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Trends in Natural Resources Management

Message from National Park Service Director

by Russell E. Dickenson

The art of natural resources management in the National Park Service is healthier today than anytime in the past! A renewed resource awareness has begun that is responsible for more aggressive and professional activities all across the nation. The welfare of the National Park Service's natural resources has become the principal concern of the hundreds of park rangers and other dedicated employees working at all levels within the National Park Service.

I have found, on recent visits to the parks, that there is more than a renewed dedication among the men and women of the Service. The intensity of that commitment has increased, and the demand for professional resource management is greater now than at any other time in our history.

The 1980 State of the Parks Report was a key catalyst in the evolving strategy for protection and management of park resources. That report, perhaps for the first time, pointed out to the Service the magnitude and extent of threats to park resources. It focused sufficient attention from the Congress, special interest groups, and the American publics, that proactive resources management has again become a major initiative in the protection of dwindling park resources.

1981's follow-up report—State of the Parks: A Report to the Congress on a Servicewide Strategy for Prevention and Mitigation of Natural and Cultural Resource Management Problems—has outlined a short- and mid-term strategy for addressing the numerous threats. The current activities of the CORE Mission Task Force will outline a long-term Servicewide program of resource protection and perpetuation.

It is difficult to pinpoint the evolution of this new movement. It started simultaneously in the many parks across the country which began to encounter threats of a new and pervasive nature. Administrative experiments integrating natural resources management and science functions in the Southwest Region were a part of the process. The hiring in the early '70s of full-time natural resources management specialists in some of the more complex parks added fuel to the initial spark. The special emphasis placed on resources management training for park managers, mid-level staff, program specialists, and new employees during the last two years has certainly fanned this into a brighter, more active program.

Long- and short-term planning efforts recognizing the need to attend to park resources have culminated in a Servicewide effort to develop product-oriented resources management plans which address an overall program of maintenance, protection, research, and prescriptive management action. This plan will, I am confident, serve as a beacon upon which all of a park's activities can orient and gain direction, ensuring a unified awareness of a park's resources management objectives and goals.

I strongly support this new wave of attention to professional natural resources management! National Park Service mandates will be better implemented by the still evolving program. Yet, we cannot allow ourselves to overlook the important responsibilities to visitor and employee health and safety, facilities management, and other key activities. These, though, are complementary to, and need not compete with, the emphasis on stewardship of the resources entrusted to us.

Recent organizational changes in the Washington Office—moving the responsibility for natural resources management back into Management and Operations—were accomplished to reinstate that program into an organizational framework more closely aligned with the field. It should in no way be construed as a move to down play the role of science and information transfer. These areas of responsibilities continue to be dependent upon one another.

Park management must prioritize park problems, and, through the thoughtful development and annual review of resources management plans, provide scientists with a clearer understanding of management's needs. In turn, planners and decision-makers must take advantage of the available information, both old and new, before making a commitment of park resources. The marriage between science and resources management must continue to be founded on communication and trust.

I am pleased that this issue of *Trends in Natural Resources Management* has been dedicated to the "new role of natural resources management" within the National Park Service. It is a significant and evolving role that is the cornerstone for the long-term stewardship of national parks.

Let us keep in mind that park resources—those natural and cultural features—are the essense of why the parks were established and how the Service came to be. Without the resources there would be little purpose for people to seek out the parks. Our principal daily concern must therefore, be the protection and perpetuation of all our resources; care of those resources is the core of the National Park Service mandate and our most sacred obligation.

Contents

Trends in Natural Resources Management

Trends

A publication of the Park Practice Program

The Park Practice Program is a cooperative effort of the National Park Service and the National Recreation and Park Association.

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Membership in the Park Practice Program includes a subscription to all three publications and a library of back issues arranged in binders with indices and all publications for the remainder of the calendar year.

The initial membership fee is $80; annual renewal is $20. A separate subscription to *Trends* is $15 initially, and $10 on renewal. Subscription applications and fees, and membership inquiries should be sent only to: National Recreation and Park Association, 3101 Park Center Drive, Alexandria, VA 22302.

Articles, suggestions, ideas and comments are invited and should be sent to the Park Practice Program, Division of Cooperative Activities, National Park Service, Washington, D.C. 20240.

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Introduction:

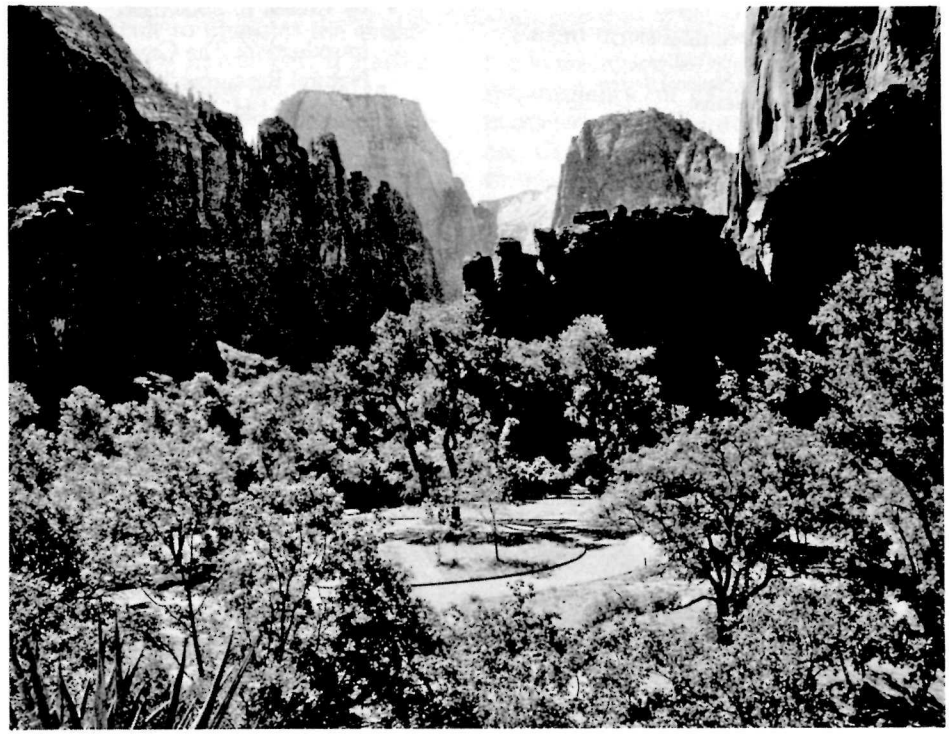
The Greening of Natural Resources Management

by Roland H. Wauer

The history of resources management in the National Park Service has often been one of trial and error where success was due more to individual personalities than to sound guidelines and good information. Too many decisions have been made by gut reaction than by following a systematic approach. Such crisis management has led to results that are fragmented and short-lived, rather than objective, consistent and enduring.

Many of the Service's early natural resources management programs that were undertaken with vigor and consumed considerable national park dollars, actually damaged park resources which the Service is mandated to preserve in perpetuity. Examples are numerous:

- The widespread reduction of predators in the early 1930s permitted ungulate populations to erupt dramatically. These unnaturally large populations severely depleted their food supply so that disease and starvation caused the populations to crash.
- In the western mountains, massive programs were undertaken to eradicate gooseberry and currant bushes that serve as intermediate hosts for the blister rust fungus disease of western pines. Millions of these *Ribes* bushes were cut and burned with minimal effect. Not until the late 1950s was an antibiotic discovered that would arrest the disease and could be broadcast over the infested forests.
- Along the coastline, extensive beach and dune restoration projects were undertaken in an effort to protect structures built on threatened sites. The National Park Service stopped fighting this loosing battle with Mother Nature only during the last decade.



Roland H. Wa

No national park is immune to the vast array of threats that are bombarding the resources from every conceivable direction.

- The philosophy that all wildland fires are bad has changed drastically in recent years. Prescribed fire is now considered a valuable management tool in natural zones throughout the national parks.

Early relevant environmental laws and regulations were mostly designed for the protection of things—the grand scenery and the unique and historic monuments. Park boundaries were established on topographic features, and the concept of protecting complete ecosystems was rarely considered. It was not until "ecology" became the password of the American publics that attitudes began to change. The mood of the lawmakers shifted from the protection of things to the protection of habitats. During this period such farsighted legislation as the National Environmental Protection Act and Endangered Species Act were passed. The Redwood Act and Clean Air Act were pieces of legislation that suggested that the mood of the nation had matured even more—shifting from the protection of habitats to the perpetuation of natural systems. These and similar far-reaching laws greatly influence the way the National Park Service does its business today.

In the March and April 1979 issues of *National Parks and Conservation Magazine,* the National Parks and Conservation Association (NPCA) published information they had obtained in a 1978 survey of 203 parks under the title of "NPCA Adjacent Lands Survey: No Park is An Island."

These articles revealed a multitude of internal and external threats that were affecting park resources. In summary, the authors stated that, "Unless all levels of government mount a concerted effort to deal with adjacent land problems in a coordinated manner, the National Park Service mandate. . . will be completely undermined."

This NPCA publication received considerable attention from the Park Service and in Congress, and apparently awakened key Congressmen to the problems existing within the parks. It resulted in a special request, in July 1979, from Congressmen Phillip Burton and Keith G. Sebelius, to the Director of the National Park Service, for a State of the Parks Report. The request stated, "What we have in mind is in the line of factors such as increasing air and water pollution, encroaching developments, troublesome visitor use pressures, legally on-going or rights to exercise incompatable uses with the parks, and the like."

On May 6, 1980, "State of the Parks—1980, A Report to Congress," was sent to the Congress by the Director. It was the first time that the Service had undertaken a complete evaluation of the conditions of its natural and cultural resources. The report stated that no parks were immune to the vast array of threats that were bombarding the resources from every conceivable direction. It documented the magnitude of the threats from within and outside the parks, and stated that the large natural areas, the nation's crown jewels, are most seriously threatened. The report focused attention on the resources like never before and reminded the Service of its primary mandates to protect the significant resources within its stewardship. Today it provides the very best hook available for the Park Service to obtain the support necessary to turn the corner; to initiate the kind of sound natural resources management program necessary to address the ever increasing spiral of threats.

National Park Service

Prescribed fire is considered valuable management tool in natural zones throughout the national parks.

As a followup to the May 1980 report, the Service was requested by Congressmen Burton and Sebelius to prepare a second report that would outline a strategy for preventing and mitigating the myriad of internal and external threats that were identified in the first report.

In this second report—"State of the Parks: A Report to Congress on the Servicewide Strategy for Prevention and Mitigation of Natural and Cultural Resources Management Problems"—was sent to Congress in January 1981. It identified numerous prevention and mitigation activities underway and anticipated within the parks, and also listed a number of generic projects that are planned Servicewide. These projects were separated into short- and mid-term strategies.

The short-term strategy (now completed) was designed to identify the Service's most significant resource problems for input into the FY 1983 budget cycle. This was accomplished with a four-step process that began with the development of park SRP (Significant Resource Problem) statements that were ranked according to Servicewide criteria. The SRPs were then submitted to pertinent regional offices and were further prioritized on a geographic basis. In mid-March 1981, further ranking of all regional SRP lists was accomplished at a Regional Directors' SRP Ranking Workshop which was chaired by the Director. Out of that meeting evolved a list of "minimal essential" SRPs that were utilized in each region's FY 1983 budget submissions.

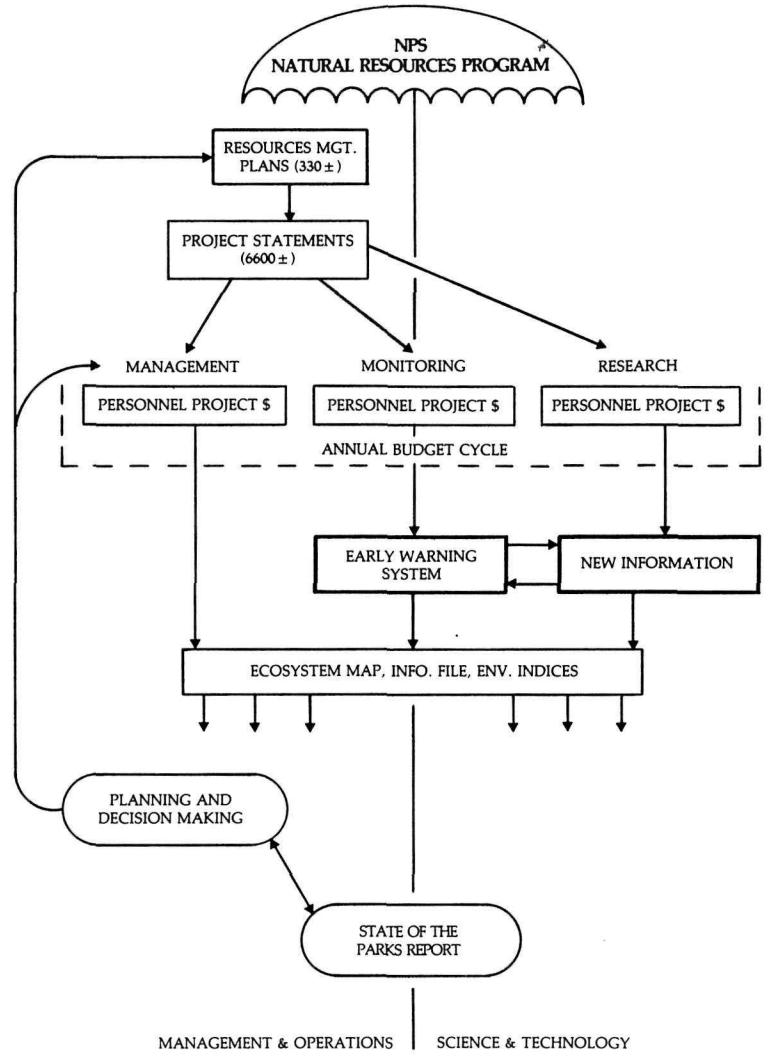
The mid-term strategy of the prevention/mitigation program was a dual one. One program focuses on the development of comprehensive Resources Management Plans for each park unit in the system and the use of these plans in the FY 1984 and later years' budget processes.

Resources Management Plans are one part of the Service's General Management Planning process, but usually are prepared independently by park superintendents. The Resource Management Plans docu-

ment all of a park's maintenance, protection, monitoring and research activities relating to the management of natural and cultural resources. They describe all of a park's resource problems and discuss a full range of resource-related activities underway and anticipated. Resources Management Plans are the park's single most important document for the management of natural resources (see Milford Fletcher's article in this issue for further details on resource management planning).

Although Resources Management Plans have been utilized by the National Park Service since the mid-1960s, revised 1980 guidelines require all parks to complete or to update their plans by December 1, 1981. Each plan's Project Statements—the section which describes the park's various projects—will hereafter become the basis of all natural and cultural resources management planning. No new natural resources management project will be funded unless it is first documented in an approved plan. In a sense, each park's highest ranked Project Statements become its SRPs. Further refinement of the process by which the Project Statement will be programmed into the annual budget cycle is now underway. Figure 1 illustrates this systematic process to be utilized by the NPS natural resources program.

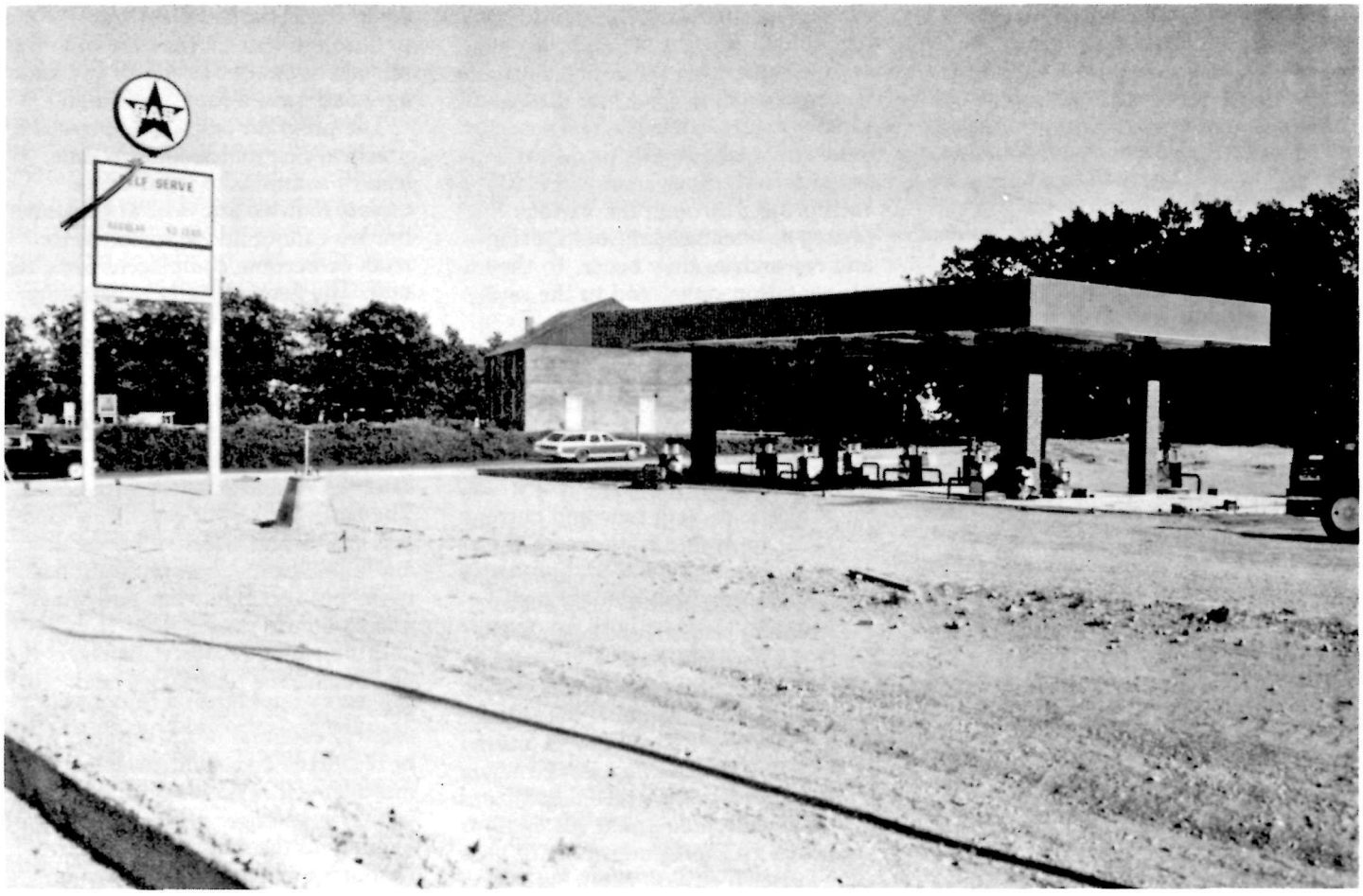
Figure 1.



The second part of the mid-term program documented in the State of the Parks prevention/mitigation report included a number of new generic resource programs that are either underway or in the planning stage. The following is a description of five of the natural resource programs:

1. *Information Baseline Standards* (IBS) are under development. These standards will provide a complete checklist of potential data which each park should possess for sound planning and decision-making. The standards will address three levels of need. Level one information is that which is required prior to General Management Planning, i.e., those data which must be utilized for boundary determinations and development concepts. Level two is required for special action plans. Level three includes all other data that could be obtained for an area.

The following are examples of the three IBS levels as they relate to planning the location of a park visitor center and visitor pattern of use: planners must have sufficient information available so that the impact of a development on the environment is fully understood. The wildlife database must include details on the migration route of key species, such as elk or caribou. The construction of a visitor center and required facilities in the heart of a migration route would seriously impact the species and damage the principal resource for which the park was established to protect. Once that information is



Ralph Hapel

Urban encroachment threatens many parks. (Salem Church, built in 1844, in Fredericksburg and Spotsylvania County Battlefields Memorial National Military Park, VA in background.)

available and general building site alternatives are selected, knowledge of the soils that will support the structure must be obtained. In this example, knowledge of the wildlife migratory patterns and a soil profile are part of the park's level one database.

Level two information would be necessary prior to the development of the park's elk or caribou management plan, or for an interpretive trail to be built near the visitor center. Level three is the remainder of the park's database that may never be used, or may serendipitously modify an interpretive story, or may be so important that it would cause a significant change in the park's way of operating. Data-gathering will, in all likelihood, never be completed. It is imperative, however, to document what data are required for all of the various levels of activities.

2. *Biological Monitoring and Environmental Indices Guidelines* will provide the Service with instructions on the use and methods of implementing a variety of monitoring programs that will serve as an early warning system and evolve into long-term environmental indices. These guidelines will be prepared in such a manner that the most appropriate system and program can be selected for use by the field to best match particular needs. These guidelines will provide continuity and consistency to this extremely important part of the Service's natural resource program.
3. An *Early Warning/Consultation/Response Team* is planned to interface with other agencies and

organizations in a consultant role, and provide on-site review and assistance as needed. It will serve individual parks in the following ways: a) as a "SWAT" team to address selected resource management programs; b) to monitor and gather information about demographic growth/development trends so as to identify threats before they reach a crisis stage; c) to develop a strategy for regional responses to those threats which cannot be addressed by individual parks and which are most appropriately addressed by regional action.

4. *Resources Information Tracking System* is intended to fulfill a Servicewide need for tracking all natural resources activities of management, monitoring and research. RITS will: a) increase the availability and speed of access to information at all levels of the Service; terminals will be utilized at all major parks, each region, and the central office; b) reduce duplication of efforts and costs by eliminating redundant projects in management and research; c) provide for an adequate database for planner and decision-makers by making current information readily available when needed; and d) eliminate or greatly reduce paperwork relating to status reports on a wide variety of issues.

RITS will track resource projects throughout their existence, beginning with the documentation of a program or activity with each area's Resources Management Plan as Project Statements (see Figure 1). As presently conceived, the system will track each project through the various phases of management, monitoring and research as they occur, to the implementation stage, and to the revisions of the specific Project Statements. RITS is designed to provide up-to-date information and tie together the functions of planning, research, monitoring, reporting and management into a cohesive and integrated program.

5. Training of both new and current NPS employees is an essential element in a successful and proactive natural resources management program. This activity involves two distinct types of training; courses for superintendents, mid-level and beginning employees, and topical workshops for resource specialists. Courses are designed for introducing new knowledge and retreading or updating employees, and workshops are designed to provide more in-depth information transfer of a more technical nature. Workshops scheduled for FY 1982 include threat identification, assessment and mitigation for natural zones as well as more specific management areas, such as coastal zones. (See the articles on training for more details on these programs.)

Summary

Natural resources management in the National Park Service has come a long way since the days of predator control and the Smokey Bear philosophy that all fires are bad. But in some ways, we're still in the dark ages and have a long way to go.

The program described above is a practical one that would, in time, lead to solutions to most of the threats that we know of at this time. But we cannot allow ourselves to relax or become complacent for a second. The geometrically progressing level of industrial and urban technology will surely create new threats before the current ones are mitigated. The level of expertise and technological competency of the National Park Service must somehow catch up to and pass the exploiters. The necessity to put together a comprehensive and effective prevention and mitigation action program has never been so great, but now may almost be too late!

Professional resource managers that understand the technology and possess the political savvy are absolutely essential in the modern world of resources management. Resources management is no longer a part-time job. It is no longer a game of responding only to the most visible issues. Resources management by benign neglect will no longer even get us by another year. We must abandon the trail-worn philosophy of greasing the squeaky wheel or else the sudden loss of the previously silent ones will just as surely halt us in our effort.

All of the issues today are critical to the perpetuation of park values. The preservation of the National Park Service itself is at stake.

Roland H. Wauer is Chief, Division of Natural Resources Management in the National Park Service.

Integrated Pest Management

by George M. Gardner

Center for the Integration of Applied Sciences/John Muir Institute

LBJ Memorial Grove Park Manager sprays soap onto azaleas for azalea lace bug control.

Former President Carter's 1979 Environmental message and accompanying memorandum to heads of federal agencies directed those agencies to take steps to encourage the development and use of integrated pest management (IPM). Agencies are directed specifically to review and "modify as soon as possible their existing pest management research, control, education, and assistance programs and to support and adopt integrated pest management strategies wherever practicable." The National Park Service is moving aggressively to comply with the Presidential Directive.

The National Park Service, as the steward of approximately 3% of this nation's land area containing the "crown jewels" of our natural and cultural resources, is an agency whose core mission is quite closely aligned with the principles and philosophic appoach underlying the IPM concept. The National Park Service's primary mandates are the preservation and interpretation of natural landscapes and ecosystems, and historical or cultural assets. Service management policies and philosophy provide for zoning of all park lands into one or all of four land classifications, i.e., natural, historic, park development and special use.

Managers of park lands possessing significant natural features and values are concerned with ecological processes and man's impact upon these processes and resources. The concept of perpetuation of a total natural environment or ecosystem as compared with the protection of individual features or species, is a distinguishing aspect of the Service's management of natural lands. The maintenance of the historic scene and of the integrity of cultural resources is a primary objective in historic zones.

Park Development Zones

Park development zones are managed and maintained for intensive visitor use. It is understood that roads, walks, buildings, and other visitor and management facilities may occupy much of the area, and that the natural aspect of the land will accordingly be altered. Historic features will generally be absent in park development zones. Management of these zones is aimed at maintaining a natural environment, if possible, given the use of the zone. Such management may be accomplished through the manipulation of the natural environment of any conformance with the approved historical or cultural theme in historical parks. Any manipulation done is of the minimum necessary to achieve the planned use.

Chemical Pesticides

To the greatest extent possible, the National Park Service relies upon natural processes to regulate populations of native species. Exotic species are managed in selected circumstances provided that scientifically valid information indicates that control is feasible and warranted. Also, the proposed control program must comply with NPS policy and guidance pertaining to the use of chemical pesticides in those instances where the contemplated control method is a chemical one.

The NPS Management Policies Handbook (1978) sets forth the following policy on pesticide use: "Chemical pesticides of any type will be used only where feasible alternatives were not available or acceptable. The Service's use of *all* pesticides shall be approved by the Director. Application shall be in accordance with applicable laws, Departmental and Service guidelines and Environmental Protection Agency and Occupational Health and Safety Administration regulations."

National Park Service policy does not prohibit, as such, the use of chemical pesticides. However, chemical controls are allowed only if (a) there is a clear and present danger to the health and safety of man; and/or (b) there is danger of destruction of significant property or resources and a determination has been made that control methods of no action, mechanical, cultural, and/or biological control are nonexistent, unavailable, or unacceptable. The Service is placing ever increasing emphasis on the nonchemical approach to pest management and has fully embraced the adoption of integrated pest management techniques.

Integrated Pest Management is a technical decisionmaking process that combines all available pest control techniques into a program for suppressing pest populations below a level at which they pose a threat. IPM seeks maximum use of naturally

occurring pest controls including weather, disease agents, predators and parasites. In addition, IPM utilizes various biological, physical, mechanical and chemical control and habitat modification techniques. Artificial controls are imposed only as required to keep a pest from surpassing intolerable population levels predetermined from accurate assessment of the pest damages and the ecological, sociological and economic costs of the control measures. IPM control philosophy recognizes that the presence of a pest species does not necessarily justify action for its control. In fact, tolerable infestations may be desirable, providing food for important beneficial insects, for example.

Center for the Integration of Applied Sciences/John Muir Institute

National Capital Region central grounds crew applies mulch to renovate turf.

Pilot IPM Program

The Service has two major programs underway to further the development and use of IPM in managing park areas. The first program is a 3-year effort, underway since 1979, in the National Capital Region to develop a pilot IPM program for the Region. This program has been funded by an interagency agreement between the Environmental Protection Agency (EPA) and the National Park Service, and is coordinated through the Offices of the Ecological Services Laboratory, Professional Services, NCR/NPS, and the Office of Pesticide Programs, EPA. The NPS has contracted this project to the Center for the Integration of Applied Sciences (CIAS) of the John Muir Institute for Environmental Studies (JMI).

Under this project CIAS personnel are: (1) developing a comprehensive survey of all NCR pest causing problems; (2) identifying the natural enemies of all NCR pests causing problems; (3) conducting literature searches and compilation for all pest problems, natural enemies, and past and current treatments; (4) determining the efforts of existing treatment programs; (5) making recommendations that can reduce pest control expenditures and environmental impacts; (6) conducting feasibility studies on the importation of natural pest enemies; (7) setting up field experiments to test new or evaluate potentially useful existing IPM procedures; (8) organizing and conducting workshops for NCR personnel; (9) providing educational materials for public distribution; and finally, (10) making more specific recommendations.

Lessons learned through this pilot program will be important in teaching and guiding users throughout the NPS in the further implementation of IPM practices.

IPM Management Information System

The second major program initiative is one designed to help overcome one of the most significant barriers of the implementation of IPM systems, i.e., the inadequacy of user information sources about the full range of IPM strategies available to manage a particular pest in a manner that disturbs the ecological balance as little as possible. In FY 1981, the National Park Service initiated the development of a Servicewide computerized information system to facilitate technology transfer from researchers to users. Scheduled for operation by end of FY 1982, this system will provide a comprehensive, accurate, integrated pest management information to the field concerning pest and natural enemy phenology; alternative control strategies; monitoring techniques; recommendations on specific chemicals to use that are least disruptive to the natural controls operating to suppress the pest organisms, and least hazardous to human health and the environment; specific injury and action or treatment levels to be utilized; and specific information about the institutions, if any, that are currently servicing the problem. The use of computers will help to assure that the user obtains the necessary information within the relatively short time spans that effective pest management control efforts require.

As the Service moves forward with the use of IPM, several barriers to progress are surfacing, particularly user uncertainty and the need for an employee training program to teach Service personnel how to acquire and apply information necessary for IPM implementation. During FY 1982, the National Park Service will be developing a new program thrust to address these barriers.

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Fire Management Update

by David B. Butts

Bureau of Land Management–BIFC

The first NPS Category I Hotshot Fire Crew, Arrowhead 1, was hired in 1981.

If you mention fire the first vision conjured up in the minds of most people is that of a fire lookout on a lofty ridge. The second most likely vision would be that of a smoky scene of a firefighter working with a shovel against a background of flame. We all project these scenes based upon our own personal experiences, and in the Southeast, of course, the firefighter would be working with a rubber flapper, which most Westerners neither understand nor have seen. The idea of fire suppression or fire control would be adequately portrayed by both of these symbols to which we relate.

However, the term "fire management" today takes on a much different concept. There is still a facet of fire management that relates specifically to finding and putting out fires that we do not want, wildfires. But the overall emphasis in most land management agencies today is the broad and infinitely more involved concept of fire management. This includes a wide array of options to the manager, as well as modern tools. It is tied indivisibly to the management of the resources of the area. After all, the fuel for these fires is the vegetation of the area.

Fire Management Technology

The knowledge of fire is greatly expanding today. Numerous universities and agencies are conducting research related to a broad array of fire-related technology. These range all the way from hydraulic engineers working with improved trucks and pumps, through the electronic era tools of computers and computer modeling of natural systems, to the studies of post fire response by various vegetative species.

Technology today is both an aid to fire management and a significant facet in the new demands placed

upon the fire manager. The fire personnel must keep up with the equipment, software programs and applied fire management technology as far as tools of the field. They must also provide feedback to the designers of this technology, so that the maximum potential use, or refinement, can be made of these systems and equipment. The volume of information flowing through fire management today is compounding very rapidly. Fortunately, part of that technology includes a spohisticated library retrieval system, FIREBASE, managed by the U.S. Forest Service (FS) to help track information and publications.

This multi-faceted activity includes fire prevention aimed at unwanted human-caused fires so well characterized by Smokey Bear. It extends on into the preparations for fires, should they occur. This presuppression activity is a vital and sometimes overlooked facet of the program that is essential if personnel are to respond appropriately and with adequate equipment when the fires occur. The suppression of wildfires is an obvious and always present facet of the program, dictated to a large extent by the realities of the weather.

Today, we no longer consider that once the fire is out the job is done. In many cases, the rehabilitation focuses more on the damage done by the suppression action than on that done by the fire itself. The known effects of fire on vegetation now guide us in the most rapidly expanding, and probably in the coming decade, most significant facet of fire management, the use of prescribed fire. The full spectrum of fire management today requires a concerted effort on the part of all personnel involved if they are to keep pace.

Cooperative Efforts

Multi-agency activity is the state-of-the-art. Two key examples tell the story. The National Wildfire Coordinating Group (NWCG), through its member agencies, has fostered much of the progress visible in the field. The Forest Service, Bureau of Land Management (BLM), National Park Service (NPS), Bureau of Indian Affairs (BIA), Fish and Wildlife Service (F&WS), and National Association of State Foresters join in this organization. The fire qualification system designed by one of the working teams is the key element in national exchange of highly skilled fire personnel. The associated training packages are now distributed through the National Audiovisual Center to other federal, state and local agencies.

The Boise Interagency Fire Center is owned by BLM, FS, NPS, BIA and F&WS, plus the National Weather Service, and these agencies cooperate on fire-related activities. This co-location of independent, similar programs is a real economic bonus for the taxpayers. Members of six agencies can work on common problems without travel costs or red tape!

Prescribed Fire

The use of prescribed fire is expanding significantly throughout the United States. This is taking place for several reasons. The techniques for safely conducting such fires are becoming more widely known. The opportunities to use fire to achieve specific effects and objectives are also recognized as indicated by a recent article in *Trends*, Volume 17, #4, "Vegetation Fire Control at East Bay."

Prescribed fire is a more recent refinement of what was at one time referred to as controlled burning. In the initial stages of this technique, fire was merely limited to a physical area by roads, trails or cut fireline, and the area was burned. Today, that simplified approach is fairly limited in application. In most cases, as a part of most agency programs, a considerably more refined system is utilized. Quite briefly, it involves the use of fire prescriptions that spell out in detail the end results desired and the conditions that need to exist in order to attain those results. Much as a doctor prescribes medicine for a specific illness, the land manager can prescribe those conditions of temperature, relative humidity, wind speed, and fuel moisture that will enable the fire to attain both the intensity and rate of spread necessary to achieve specific results. The prescriptions must be tuned to the specific vegetation, fuels, and climate and topography of the area.

Fortunately, with the refined technology available, considerably more is known about the inputs of fire behavior, and the effects to be expected from certain weather parameters. In most cases, prescriptions have both top and bottom limits. If the particular species for which a prescribed burn is being conducted is favored by a specific intensity of fire, then the top and bottom limit of relative humidities, temperatures and winds may be specified in order to generate that intensity of fire. If the conditions are in excess of the prescription, the fire will burn hotter and faster, and in general create more mortality to vegetation than would be desired. On the other side of the coin, insufficient intensity of fire by too cool a temperature, too high a humidity, or too high a fuel moisture will mean that a smudgy and incomplete fire will take place, which may also fail to achieve the desired results.

The purposes to which prescribed fire is put has also expanded the horizons for its application. The first controlled burners were in the South. These persons were criticized to some extent for their use of fire to accomplish the objectives that they saw at the time. Some of the objectives which they espoused were valid; some have since been questioned from the standpoint of desirability of the results.

Ironically, not unlike the use of some herbs, we find there were valid scientific principles involved in an otherwise superficial practice. The controlled burns in the South were conducted to do away with chiggers and to open up the pine woods for grazing. Both of these objectives are to some extent achieved by the very simple application of controlled burning in a climate which usually lends itself control of these fires. Today, specific prescriptions may be written for the fostering of forage production under certain species of pines in several parts of the country.

When taken in context of park management, the tool of prescribed fire stands to contribute significantly in the management of natural systems. The prescribed natural fire, one ignited by lightning or volcanic activity, is an integral part of those parks in which these types of fires are known to occur. An effort is made to perpetuate those fires based on predetermined criteria that allow each and every ignition to be judged against a set standard. A decision of go/no go may then be made in regard to those fires, and a monitoring of those fires initiated so as to assure its achievement of the predetermined results. Yellowstone National Park had more than 28 of these in 1981.

In cultural areas, we find that prescribed burning lends itself to the achievement of historic settings. Areas that are being maintained in a sub-climax pine setting typical of the historic period may be perpetuated by the design of specific prescriptions to control invasion of the more tolerant and persistent hardwoods. A few other facets of prescribed fire lend themselves to serious consideration.

One is the use of fire as a maintenance tool. Where vistas are being maintained, particularly in the East, we find that prescribed fire lends itself to the control of brush and tree invasion of otherwise grassy vistas. The trade off here is twofold. In addition to maintaining the open setting, we may also substitute fire for the previous prevailing method of mowing. The energy consumption today to mow extensive areas of vistas and rights-of-way may lend itself to the substitution of prescribed fire. Where this is done, the use of prescribed fire every 2–5 years may achieve the same objective and eliminate both costly maintenance equipment and gasoline consumption.

Prescribed fire is not without its faults. The production of smoke from prescribed fire is a real factor. With the Clean Air Act came restraints on production of smoke. However, with the development of carefully designed prescriptions, including considerations for smoke generation and dispersal, these factors can be overcome.

What's New in Fire

If I were to characterize what's new in fire today, it would be the growing multi-agency effort in regard to the entire spectrum of fire management. The topics that we address will emphasize the contributions by several agencies to the various facets of both suppression and use of prescribed fire. Whether we are talking RAWS, ALDS, 214s, Category I crews or TI-59s, they all characterize the expanding contributions of technology in modern fire management.

Hand-held Calculators

Let's start with a small but potent contribution to fire management. Without emphasizing any particular brands or companies, the initiation of fire danger and fire behavior modeling on hand-held calculators has expanded manyfold the access to this fine technology. A multi-agency effort led by the U.S. Forest Service developed "chips" for the Texas Instruments TI-59 Hand-Held Calculator. The use of these two microchips, one for the National Fire Danger Rating System models and one for fire behavior models, has placed in the hands of field personnel major computer technology. The units are being used by many agencies throughout the United States as a means of tapping this scientific tool in order to better carry out both fire management planning and preparedness, and also the real time fire behavior projections on going wildfires or prescribed fires.

This technology is parallel to models that are up and running on larger standard computers. The advantage is that the calculator can be carried in the pocket to the field where the conditions exist, and readily utilized throughout the United States. Particularly in the area of prescribed burning, these hand-held calculators will significantly improve and make readily available the technology necessary to refine prescriptions.

Bureau of Land Management–BIFC

This Bell 2141A helitanker is jointly funded by the Interior Department's Bureau of Land Management, Bureau of Indian Affairs and National Park Service.

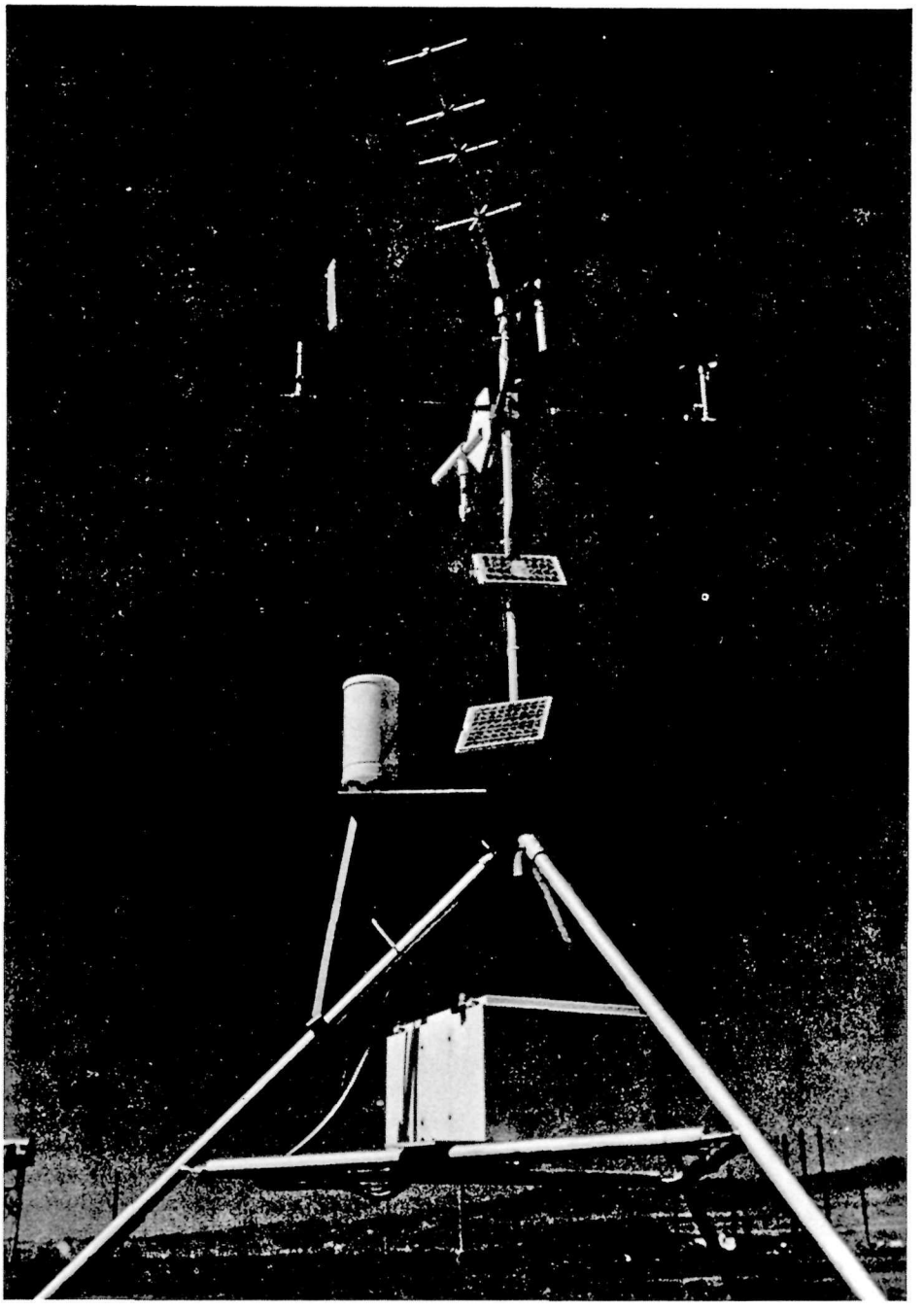
Fire Crews

All technology is not electronic or mechanical. The adoption of the National Park Service this year of three Category I interagency hotshot fire crews was a significant contribution to its fire management program and to the multi-agency personnel pool, predominately supplied by the Forest Service. Arrowhead crews #1, #2, and #3 were hired for the first time this year, and assigned to fire duties based out of Grand Canyon National Park, Sequoia & Kings Canyon National Parks, and Yellowstone National Park. These crews saw duty on fires on Forest Service, Bureau of Land Management, Bureau of Indian Affairs and National Park Service lands this season. They are highly trained, skilled fire personnel with several years' experience of fighting major fires. They are being utilized in the national parks not only for suppression of wildfires, but also in the preparation and conduct of prescribed fires in line with the resource programs for the parks in which they operate. Thus "project work" in their base park keeps them busy between wildfire assignments.

Helitanker

If you have crews and fires, transportation becomes a necessary component. One of the most potent facets of technology today is the Bell 214 1A helitanker. This large helicopter is capable of transporting up to 15 personnel to fires in remote portions of parks where the fires occur. In addition to the delivery of crews, supplies and retardant delivery are also a standard practice with this helicopter. The impressive facet of this operation is the power of the ship, and its ability to deliver large quantities of water or retardant to fires in a short period of time.

One of the crews and the Bell 214 saw service in the large fires in south Florida this season. On one occasion it delivered in excess of 10,000 gallons of water per hour to combat wildfires raging in Big Cypress National Preserve, one of which was the largest fire in the history of the NPS. The versatility of this ship and its ability to perform in very high temperatures and higher elevations with a high level of output make it an ideal tool during extreme conditions.



Bureau of Land Management-BIFC

The Remote Automatic Weather Station utilizes photoelectric cells for energy and records weather data hourly.

RAWS

The Remote Automatic Weather Stations (RAWS) that are being purchased throughout the country open a new avenue to monitoring weather conditions. These simple appearing units are solar powered and may contain a variety of instrumentation. There are two particular facets of these units which increase their value. First, they are portable and may be placed near where you want the data gathered. Second, they are satellite linked so that data gathered, even in remote locations, may be transmitted to satellite and then down-linked to storage facilities thousands of miles away. The data from these satellites can then be fed directly into the National Fire Danger Fire Weather Library and stored for use by parks in the National Fire Danger Rating System planning process.

ALDS

A closely related technology is that of the Automatic Lightning Detection System (ALDS). This system, developed by the Bureau of Land Management, provides for the electronic detection of ground discharges of lightning. Because of the unique electrical signature of ground discharges as compared to cloud-to-cloud lightning, the system is able to document only those strikes that hit the ground and are potential sources of lightning fires. These units are highly sensitive and capable of accurately detecting strikes of significant potential, within a 200-mile radius of the base station. By interconnecting two or more of these stations, it is possible to triangulate on the strikes and thereby pinpoint potential wildfire locations. The ultimate objective is to provide interlinking with the RAWS and ALDS systems so as to track not only the probability of lightning taking place, but also whether or not precipitation took place. This would give increased accuracy to predicting the probability that wildfires will occur.

In addition to the implication for the automatic lightning detection for suppressing those lightning fires that are unwanted, is the contribution of this technology to better understanding the natural occurence of lightning in areas where prescribed natural fires are acceptable. In these areas, we can learn a great deal about how lightning and the vegetative patterns of these parks might have evolved unmodified by modern people.

The fire management program available to land managers today is one that lends itself to a wide variety of adaptations. The fire manager can choose a program to produce the suppression or prescribed fire facets necessary. Given an adequate definition of objectives to be achieved, these programs use modern technology to meet those needs. In the future, we can expect further refinements of these programs and hopefully, with improved meteorological accuracy, we will be able to further refine prescriptions to more precise objectives.

David B. Butts is the National Park Service's Chief of Fire Management stationed at the Boise Interagency Fire Center, Boise, Idaho.

On the Biology and Management of Species Threatened With Extinction

by A.R. Weisbrod

Chihuahuan Desert Research Institute

About half of the known peregrine falcon nesting sites are found in NPS' Rocky Mountain regional parks.

The first recorded species extinction was announced by the Roman Empire in 80 AD that a program of systematic elimination of lions was successful. The last known lion (*Panthera leo)* to inhabit Europe was dead. Subsequently, other species have disappeared from Europe and elsewhere. Today there are some 130 species that have doubtless become extinct since 1600 AD (the year established by the International Union for Conservation of Nature and Natural Resources, from which modern/recent extinctions are measured because virtually all higher vertebrate species known to have become extinct were adequately described by that date, and for which specimens exist). In addition, there are about 750 more that are recorded on one of several listings as in immediate danger of, or threatened with, extinction.

When the last recorded extinction will take place is less clear than the first announcement, but what is clear is that the rate at which species are in jeopardy of extinction in the United States, and throughout the world, is accelerating. As a result, reserved public lands, such as those in the National Park System, are becoming increasingly important areas for the protection and maintenance of the dwindling populations of listed species. The effectiveness of such land for maintaining rare species depends on the interaction of a number of biological factors pertaining to population dynamics, evolutionary mechanisms, and genetics, and their implications for management strategies. To develop and select effective management strategies for saving endangered species, it is necessary to first understand the process of extinction.

Extinction Ecology

Paleontologists estimate that a species' earthly life expectancy varies between an average of about 600,000 years (for mammals) to an average of 2 million years (for birds and reptiles). No species yet has lived more than a few million years before it either evolved into one or more different species, or disappeared without leaving any known relatives. In short, 99% of all organisms that have inhabited the planet are now extinct. Consequently, extinction should be regarded as a natural process which can be examined and understood in terms of population biology and related areas of genetics and ecology.

One fundamental notion necessary to comprehend the extinction process is to realize that death of an individual is not extinction of a population; individuals die, populations become extinct. These are normally not equivalent events and phenomena, even though individuals make up a population, because no one individual contains all of the extant genetic material present in the entire population. However, should a population become so reduced in number that the fate of each individual determines the probable existence of the population, only then does individual death and population extinction approach equality. This is obviously the case with endangered species. In essence, a population ceases to exist when more individuals are removed from it than are replaced; more die than are born; more emigrate than immigrate. It makes little theoretical difference what factors prevent replacement, whether diminishing survivorship or lowering fecundity; if they are too effective singly or in some combination, the population vanishes.

The problem in preventing extinction is first one of untangling the many interrelated factors and then devising management strategies appropriate to the situation. Such management strategies will have to deal with the two basic problems, i.e., causes of mortality (factors affecting survivorship of individuals such as predation, disease, overharvesting, habitat destruction, pollution, etc.), and reduction of fecundity (factors affecting reproductive potential, such as toxic chemical disruption of breeding, loss of breeding habitats, competition with other species for breeding sites, etc.).

Genetic Components

As a practical matter there are also definite limits below which the loss of genetic variability from a population all but assures extinction. Such limits vary from species to species and are a function of generation time, genetic mutation rates, and other factors influencing a population's genetic base. As a general rule for vertebrate species, if the entire population is less than 50 individuals, it is likely that the genetic base is seriously impaired; that is, the genetic plasticity necessary for future generations meeting changed environmental conditions is greatly reduced. Subsequently, a population's adaptive changes are simply unable to keep pace with the changing environment and it dies out. The adequacy of genetic components and their behavior within a population must be considered when developing management efforts to restore or aid in recovery of a rare species.

Descriptive Models

Population ecologists have developed descriptive models used to explain variations observed in life history patterns among different species. In brief, there seems to be two basic life styles or living strategies for assuring continuation of populations. One strategy places considerable effort into reproduction and relies less on efficient resources utilization. They will use whatever is available within certain broad limits. Such species typically produce large quantities of offspring and have short generation times.

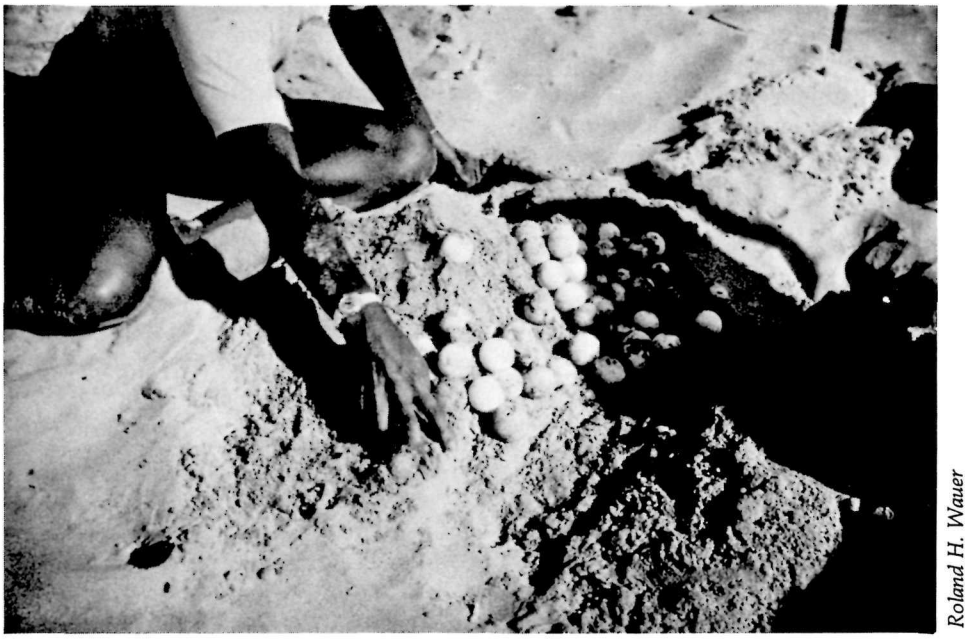
For example, European rabbits (*Oryctolagus cuniculus*) are mammals with an unusually high reproductive potential. They are capable of producing litters, averaging eight young, every 28-30 days for several successive months. The young rabbits themselves reach sexual maturity in a few months and under right environmental conditions, rabbits born early in the breeding season can contribute new litters to the population by the end of the season. Certain starfish have similar proclivities in which a single individual is capable of producing over a million eggs in a single season. There are many other species which likewise exhibit high reproductive potentials.

The second pattern for assuring population continuation relies on more efficient (or specialized) resource use than a high reproductive rate. Such species typically produce fewer offspring, have relatively long generation times, and have rather narrow environmental limits. For example, desert tortoises (*Gopherus agassizi*) produce the first clutch of 2-4 eggs only after they have lived a decade or so. The number of eggs produced annually increases slowly to about a dozen over the next decade.

Most living species studied seem to fall somewhere between those two outlined life history strategies. However, many endangered or threatened species typically exhibit more attributes of the second pattern than the first, implying that species adapted for efficient (or specialized) resource use are more susceptible to extinction pressures than those species inclined to less ecological specialization.

Roland H. Wauer

The female ridley sea turtle crawls ashore to lay a 100-egg clutch in warm beach sand 3 times each year.



Roland H. Wauer

Scientists interested in ridley turtle recovery remove eggs from nests and take to Texas where eggs are incubated in sands of Padre Island National Seashore.

Land Area Influence

During the past decade it has become increasingly clear that population extinctions are influenced by land area. Many studies of island biota and comparable mainland communities have showed species inhabiting islands are more likely to become extinct than mainland populations. Ecological geographers have offered a number of explanations for these findings of which the most prominent deal with empirical relationships such as: the number of species in an area is directly proportional to the area's size; the number of species an area ultimately supports is a dynamic equilibrium between immigration into the area and extinction; and as an area becomes increasingly isolated the number of species contained therein will diminish. These relationships describe the quantitative relationship between populations and land area, but they do not specify whether a particular population survives or becomes extinct.

There is additional information suggesting that organisms inhabiting islands (or comparable isolated areas on mainlands) may become more efficient (specialized) in using an island's limited resources than their mainland counterparts, and any change is likely to disrupt their resources or its utilization resulting in reduced population size. Thus, if incoming populations somehow impair the restricted resources, or their utilization, the existing populations may suffer. This results in a tendency in isolated areas for immigrant populations to replace established populations so over time there is a complete change in the species, but at any given point in time the total number of species present is constant for the area.

On Management

The management of game and other commercially valuable species (from deer to Douglas fir) has consisted historically of establishing regulations or other legal restrictions, promoting broad scale habitat protection, and in some cases, augmenting nutritional or shelter requirements. Such traditional methods have led to considerable scientific research in developing more

sophisticated practices for assuring continuing numbers of harvestable game species or other renewable resources. The generally good success of these traditional methods is predicated in part on the life history strategy exhibited by most game and commercial species. However, when these traditional management practices have been applied to rare populations, success has been less apparent.

The fundamental difference between populations with high fecundity and broadly adapted to varying environmental conditions, and the typical rare species with low fecundity and narrow environmental limitations requires whole new concepts and management practices for the latter populations. The new management concepts must take into account not only the traditional legal and broad habitat protection measures, but include strategies and practices for dealing with populations possessing reduced genetic diversity and confined to limited or isolated habitat areas. Furthermore, such management strategies must be peculiar to each particular rare species because the information base does not yet exist to devise a broad frontal approach to all endangered populations. (There is probably more published research information available for white-tail deer, than all endangered species combined.)

Once the particular aspects of each population's biology is known, then sound management can follow. Unfortunately, time and numbers do not necessarily permit such information gathering luxury prior to active management. Consequently, endangered species research and management must develop closely together if endangered, threatened, and rare species are to be kept from extinction.

It is also imperative that such research and management efforts deal with both the obvious and immediate factors affecting population declines, as well as subtle and long-term factors if the management is to be truly effective. The paradox faced by practical public land or natural resource managers in producing management efforts necessary for endangered populations is the inherent slow response of the population to recovery efforts. Public natural resource managers must anticipate relatively high initial costs for relatively slow recovery. Unfortunately, such cost benefit considerations can frustrate managers and biologists alike, but the long term recovery of the rare population can be achieved by careful long-term commitment of funds and personnel.

The National Park Service currently has, or has recently had, about half of the populations recorded in the 1980 listing of Endangered and Threatened Species published by the U.S. Fish and Wildlife Service. In some national parks active management efforts are underway for the species present; in other parks little or no management activities are as yet necessary. There are three populations occurring in national park areas; i.e., a bird, a marine mammal, and a reptile that elucidates the kinds of problems faced by natural resource managers and the innovative approaches taken to resolve the management problems associated with each.

Peregrine Falcons

Peregrine Falcons *(Falco peregrinus)* are large, fast falcons distributed throughout the world from polar regions to the tropics, with a life history pattern intermediate between the extremes discussed above. Nowhere were they ever abundant, but they were always present in a variety of habitats as a major predator upon other birds. By the mid-60s their North American population had declined so dramatically that there were no known breeding pairs east of the Mississippi River.

The cause of the rapid decline was found to be pesticide residues that altered the birds' breeding physiology by disrupting egg shell production. This resulted in thin shelled eggs. Consequently, during incubation by the parent birds, the eggs broke. Dr. Tom J. Cade and his colleagues at Cornell University found that peregrines could be raised in capitivity, free of pesticide contamination. The Cornell scientists discovered, after careful research, they could return both eggs and chicks to the wild by quite different, but equally effective, techniques. Eggs could be placed in the nest of a breeding falcon pair who then reared the falcon chicks.

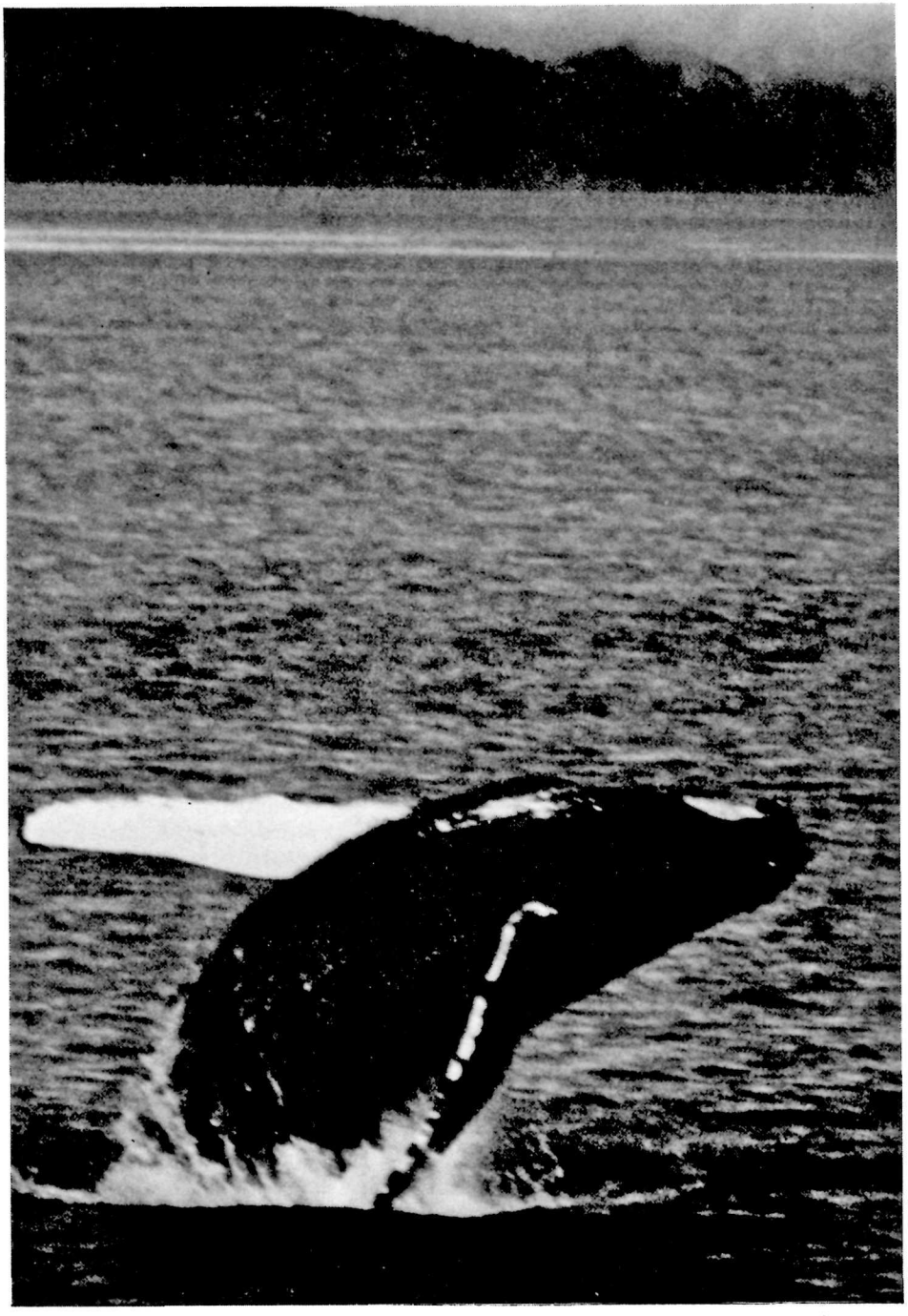
Sometimes the eggs were placed in the few known peregrine nests, but in the west they found Prairie Falcons *(Falco mexicanus)*, a closely related species, served equally well as foster parents for peregrine chicks. Juveniles were returned by placing well grown chicks in a suitable nest site where they were protected, literally night and day, by the scientists and fed until the chicks fledged and learn to hunt on their own. Several sites in the east and west were used for this latter method. Among those western sites were several national park areas, located in the Rocky Mountain system, where about half of the known peregrine nesting sites are presently found. Historically, virtually every park in the Rocky Mountains contained at least one pair of breeding peregrines.

Release programs have been established in those parks from which the falcons have been extirpated as an effort at restoring populations. Rocky Mountain National Park, Dinosaur National Monument, and Grand Teton National Park, and even Mount Rushmore National Memorial have ongoing release programs and active management efforts to protect nest sites and prey populations, as a beginning step towards their recovery.

The National Park Service engages in close cooperation with the U.S. Fish and Wildlife Service, state wildlife management agencies, and the Peregrine Fund in these management endeavors. It is clear the efforts in cooperative management have been successful among these agencies involved, but what remains uncertain is the fate of the peregrine falcon. Its ultimate fate is undoubtedly tied to the rapidity with which its world is cleansed of pesticide residues. Until then, the National Park System of the United States will remain a basic part of this species recovery.

Humpback Whales

Humpback whales *(Megaptera novaeangliae)* are large (50 feet long) migratory whales found in all oceans of the world. The North Pacific population winters in the tropical regions of shallow coastal waters in Hawaii, off Baja California, central Mexico, and many islands in the central Pacific where females give birth to their single calf every few years. These long-lived marine mammals summer in the cold temperate waters along northern California north into the Gulf of Alaska, west through the Aleutians, and south to Honshu Island, Japan.



Bruce Paige

Cooperative efforts of public and private organizations are needed to assure the continuation of the humpback whale population.

The original North Pacific population is estimated to have been about 15,000 individuals before commercial whaling reduced the population to less than 1000 whales by the 1940s. Consequently, the species has been officially designated as an Endangered Species.

Currently, about 100 individual whales have been identified summering in southeast Alaskan waters of which 20-25 animals were regularly recorded from 1967 to 1977 in Glacier Bay National Park. In 1978 the whales entered Glacier Bay but left unexpectedly early. In 1979 and 1980 only a few individuals returned to the Bay. The limited information available suggests the humpback's change in usage may be in part a function of increasing human activities in the park's waters. Such increased human use of coastal waters is not limited to Glacier Bay and the movement of the whales to other areas may be indicative of a broader problem.

The National Park Service has supported initially a small research effort to assess the whale's responses to changing conditions in Glacier Bay. As a result of this study, the National Park Service promulgated regulations for vessel traffic during the season the whales are present. The issue of vessel regulation has created considerable interest among most user groups in the Bay, i.e., the State of Alaska, the tourist industry, commercial fishermen, and private boaters as well as various environmental organizations. The nature of these various interest groups suggest that careful, well-planned research on the whales and their environment must be continued to obtain resolutions of these conflicting needs and interests.

Consequently, the National Park Service is cooperating closely with the U.S. Marine Mammal Commission, the National Marine Mammal Laboratory, and several well qualified marine mammal scientists to study behavioral responses of the whales and the physical and biotic characteristics of Glacier Bay. In addition, the Alaskan cruise ship industry is providing strong encouragement and even financial support in the combined research and management effort undertaken to give the whales maximum protection and allow park users to observe these 50-ton summer visitors in the Bay's glacier-fed waters.

Ridley Sea Turtle

Kemp's (Atlantic) ridley sea turtle *(Lepidochelys kempii)* is the smallest of the great sea turtles. Their mysterious ways eluded scientists until the early 1960s when it was discovered, from old film clips, that they nested on a single beach locality near Rancho Nuevo, Tamalipas, Mexico. The turtles are found throughout the tropical and warm temperate waters off the Gulf of Mexico and the Caribbean Sea, except when the females crawl ashore at Rancho Nuevo to lay their 100-egg clutch in the warm beach sands three times a year. A few females occasionally come ashore to nest on Padre Island, Texas.

During the 1940s, the annual nesting aggregation at Rancho Nuevo numbered about 40,000 females. Today, at the same nesting area, less than 200 females come ashore to lay their eggs. The causes of such dramatic decline probably arise from several factors. Mortality is greatest among hatchlings which are susceptible to heavy predation by crabs, fish, reptiles, birds, and mammals. After a year, the larger young and the adults are probably only taken by sharks. Commercial harvesting for eggs, skin, and shell is also a major factor as is incidental capture in other commercial fishing activities. Despite the seemingly high reproductive potential, the populations continue to decline.

Historic occurence of nesting ridleys on Padre Island National Seashore led the National Park Service to seek restoration of that population. A close working relationship was achieved among organizations interested in ridley turtle recovery, i.e., Mexico's Instituto Nacional de Pesca, Texas Department of Parks and Wildlife, U.S. Fish and Wildlife Service, National Marine Fisheries Service, National Audubon Society, and National Park Service. Each year since 1977, during the turtle nesting season, a group of scientists from these organizations meet at Rancho Nuevo where they carefully study and evaluate the nesting females.

Usually between 1000 and 3000 eggs are removed from their nests and taken to Texas where they are incubated in the Padre Island sand. Upon hatching some are released at a protected park site while the remaining turtles are transported to the National Marine Fisheries Service's Galveston Laboratory. Here the hatchlings are reared until they are about one foot long; too big for most of their natural predators. The young turtles are then released in designated protected national park area waters around the Gulf of Mexico.

It is hoped after these young turtles reach sexual maturity, in several years, and weigh about 100 pounds, they will return to Padre Island to establish a permanent nesting colony and augment the dwindling Rancho Nuevo population. Then the National Park Service will have restored one more animal species that once inhabited Padre Island National Seashore.

Conclusion

The species discussed here are only three of some 230 listed as threatened or endangered in the United States, and they demonstrate a comparable fraction of issues involved in management of such populations. The biological issues here basically center on increasing mortality and differing life history patterns. The kind of management options varies accordingly; for example, managing the peregrine and the ridley turtles seems largely one of increasing survivorship while simultaneously encouraging long range solutions to the problem of pesticides (peregrine) and commercial overharvesting (sea turtles).

The whales pose a different set of problems largely because their biology is poorly known (compared to peregrines or even the ridley turtles), and the logistics required to obtain the requisite information is immense. In all three cases one organization is not truly able to pursue all the necessary facets of research and management to assure the continuation of the particular endangered population. Consequently close-knit cooperation among public and private organizations is necessary to pursue and achieve basic recovery efforts.

Finally, the importance of national park lands and other comparable public and privately-owned lands cannot be understated in the recovery and future viability of endangered, threatened, or rare populations. As the National Park Service becomes increasingly involved in recovery efforts, the National Park System will provide the American (and world) public, including future generations, with the opportunity to experience these magnificent and truly fascinating beings with which Man shares the planet.

A.R. Weisbrod, Ph.D. is an Endangered Species Biologist in the National Park Service's Natural Science Division.

Wildlife Population Management

by Christine Schonewald-Cox

Bryan Harry

Attempts have been made to restore elk and other animals to their former ranges.

There was a time when considerable buffer zones of underdeveloped land existed at the peripheries of parks, making their protection possible by simply guarding boundaries and thereby preserving the natural resources contained within. It is out of this semi-pristine period that wildlife management techniques in the United States were born and subsequently developed.

Many of the techniques used were borrowed from Old World game management methods developed to perpetuate desirable species for hunting by the royal families. The adherence of these techniques, despite considerable advances in the ecological and zoological sciences and drastic habitat and land use changes in the last half century, has made it difficult for the Service to maintain, let alone improve, its performance towards the Organic Act's mandates in a time of increasing resource obligations. The matter has been seriously aggravated by the lack of provisions in new legislation for biological inventory, monitoring and maintenance of resource management programs in proportion to the acquisition of new park lands. External pressures brought upon the National Park Service have commonly forced the use of quick-result procedures that actually are ineffective or destructive management strategies when compared to longer-sighted and more stable ones.

The National Park Service resources management program has traditionally focussed upon species which have a strong public appeal, largely game species such as white-tailed deer, elk, bighorn sheep, caribou, wolves and grizzly bears. These species have consisted mostly of large mammals which require vast expanses for their mitigations, foraging, and dispersal, and which—in spite of their apparent ruggedness—are sensitive to the most subtle of changes in the natural balance of their respective ecosystems.

Many of the currently available resource management techniques are remnants of systems used prior to the progressive insularization of park lands. Therefore, they do not take into account the additional impinging threats created by the polluted air and water, exotic species, pesticides in the food chain and pest/predator control programs. These potential detriments are the new determinants. Fortunately, resource managers are beginning to recognize them as powerful influences upon the dynamics of ecological processes.

They are also beginning to realize the concomitant that they, the

managers of the ecosystems where both sets of determinants operate, need more training in newer wildlife management techniques. In extreme cases in which natural ecological processes have been arrested, techniques that can effectively stimulate these processes to work once again still need to be developed.

The modern isolation of focal species populations in protected areas, the hunting of them up to park peripheries, and the dependence of them upon large spaces in which to move and forage, have led to a multitude of perennial, as well as day-to-day management problems. Such problems include local population declines and extinctions; the need to reduce populations in crowded habitats; the need to transplant animals into new habitats for restoration purposes; local population explosions or concentrations where there are highly localized and predictably inadequate food sources; and the legal and scientific defense of damage claims for alleged changes in resource abundance or quality.

For cases in which local extinctions occur, additional problems arise regarding the restoration of extirpated populations to their former habitats, as has been the case with elk, wolves and caribou. In dealing with these problems the National Park Service has had to utilize conventional and often dated tools. In its attempt to cope with the accelerating rates at which new problems emerge, and influenced by funding restrictions and other pressures, park resources management has frequently been forced to treat symptoms rather than the underlying pathologists of biological resource problems.

In the last decade we have been seeing a shift by park resources management to a slowly developing willingness to address the causes of the problems, and to seek out the means to develop our capabilities to mitigate potentially explosive conditions in wildlife populations *before* they become too serious to handle successfully. The questions which the Service is beginning to address in relation to the management of specific natural resource problems have to do with assessing the effectiveness of currently-used conventional techniques when compared to the effectiveness of newer techniques.

Local Declines and Extinctions

Bighorn sheep, particularly desert bighorn, which suffered extensive losses throughout their geographic range in spite of protection and closely guarded management, have failed to recover. They have proven to be extremely susceptible to parasites and diseases including, but not restricted to, those carried by domestic and feral livestock. They have shown extreme vulnerability to changes in water supply, and to the presence of humans and even roads. In June 1980 an entire population of bighorn sheep at Lava Beds National Monument died very suddenly when they contracted fatal bacterial pneumonia. It is not an unusual case when a whole herd suddenly becomes infected with a disease or parasite and mass mortality occurs.

The bighorn sheep population of Zion National Park also may be undergoing some suspicious changes. This population has been monitored closely, but with recent funding cuts, all research and monitoring of the population has ceased. This is especially unfortunate since in 1981 no lambs were born, and consequently, no new recruitment to the population has occurred. It is difficult to speculate on the causes or the probable consequences of this observation without close monitoring of the population.

In Badlands National Park, bighorn sheep are suffering yet another problem, a severe susceptibility to water shortages.

The recent volume, *The Desert Bighorn*, is replete with examples of the susceptibility of these sheep to disease, parasites, water shortages, and other survival problems to which most herbivores are frequently exposed, but are capable of adapting to.

The pattern and preponderance of current declines in bighorn sheep and of their inability to regain their numbers when proteced do not suggest the sturdiness that, at one time, must have characterized this species as it ranged throughout North America. Historically, bighorn sheep exhibited a phenotypic flexibility that enabled it to occupy the extremes of wet and cold mountain ranges of western Canada, as well as the hot and dry deserts of the American Southwest.

The victims of uncontrolled hunting in the late nineteenth and early twentieth centuries, bighorn sheep were reduced to small and isolated remnant populations. Desert bighorn were so severely reduced that it is likely, though unsubstantiated, that they lost a significant proportion of their former genetic diversity. Specifically, it would seem that they have lost a portion of those alleles which would enable a species to resist infection and disease. They also are likely to have lost alleles which would allow them to survive the extremes of climate and nutrition, characteristic of their local habitats, as well as alleles which would provide flexibility in their behavior and, consequently, their ability to modify their behavior in the course of habitat change and stress.

Furthermore, many populations which exist as a result of restoration projects were founded with such small numbers that they are likely to have

suffered additional losses in variability due to severe inbreeding and lack of compensating gene flow. In present and future efforts undertaken to preserve the desert bighorn sheep, methods will have to be employed that compensate, at least to the extent feasible, for the losses of genetic diversity. That is, we foresee a strong need to create gene flow between populations and thereby expand the genetic options from which bighorn sheep and other rare species may draw to cope with the stresses of survival. We also need to utilize preventive measures in establishing new populations so that they will have the greatest potential for success in their new habitats.

Range Expansion by Establishing New Populations

Many attempts have been made to restore desert bighorn sheep, elk, bison, bears, wolves, and caribou to their former ranges. These restoration attempts have commonly failed, although sometimes decades later. Some attempts were unknowingly initiated in inappropriate localities, with incorrect subspecies or species, or with inappropriate population sizes and compositions. While in the planning efforts resource managers considered foraging conditions and space, the factors traditionally explored in-depth. However, major population, demographic, taxonomic, genetic, and reproductive parameters, which are central in influencing the success of bighorn and other species colonizers, were frequently ignored.

One example of such a colonization attempt is of Rocky Mountain elk introduced to Guadalupe Mountains National Park in 1929 to replace the extinct race of Merriam's elk. These elk faired well until the mid 1960's when the population declined in the space of 10 years from approximately 350 animals to about 125 and continued to decline. This decline was at first attributed to the loss of the supplementary water supply in the mid 1950's; however, any reaction to water loss should have materialized in less than 10 years.

Symptoms characteristic of inbreeding and of gene-related mortalities, such as decreased calf crop with suspected high mortalities in utero and the greater-than-normal first-year calf mortality rates, were observed in the declining population. It is possible that the manner in which the population was founded, coupled with the elks' behavior in the first year, predisposed it to a genetic impoverishment that contributed to the decline observed four decades later.

The initial population size consisted of 28 adult females, 5 adult males, 9 yearling females and some first-year calves of both sexes. One animal of unspecified age and sex died upon release and one stray adult male was shot during the first year. In addition, the colonizing herd split into two herds during the first year. One group gave rise to the herd of unknown status but which still persists on the dry flats at the base of the Guadalupe Mountains (not the subject of the population decline observations and study).

It is immediately apparent upon examining the constitution of the founding herd which remained in the mountains, and of the other herd as well, that they were predisposed to genetic problems. One to two males probably monopolized all the breeding for at least four to five years. The four- or five-year time period is required for male calves to reach sexual as well as social maturity when they first have a competitive advantage over the older males in obtaining females.

The female calves and offspring of the first two years, once reaching sexual maturity (in about 3 years), very likely mated with their fathers and subsequently they and their female offspring probably mated in successive years with their brothers, half brothers, and uncles. The smallness of the founding herd, the fact that it divided into two distinct, even smaller herds occupying different habitats, and the sex ratio and age composition of the population encouraged a serious loss of genetic diversity through inbreeding and what is termed "the founder principle."

This "founder principle" refers to the initial loss of alleles which occurs in extracting from a large parent population a small group of colonizers. The sample of alleles present in the colonizing group in all likelihood represents only a portion of the total number of genetic options carried by the larger parent population—options that may be needed by the colonizers for coping with habitat stresses.

It has been demonstrated with livestock, and with zoo populations of wild ungulates, that inbreeding, lack of gene flow and small population size, aggravated by polygynous habits (one male mates with many females) of many ungulates all pose documented threats to the survival of these populations.

The problems which exist with bighorn sheep populations and quite a few elk populations suggest that precautions should be taken vis-a-vis genetic interactions in the establishment of new populations.

Problems in Animal Behavior Management

Difficulties that resource managers face involve dealing with behavioral characteristics. For many reasons, these characteristics can directly counteract our attempts to protect species, and thereby create serious management problems. For example, it has long been known that caribou are long distance migrators. Yet, the legislation which set aside national park lands neglected to include the requirements for the entire migration routes of resident caribou populations. While the caribou and their habitats are given complete protection within a park, they seldom have protection outside the park.

Not only are caribou a popular game species, but their habitat is being explored for mineral and other commercial interests. This results in construction, traffic, and urban and industrial expansion which seriously hampers normal herd movements.

Plans exist to reintroduce caribou to areas from which they were extirpated, such as a site near Voyageurs National Park. Also, proposals have been made to introduce them directly into this park. The migration drive of caribou and their potential vulnerability outside the park present serious management obstacles in addition to problems of parasitism, the carrying capacity of the habitat, and considerations of how to go about founding the new group. Through continued interagency, state, and intergovernmental cooperation, the probability of the success of this restoration effort can be enhanced.

A similar kind of management challenge exists in the proposed restoration of wolves at Yellowstone National Park as part of an effort to restore natural predation to the ecosystem. Since wolves are social predators, their packs require large territories to provide them with sufficient prey. Aside from the complex genetic questions there is the fundamental problem of keeping the wolves inside the park.

National Park Service

Black bear relocation attempts are underway as part of range expansion efforts.

Ranchers at the park's periphery show concern at the prospect that some wolves may leave the park and hunt livestock. Yet, despite these reservations, these ranchers show a willingness to cooperate with the park. If cooperation continues to be fostered by those on both sides of the park's boundary, a very exciting and potentially successful restoration effort may take place.

Another animal behavioral characteristic which has precipitated some serious resource management problems is that animal species learn to depend upon, and return to, highly localized and predictable food sources. If this food source is of unnatural origin it can result in new demographic or behavioral manifestations that are very difficult to resolve.

A classic example is that of providing supplementary winter forage for deer or elk, a procedure which in itself enhances the animals' short term survival when related to poor winter food supply. But in the long run, the procedure is deleterious for it results in population growth, exaggerated grouping tendencies which take on pathological proportions in terms of overcrowding the range, the spread of disease, and stress-related behavior or illness.

Sometimes the highly localized and predictable food source is provided inadvertently, as it is in garbage dumps. Grizzly bears are omnivorous and defend their food and space. Food refuse

available to the grizzlies in dumps has given rise to serious problems, with bears attacking park visitors who inadvertently come upon or approach these dumps. Even if a dump is no longer being used for refuse disposal and, therefore, no longer a food source for the bear, the animal's memory motivates it to defend the site.

Interagency efforts to control violent grizzly-human interactions have been underway for several years. Significant progress has been made in defining park management problems that predispose bears to attack humans and studying the overall natural as well as human-modified behavior of bears in our parks.

Relocation efforts also have been underway for problem bears, and have met with considerable success. However, there occasionally are animals whose homing drives and capabilities spoil even the best management efforts. Black bear relocation attempts have been underway in the East as part of range expansion efforts. These have demonstrated strong influences attributable to sex, age, and reproductive conditions upon black bear's homing tendencies and the successes of resource manager's relocation efforts.

Exotic and Surplus Wildlife

Much as air and water moves across park boundaries, certain species which exist comfortably outside the park are not hampered in moving freely across park boundaries *into* the park. This sort of free movement, which should be ideal for native species that are encouraged to thrive in the park, is largely characteristic of exotic invaders such as grasses blown in from agricultural areas, other introduced plants such as kudzu or honeysuckle, or exotic animals such as starlings, feral goats, hogs, or burros. These species not only establish themselves in parks but thereafter compete with the native species. Frequently these exotics have no predators to keep their members in check. They also may bring with them diseases or parasites to which endemic species have not developed immunities and thereby aggravate any preexisting struggles for survival by species within the parks.

The nature of exotic invaders is such that they are usually capable of exploiting a variety of transitional-to-climax ecosystems, and they have a great deal of nutritional flexibility. These facts, coupled with the abundance of vulnerable food sources in parks, have resulted in habitat destruction and endemic species decline. The Service's mandates clearly discourage preservation of non-native biological resources, and the National Park Service is now examining the biology of exotic species to find ways of characterizing and eliminating them from the parks wherever possible.

Many native species are confined to their parks as they cannot survive outside them where development, industry, or hunting act as checkmates. If the park lacks natural predators for these species, or is too small to sustain a sufficient predator population to prey upon surplus animals, some native species populations may grow beyond capacity of the park and stray, as prairie dogs in Badlands and Wind Cave National Parks have done, becoming pests upon private lands. They are then subject to control as pest species, or may be subject to hunting as game or recreational species. Some species are so immovable, contained, or imprinted upon the park that they overexploit the park's food supplies and face malnutrition or starvation. This happened with elk and bison in several of the Rocky Mountain and Western regional parks.

Surplus animals often pose some complex problems for park resource managers who are forced to exercise artificial selection on their populations. Occasionally it is decided that the population crashes are an acceptable outcome of overpopulation, as is the current situation with wolves at Isle Royale National Park. However, because of the public interest and appeal of the species, the National Park Service is attempting to find alternatives to forage depletion and starvation.

In other locales, elk and bison are usually shipped to different parks, given to Indian tribes for use in range expansion programs, or occasionally sold to private, non-profit interest groups. Rodents and other species considered pests are controlled near park boundaries in order to prevent their expansion into adjacent lands.

It is important to note that if we remove or eliminate entire colonies or herds we simultaneously risk inadvertently eliminating some genetic characters which now or at some later date may be crucial to the survival of the species. Just as in founding new populations, serious considerations need to be given to the biology, genetics and behavior of the species before reducing any population.

The Old Sciences of Taxonomy and Systematics

The National Park Service is very concerned with maintaining the taxonomic integrity of its species. That is, when a population of a species has been extirpated from a region, plans usually are made to restore the same species and preferably the same race of the species to that habitat. When, because of habitat changes outside the park, two species or races begin to come together and the margins of their ranges begin to overlap, the National Park Service would favor maintaining

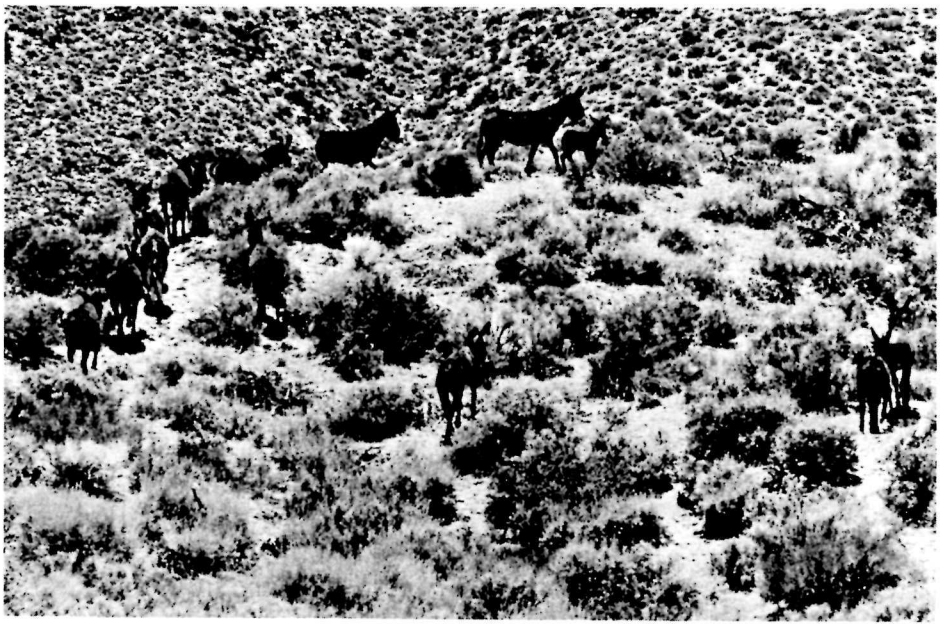
the historical separation, particularly if the range expansions are brought about by human industrial or demographic changes.

There is presently such a problem facing the Northwest Region where Rocky Mountain elk are expanding their range over the Cascades Mountains' crest westwards towards the area already occupied by Roosevelt elk. The National Park Service considers the Rocky Mountain elk exotic in the Roosevelt elk habitat.

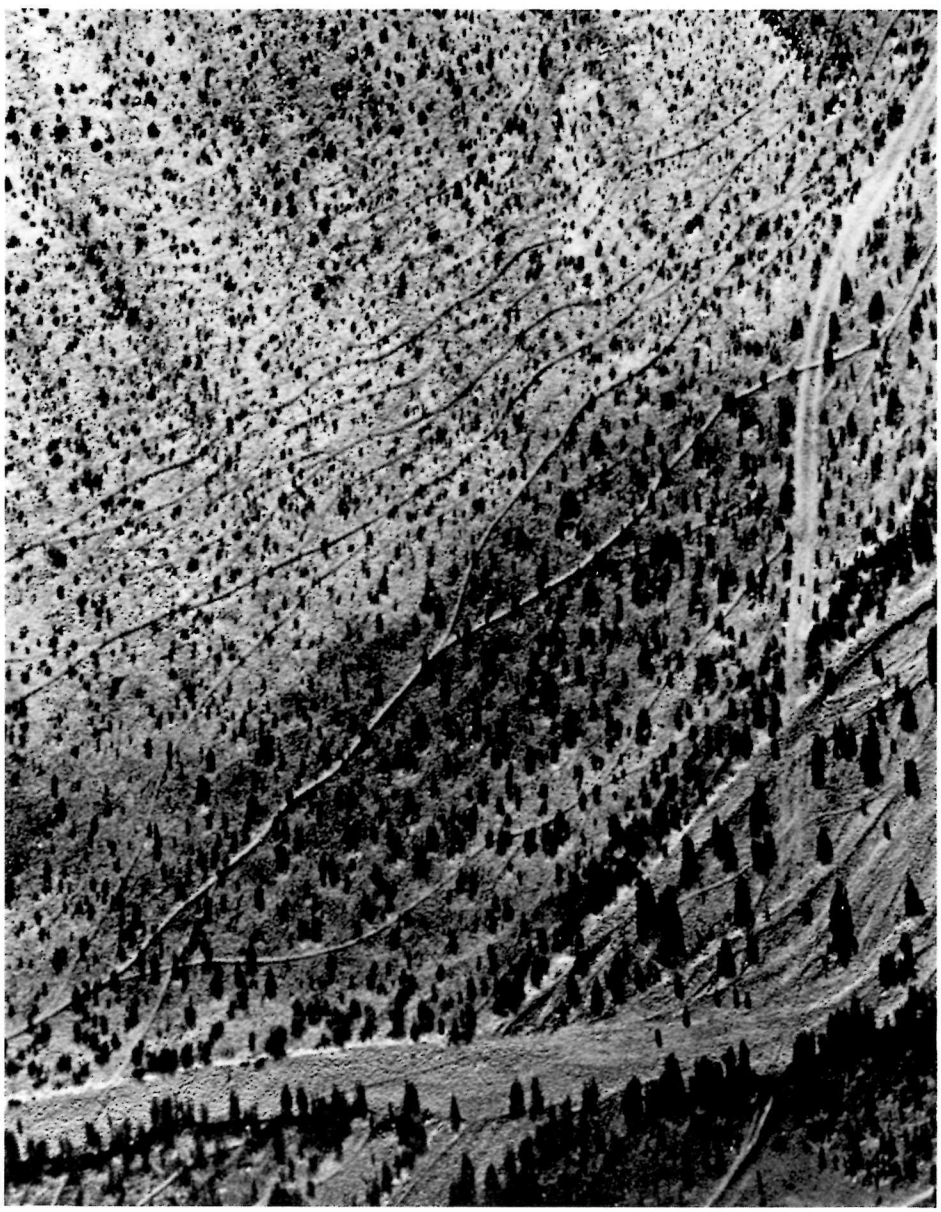
Also, there is an additional, little recognized problem in cases such as this one. The current taxonomy of many species (particularly elk) have not been given substantial review since the subspecies were first described. North American elk subspecies were described on the basis of very few specimens, one of which was immature and another had developed in a zoo.

There has never been a thorough geographic review conducted that examines the geographic variations of elk subspecies throughout North America, and that also tests the existence of the present subspecific designations. Only a few studies have been conducted, and these have drawn from only 3 or 4 localities and again used very small sample sizes.

The lack of substantial taxonomic information is potentially volatile since legislation is commonly written for species and subspecies whose relationships to other members of genera or species has not been documented. Thus, in the case of the Rocky Mountain elk coming into contact with Roosevelt elk, the concern may be well placed, yet no one can be certain until data are published to verify it.



Richard Frear



Richard Frear

Burros in Death Valley compete with native species and create tracks which destroy the landscape.

Differentiating Between Natural and Induced Trends

All of the National Park Service's resource management procedures, including those aspects discussed here, concern themselves with the problems of maintaining natural ecological processes in the parks. The singlemost important activity which serves to document the basic structure of an ecosystem and to substantiate any changes or developing problems in the system is baseline inventorying and follow up monitoring. However, one of the concepts which seems hardest to get accepted is that a baseline inventory fills the important practical function of providing a manager with a norm against which to decide whether or not there are any problems pending. Without a control sample of data for use in *comparing observed trends,* no determinations of change can be made and no valid conclusions can be drawn on the status of the resources.

Baseline inventories can become quite complex and expensive, but an agency can collect a minimum of data and still have a baseline that is valuable. While the initial collecting effort may be a low cost venture, subsequent funding may increase as the usefulness and validity of the data become apparent. Even the simple species list, which was the most typical baseline data set recorded in the last century and early part of this one, is useful.

However, one caution must be taken: the taxonomy of the species on the list may change and the characters, such as external morphology, may also change. The only way that a true species identity can be documented and changes in morphology traced is with the use of voucher specimens kept in scientific study collections. Populations or demographic data are also extremely valuable in detecting species turnover rates and normal fluctuations in species abundance and recruitment.

One of the difficulties in substantiating threats to a park is that, while pollutants may be entering the park or infringements may be occurring, the changes in populations of species that are recorded may actually be minor compared to the natural fluctuations that would have been recorded over a 50-year or 100-year period. This is crucial when claims are being made that pollutants are affecting the park. Use of baseline data and subsequent monitoring data can help managers determine whether pollutants or other infringements are affecting park resources, i.e., exceeding normal trends. Some very subtle changes not easily perceived without baseline data may reveal themselves and permit conclusions to be drawn that tie together cause and effect where threats are acting upon park resources.

None of the isolation, declines, extinctions, species composition changes, species demographic changes, etc., can be adequately documented without the collection of a minimum of baseline data, followed by subsequent periodic monitoring of the changes relative to the baseline.

Conclusions

Resource management techniques are changing to meet the needs and demands of natural resources facing the twentieth century struggle for survival. While we are generally moving in a positive direction in which we are increasingly aware of the threats to resource survival, we are moving slowly. Most agencies, including the National Park Service, lack sufficiently trained personnel to plan, let alone carry out, sophisticated resource management programs. Many resource managers work alone and have no staff support. Their parks frequently have little, or more often, no in-house science staff to assist or guide them.

Furthermore, most locations in which resource managers work, namely the parks, are isolated and often over a hundred miles from the nearest university or technical library. Without substantial in-house training in the new and developing techniques of resource management, these individuals face the impossible task of keeping up-to-date on the most advanced and effective techniques available for use.

The National Park Service recognizes the need for training, and several proposals currently are being reviewed for use in training programs, speciality symposia and workshops so that resource managers can make use of the newest ideas coming out of the academic and scientific communities. With all these challenging problems and the worst of handicaps, the strides which resource managers of the National Park Service have made are truly remarkable, and they are still leading the field of park and natural resource management.

Our successes will increase when the non-resource management/non-scientific community of legislators, administrators, and policy makers learns that the simple protection of natural resources by defining boundaries of protection is a very weak preservation tool if it stands alone. If definition of boundaries is not supplemented by inventorying, monitoring, and careful foresight, all applied towards long-term active management, the establishment of the park boundaries will mark the initiation of the insularization process, and will define the limits of islands which have already begun to experience their first extinctions, invasions, and the arresting of crucial natural ecological processes.

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Minerals Management

by Charles W. Wood and Daniel M. Hamson

National Park Service

Access to Billie Mine is across NPS Death Valley National Monument land.

Management of mineral interests and resources on lands administered by the National Park Service received little attention until recent shortages in energy resources and other strategic minerals focused attention on lands with developable minerals located on National Park System units. The national parks have traditionally been viewed by the public as a system of unique natural, cultural, and recreational lands set aside for permanent preservation. In recognition of this, Congress has normally closed new parks to mineral entry under the General Mining Law of 1872.

However, much of the land reserved or acquired for parks contains inclusions of state or private mineral rights, usually in the form of outstanding mineral leases and mining claims. Such mineral holdings are always subject to potential development under applicable state and federal laws and regulations. As a rule, National Park Service policy has been directed at minimizing mineral activity wherever the activity would conflict with the fundamental purposes for which the parks were established. Recent advantages in mineral extraction methods, higher prices for the minerals, and nationwide energy shortages have increased the pressure for development of mineral resources within park bounds, and it has become extremely important for the National Park Service to gain an understanding of ways in which a balance may be achieved between preservation of our outstanding national resources and the extraction of minerals.

In 1975 the issue of mining in the parks received national attention when a series of claims were staked on some of the most popular scenic lands within Death Valley National Monument, one of the few units in the system open to mining at the time. Following considerable public outcry and lobbying by conservation groups, Congress passed the Mining in Parks Act in 1976, which closed all of the remaining units of the system to mineral entry, including Death Valley, and resulted in development by the Park Service of a regulatory system for managing mineral activity.

The Mining In Parks Act

With passage of this Act (Public Law 94-429) Congress formally recognized that the continued application of the 1872 mining law to National Park System units was in direct conflict with the purposes for which those areas were set aside.

The Act contained three important provisions for park managers. First, it repealed the mineral entry provisions for the six Park System units in which this privilege remained. Second, it authorized the Secretary of the Interior to prepare regulations governing all mining activity in the Park System to ensure that the primary resources of each unit would be protected while at the same time permitting mineral owners to exercise their valid rights. The law also set a one-year deadline for claimholders to record their mining claims with the park superintendent. Any claims not reported during this period would be presumed abandoned.

At the end of that year (1977) over 2500 mining claims had been recorded in 16 Park System units. When the tremendously large parks located in the state of Alaska were added to the Park System in 1980, an estimated 3700 additional mining claims were included in the new areas. Some of these claims have since been declared invalid on the basis of failure to demonstrate

a valuable mineral discovery or failure to comply with the procedures necessary to maintain a claim. Approximately 5000 claims have yet to be examined.

Regulations for Mining and Mining Claims

Following passage of the Mining in Parks Act, the National Park Service acted quickly to develop mining regulations. On January 26, 1977 these regulations were added to the Code of Federal Regulations (Title 36 CFR; Part 9). They were based on the premise that preservation is paramount to economic uses of the parks, and are designed to insure that any mining activity within a park unit is conducted in a manner which minimizes damage to the environment, and that the beauty of the units is preserved for the enjoyment of the visiting public.

A major provision of the regulations is the requirement for a comprehensive Plan of Operations (PO) covering all aspects of a proposed action by a mining company and/or mineral owner (including access across park land to a mineral body outside the boundary). This document furnished the data necessary to make a sound decision on the effects the proposed mining activity would have on other park resources. If the proposed mining is in accordance with the regulations, affords adequate protection of park resources, and does not compromise the purposes for which the park was established, operating authority may be granted.

Regulations for Non-Federal Oil and Gas

Early in 1978 an initial review of park land records showed that a minimum of 59 units of the National Park System were encumbered by private oil and gas rights. Because of the complexity of inventorying mineral ownership records, it was also felt that additional units would be discovered, when records could be researched more thoroughly. Recognizing that the potential impact on park resources would be significant if these rights were developed, servicewide regulations pertaining to the exercise of non-federal oil and gas rights were written to insure that these activities are uniformly conducted to prevent or minimize damage to park resources.

The key to these regulations is access. When an operator requires access across park lands or waters to explore or develop his oil and gas holding, then a Plan of Operations detailing the planned activities, areas of disturbance, and reclamation measures must be approved by the NPS. The approval process provides a means to minimize the effects of the proposed activity, safeguarding park resources and visitors. Most particularly, the NPS is given an opportunity to designate the most benign access route.

Today, most oil and gas activity within the National Park System is taking place in Texas, Utah, and Florida. In most cases, operations occur on lands where the Federal government owns the surface rights but not the mineral rights.

Mineral Leasing

Five National Recreation Areas—Lake Mead, Glen Canyon, Ross Lake, Lake Chelan, and Whiskeytown-Shasta-Trinity, were established with specific provision in their enabling legislation permitting mineral leasing. (Mineral leasing as used here refers only to leasing of federally-owned minerals.) As on other public lands, the Bureau of Land Management and the Geological Survey (USGS) administer leases and operations, while the National Park Service has review authority for all lease applications. Only two of the Recreation Areas have ever received a lease application.

At Lake Mead NRA, mineral leasing has ebbed and flowed more or less in concert with events that foster an interest in minerals since the recreation area was established. In the 1950's, for example, numerous leases were awarded for uranium, while in recent years the area has experienced renewed interest in oil and gas leases. The majority of applications received over the years were approved and later allowed to lapse after periods of exploration. To our knowledge, only a small mineral quantity has ever been produced from Lake Mead NRA.

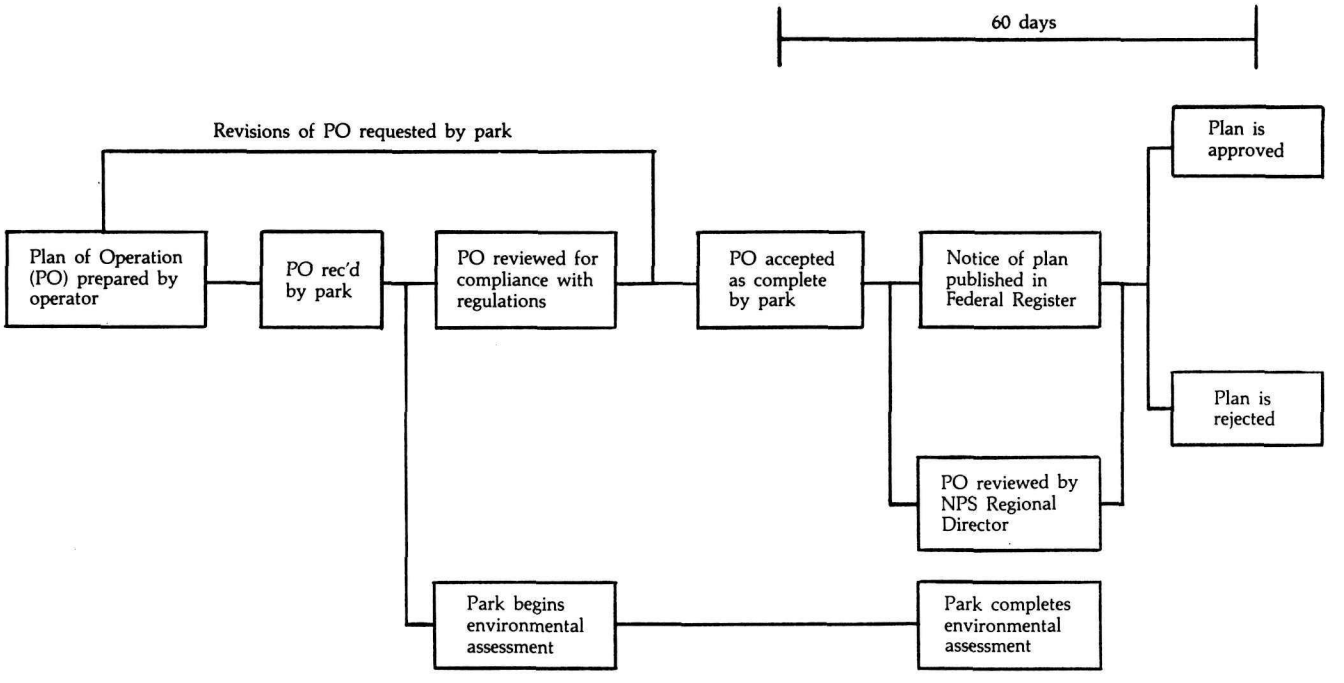
Glen Canyon NRA contains numerous oil and gas leases that were in existence when the unit was established in 1972. Exploration of these leases was suspended for several years pending development of a minerals management plan for Glen Canyon which would delineate environmentally sensitive areas to be avoided. The plan was completed in 1980, and recent developments include the issuance by USGS of an exploratory drilling permit for oil. The single well drilled under this permit yielded oil "shows," portending further drilling permit applications.

In hopes of standardizing mineral leasing procedures in all of the areas where the activity is permitted, the National Park Service drafted leasing regulations which could be applied servicewide, and thus would establish a management framework for all five recreation areas and any future parks created with mineral leasing provisions. These regulations are currently under review by the Department of the Interior and no new leases will be issued until the regulations become final.

Figure 1

Minerals Management Regulations

Mining and Mining Claims
Non-Federal Oil & Gas Rights



Implementation

The procedures established by the three sets of regulations center around the Plan of Operations as a basic minerals management tool (Figure 1). The plan formulation and review process allows park managers to work with the applicants to insure that adequate measures are taken to protect other park values. In addition, the park managers negotiate with the company or individual to make sure that the land will be reclaimed and restored to its natural condition once the mineral has been extracted.

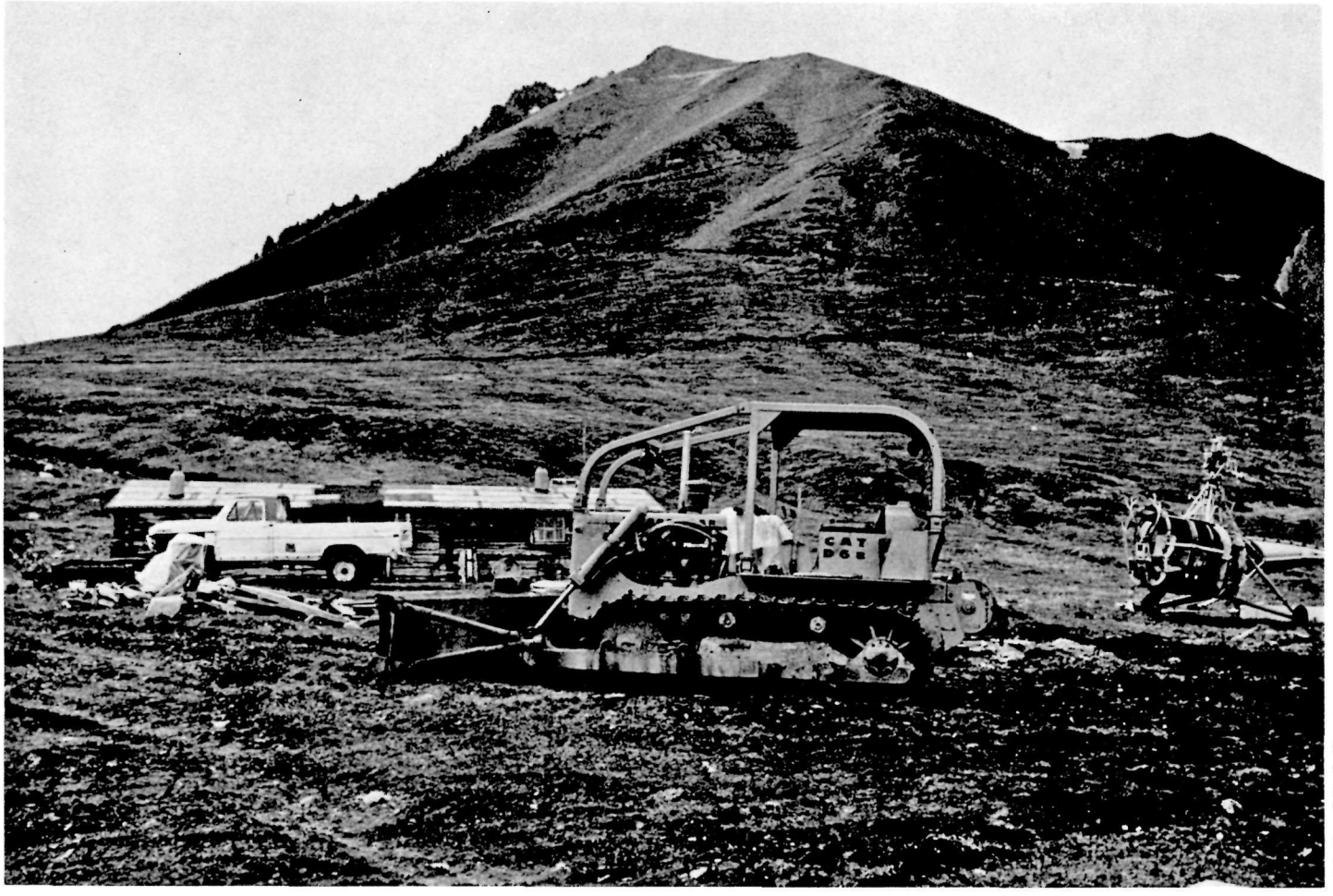
Completion of the environmental assessment called for in the regulations provides sufficient information to decide whether the proposal warrants a full Environmental Impact Statement (EIS). If an EIS is found necessary, the regulations provide for the extra time needed to complete an adequate analysis of the full range of impacts on park resource values.

As of September 1981, approximately 32 plans of operations for mining have been approved, with several more pending. Only two plans have been rejected because the claims were still under contest for validity. Sixteen oil and gas plans of operation have been accepted with 15 approved. The 16th plan is still in the review process. In almost all cases, plans have been approved within the 60 days following acceptance of a completed plan by the NPS.

During the approval process for the operations the NPS has worked with industry to meet the twin goals of resource preservation and the meeting of the country's energy needs. Several examples from Death Valley NM and Padre Island National Seashore have indicated that conflicts can be successfully resolved. Major projects as originally proposed in these park units would have pitted industry against environmentalists. But, after plan review and negotiation, environmental conflicts were resolved and the projects were completed with little or no damage to the units.

The Mining in Parks Act also directed the Department of the Interior to determine the validity of all mining claims in the six units which had previously been open to mineral entry: Death Valley National Monument, Glacier Bay National Monument, Crater Lake National Park, Mount McKinley National Park, Coronado National Memorial, and Organ Pipe Cactus National Monument.

The greatest effort in the NPS minerals management program has been directed toward determining the



National Park Service

Mining camp and equipment of Antimony Mine in Denali National Park and Preserve.

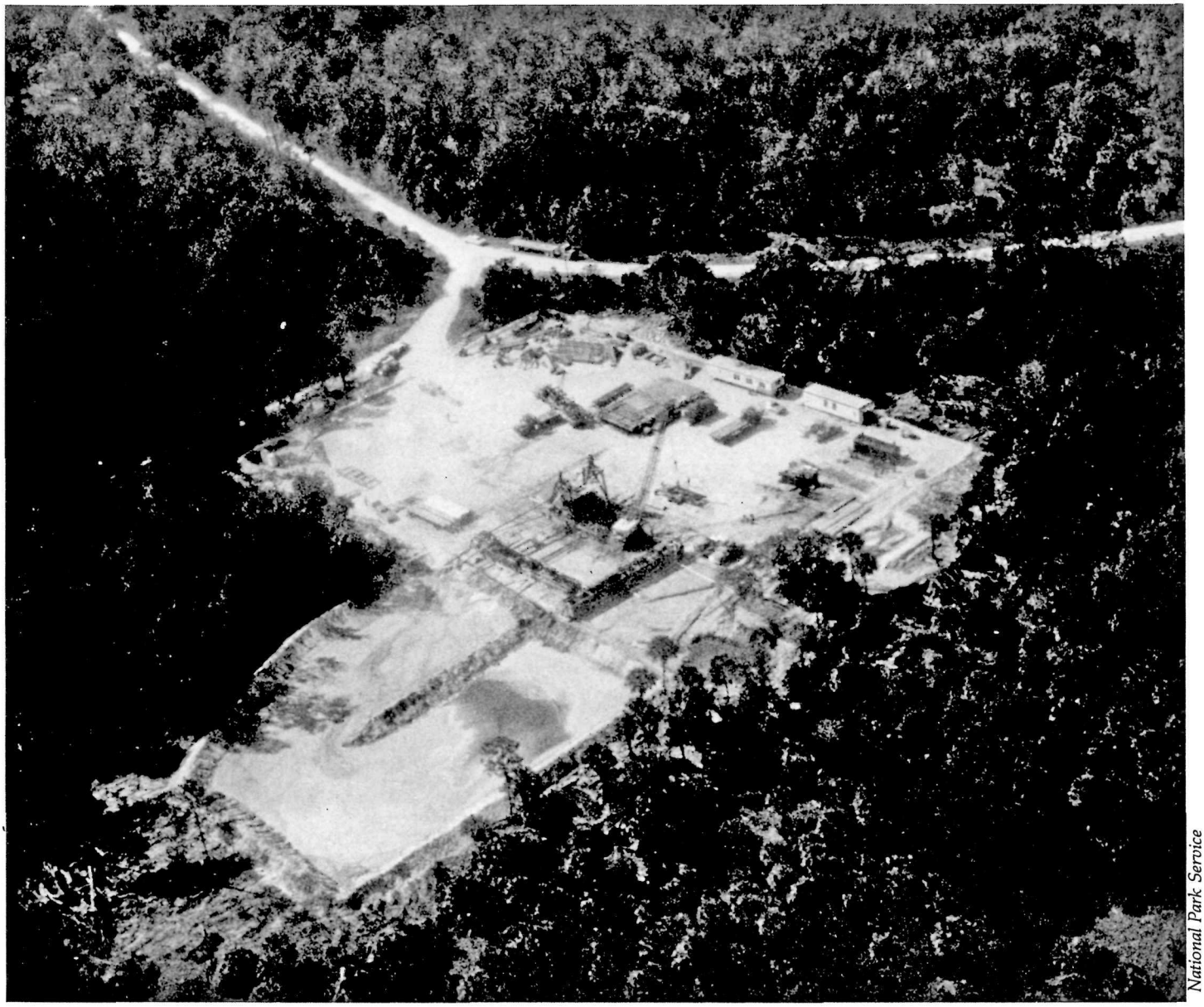
validity of these claims (a mining claim is legally valid only where a valuable mineral deposit can be demonstrated). NPS mineral examiners have made determinations on the majority of the claims outside Alaska, although over 5000 claims still remain to be examined nationwide. Also, where a finding is made that a claim does not possess a "valuable" deposit, the findings are usually contested in court. The validity determination for a single such claim may consume several years.

Current Problems and Future Concerns

The Park Service is fortunate to have established a regulatory and policy groundwork for mineral resource management because mineral issues have already become a burgeoning problem area. The recent addition of the Alaska parks and a renewed interest in developing domestic energy and raw materials in general have tremendously expanded the minerals management workload for NPS. The lengthy process of completing the remaining validity examinations, continuing efforts to evaluate Plans of Operations, and the need for field monitoring to ensure that plans are filed and then complied with, add up to a formidable task even for the most well-staffed agency. With only a skeleton staff in the new Alaska parks and few personnel trained in minerals management, the NPS is faced with a critical manpower shortage for accomplishing this work.

In the Alaska Region virtually all of the approved mines are operating under temporary authorizations—pending the completion of validity exams on the claims involved. Frequently, POs are not even submitted by miners, posing an enforcement problem and highlighting the need to establish a more effective working relationship between rangers and miners in Alaska.

Glen Canyon and Lake Mead National Recreation Areas are located at the edge of active oil and gas exploration provinces and we expect to see increased levels of lease applications in these two units once the leasing regulations become final. This will add a new layer of minerals management problems for at least two NPS regions.



National Park Service

A typical oil and gas drilling operation at Bear Island Field, Big Cypress National Preserve.

A further difficulty lies in the fact that we do not know the full extent of state and private mineral rights throughout the system. A more complete inventory of mineral interests in parks is necessary to more fully understand the scope of the problem and avoid surprises in the field.

As a final point, the NPS must contend with external threats to the parks, resulting from energy and mineral developments on adjacent lands. Proposals to develop coal and oil shale in the intermountain west, the siting of power plants, oil and gas activity in the overthrust belt or geothermal exploration near Yellowstone all pose potential threats to nearby national parks through air and water quality impacts, effects on scenic quality, and a variety of other direct and indirect effects. While not specifically a minerals management problem on park lands, the NPS must keep abreast of such regional developments to be certain that impacts on the national parks are minimal.

In summary, our current problems and those of the future present great and exciting challenges for the NPS in the field of minerals management. In many National Park Service areas, minerals development would be completely inappropriate and could not only jeopardize key resources but also prevent the visiting public from enjoying and benefiting from America's great natural heritage. To meet such challenges the National Park Service will continue to enforce its mining and minerals regulations, and will place increased emphasis on minerals management training and program development, ensuring successful adaptation to a rapidly evolving set of problems.

Charles Wood and Daniel Hamson are Ecologists with the National Park Service assigned to the Science Section, Denver Service Center.

Resources Management Plans — a Strategy for the Future

by Milford R. Fletcher and William R. Supernaugh

The National Park Service, faced by a bewildering array of nationally significant natural and cultural resources, ever increasing threats to and impacts upon those resources, and the need to manage them in a more sophisticated and technical manner, has developed and implemented a method of dealing with resource planning and programming in a systematic, standardized manner. While not a new concept by any means, resource management planning in the Park Service has not had the benefit of a concerted effort to develop a systemwide approach. Even though the Service had previously required that Resources Management Plans be completed by parks prior to expending research or management dollars, the response was sporadic.

Guidelines released in December 1980 initiated a major move by the National Park Service to: 1) quantify the current status of each park's natural and cultural resources; 2) identify research, monitoring and hands-on management needs; and 3) prioritize individual projects so that budgeted funds can be allocated according to greatest need.

The method appears so simple and logical one might ask, "How come it took the Park Service 64 years to write it down"? Indeed any land manager reading this will probably see a parallel to the process they use, regardless of whether the resources are managed by a federal, state, or county agency. The challenge, however, was to develop a strategy which would fit the wide range of resource types and values protected and managed within the National Park System. With natural resource concerns spanning arctic, desert, coastal and mountain ecosystems and cultural resources reflecting 10,000 years of occupation and use, a systematic process was needed which allowed decision makers to identify their resource problems, set forth their needs, prioritize their budgetary requirements and evaluate the interrelationship between a larger number of projects which may have cumulative or synergistic effects on the overall welfare of the park's natural and cultural resources.

Resources Management Plan

A Resources Management Plan (RMP) then, documents the extent of a park's resources and provides overall direction for the management of a park's natural and cultural resources. Consistent with the Service's management policies, general and specific legislative mandates, regulations and Executive Orders, the RMP outlines resource management actions, monitoring and research programs, and establishes a reasonable time frame to accomplish the state objectives.

The plan is meant to be program-oriented and is usually prepared at the park level by the Superintendent and his/her staff. This is particularly important since it requires the management, maintenance, interpretation and protection staffs to outline their resource related problems or areas of responsibility, a function which requires sharing of information and interdivisional coordination. A manager may then evaluate the resources under his/her stewardship and make accountable decisions based on an awareness of how a park's total management program will ultimately affect the resource.

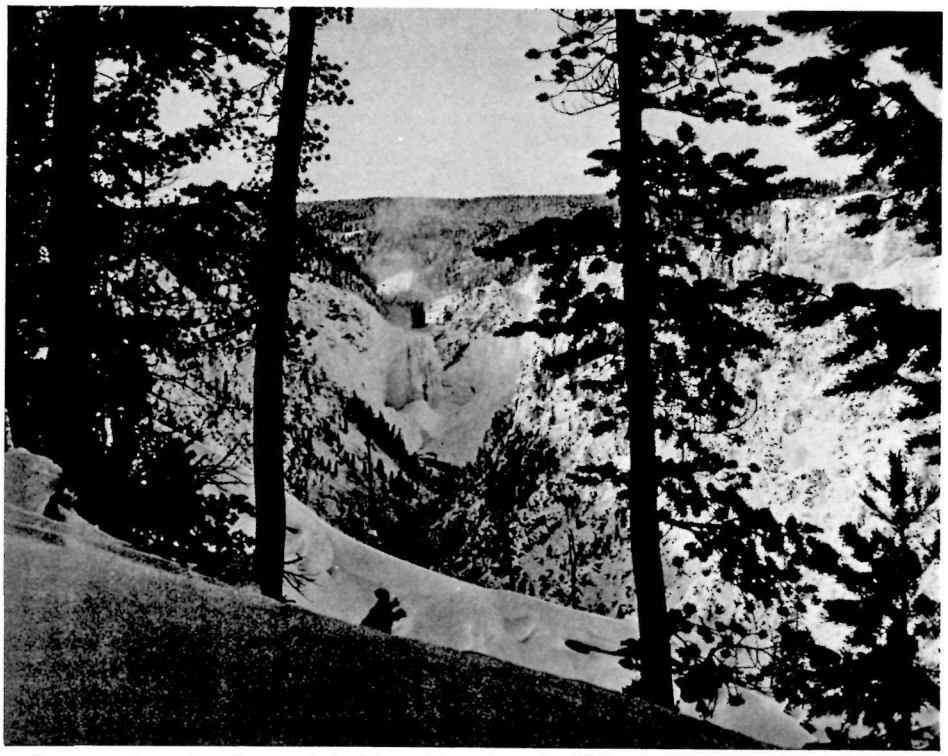
There is considerable room for variation within plans and this is entirely proper. Certainly a Yellowstone National Park, which must deal with a wide variety of wildlife management considerations, would have different emphasis and direction than say, Aztec Ruins National Monument whose resources consist almost entirely of prehistoric Indian ruins. Most parks have a mix of both natural and cultural resources, in varying proportions, and although they are treated in separate sections of the RMP, seldom can their actual management be separated. For example, the cultural resource objective of maintaining the park's historic scene may utilize vegetative manipulation, herbicides, or prescribed fire to restore and maintain vistas, battlefields, and cultivated areas.

Purposes of RMP

The RMP serves a number of purposes. First, it constitutes a contract between the Superintendent and the Regional Director dealing with important natural and cultural resource problems. It may thus be used over a period of time to measure actual accomplishments against resource management commitments.

The RMP may also serve as an educational implement and an introduction to the area for new employees. Since the RMP has outlined the primary resource management actions and recognized research needs, a careful reading of the document will inform the individual as to what the perceived problems are and how these problems are being approached.

One Superintendent in the Southwest Region uses the Resources Management Plan to generate university interest in park research projects. He sends the plans to water chemistry labs and biology departments and, in a cover letter, indicates that limited funding may be available to graduate students who wish to work on the particular problems identified in the Resources Management Plan. He has had considerable success in accomplishing needed research using this technique.



W. S. Keller

Yellowstone National Park must deal with a wide variety of wildlife management considerations.

RMP Format

The format for the Plan has considerable flexibility but the following items constitute the basic requirements common to all plans:

I. Cover Sheet
II. Table of Contents
III. Introduction
IV. Resources Management Program
  A. *Natural Resources Section*
    1. Overview and Needs
    2. Five-year Resources Programming Sheets
    3. Project Statements
      a. Park Code Number, Project Title
      b. Statement of Issue or Problem
      c. Alternative Actions and Probable Impacts
      d. Recommended Course of Action
    4. Completed Research
    5. Bibliography
  B. *Cultural Resources Section*
    1. Overview and Needs
    2. Five-year Resources Programming Sheets
    3. Project Statements
      a. Park Code Number, Project Title
      b. Statement of Issue or Problem
      c. Alternative Actions and Probable Impacts
      d. Recommended Course of Action
    4. Completed Research
    5. Bibliography
V. Scope of Collection
VI. Environmental Assessment
VII. Review Dates and Changes

Project Statement

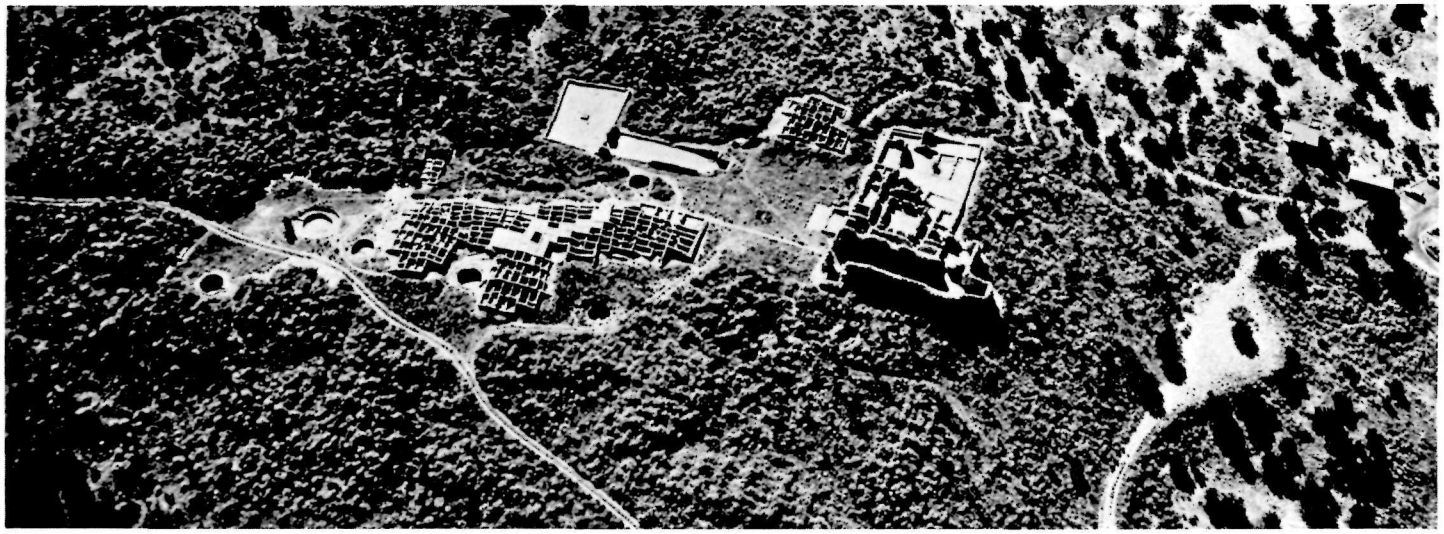
The heart of the RMP is the project statement section where ongoing and anticipated natural and cultural resource activities, including all activities which involve manipulation of a park's resources, are addressed. Thus, not only wildlife, fire management and ruin stabilization would be included, but also erosion control, road de-icing, mowing and landscape programs. This section of the plan reviews past and current resources management, monitoring, and research activities. The relationship of the actions to the park's total resources are considered here as well as the relationships between identified problems and legislative constraints.

Alternatives to the proposed action must be considered in light of the area's resources management objectives, congressionally mandated actions, and Service policy. The recommended course of action is identified and the alternatives are presented in a practical, systematic narrative which delineates separate action categories of Resources Management Actions, Monitoring Actions, and Research Actions.

Review Process

The review process that an RMP goes through is of particular importance. The plan is coordinated and written by the park staff and sent to the Regional Office for review. In most regions, the plan is reviewed by a wide variety of program specialists to insure that the direction set out in the plan is in compliance with legislative mandates, existing laws, Department of the Interior regulations, and NPS policies. This review often can be used to identify some very basic long-term management objectives.

For example, there are areas surrounding several historic forts that have undergone considerable vegetative changes since the forts were in use by the military. These changes have often significantly altered the historic scene and make it difficult to provide visitors with a true perspective on key events and historic uses. The preparation of an RMP for the park allows basic decisions to be made on which management actions can be used to restore and then preserve the historic scene. If open fields are to be maintained as part of the historic landscape, a combination of techniques may be used. Grazing, if accurate to the period, may be an appropriate use to keep undesired vegetation from encroaching. Prescribed fires may also be used to obtain the desired results. Since many of these situations are complex and decisions are thus difficult, the options and their projected effects should be fully explored and documented in the RMP.



Fred Mang, Jr.

Gran Quivira National Monument preserves a prehistoric Indian pueblo and a historic church.

Gran Quivira National Monument preserves a prehistoric Indian pueblo and a historic church, and has implemented a mix of management practices over the years. Past superintendents have decided that the historic scene to be represented is the era of Indian occupation. No effort was made to reforest any part of the monument, the reasoning being that there probably were no pinon pine left standing for a considerable distance. Later superintendents have, in their turn, planted pinon pine for aesthetic values, i.e., shade and visual relief. But at no time had a vegetative plan been thought out—documenting the resource objectives, identifying research needs and developing a historically accurate scene. Now it would be appropriate to conduct the necessary research to establish a stage of vegetational cover, agree on the historical scene which should be presented, and then tailor management actions to recreate the desired appearance.

Funding and workload needs can be time-phased over several years, monitoring programs developed and progress toward the objective measured. After the information is gathered, the next revision of the RMP can further refine the management goals and if necessary, modify the approach used to achieve them.

Certainly, some components of management plans will require further documentation of compliance with laws such as the Endangered Species Act or National Environmental Policy Act. In such cases, as removal of feral burros from a park, a separate action plan and NEPA document will be prepared. In some cases, after appropriate analysis, consultation and review, an Environmental Assessment will be deemed to suffice. Other cases may require an Environmental Impact Statement due to the complex nature of the proposed action or the controversiality of the anticipated impacts.

Resources Programming Sheet

Coupled with the Project Statements is a 5-year Resources Programming Sheet. When the plan is submitted, the time and dollars necessary to accomplish the task are computed. Costs are then submitted on Park Service programming forms 10-237 or 10-238 and entered into the budget cycle. It is particularly important to submit these documents with a well-reasoned justification and cost analysis. This process allows the park or Region to request additional funds to accomplish the prioritized tasks identified by the park manager. This facet of the RMP cannot be overemphasized.

Research Funding

In theory, all research projects initiated in a park must be addressed in the RMP and should relate directly to a project statement. However, not every problem can be anticipated far enough in advance to be fully integrated into the plan. Some problems, such as the spread of exotics in Hawaii, can be fairly well documented and the consequences of deferred or no action at all are fairly clear. However, the occurrence of a major natural disaster such as a hurricane cannot be anticipated in advance. Considerable creativity must be used to obtain funding for any research needs which result from a perturbation of such magnitude. Sometimes the Regional Office is able to fund research on such one-time unanticipated events. If this is not possible, one must appeal to academic, corporate or sister agency sources for support.

Conclusion

One can easily see that the RMP becomes a very valuable document in a number of ways. It provides the management direction for the staff of a park and the vehicle for obtaining funding for both one-time research projects and continuing functions such as ruins maintenance and long-term monitoring. In order to be workable the RMP must be a viable and up-to-date document. Its objectives must be realistic and project statements require annual review and revision as needed. If used properly, the Resources Management Plan can be a key element in a manager's overall strategy for providing a highly professional approach to natural and cultural resources management.

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William R. Supernaugh is a National Park Service Wildlife Biologist in the Division of Natural Resources Management, Washington, DC.

Natural Resources Management Training in the National Park Service

by Douglas Morris

National Park Service

Resources management training includes field exercises.

The National Park Service has long represented diversity, not only in the variety of natural and cultural treasures within the System, but in terms of the special abilities needed to meet its multiple responsibilities. As with all organizations, agendas tend to reflect the realities of a changing world. Explosive increases in visitor use, new technologies, changing social values, and new sets of visitor expectations are among the many factors that have prompted new ideas and strategies in park management. Partnerships between people with diverse talents are a requirement if we are to meet these new challenges.

One of the most significant of the changes has been an evolution in concepts and policies that guide natural resources management. Based upon research, experience, and heightened public concern, the era of doing little more than simply protecting park resources is past. In many areas, active manipulation of resources components is necessary to preserve, or restore, the natural scene that makes each park unique and significant. Skilled and highly qualified people are needed to manage and carry out these tasks.

The training function has also evolved with time. During the past twenty years, the National Park Service has developed a comprehensive training program designed to improve all aspects of our visitor service and resources management responsibilities. In the early 1960's, a modern Training Center was constructed in Grand Canyon National Park; a short time later, a former college was renovated for use as a Training Center in Harpers Ferry, West Virginia. Curriculum and subject emphasis at these Training Centers have continually focused on the skills, policies and philosophies basic to the mission of the National Park Service.

Training needs in resources management vary and reflect specific programs, staff organization, and other factors unique to each park. For example, in most of the large national parks, resources management is separated from other traditional ranger functions and managed as a separate and more independent program. With increasing frequency, Resources Management divisions in these parks are staffed with specialists who often have advanced academic backgrounds. By virtue of organizational design, these people are able to devote full time to planning and coordinating resources management activities. Training programs designed for these already highly trained specialists must be developed to facilitate exchange of strategies, new technologies, and provide update concerning laws, court decisions, policy, and current Servicewide emphasis. However, in the majority of park areas, more traditional ways remain the only logical approach toward the accomplishment of objectives in this discipline. Here the park ranger must daily assume resources management responsibilities.

The park ranger evolved as a protector of visitors and resources, and also as the person responsible for carrying out resources management projects. This role has also changed, with booming visitation and the attendant increase in law enforcement and other visitor service chores requiring most of the park ranger's time and attention.

In the mid-1970's, the Congress and Department of the Interior enacted laws and policy requiring all rangers involved with law enforcement to attend between two and three months of law enforcement training, to be followed annually with a week of "refresher" training in key aspects of this function. Concern has been expressed by a number of managers, and rangers, that the National Park ranger was receiving training giving unbalanced emphasis to visitor protection with no comparable mandate regarding resources management.

In a broader sense, this perception reflects the much increased workload in visitor protection required of park rangers. When faced with the need to choose between preserving visitor safety and accomplishing resources management projects, the field ranger often has little choice but to serve the more immediate visitor needs. Such a decision is often valid, but not always. Decisions giving priority to visitor protection may also be based upon such influences as training emphasis, management attitudes, and established work habits. In fact, resources management activities may often warrant top priority.

For the field rangers and supervisors in all parks, then, a re-emphasis should be given to resources management to assure full awareness and sensitivity toward the resource. For even

National Park Service

As part of his resources management responsibilities, ranger has temporarily disabled bear with a dart gun.

where a separate resources management unit is established, field rangers should be an important component of resources management programs. Training must play an important role toward fulfillment of this goal.

Recognizing, then, the concept that resources management training programs must be relevant to existing trends and needs, broad objectives can be identified. These objectives should reflect evolution from past to present; but, most of all, they should reflect policy and goals for preserving park resources into the future. The following set of training objectives seems to have emerged as critical to better serve resources management activities in the National Park Service:

1. To bring about renewed dedication on the part of all employees toward preservation of park resources.
2. Assure understanding and sensitivity with respect to basic ecological principles.
3. Provide a foundation of legislative mandates and executive orders, and update understanding of the implications of recent court decisions interpreting federal laws concerning resources management. Through knowledge of legal authorities and constraints, park managers can more effectively deal with both internal and external threats to park resources.
4. Assure understanding of the key ingredients of the planning process: problem identification, research and analysis, preparation of resources management plans, public involvement, compliance with the National Environmental Policy Act, and planning implementation.
5. Communicate new technology and successful strategies concerning the multitude of resources management activities that occur throughout the National Park Service.

Given funding and travel constraints, today's resources management training programs must be diverse, with each session achieving at least several of the aforementioned training objectives. They must be designed to meet actual field needs and result in getting the resources management job done better than before. Programs must be targeted for supervisory level people ranging from the management level to field supervisors. Field technicians should likewise be included under the umbrella of resources management training. Programs must effectively cross the functional lines that distinguish the role of the field ranger, interpretive specialists, and maintenance people.

Increased recognition, particularly, is now being given to the significant impact that maintenance work has on park resources. Finally, workshops are needed to bring resource specialists together, with programs that include

several objectives but focus mainly on new technologies and information exchange.

During the past few years, recommendations from many sources have combined with critiques solicited following training programs to provide additional guidance toward improving resources management training. A consensus has formed leading to development of several types and levels of training, ranging from comprehensive management concepts for superintendents to workshops specific to certain activities or environments. Two of the current course offerings that blend a number of subjects and objectives into a single session are specifically described as follows:

1. *Management of Natural Resources—Mid-Level*
   This course addresses the goals and activities involved with a systematic approach to management of natural resources. Subjects such as history of resources management, applicable laws and National Park Service policies, threats to the parks, and resources management planning will be on the agenda. Special emphasis is given to examination of several different kinds of ongoing resources management programs.

   Also, interrelationships between resources management specialists, park and contract scientists, central office support, and managers will be discussed as they relate to resources management programs. The participants will be those mid-level managers whose programs impact natural resources use and preservation. Chiefs and other supervisors in the fields of ranger activities, maintenance, and interpretation will be given priority for attendance at this course, which is extended to 8 days this year and will be given once in the east and once in the western part of the country.

2. *Management of Natural Resources—Superintendents*
   This one-week course is designed to provide superintendents and other management people with a perspective of ecological concepts and philosophy, and a working knowledge of the policy, environmental law, planning responsibilities and techniques necessary to assess internal and external threats to parks. The course will review ongoing resources management activities, giving managers examples of successful programs which may be applied to their park efforts. An important result of this training will be increased ability for superintendents to be conversant about resource concerns with the many individuals who may be affected by management decisions. Additionally, such training will mitigate the occasional complaint from subordinates that "management is uninformed" about their respective disciplines.

A second category of resources management training is represented by two workshops planned for 1982.

1. *Coastal Zone Management*—
   Managers and specialists responsible for developing resources management programs in coastal zones confront a variety of special problems and constituencies. Among these are legal implications of coastal zone management, conflicts among various local, state and federal agencies, the structure and unstable nature of seashore resources, developing basic inventories, and development of management options. This seminar will address these issues with participants selected from barrier island parks, and other National Seashores. It will be held on the campus of the University of West Florida in Pensacola where expert discussion leaders will be drawn from the university faculty.

2. *Natural Systems Workshop*—
   This seminar will stress natural systems management in terms of the growing human impact and the variety of internal and external threats affecting virtually every park. It will discuss a systematic approach to natural resources management that deals with impact prevention and mitigation, and the various monitoring programs required to establish early warning systems. Special attention will be given to a wide range of backcountry issues such as aquatic, fisheries, wildlife, and vegetation management. Participants in this workshop will include a number of resource management specialists, but will also be drawn from mid-level supervisors directly responsible for planning and implementing resources management programs.

Resources management workshops identified for the future include: Developed Areas, Aquatic Systems, Fish and Wildlife, Cave Systems, Plant Communities and Species, and Air Quality.

A third component of the National Park Service's efforts in the field of resources management training is emphasis given during the five-week Rangers Skills program. Along with such functions as interpretation, communication, search and rescue, law enforcement, and administration, management of natural resources is accorded a major block of time during this popular course.

For about a week the participants, who are generally selected from the wide variety of uniformed people in the first five years of their careers, concentrate on basic concepts and skills involving resources management in both classroom and while on field trips in the Grand Canyon and elsewhere. Subjects ranging from environmental laws and policies to basic ecological principles are presented together with case studies to create im-

Natural Resources Management Development (Trainee) Program

Less than 1 percent of the approximately 9,050 National Park Service permanent employees are involved full-time with the responsibilities of natural resources management. In order to address this deficiency, the Service intends to provide greater emphasis on natural resources management professionalism through a training initiative that will provide a cadre of qualified natural resource specialists into the parks in the quickest time possible. The process includes the selection and training of 30 qualified applicants for careers in natural resources management in 1982. Comprehensive training programs will be developed jointly by the regional offices and benefiting parks. Program funds and positions will be allocated through the Washington Office of Natural Resources Management, and principle coordination will be provided by the pertinent regional offices.

The Natural Resources Management Development Program is designed to respond to the increasing threats to the significant natural resources for which the national parks were established. It is vitally important that the highly volatile threats be identified, assessed, and a plan of mitigation be developed and implemented for each case before they reach crisis stage. Since current workloads no longer permit the multidisciplined park rangers the luxury to respond to all issues, resource management programs have become high priority for most parks. The development of qualified resource management specialists, who are able to address today's technological problems of both internal and external nature, are essential to the necessary resource management programs that are required to preserve and perpetuate the park's natural resources.

The program has been developed with the idea that resource deterioration can best be combated by employees at the field level who are knowledgeable and who are responsible for the day-to-day resource management activities—including problem identification, program development and implementation, liaison with investigators, implementation of recommendations, and monitoring. The transfer of research findings into use by park management is absolutely essential in threat prevention and mitigation. The missing link has been an effective facilitator that relates to both disciplines, a body that can talk to both manager and scientist.

Training assignments will be established for 18- to 24-month periods during which time the trainees will be assigned to and live within the benefiting parks, and will include special sessions in the specific regional offices and Washington. Curriculums will be developed to include a variety of components that reflect the major needs for each benefiting park. They include, in no particular order of importance, backcountry management, air quality and water quality monitoring, vegetation management, insect and disease control, biocide control aid use, exotic animal and plant control, wildlife and fisheries management, threatened and endangered species, animal and plant restoration, landscape rehabilitation and restoration, cave management, threat identification and mitigation, monitoring and early warning systems, information baseline file and ecosystem mapping, and other topics as necessary.

At the completion of each training program, the trainee will remain at the benefiting park to continue on as the area's natural resources management specialist.

Trainee positions, when they become available, will be open to anyone within and outside the Service who has the proper academic background, experience, and desire to become a full-time, professional natural resources management specialist for the National Park Service. In my view, the most highly qualified individual would possess a Master's Degree in a biological science, have already worked for a few to several years within the Park Service or as a natural resources land management professional, and have the desire to make a career of natural resources management.

More information on this program may be obtained from Roland H. Wauer, Chief, Division of Natural Resources Management, National Park Service, Washington, DC 20240.

proved understanding and appreciation for resources management in the National Park System. Class critiques usually highlight this portion of the course as extremely valuable and invariably remark that resources management training should receive even greater emphasis.

We hope that existing training programs in resources management will continue to expand and improve. For just as threats to park resources intensify, so must training better serve as one of the tools to mitigate these threats. Where is the best balance between training for the resources management specialists who plan and design such activities, and the broad spectrum of National Park Service employees who daily make decisions that impact park resources? How can we successfully blend the many disparate disciplines within the National Park Service into a single preservation ethic? What training methods and course designs are most effective? These and other questions require careful scrutiny, with the best solutions collectively developed among managers, resources management specialists, and training administrators. The task is challenging, and, more than ever before, a vital part of our training mission.

Douglas Morris is a Training Specialist (Park Ranger) with the Horace M. Albright Training Center, Grand Canyon National Park, Arizona.

Natural Resources Management in the Parks—An Explosion of Complexities

by Gary R. Gregory

Jack Boucher

While native to some parks, the mountain goat is considered exotic at Olympic National Park.

In 1492 a wobbly figure stumbled across the beach, plunged a flag into a sand dune and in the name of the Queen, proclaimed the new land to be "America International Park"—a park to be maintained in perpetuity as a *natural* park! Let's reflect for a moment. What are the duties of a newly appointed natural resources manager in this vast new and wild park? Should his first job be to build a dam to stop the horrible erosion occurring at a place to be called Grand Canyon? Or should he attempt to extinguish the many lightning-ignited wildfires which are blackening the landscape? Perhaps the elimination of the wolves, which are destroying the seemingly defenseless deer and elk, would be at the top of his list of duties. Under today's policies and guidelines, there would have been *no* such list in this would-be park. There would have been *no* need, for there would have been *no* problems!

In a truly natural park every action taking place in nature is right, correct, good. In 1492 the complex natural systems have been operating unimpeded for thousands of years. Even the native American—the Indian—was an integral part of this natural system. He influenced the environment in which he lived, as every other component of the natural ecosystem influences its surroundings. The Indian, unlike the European, struck a balance within the system largely because he did not have the tools and means to disrupt natural cycles *and* he frequently appreciated the complex relationships taking place around him.

The real challenge to our new natural resources manager would have been to resist the temptation to "correct" what he perceived to be "problems." Of course, as soon as the first "visitors" arrived to experience their new park, there would have been actual problems. Visitors' dogs would have begun to harass the native wildlife. Visitor campsites, with fire and litter, would impact on the landscape, and vegetation would be cut to build lean-tos and trails. Non-native rats would be climbing down the ropes of the visitors' ships and escaping into their new homeland. The *real* duties of the natural resources manager now begin to come into clearer focus!

Today, the great "America International Park" is but a dream. Remnants remain—three percent of the United States (including Alaska) is now within the National Park System. Even those parklands remaining have been threatened, abused, mistreated, misused and, yes, even mismanaged. The job of natural resources management in the parks today is infinitely larger and more complex than that simplistically portrayed in 1492. The task today is to rehabilitate systems which have been seriously damaged in the *past;* to mitigate unnatural impacts which are *ongoing* today; and to recognize threats and prevent damage from occurring in the *future.*

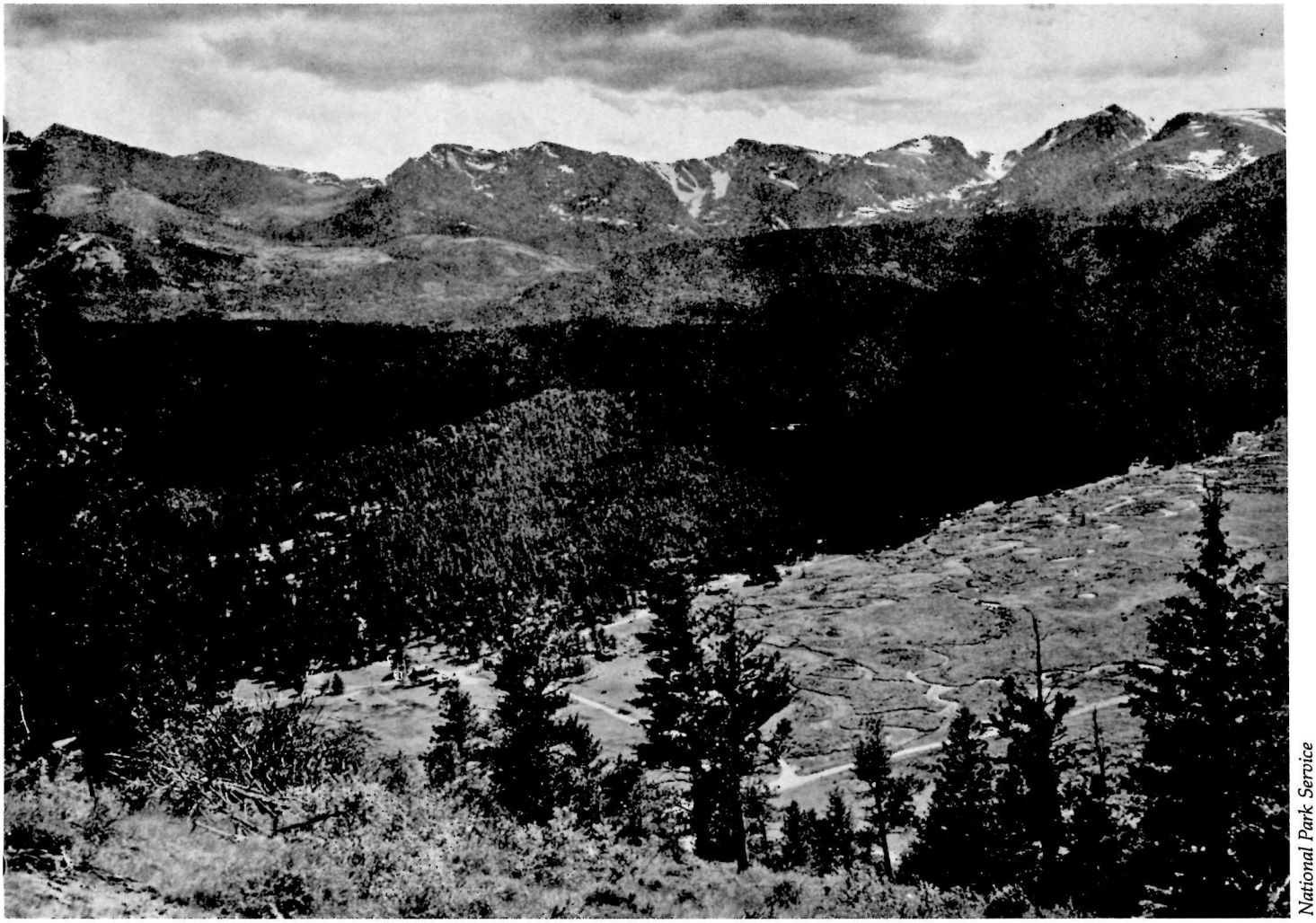
Past Damage

Early park managers often believed they could preserve the status quo in an ever-changing natural system. The attempt to freeze in time something so powerful and dynamic as nature resulted in severe imbalances. All fires were considered bad and suppression action automatically took place, leaving us even-aged forests with low resistance to catastrophic loss. Today we recognize the importance of natural fire and are gradually reducing fuel loads so fire can once again assume its proper role in a diversified ecosystem.

In the past we practiced fairytale management, attempting to preserve "good" species and rid parks of "bad" species. Mountain lions and wolves were eliminated whenever possible, native forest insects were sprayed if they were perceived to be damaging the forests. Elks were fed hay in the wintertime.

Today we realize that animal populations rise and fall; that forests grow, die, and are replaced; that every element in a natural system affects every other element. We must now reestablish the natural cycles and restore the forces which created the beauty of the parks so they will be as attractive and interesting in the future as they were in the past.

Many of our parks were carved from lands which were heavily impacted by man's actions. Some have been logged, some farmed, most have been grazed and some were even in housing developments. The rehabilitation of these lands is necessary to restore a degree of naturalness. In



National Park Service

Many panoramic vistas will disappear if the atmosphere particulate load continues to increase.

some cases land must be reshaped, trees planted and extirpated animals reintroduced, to more closely approximate the "America International Park" of an earlier age.

Ongoing Damage

Park managers are faced with continuing adverse impacts upon the natural systems of the parks. Many species of non-native plants and animals are now well-entrenched in the parks, others are gradually encroaching. Non-native animals which are causing damage include burros at Death Valley and Bandelier, goats at Hawaii and Haleakala, wild boars at Great Smoky Mountains and Hawaii, mountain goats at Olympic and barbary sheep at Carlsbad Caverns and Guadalupe Mountains. Some of the most devastating non-native plants include melaleuca at Everglades and Big Cypress, kudzu at Chickamauga-Chattanooga, gorse and firebush at the Hawaii parks, and tamarisk at all the desert parks.

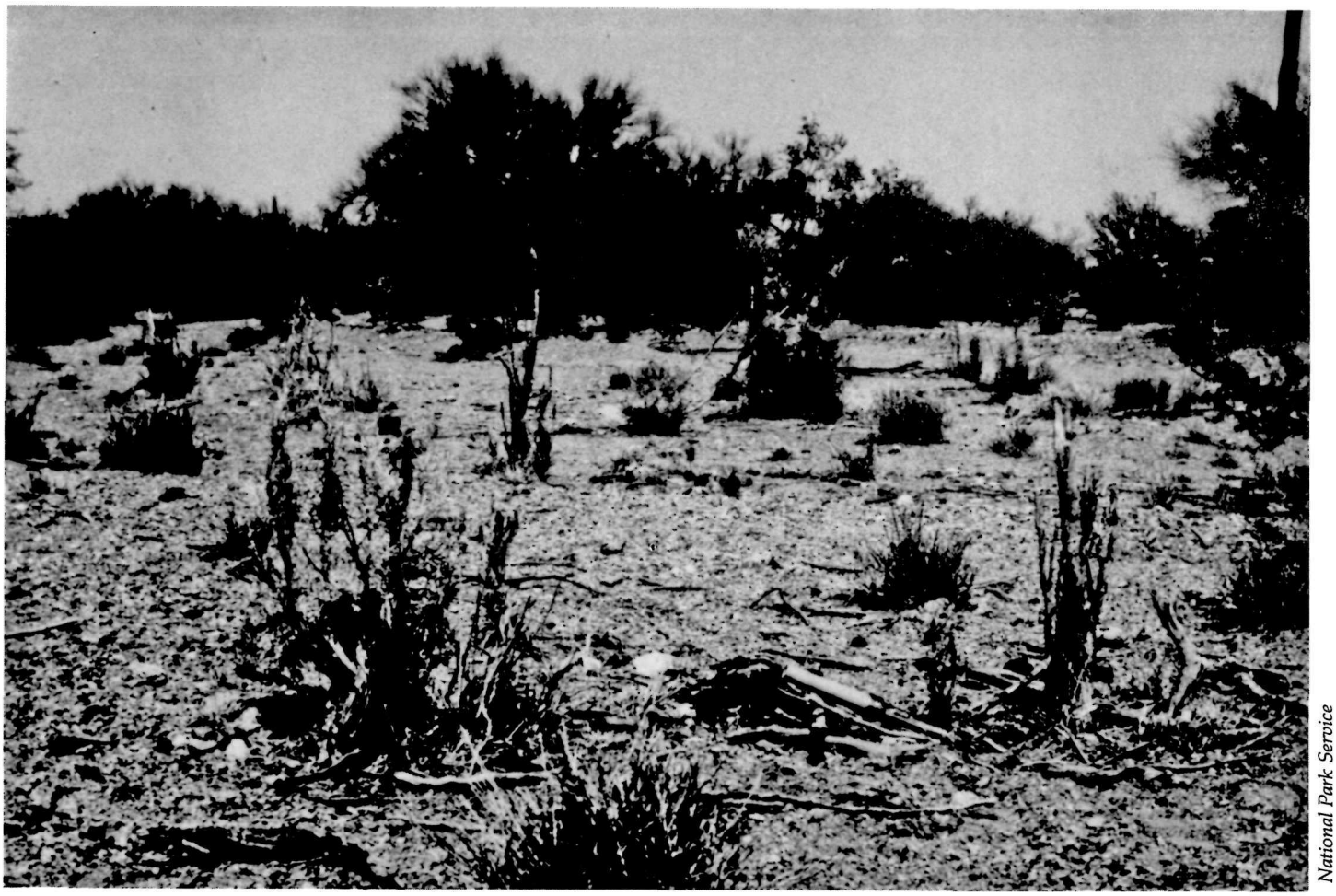
Visitor use of the parks is causing damage through over-use, trampling of fragile alpine meadows, illegal camping and firewood gathering. Livestock grazing, both under permit and by illegal trespass, continues to adversely impact on natural systems.

Future Damage

Many changes are taking place in our society that have potential to further damage our parks. Air moving through the parks often is laden with pollutants such as heavy metals, sulfur oxides and acid rain. We are only now beginning to see the damage which can be wrought. Fish kills, destroyed aquatic ecosystems and dead vegetation are just some of the catastrophes which are projected if current trends continue. Many panoramic vistas will disappear if the atmospheric particulate load continues to increase. Land development adjacent to the parks threatens to destroy the unique solitude, vistas and environmental quality of many parks.

Challenges for the Future

The challenge to park management to correct, mitigate and prevent damage to the parks is awesome. The function of natural resources management is to provide the park manager with the tools to enable him or her to meet that challenge. Natural resources management policy must be reviewed and fine-tuned in order to be both timely and acceptable to decision makers. Guidelines must be developed and continually modified to reflect the state-of-the-art. New research findings are continually expanding our knowledge of the complex interrelationships observed within park



National Park Service

Cattle damage to smoke tree (Dalea spinosa) in Organ Pipe Cactus National Monument, AZ.

ecosystems. Research results must be interpreted, incorporated into management guidelines, and made available to the park manager for inclusion in the park's resource management plan.

The resource management planning process must be coordinated, completed plans reviewed for program compliance and field implementation reviewed and monitored. Special assistance is provided to the park manager on complex resource management problems. A natural resources management training program is also conducted for managers and natural resources specialists to keep them abreast of new policies and techniques.

The scope of a servicewide program for natural resources management becomes even more complex because of constraints placed on the park manager. Programs and guidelines must be specific, yet flexible enough to assist the park manager in meeting this vast array of management constraints. Many parks are not large enough to contain complete ecosystems. Mountain lions wander out of parks and prey on ranchers' livestock. Native bark beetles can build up populations inside park boundaries and threaten commercial timber outside the park. Deer, elk and buffalo populations can increase to artificially high levels in parks too small to contain the elements of the natural ecosystem which limit the size of the herd. Extirpated wolves cannot be reintroduced in most areas because of their wide roaming tendencies.

The legislation creating a park often contains provisions which modify the management of the park as a natural entity. Hunting is allowed in some parks, mining in others. Recreation is the primary use by law in many parks. In the many historical parks, maintenance of the historical scene is a high priority management goal. Natural resources management must develop programs and provide techniques for managing each of these diverse park functions.

The fact that many adverse impacts on the parks emanate from outside the park boundaries exacerbates the problem of trying to maintain natural ecosystems. The myr[illegible] of political jurisdictions compounds the problem. Often, identification of sources of pollution is difficult because of the long distance involved.

It is clear that natural resources management has an enormous and complex responsibility in this rapidly changing world, but the very survival of our national parks depends on that responsibility being fulfilled.

Gary R. Gregory has completed the Interior Department's Executive and Management Development Program and is serving as a natural resources specialist in the National Park Service's Division of Natural Resources Management.

Role of New Resource Managers in the National Park Service

by Bryan Harry

Probably there isn't much difference between the best of the old-time park resource managers and the best of the new—except those today have a few more decades of knowledge, experience, and much more efficient tools. (Incredible that people used to analyze transect data by hand crank adding machine, census goats by foot, track a moose's home range by skiis. Think of what George Wright, first National Park Service Chief Scientist, might have done with computers, helicopter, radio collars and landsat images.) Even today Boss Pinkley or Johnny Mac could show any of us more than a few new ways to be effective resource managers.

Among similarities between old and new, both operate with the same legislative mandates to care for park resources—though I believe Johnny Mac saw no dichotomy in the 1916 goal of preservation and enjoyment. He read the mandate simply that parks were to be enjoyed only in such manner and means that resources would be left unimpaired, and argued no further about it.

Resource managers today spend more time, discussion, training, and professionalism on the resource half of our title; maybe Pinkley and MacLaughlin were successful because they were good as the "manager" half. If so, I might, with a few colloquial examples, speculate on our roles as *managers* in general, as much as resource types in particular. Other managers would use different examples, but perhaps the principles and resultant manager roles might be quite similar.

Competent resource managers ought to be managers. Managers don't necessarily practice biologic investigation, public relations, statistical analyses, or historic building inventory (though these may be their tools)—they practice *management* of park resources. Drucker, speaking of

National Park Service

Cris Jorgensen's early—1900 watercolor recorded the open, cathedral-like Mariposa Grove as it first appeared to modern man....

National Park Service

....but 50 years later white fir thickets obscured the sequoias and were such a fuel hazard a single wildfire could destroy the entire Grove.

managers in general, writes that management isn't knowledge; it's performance (based upon knowledge and responsibility). Managers are people whose function is to find the right things to do, and assure they are done. In some parks this may as well entail defining wrong things to do and skillfully avoiding doing anything. Managers make timely decisions under uncertainty, perhaps with some considerable risk; or they provoke vigorous dissent; going against ingrained habit. Otherwise park resources might just be able to care for themselves, by themselves, without managers. However, not all of them can.

Hawaii Volcanoes National Park Ecosystems

The Hawaii Volcanoes National Park remnant island ecosystems are examples. Most species are found nowhere else on earth. Most evolved in tiny isolated niches in Hawaii. None have high reproductive rates, ability to compete, resist predation or browsing. There were no predators, no browsers, few forms with which to compete. Their attribute was their ancestral forms' adaptations or luck to travel across more than 2,500 miles of ocean—difficult odds indeed. Few made the trip, and those that did evolved without competition into an array of diverse, particularly adapted forms that would have awed Darwin.

But endemic forms by their isolation were very vulnerable to any disease, predator, grazer or browser that later came to the islands. Modern man brought in cattle, goats, mongoose, rats, dogs, cats, mosquitoes, malaria, and exotic grasses. The resulting decimation of the island ecosystems has been disastrous.

Much of the National Park Service's most active manipulative resource management is done in Hawaii in an attempt to partially thwart the effect of these exotic introductions by modern technologic man. A specific example of the process, and resource action/dilemma, involves the tree *Hibiscadelphus giffiardianus* (being uncommon, it has no common name) and a bird, the black mamo. The soft barked *Hibiscadelphus* tree was once commonplace in the Kilauea forests at Hawaii Volcanoes National Park. Its year-round blooms contained large amounts of a nectar which was the main food source for mamos, a large honeycreeper whose great curved bill fit precisely into the curved *Hibiscadelphus* bloom. *Hibiscadelphus* had no defense mechanisms (thorns, scruffy bark, bitter or poison taste) to defend its bark against nonexistent grazers. So, the cattle and goats that modern sailors brought to Hawaii ravaged the tree.

In early manipulative management measures at Volcanoes Park, rangers locally controlled cattle and goats, and successfully propagated cuttings from the single *Hibiscadelphus* tree remaining from the cattle/goat devastation. Now a small grove of the rare tree exists in Volcanoes Park—but there are no mamos. The species simply could not survive in a single tree habitat.

In Hawaii there are countless examples to show that native park resources can no longer survive without active resource management. The major role of resource management is to take decisive action to preserve park resources. As in Hawaii, it must be the right action at the right time. The mamo/*Hibiscadelphus* case could have been easily remedied by proper, timely resource management.

Many feel that management's role is merely to remedy problems. As the mamo episode shows, that may not be the case at all. Able management should seek and exploit opportunities. While one *Hibiscadelphus* remained, opportunity existed to save and restore that species—but at that late time, opportunity had long passed for any management to save and restore the system of *Hibiscadelphus* and mamos. A major role of managers is to have *and* use the wisdom to exploit these resource opportunities. Managers who merely patch problems fail. Often, resource failures are permanent. No future managers will ever resurrect mamos.

Yosemite's Mariposa Grove

A neat example of a complete, successful management venture exploiting an opportunity occurred in Yosemite's Mariposa Grove of giant sequoias. Yosemite has had a long succession of able land managers including Olmsted, with the first Yosemite Master Plan, Galen Clark, its first caretaker, and Capt. A.E. Wood, an able manager at dealing with grazing and timber trespass. These good people lacked modern understanding that light recurring fire was an integral sequoia grove component of the Sierra mixed conifer forest system. By the 1960's a century of effective fire protection in the Sierra woodlands allowed white fir to replace sequoia in the understory. Not only were sequoias endangered from replacement by fir, but the understory fuel buildup was so volatile that a single wildfire could destroy the entire big tree grove. Also, visitors in cars overwhelmed the grove.

During the late 60's, the Mariposa Grove was transformed back to a natural, dynamic sequoia/fire system. Forestry crews, boy scouts, volunteers, and convict labor thinned out the dense fir understory. Small fires were lit under careful prescription. Cars were replaced by open air buses and hiking trails. An overnight lodge was removed. Though Mariposa Grove was small, the task was not trivial. It required a decision to cut large fir trees as well as low undergrowth, to

set deliberate fires among sequoias, to close a popular public road to autos.

Perhaps a wise superintendent would waffle and "study" the situation to avoid personal risk by delaying until the next manager inherited the problem. Not only was then Superintendent Larry Hadley willing to take the risk at the time of great opportunity, he exercised another of the major roles and responsibilities of resource managers. To assure success, very important resource opportunities deserve assignment of the very ablest staff. Bad as it is to waste talented resource managers (they are in precious short supply), or waste momentary opportunity to make real progress in a resource situation, it is worse to fail at a controversial, risky endeavor.

Hadley assigned Bob Barbee to lead the Mariposa Grove sequoia project. Barbee is among the most effective resource managers in the parks, and Hadley, within reason, also gave Bob use of Yosemite's crack forestry and fire crews, and license to deal with the state for convict labor. Barbee has an easy-going ability to unite diverse park divisions in a common cause despite their deep distrust of risky—even wrong—resource ventures. It's not remarkable that the Yosemite crews and Barbee succeeded. By luck, or by Hadley's and Regional Director Rumburg's wisdom, the very best talent was applied to a major resource concern at the precise time of opportunity. Again, this is the role of a resource manager.

Resource Management Plans

How do managers know these times of opportunity, where to direct their best talent and money, and when? Policy of the National Park Service dictates that each park area have a current resource management plan and corresponding NEPA assessment or statement and/or historic structures maintenance guide. Though resource managers usually are the authors or catalysts to write or revise these plans—the plans have greater input from research, the public, neighbors, and other professionals.

Plans, through reference to various resource data bases or appendices, summarize the parks' significant resources and their trends and dynamics; or, they propose research to define these. They also develop actions to maintain park resources in accord with the 1916 Act, the specific local area legislation, and specific applicable historical, antiquity, wilderness, endangered species legislation, various policy reviews such as the Leopold Report, and the park's General Management Plan.

Explicit in these plans are monitoring measures to assess resource trends, e.g., animal populations, slumpage of Anasazi ruins, presence of rot in building foundation, vegetation patterns. When necessary the resource management plans are revised to reflect results of monitoring, new research, small scale experiments with resource manipulations, or moderation in adverse public opinion. The plan synthesizes specific resource needs and leads to programming and budget requests. These requests must be timely and so skillfully prepared that they stand fairly on their own in the NPS priority setting process.

Actions without thoughtful public plans foreclose other knowledgeable people from giving effective critique, and narrow the knowledge base a manager works with. More severely, lack of a plan limits the life of a resource management action to the tenure of a single manager. Most resource situations are long-term ventures, or have expected results long after the management stimulus.

Or, another way, the time of opportunity to affect a resource is long before the damage is apparent. Perhaps a historic resource plan demands expert monitoring for building termites every three years. If, in the absence of a plan, a new manager checks for termites *only* when finally aware of them—that may be when the roof collapses.

Hawaiian Feral Goat

Another equally expensive example is the Hawaiian feral goat. Exotic goats were brought into the islands in 1779 by Captain Cook, and the destruction they wrought to native Hawaiian forests and bird life is well documented and widely known. Hawaii Volcanoes NP has lost more bird species to extinction than the entire mainland United States. Efforts to rid the park at least of feral goats have been sporadically persistent for more than a half century.

Yet in 1970, there probably existed as high a feral goat population as ever. Probably is the word, because prior to then goat censuses were never made. Only the number of goats killed was recorded (Figure 1). In the absence of written long-range plans, Volcanoes Park was at the mercy of any individual resource manager. Some were superb. Some weren't.

Figure 2 shows a conservative population growth curve for feral goats in Volcanoes Park. Goats numbering as few as 20 can be detected only by skillful monitoring, censusing, and release of radio collared "Judas" goats which join others in the wild. These continuing efforts require dedicated persistence at times when there is "no need because all feral goats are eliminated."

From the point on the graph that casual observers are first aware that goats exist is at best only 3½ years from when the goat population peaks at the carrying capacity of some 40,000 animals—with enormously adverse, long-range effects. Dozens of

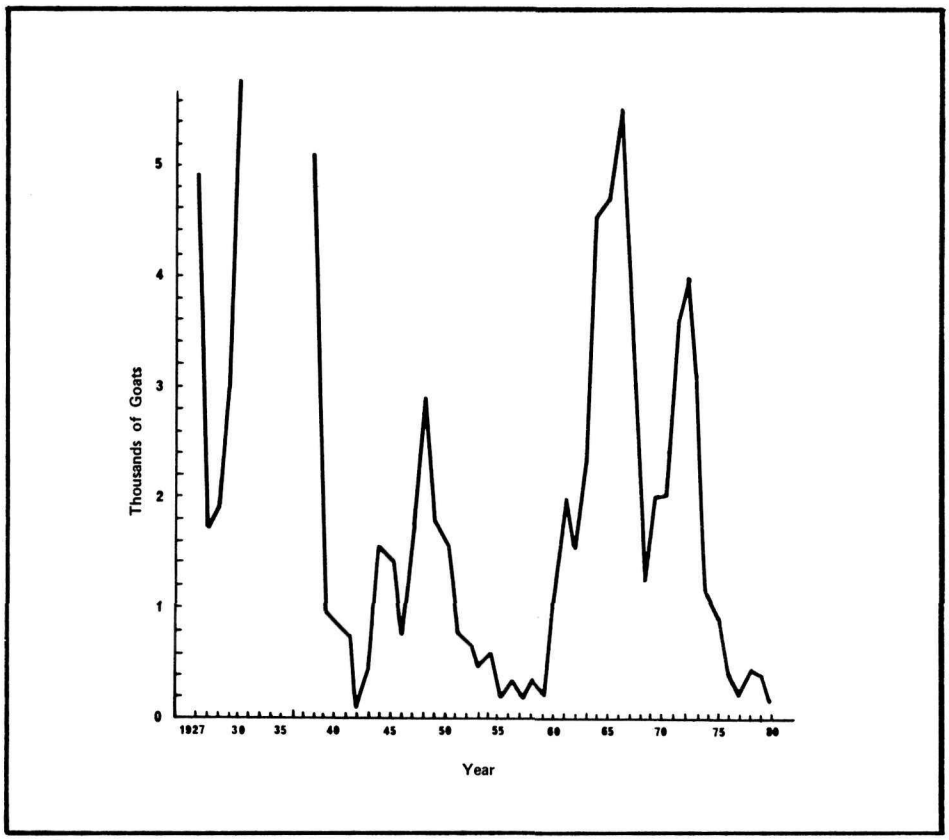


Figure 1 - Number of goats taken annually from Hawaii Volcanoes National Park.

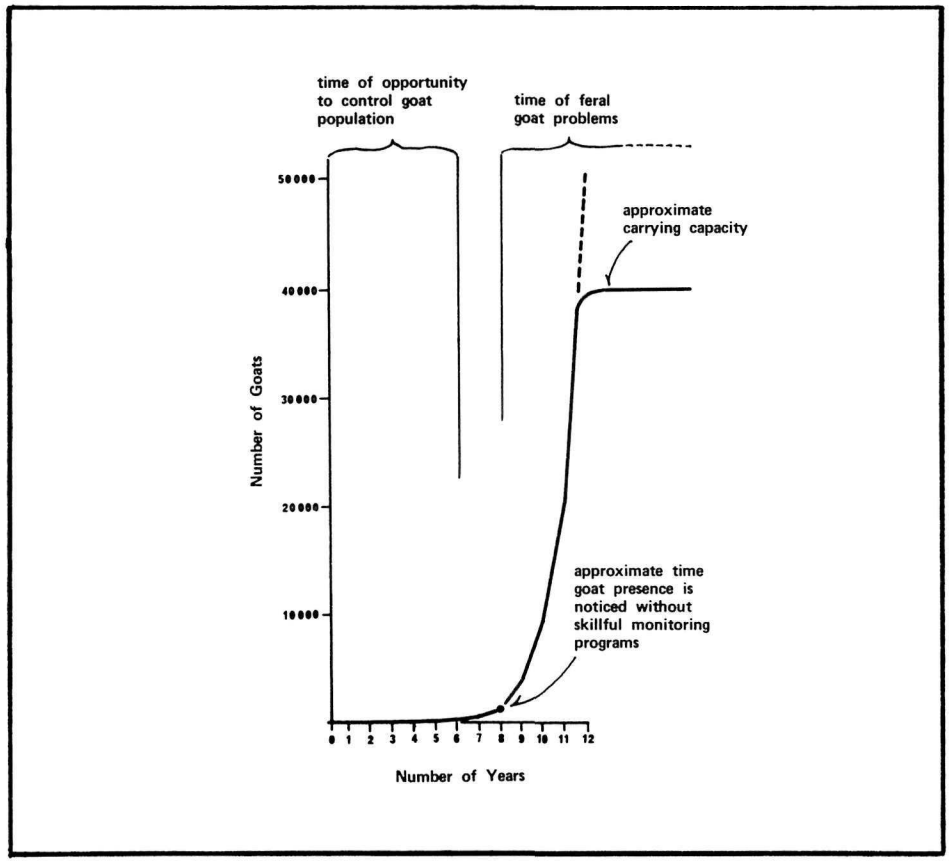


Figure 2 - Theoretical Recovery of a goat population in Hawaii Volcanoes after all but 2 goats are removed.

rare plants, several endangered birds, entire dry forest ecosystems would again be jeopardized. Repairing a goat population explosion—a *10 year*, ¾ million dollar task—is easily precipated by a *3½ year* lapse.

The obvious axiom is that resource management must be continuously based upon an effective conservation plan with predetermined objectives and goals. It must be a coherent program so that if the manager leaves, the successor immediately knows what ought to take place.

Resource Manager Roles

Resource managers cannot be people so egocentric that they must make their own individual mark on things. With ecosystem cycles lasting centuries and the results of a resource action often apparent only decades later, managers' successes are team successes. It is like running a distance relay race; each player exacts every dram of one's stamina and strategy to put the next runner in best position. Individuals uncomfortable with such a role should seek other work. They are dangerous as resource managers.

A characteristic and fundamental role of a good manager is to involve other new managers unselfishly into his or her own important projects. If even the best managers by themselves cannot accomplish an entire resource task in a single assignment or a single career, it is obvious that a critical role of a manager is to seek out, bring along, train, delegate to, and develop new talent as a replacement.

Managers are measured by results alone, not by efforts they expend, or their knowledge, or how large a staff they supervise. And one must consider those *latent image* results that develop to *visible images* only decades later. The ablest of the managers are sensitive caretakers who hand along park resources to their apprentices in not

Bob Belous

Managing resources which are hunted for a subsistance living by native inhabitants of a national park is a difficult new dimension to resource management.

only as fine a shape as they themselves received them, but with only those latent image impacts agreeable to meeting the park resource goals. Not an easy order, so good resource managers give sufficient thought to the future, particularly to the subtle omens indicating resource trends.

Who are these new managers who, to be reasonably effective, must possess access to King Solomon's Ring? Titles and position descriptions are deceptive. Or, not all genuine resource managers are so titled. Some who wear that title perhaps are not. A few months back I floated the Colorado with Sam West, a Grand Canyon river-runner ranger. Resource management is neither in his job description nor is his bag. But he showed where he and volunteers, YCC, and other river rangers were consolidating the eroding mosaic of inner canyon hiker and burro trails into single, ecologically sensitive foot trails. They'd hauled tons of river alluvium to obliterate the erosion damage, planted seeds and seedlings from correct nearby native plant seed sources. By demonstration, he taught others how to carry on. Whatever his job or title, Sam is an able resource manager.

Rangers as Resource Managers

Many superintendents, often our directorate, are responsible resource managers. Once most rangers were resource managers, and certainly in Alaska, Haleakala and such places where the new wave hasn't yet reached, they still are. Sadly, a reason for emphasis on new resource management divisions is, I believe, because rangers of many parks preoccupy themselves with such unduly perfectionist standards that they scarcely talk resources anymore.

Occasionally rangers, fully fire-qualified, can't identify key plant species in their forest systems much less evaluate how significant species of different size classes respond to varying intensities of fire. Or they might direct a fire line swath directly through an early man archeologic site or an endangered plant critical habitat. One is scarcely a manager of resources who doesn't at least know them. Parks with such rangers drift toward developing separate resource management divisions to assure competent ecologist, archeologist, historian, architect or maintenance management talents are applied to the resource caretaking responsibility.

There is no proper or improper organization. However, the resource management function must be staffed for performance with the very best talent, motivated toward resource management. If rangers neglect the responsibility and fail to perform it in their highest priority, superintendents have no choice but to delegate this vital responsibility elsewhere.

The role of the new resource managers has not gotten easier. New technology now demands management judgments where once standard actions could be done by rote. Old line parks like Yellowstone weren't faced with mineral claims, oil leases, private inholdings, sticky rights-of-way. Some new areas test the skills of *any* manager.

Challenges to Resource Managers

At Cape Krusenstern prehistoric man subsisted on seals, walrus, whales, fish and waterfowl at the edge of the sea. Inland was virtual desert to those who must live from the sea. The beachline changed as regular currents deposited ever new beach ridges. With each new deposit, people moved seaward and left a remarkable chronology in horizontally-laid beach ridges—an uninterrupted archeology from some 40,000 years ago until now.

Problems? The recent Eskimos still subsist on the most recent ridge next to the sea, eating rare marine mammals and migrant waterfowl eggs and young. Also, Krusenstern wildfires, if not suppressed, threaten the Eskimo towns. If fires are suppressed carelessly, bulldozers destroy precious archeologic sites. Thus, Mack Shaver, superintendent of Cape Krusenstern National Monument, needs to know more about archeology than burning indices to suppress fires, and likely Mack will spend more hours chewing the fat about park resources with subsistence Eskimo inhabitants than anyone could ever perceive as prerequisite to a resource management endeavor.

Elsewhere, some relatively new, generally accepted, operations like letting fires burn under appropriate prescriptions in feral forest systems may become very complex in places such as the Four Corners, Arizona's Kaibab, and the Sierra. Clean Air Standards, smoke dissipation and monitoring must be cranked into future prescriptions or the use of fire as a resource tool will be curtailed. Not only is it illogical to complain that proposed coal-fired power plants threaten scenic visibility at Bryce or Grand Canyon while we allow let-it-burn smoke to obscure the same canyon scenery but the city of Phoenix may legally block our use of fire unless we convince them with hard data that *our* smoke dissipates elsewhere and doesn't cause *their* smog. New resource managers need a far wider view than merely one within our own province.

Conclusion

Park resource managers perform the strategy and action needed for the National Park Service to comply with the 1916 Act requiring that we ". . . conserve the scenery and the natural and historic objects and the wildlife . . . (and) . . . leave them unimpaired for future generations." We've comprehended this to be a complex and trying task, requiring skillful, persistent and long-sustained management to avoid failure. The resource manager's role in that endeavor is to make decisions, devise strategies, and take actions to get the right things done on time. Those strategies involve sound, long-range resource plans based upon accurate knowledge, monitored progress, and allocating best talent and money to highest priority resource opportunities (and developing apprentice talent to insure long range continuity).

It would appear that those who might take their old role as resource manager frivolously or ineffectively have failed, and indeed, are personally accountable. Managers are measured by results alone, not by procedures they follow or the energies they expend.

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