shinned hawks will be conducted along the riparian corridor in Rodeo Valley where they tend to hunt in the willow thickets. Nets will be used with a lure bird and willows as background. Second, trapping for American kestrels will be done systematically along roads. Bal-chatri traps will be used with mice as lures. Third, an additional trapping site will be established west of Battery 129 to capture species not seen on Cross Hill.

The feasibility study in 1983 and more intensive trapping of migrating raptors at Point Diablo in 1984 were successful (Howell and Shor 1984). With planned changes in methods and increased trapping efforts by volunteers, future seasons should produce numbers of bandings that will lead to meaningful recovery results. As the program grows and becomes more successful an effort will be made to use biotelemetry to maximize results.

Howell is a Natural Resource Specialist at Golden Gate NRA; Shor is a VIP (Volunteer in Park) working in the banding program.

Table 1. Approximate numbers of raptors observed, attracted and captured in 1983 at Point Diablo Hawk Lookout, Golden Gate National Recreation Area, Calif.

	Number of Sightings	Number of Attractions to Bait	Number of Captures	Capture/Attraction (%)
RTHA	142	76	29	38
COHA	26	18	8	44
SSHA	7	2	1	50
AMKE	18	8	3	37
NOHA	14	7	0	0
MERL	2	2	0	0
GOEA	2	1	0	0
BSKI	1	0	0	0
TOTAL	212	114	41	35

Table 2. Capture rates of four hawk capture techniques at Point Diablo Hawk Lookout, Golden Gate National Recreation Area, Calif.

Capture Technique	Net Hours	Captures	Captures/Hr.
Dho-gazza	140	15	0.11
Bal-chatri (fixed)	60	0	0.00
Bal chatri (road trapping)	10	3	0.33
Bow net	58	23	0.40

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