DRAFT

THE NATIONAL PARK SERVICE INVENTORY AND MONITORING PROGRAM: PHASE I OVERVIEW AND STRATEGY

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INTRODUCTION

The National Park Service (NPS) occupies a very unique and critical position in American -- indeed worldwide --natural resource conservation. Probably no ecosystem on earth today remains totally unaffected by modern human activities. But, in a world where natural places have become so few and precious, knowledge of the composition and function of relatively unaltered places is critical. Many of the units of the NPS represent such places. This fact has led some to state that preserving the natural resources (and natural processes) in the national parks may be the most important legacy the Park Service can provide American conservation.

Realization of the unique value of NPS units to American conservation has led to the development of organizational policies designed to insure the protection and preservation of those resources. For example, NPS policy requires that park managers conduct natural resource inventory and monitoring efforts in order to determine the condition and status of natural resources under their stewardship, have the means to detect changes in those resources, and understand the forces driving the changes in order to fulfill the NPS mission of conserving parks in an unimpaired condition (Management Policies 4:4).

The extent to which natural resource inventory and long-term monitoring have actually been implemented in the NPS varies greatly throughout the system. Few parks, with the possible exception of some International Biosphere Reserve units, have all of the elements of a comprehensive I&M program. Most park units have completed at least partial natural resource surveys and a significant number have implemented monitoring programs around specific park management issues and concerns. This is an impressive and important beginning but a more comprehensive approach is needed if the Service is to deal effective with the full array of intrinsic and extrinsic threats facing the parks.

Recognizing that a greater effort is needed, the Associate Director for Natural Resources appointed a special Servicewide I&M Task Force in 1989 and gave that group the assignment of developing a workable plan for implementing natural resources

inventory and monitoring on a programmatic basis throughout the entire NPS. Implementation of that group's recommendations began in earnest in fiscal year 1991. This manuscript summarizes the progress of that effort to date and provides an outline of projected future activities.

PROGRAM STRUCTURE AND MANAGEMENT

The Servicewide I&M Task Force used as its starting point the program strategy laid out in the 1987 "Evison Report." The ensuing program development effort built on that report and relied heavily upon experiences gained by individual parks which had previously initiated monitoring programs in various parks. In particular, the approach developed by the Western Region was selected as a model for the Servicewide effort.

The Task Force recommended a "two-phase" programmatic approach. During the first 10 years (Phase I), the Task Force recommended that the Servicewide I&M Program complete basic natural resource inventories for all natural resource park units in the system, implement comprehensive monitoring programs in a selected sample of "prototype parks", and design monitoring programs for a portion of the other parks in the system. Thus, the recommended focus of Phase I was on : (1) preparing the parks for long-term monitoring and, (2) developing the expertise and experience needed to design and implement effective natural resource monitoring programs in individual park units. For Phase II, the Task Force recommended that long-term monitoring be extended to all natural resource parks in the NPS and continued in perpetuity.

Several significant events giving additional structure and direction to the Servicewide program have occurred since the task force completed its deliberations. For example, NPS-75, a Servicewide policy guideline for designing and implementing inventory and monitoring programs in individual park units, has been published (NPS 1992). A Servicewide Inventory and Monitoring Program Coordinator has also been hired to work in the office of the Deputy Associate Director for Natural Resources in Washington D.C. The Servicewide Coordinator will work directly with a National Technical Advisory Committee (Appendix A) established to assist in various aspects of program development and implementation as well as with Regional I&M Coordinators in all 10 NPS regional offices. Finally, a listing of the park units containing significant quantities of natural resources have been identified (Appendix B). Collectively, these units represent the NPS "I&M System".

STRATEGIC I&M ACTION PLAN

A draft strategic I&M action plan, designed to guide Phase I of the Servicewide program, was recently completed and is now being reviewed. The strategic plan identifies five programmatic goals (Table 1) and objectives as well as specific actions needed to accomplish those goals and objectives. The following briefly describes the goals contained in the strategic plan and the rationale behind them.

Goal 1: Natural Resource Inventory

Natural resource inventories are accounts of park resources, including the presence, class, distribution, and normal variation of plants, animals, and abiotic components as water, soils, landforms, and climate. Thus, inventories are designed to contribute to a statement of the condition of park resources, which is best described in relation to a standard condition such as the natural or unimpaired state. They may involve both the compilation of existing information as well as the collection of new information. Baseline data about natural resources is fundamental to the management of national parks. It should go without saying that park managers cannot do an effective job of managing park resources if they do not know what those resources are.

In recognition of that importance, a large number of parks have at least initiated the collection of baseline data but have attained varying degrees of success. A recent Servicewide survey (Stohlgren et. al. 1992) revealed that only about 20 percent of all units have acquired a significant amount of such data and that the data which has been collected varies greatly according to type (e.g. taxonomic group, geo-physical) and geographic distribution. Furthermore, the quality of the data currently available is largely unknown.

The NPS long-term goal must be to insure that every unit containing significant quantities of natural resources has at least a nominal inventory of those resources and that those data are available in a data management system consistent with park management needs. To accomplish less would be to undermine the agency mandate of providing adequate resource protection and preservation. Later sections describe in greater detail the approach which will be used to complete baseline natural resource inventories in natural resource parks throughout the Service.

TABLE 1. Long-term programmatic goals adopted for the National Park Service Servicewide Natural Resource Inventory and Monitoring Program.

• Inventory the natural resources and park ecosystems under National Park Service stewardship to determine their nature and status.
• Monitor park ecosystems to better understand their dynamic nature and condition and to provide reference points for comparisons with other, altered environments.
• Develop the expertise and techniques needed to integrate natural resources inventory and monitoring information into National Park Service planning, management, and decision-making.
• Establish natural resource inventory and monitoring as a standard practice throughout the National Park Service which transcends traditional program, activity, and funding boundaries.
• Share National Park Service accomplishments and information with other natural resource organizations and form partnerships for attaining common goals and objectives.

Goal 2: Ecosystem Monitoring

Natural resource monitoring refers to the long-term, systematic repetition of a specific resource survey and the analysis of those data to detect or predict changes in natural resource condition. Such ecosystem monitoring studies must be implemented throughout the NPS to acquire the quantitative information resource managers need to determine resource conditions and trends over time. Basically, ecosystem monitoring needs to be the "heart and soul" of any effective management program aimed at keeping track of natural resource conditions in the parks and evaluating threats to those resources over time and space.

The over-all objective of the Phase I monitoring effort is to develop the experience and expertise needed to implement long-term monitoring Servicewide within ten years. To meet this objective, the Servicewide Program will implement a system of experimental or "prototype" monitoring parks in an effort to answer 3 fundamental questions. How can the NPS: 1) design and implement monitoring programs within individual parks or clusters of small parks to meet resource management needs, 2) effectively transfer what has been learned in one park to another park occupying a similar ecological setting, and 3) implement long-term monitoring in approximately 250 natural resource park units in the shortest amount of time and at the least cost? Phase I monitoring efforts are also described in greater detail below.

Goal 3: Planning and Management Technology

Park-wide baseline inventories and monitoring studies are critically needed to acquire data about the natural resources and ecosystem mechanisms operating in all natural resource park units. Long-term data sets have a tremendous amount of scientific value in terms of developing better understandings of park ecosystem dynamics and facilitating comparison with other areas.

However, given that the NPS is a land-management agency, it becomes equally important to develop tools and procedures to fully integrate inventory and monitoring data into planning and decision-making and establish priorities at the park and regional levels. Tools must be developed and implemented throughout the NPS which will allow data sets acquired through inventory and monitoring programs to be used effectively for identifying alternative courses of management action, assessing trade-offs, and evaluating consequences. Furthermore, organizational processes need to be implemented to insure that this type of information is readily available to policy makers, planners, and managers at various levels throughout the NPS.

Goal 4: Program Integration

To have a significant, long-term impact upon natural resources preservation and management in the NPS, steps must be taken to insure that natural resource inventory and monitoring are fully integrated along with all other activities at the park, regional, and national levels. It is unlikely that the Servicewide I&M Program will accomplish the desired results if it is viewed as a "special initiative" rather than as a vital requirement for effective natural resource preservation and protection.

The importance of inventory and monitoring is already recognized by many NPS entities. In fact, natural resource inventory and monitoring studies are now being conducted by several NPS organizational units other than Natural Resources, e.g. Planning and Development, Operations. Efforts are also being carried out at various organizational levels (e.g. regional and park-specific). The goal must be to insure that these various efforts are well coordinated and focused on the same long-term objectives to achieve maximum benefits, avoid duplication of effort, and prevent unnecessary expense. Accomplishing this goal will require that the Service develop interdisciplinary policy guidelines, budgetary requests, and organizational structures which consolidate ecological inventory and monitoring efforts and improve leadership, coordination, and accountability.

Goal 5: Partnerships and Cooperation

The NPS is undertaking its Servicewide I&M Program at a time when huge federal deficits are having major impacts upon Federal program priorities and policies. There is severe competition, not only within the NPS but between agencies as well, for the funds needed to finance the NPS I&M Program. Thus, the NPS must make every effort possible to share resources and knowledge with sister agencies pursuing similar goals and objectives and thus avoiding unnecessary duplication of effort.

Several other Federal agencies and professional organizations have undertaken efforts similar to the NPS Servicewide I&M Program. For example, the U.S. Department of Defense has developed and initiated the Land Condition Trend Analysis (LCTA), and LEGACY programs, both designed to acquire information about natural resources on military installations nationwide. The U.S. D.A. Forest Service, in association with the Environmental Protection Agency, has developed a National Forest Health Monitoring Program. The National Science Foundation is also actively involved in long-term data collection and monitoring activities. These agencies have accumulated a

tremendous amount of expertise and knowledge that could benefit the NPS program. The NPS will pursue every opportunity for developing cost-sharing and technology-exchange agreements with those and other appropriate agencies.

PHASE I NATURAL RESOURCE INVENTORIES

The acquisition of natural resources data for approximately 250 I&M park units represents a tremendous undertaking that perhaps can best be accomplished through the implementation of a well-coordinated, systemwide data collection initiative. By undertaking such an initiative, as opposed to requesting that each individual park obtain its own natural resource data, the Service can better insure that the inventory will satisfy a number of important criteria. For example, the information collected should at least contain the "core" set of data needed to deal effectively with park planning and management. In a similar manner, the data collection effort must address the issues of long-term data compatibility and integrity. It is imperative that baseline data be collected and maintained in accordance with clearly defined protocols and quality-assurance standards.

Another major consideration in the data acquisition process has to be cost effectiveness. In order to reduce costs, the Service should consider clustering individual park units to achieve economies of scale that might otherwise not be available if each park were to conduct inventories individually. Costs may also be minimized by negotiating national agreements with sister Federal agencies at the national level. For these reasons, the Phase I natural resources inventory will be conducted as a Washington Office initiative with strong regional and park oversight and priority setting.

The following sections briefly outline the components which have been identified for the Phase I natural resources inventory as well as some of the mechanisms to be used in the data acquisition process. These natural resource inventory components represent the recommended minimal data set for all natural resource parks listed in NPS-75. A schedule for completing the inventory is also provided below.

Automated Historical Data Base / Bibliography

This inventory item is based upon the belief that, at a very minimum, every park unit should have a basic compilation of all of the natural resource studies which have occurred within the park boundaries during the past. Therefore, completion of this

inventory component will involve the compilation of historical scientific material currently being stored in the park, including rare event records, maps, photographs, manuscripts, specimen collections, etc. Unlike the other components of Phase I inventory, the compilation of historical information is seen as a park responsibility which should be handled within the park's base or with regional project funding if seasonal assistance is needed.

Park bibliographies should be developed which include all descriptive documents and scientific studies pertaining to park natural resources, including extended searches for published and unpublished documents outside the park, and be incorporated into an automated program along with procedures for maintaining the information current. Plans are to evaluate alternative computer-based systems for creating and maintaining automated bibliographies and provide recommendations to park personnel, probably sometime during fiscal year 1993.

Species Lists

Similar to historical studies and publications, there is also a strong belief that every natural resource park should possess listings of the priority biota currently known to occur within the park boundaries and that those listings be incorporation into a national data base to facilitate regional and/or national summaries. Recommended priority biota groups include: 1) vascular plants, 2) vertebrates, 3) Federally and State listed threatened and endangered species, and 4) species of special concern within the park, including endemic and exotic species, as well as others based on legislation or other factors.

Vascular plants have been recommended for priority attention because they are the predominant biota in most terrestrial ecosystems. Likewise, vertebrates, also recommended as priorities, are a good starting point for animal species because they often are the subject of management actions or concerns, including those related to threatened and endangered status. Additionally, information is likely to be more readily available in most ecosystems for both vascular plants and vertebrates, compared to other classes. Because this is the case for most parks, priority is accorded these organisms and Servicewide databases for vascular plants and vertebrates will be maintained.

However, for parks containing significant ecosystems where vascular plants and/or vertebrates are not the primary ecosystem components, for example in marine areas, nonvascular plants and invertebrates may considered to be as high or higher priority species for park management. These classes of organisms should be added to the basic species list requirements where this condition occurs.

Vegetation Mapping

Perhaps no single piece of natural resource inventory data has more overall application and utility for park management than does a good, high-resolution map of major plant communities occurring within park boundaries. For example, such maps are indispensable for studies of wildlife habitat and development of fire management plans. For that reason, a Phase I inventory goal will be to insure that every I&M park unit has a vegetation map based upon aerial photography no more than 5 years old and suitable for input into a Geographic Information System (GIS).

The vegetation inventory will be completed under terms of a Servicewide contract or agreement with an outside entity which has not yet been identified. Maps are to be developed with a minimum unit of 1 acre or less and, except for Alaskan parks, mapped to a 1:24,000 map base. In Alaska, spatial accuracy will be somewhat less because the standard map base in that area is 1:63,360. Vegetation classifications will be at least to the plant association level of detail and each class must obtain a level of 85% correct as the minimum level of accuracy.

Completion of the vegetation inventory will require that the NPS develop and adopt vegetation classification schemes that, not only meet NPS internal needs, but also provide maximum opportunity for linkage with data bases maintained by other Federal and state resource management agencies. These classification schemes will be developed during fiscal year 1993 and likely involve regional teams of scientists from both the NPS and outside agencies.

Base Cartographic Maps

Base cartographic maps include several themes useful for a wide variety of park planning and management activities. Included in this inventory will be digital elevation models (DLM), and digital line graphs (DLG) for park boundaries, hypsography, hydrography, and transportation networks. The acquisition of base cartographic maps will be coordinated by the Washington Office and produced through a cost-sharing agreement with the U.S. Geological Survey (USGS).

Soils and Geology

Like base cartographic maps, soils and geology maps are often useful in a variety of park planning and management situations where site suitability must be evaluated. As one example, soil characteristics are important considerations in wetland classification and delineation. Geology maps may assist planners in their efforts to locate suitable areas for visitor center or road developments.

Soils and geology mapping for the I&M parks will be coordinated by the Washington Office and accomplished through national agreements with other Federal agencies. The soils inventory will be conducted through an agreement with the Soil Conservation Service and consist of SCS Order 3 surveys, except where more detailed surveys are required for park management purposes.

Geology mapping will be undertaken under a national cost-sharing agreement with the USGS. Map products will include both bedrock and surficial geology. Plans are being developed to have the USGS assemble regional teams of scientists who will assist individual park managers in their efforts to define the types of geologic mapping needed to address park management issues and also advise park personnel regarding the quality and availability of existing geologic mapping.

Species Distribution

A Servicewide objective for species-related information is to document the presence of at least 80 percent of all plant and animal species occurring within a given part unit's boundary. Such information is needed to adequately assess the level of biodiversity occurring with the park unit and also for monitoring changes in species assemblages over time. Achieving this objective will necessitate field surveys to confirm the existence of currently reported plant and animal species and to document the presence of new ones. This inventory will also produce distribution maps for species of special park management concern and T/E species.

Uncertainty currently exists regarding how these inventories can be completed in the shortest amount of time and at least cost. However, current thinking is that the inventories could probably be completed most efficiently and cost-effectively by assembling regional field crews which would travel from park to park under the general supervision of Regional Chief Scientists and park personnel. It may be necessary to conduct field research studies over the next 2-3 years to develop field protocols needed for conducting these plant and animal surveys. Thus, this inventory activity will be scheduled for completion

during the latter portion of the Phase I period and after needed protocols have been developed.

Water Resources

Many park units are currently being threatened or impacted by the actions of other agencies operating outside park unit boundaries. For that reason, it is imperative that the Service obtain accurate inventories of water resources within park boundaries with which to detect and quantify changes in both water quantity and quality. Accordingly, the Servicewide inventory will map location of streams, lakes, wetlands, and groundwater supplies. Water quality use classifications based upon the Clean Water Act will also be obtained.

Several basic water quality parameters for "key" water bodies (determined on the basis of size, uniqueness, threats, etc) within the park boundaries will also be included in the Phase I water resources inventory. Water quality parameters will include:

- Alkalinity
- pH
- Conductivity
- Dissolved Oxygen
- Rapid bioassessment baseline (EPA/state protocols, involving fish and macrinvertebrates)
- Temperature
- Flow
- Other constituents where important as determined on a case-by-case basis, including:
  - Toxic elements
  - Clarity/turbidity
  - Nitrate/nitrogen
  - Phosphate/phosphorous
  - Chlorophyll
  - Sulfates
  - Bacteria

Field protocols for conducting these water quality assessments currently do not exist and will have to be developed by personnel from the Water Resources Division. Tentative plans for completing water resource inventories call for the use of regional field assessment teams working under the overall guidance and direction of Regional Chief Scientists and park personnel.

Air Quality and Meteorological Data

Degradation of air quality and visibility constitutes another major problem confronting many park units. The Air Quality Division has implemented monitoring efforts in many Class 1 units but considerably more work needs to be done if the Service is to be in a position to effectively detect and respond to threats to air resources.

The Servicewide program will document the location of EPA air quality monitoring stations within close proximity (50 - 100 km) to park boundaries and summarize those data for all I&M parks in an NPS Air Quality Atlas. In this manner, data from these stations may be used to get a rough assessment of air quality within individual park units. Also included in the inventory and in the Atlas will be data on visibility and related parameters. Precipitation and meteorological data included in the inventory will consist of basic information on annual precipitation, relative humidity, wind speed and direction, maximum and minimum daily temperatures.

PHASE I ECOLOGICAL MONITORING

The NPS "management product" is healthy ecosystems. To fulfill the agency's legislative mandate, NPS managers are required to take actions which will preserve and protect park ecosystems or restore them to pristine conditions were necessary. To meet this need, ecosystem monitoring must be implemented throughout the Service which provides NPS managers with two fundamental capabilities. First, "strategic" monitoring is needed to provide park managers with an ability to "anticipate the future", i.e. an ability to peer into the future and predict the likely consequences of some anticipated event in terms of ecosystem health and integrity. Provided with this information, park managers can take corrective actions before those impacts severely degrade ecosystem health or become irreversible.

Secondly, in close concert with prediction, monitoring programs are needed to provide park managers with a system of "checks and balances". Monitoring of this nature might be termed "tactical" since it should allow managers to evaluate the effectiveness of their current management actions and make localized corrections if necessary. If a particular ecosystem component is mismanaged or some ecosystem impact undetected, monitoring studies should alert managers to those situations.

Fulfilling NPS management needs will require that long-term monitoring programs focus on developing a better understanding of national park ecosystem dynamics. Thus, it will be more important to focus monitoring efforts on key ecosystems processes and mechanisms of change rather than on qualitative assessment and description. The long-term data sets acquired through these studies can then be used to establish quantitative standards, or indicators, of ecosystem integrity and health defined in terms of ecosystem composition, structure, and dynamics.

Prototype Monitoring Parks

A fundamental goal of the Phase I effort is to position the NPS so that it can quickly and efficiently implement long-term ecological monitoring systemwide during Phase II of the program. Four basic activities are being stressed during Phase I to attain that goal. These activities are: 1) prototype monitoring, 2) conceptual model development, 3) infrastructure support, and 4) sister park monitoring.

During the Phase I effort, the Washington Office will provide funding to establish a network of "experimental" or prototype monitoring parks. The charge to these prototype parks will be to determine how to effectively design and implement park-wide ecological monitoring so that the knowledge gained can be shared with other park units. Because of the tremendous variability in the size and ecological complexity of NPS units, it will be important for the prototype parks to evaluate alternative spatial monitoring paradigms. Therefore, the prototype parks will be encouraged to evaluate long-term monitoring at the population (individual species), watershed (subunits within park boundaries), and landscape (areas within and outside park boundaries) levels.

In 1992, prototype monitoring programs were initiated in four units -- Denali, Channel Islands, Shenandoah, and Great Smoky Mountains National Parks. These units were selected largely because they had essentially completed baseline natural resource inventories and were in a position to effectively implement long-term monitoring programs without lengthy delays. The monitoring programs implemented by those prototype parks have been briefly summarized by Williams (1992). The Phase I program goal is to eventually establish a network of 8 - 10 prototype monitoring parks. The timeframe and process to be used in selecting the additional prototype units are discussed below.

Conceptual Modeling

A second major focus of the Phase I ecological monitoring program relates to preparing "sister" parks for long-term monitoring. Sister parks are defined as units not conducting prototype monitoring studies but having ecological attributes similar to one or more prototype parks. A goal has been established of funding the development of conceptual models for 50 sister park units during Phase I. Conceptual monitoring models are discussed in NPS-75 and refer to the major ecosystem components, processes, and stresses interacting in the park.

Several different approaches for developing ecological monitoring prorams have been published in recent years, including those by Rugh and Peterson (1992), Davis (1989) and Abule et al (in Press). Because of the tremendous ecological diversity among NPS units, it is likely that a number of different approaches or combinations of approaches will be required to meet NPS needs.

Infrastructure Support

The third major component of Phase I ecological monitoring effort, infrastructure support, also relates to preparing non-prototype park units to implement long-term monitoring as quickly as possible. As conceptual monitoring designs are completed, emphasis will be given to exporting the monitoring protocols developed by the Prototype parks to sister parks located in similar ecological settings. However, this will require that those sister parks have in place the necessary infrastructure to effectively implement long-term monitoring studies.

The Servicewide program will provide infrastructure funds to park units so that they may acquire office space, computer facilities, and related items needed to effectively initiate long-term monitoring. By providing this type of support during Phase I, the Service should be in a better position to "hit the ground running" when full-scale monitoring is implemented systemwide during Phase II.

Sister Park Monitoring

Lastly, the Servicewide Program also plans to provide at least partial funding to parks so that they may initiate their long-term monitoring programs. These funds will be provided primarily to implement the monitoring protocols developed by the Prototype parks but protocols which have been developed and adequatedly tested by other, non-prototype park units may also receive funding. The major objective of this effort is for the NPS to gain valuable insights into how transferrable monitoring protocols are between individual park units and how much

modification to those protocols may be required.

PHASE I TIMELINE AND SCHEDULES

Phase I of the Servicewide program is scheduled to occur over a period of approximately 10 years. The schedule for each major activity is as follows.

Inventory Schedule

The 10-year timeline and estimated cost for completing Phase I natural resource inventories are illustrated in Appendices C and D respectively. In many respects, fiscal year 1993 will serve as a preparation year for several of the inventories. For example, in fiscal year 1993, needs and standards for bibliographies will be assessed. Existing bibliographies will be evaluated and standard software adopted. The Service will also develop classification schemes for vegetation mapping and procedures for water resource field sampling during fiscal year 1993.

The NPS strategy for completing the Phase I natural resource inventory is to adopt a "thematic" or data layer approach. Under this approach, the same type of data will be collected simultaneously for a number of individual park units. Each inventory component described above will essentially represent an independent survey. Thus, given that the goal is to complete inventories in approximately 250 park units over a period of approximately 10 years, it becomes important to prioritize inventories at the individual park level.

Park-specific resource inventory priorities will be assigned on the basis of individual park management problems and issues as well as data needs identified in park Resource Management Plans. Both science and resource management personnel will be asked to assign a numerical sequence in which the inventories should be conducted within that particular park. For example, some parks may decide that vegetation mapping is the piece of information most urgently needed to address park-specific management issues and concerns. Other parks, however, may already have acceptable information on vegetation and decide that completing the listing of plant and animal species occurring in the park is highest priority.

Another important consideration of the effort is to insure that the resource inventory process is closely coordinated with the development of General Management Plans (GMP) in each region. Schedules for the Servicewide GMP planning effort over the next

few years will be incorporated into over-all park priorities. In this manner, natural resource information should be fully integrated into those planning studies. Final priorities for the Phase I inventory are expected by the early part of 1993.

Additional Prototype Monitoring Parks

Given the large number of natural resource park units and the fact that they represent a tremendous diversity of ecological settings and conditions, it becomes imperative that each prototype monitoring park be carefully selected. The Service must assure that the protocols developed by the prototype parks during Phase I have the maximum amount of exportability to other park units.

For these reasons, all natural resource park units have been divided into biogeographic associations loosely defined in terms of the ecological similarities shared by park units within each associations. For example, one of the associations is "Pacific Coast". The assumption is that all park units located along the Pacific Coast should have certain ecological conditions in common and it seems probable that what is learned about monitoring in one of those units would have greatest applicability in other Pacific Coast units. Those associations and the individual park units tentatively assigned to each are provided in Appendix B.

The ideal situation would be to select at least one prototype monitoring park in each biogeographic association. That seems unlikely given anticipated funding constraints. Therefore, a selection process will be used to select prototype parks within biogeographic associations most representative of the overall NPS. During this process, it will be important to consider both the number of park units in each association as well as the total percentage of NPS managed lands involved.

Once a biogeographic association has been selected for inclusion, the approach for selecting a prototype park within that biogeographic association will be to identify the 3-4 parks currently best positioned to begin prototype monitoring. Those 3-4 parks will then be invited to prepare and submit competitive proposals to the Washington Office for final selection. It is important to note that a prototype "park" might actually consist of a cluster of small parks. In fact, there is strong support for having at least one of the prototype parks represent a cluster of small units. In addition to a proposal's scientific merits, major criteria to be considered for prototype park selection will also include: 1) park readiness and 2) number of ecosystem threats.

Park Readiness

A candidate park's existing readiness to serve as a prototype monitoring park will be evaluated on the basis if the following conditions:

- Basic Resource Inventory Status - The selected park should have essentially completed natural resource inventories.

- Organizational Capability - The selected park should already have in place much of the infrastructure needed to support long-term monitoring.

- Park Commitment to I&M - Prototype monitoring has to be a long-term proposition. Thus, the selection process will stress evidence that the candidate park has already made a strong commitment to long-term monitoring. This commitment might be evidenced by the priority the candidate park has given monitoring in its Resource Management Plan or out-year budget requests.

- Existing Monitoring Studies - It would be desirable to select prototype parks which already have some monitoring studies underway. This could conceivably reduce the cost of implementing a full-scale monitoring program in that park as well as providing additional evidence of the park's commitment to ecological monitoring.

Number of Threats

The principle focus of the prototype monitoring effort is to learn how monitoring and long-term data sets can be used by the NPS to deal effectively with specific threats -- both intrinsic and extrinsic -- to the park's ecosystems. Thus, the number of threats currently existing within a candidate park will receive consideration during the process of selecting prototype monitoring parks. Basically, threats to park ecosystems will be broken down into the following categories:

- Ecosystem Integrity - Park ecosystems show evidence of past abuse and degradation.

- Altered Air Quality - Park air quality is currently being impacted by extrinsic sources.

- Altered Water - Water resource quality and/or supply is currently being impacted.

- Excessive Resource Consumption - One or more of the park's consumable resources is being overharvested.

- Alien Species -- Non-native plants and/or animals are currently threatening park ecosystems.

- Park Operations - The park is experiencing negative impacts from excessive visitation.

- Urban Encroachment - The park is situated in such a manner that urban developments are impacting natural resources within the unit's boundaries.

As previously noted, the first four prototype monitoring parks were selected in fiscal year 1992. Those units are members of the Deciduous Forest, Mediterranean, and Artic/Sub-Artic biogeographic associations. Thus, it is unlikely that additional prototype monitoring parks will be selected from those associations. Parks wishing to be considered as future Prototype monitoring units should focus on completing baseline natural resource inventories and developing the infrastructure and staffing needed to support long-term monitoring on a programmatic basis.

Selection of the additional prototype monitoring parks will depend largely upon the availability of funding. However, the strategy will be to select and fund additional prototype parks as early in Phase I as possible to maximize the amount of monitoring experience obtained. Appendices E and F illustrate the projected schedule and cost of adding prototype monitoring parks and related long-term monitoring activities.

DATA MANAGEMENT

Implementation of the Phase I program will result in a tremendous amount of detailed data. To maximize benefits, it is essential that those data be stored in computer data bases and linked with such specialized tools as computer models and GIS systems to yield management information for park managers and planners. Therefore, data management has to be an important consideration in the Servicewide I&M effort.

The Servicewide Program will develop a recommended conceptual data management framework designed to foster consistency throughout the Service. Included in this framework will be recommendations for minimal site installations (hardware and software) and minimal site capabilities (analyses, reports, and displays). Current plans are to complete this effort by the end of 1993.

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APPENDIX A. -- National Park Service personnel providing technical guidance and coordination for the Servicewide Inventory and Monitoring Program.

I. SERVICEWIDE INVENTORY AND MONITORING ADVISORY COMMITTEE

A. Committee Function

The Servicewide Inventory and Monitoring Advisory Committee was established by the Associate Director, Natural Resources to provide overall technical direction and guidance to the program. The Committee meets twice annually and is chaired by the Servicewide I&M Coordinator. Committee members represent a cross-section of NPS entities involved with natural resources and serve terms of 3 years.

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APPENDIX B -- National Park Servive natural resource units according to biogeographic association.[1]

ARCTIC/SUB-ARCTIC UNITS

Aniakchak National Monument/Preserve
Bering Land Bridge National Preserve
Cape Krusenstern National Monument
Denali National Park/Preserve
Gates of the Arctic National Preserve
Katami National Park
Kenai Fjords National Park
Lake Clark National Park/Preserve
Noatak National Preserve
Wrangell-St Elias National Park/Preserve
Yukon-Charley Rivers National Preserve

ATLANTIC/GULF COAST UNITS

Assateague Island National Seashore
Biscayne National Park
Cape Cod National Seashore
Cape Hatteras National Seashore
Cape Lookout National Seashore
Canaveral National Seashore
Cumberland Island National Seashore
Everglages National Park
Fire Island National Seashore
Fort Pulaski National Monument
Gulf Islands National Seashore
Jean LaFitte National Historic Park & Preserve
Padre Island National Seashore

CAVE UNITS

Carlsbad Caverns National Park
Jewel Cave National Monument
Mammoth Cave National Park
Oregon Caves National Monument
Russell Cave National Monument
Timpanogos Cave National Monument
Wind Cave National Park

COLORADO PLATEAU UNITS

Arches National Park
Bandelier National Monument
Brices Cross Roads National Historical Site
Canyon De Chelly National Monument
Canyonlands National Park
Capitol Reef National Park
Cedar Breaks National Monument
Colonial National Historical Park
Coronado National Memorial
Dinosaur National Monument
Glen Canyon National Recreation Area
Grand Canyon National Park
Mesa Verde National Park
Natural Bridges National Monument
Rainbow Bridge National Monument
Sunset Crater National Monument
Tonto National Monument
Walnut Canyon National Monument
Wupatki National Monument
Zion National Park

DECIDUOUS FOREST UNITS

Blue Ridge Parkway
Catoctin Mountain Park
Cumberland Gap National Historical Park
Great Smoky Mountains National Park
Indiana Dunes National Lakeshore
Isle Royale National Park
Mammouth Cave National Park
Pictured Rocks National Lakeshore
Prince William Forest Park
Shenandoah National Park
Sleeping Bear Dunes National Lakeshore
Vouageurs National Park

DESERT UNITS

Big Bend National Park
Chiricahua National Monument
Craters of the Moon National Monument
Curecanti National Recreation Area
Death Valley National Monument
El Malpais National Monument

Great Sand Dunes National Monument
Joshua Tree National Monument
Montezuma Castle National Monument
Organ Pipe Cactus National Monument
Petrified Forest National Park
Saguaro National Monument
White Sands National Monument

GREAT PLAINS UNITS

Badlands National Park
Bighorn Canyon National Recreation Area
Devils Tower National Monument
Florissant Fossil Beds National Monument
Fossil Butte National Monument
Grant-Kohrs Ranch National Historic Site
Nez Perce National Historical Park
Scotts Bluff National Monument
Theodore Roosevelt National Park
Wind Cave National Park

LAKE UNITS

Amistad Recreation Area
Apostle Islands National Lakeshore
Coulee Dam National Recreation Area
Crater Lake National Park
Glen Canyon National Recreation Area
Isle Royale National Park
Lake Clark National Preserve
Voyageurs National Park
Whiskytown Unit
Yellowstone National Park

MEDITERRANEAN UNITS

Channel Islands National Park
Pinnacles National Monument
Santa Monica Mountains National Recreation Area
Sequoia / Kings Canyon National Park

PACIFIC COAST UNITS

Aniakchak National Preserve
Cabrillo National Monument
Cape Krusenstern National Monument
Channel Islands National Park
Glacier Bay National Preserve
Golden Gate National Recreation Area
Katmai National Park
Kenai Fjords National Park
Lake Clark National Preserve
Muir Woods National Monument
Olympic National Park
Point Reyes National Seashore
Redwood National Park
San Juan National Historic Park
Santa Monica Mountains National Recreation Area
Wrangell-St Elias National Park

RIVER UNITS

Big Bend National Park
Big South Fork National River & Recreation Area
Black Canyon of the Gunnison National Monument
Buffalo National River
Canyonlands National Park
Chattahoochee River National Recreation Area
Congaree Swamp National Monument
Delaware Water Gap National Recreation Area
Gates of the Arctic National Park
Grand Canyon National Park
Knife River Indian Village National Historic Site
Lake Mead National Recreation Area
New River Gorge National River
Notak National Preserve
Obed Wild and Scenic River
Ozark National Scenic Riverways
Saint Croix National Scenic Riverway
Wrangell - St Elias National Preserve
Yukon - Charley Rivers National Preserve

TEMPERATE - MARINE UNITS

Acadia National Park
Cabrillo National Monument
Channel Islands National Park
Golden Gate National Recreation Area
Point Reyes National Seashore
Redwood National Park

TROPICAL/SUB-TROPICAL UNITS

American National Monument
American Samoa
Big Cypress National Preserve
Buck Island Reef National Monument
Everglades National Park
Fort Jefferson National Monument
Haleakala National Park
Hawaii Volcanoes National Park
Kaloka - Honokohau National Historic Park
Kalaupapa National Historic Park
Puukohola Heiau National Historic Site
Pu' uhonua O Honaunau National Historic Park
Virgin Island National Park
War in the Pacific National Historic Park

URBAN UNITS

Chattahoochee River National Recreation Area
Cuyahoga Valley National Recreation Area
Fire Island National Seashore
Gateway National Recreation Area
Golden Gate National Recreation Area
Indiana Dunes National Lakeshore
Jean LaFitte National Historic Park
Prince William Forest Park
Rock Creek Park
Santa Monica Mountains National Recreation Area

WESTERN MOUNTAIN UNITS

Acadia National Park
Black Canyon of the Gunnison National Monument
Crater Lake National Park
Death Valley National Monument
Glacier National Park
Great Basin National Park

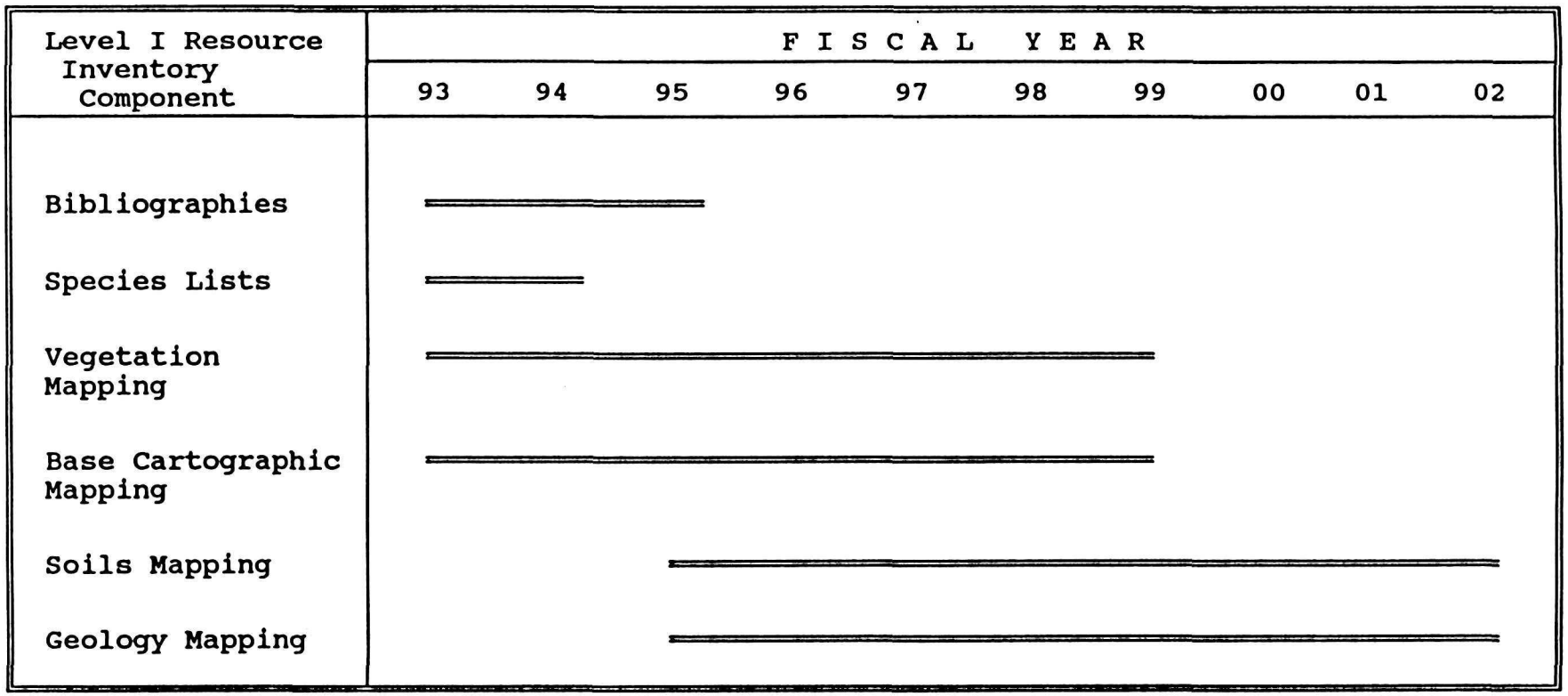
Grand Teton National Park
Guadalupe Mountains National Park
Lassen Volcanic National Park
Mount Ranier National Park
Mount Rushmore National Memorial
North Cascades National Park
Olympic National Park
Rocky Mountain National Park
Sequoia / Kings Canyon National Park
Yellowstone National Park
Yosemite National Park

OTHER UNITS

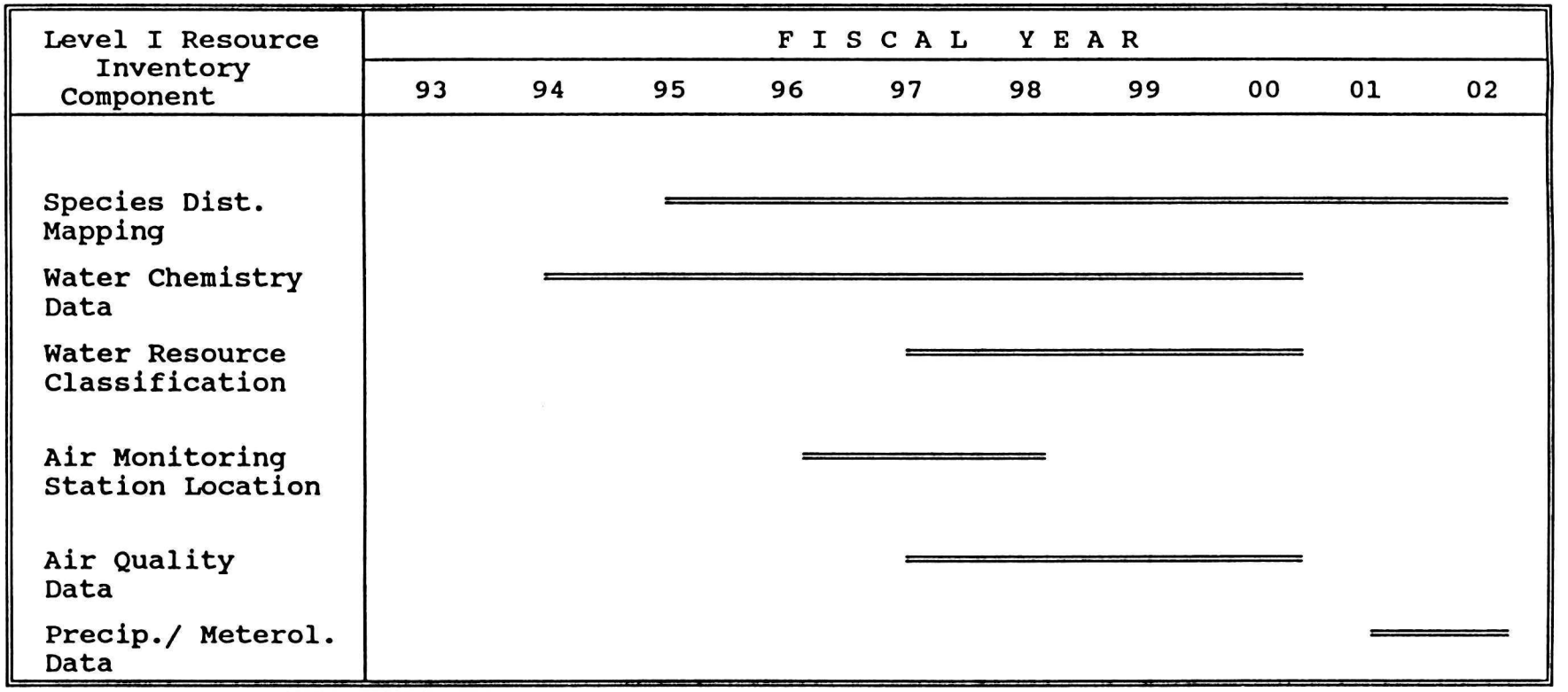
John Day Fosil Beds National Monument
Hagerman Fossil Beds National Monument
City of Rock National Historic Site
Natchez Trace Parkway
Timucan Ecological & Historic Preserve
Big Thicket National Preserve
Capulin Volcano National Monument
Chickasaw National Recreation Area
Hot Springs National Park
Lava Beds National Monument

[1] Some units belong to more than one biogeographic association.

APPENDIX C. -- Projected scheduling of National Park Service Level I natural resource field inventories.



APPENDIX C. (Continued)



APPENDIX D. -- Projected cost of completing National Park Service Level I natural resource inventories. Table entries are in millions of dollars.

Inventory Components	FISCAL YEAR										Total Cost
	93	94	95	96	97	98	99	00	01	02	
Bibliographies	0.1	1.0	1.0								2.1
Species Lists	0.3	0.5									0.8
Vegetation Mapping	1.0	1.0	3.0	6.0	8.0	8.0	3.0				30.0
Cartographic Mapping	0.7	2.0	2.0	3.0	3.0	3.0	2.0				15.7
Soils Mapping			1.0	1.0	1.0	1.0	1.0	1.0	3.0	3.0	12.0
Geology Mapping			1.0	1.0	1.0	1.0	1.0	1.0	3.0	3.0	12.0

APPENDIX D. (Continued)

Inventory Components	FISCAL YEAR										Total Cost
	93	94	95	96	97	98	99	00	01	02	
Species Dist. Mapping			0.3	1.0	1.5	1.5	4.0	5.0	4.4	2.5	20.2
Water Chem. Data		1.0	1.0	1.0	1.0	1.0	1.2	2.0			8.2
Water Resource Classification					0.5	1.0	1.2	2.0			4.7
Air Monitoring Sta. Location				0.1		0.2					0.3
Air Quality Data					0.1	0.2		2.0			2.3
Precip./Meterol Data									0.5	0.5	1.0
Total Annual Costs	2.1	5.5	9.3	13.1	16.1	16.9	13.4	13.0	10.9	9.0	109.3

APPENDIX E -- Projected schedule for long-term ecological monitoring under the Servicewide Inventory and Monitoring Program. Table entries represent the number of additional parks each year.[1]

PROGRAM ACTIVITY	FISCAL YEAR											TOTAL
	92	93	94	95	96	97	98	99	00	01	02	
PARK READINESS												
Conceptual Design	0	0	0	[4]	4	4	6	6	6	6	14	50
Infra-structure	0	0	0	0	[4]	4	4	6	6	6	6	36
MONITORING												
Sister Parks	0	0	0	0	0	[4]	4	4	6	6	6	30
Prototype Parks	4	0	2	2	0	2	0	0	0	0	0	10

[1] Highlighted entries represent the same park units and illustrate the sequencing involved with: 1) conceptual model development, 2) infrastructure support, and 3) initiation of sister park monitoring.

APPENDIX F.-- Projected cost of long-term ecological monitoring under the Servicewide Inventory and Monitoring Program. Table entries are in millions of dollars.

PROGRAM ACTIVITY	FISCAL YEAR											Total Cost
	92	93	94	95	96	97	98	99	00	01	02	
PARK READINESS												
Conceptual Design	0	0	0	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.7	2.5
Infra-structure	0	0	0	0	1.2	1.2	1.2	1.8	1.8	1.8	1.8	10.8
MONITORING												
Sister Parks	0	0	0	0	0	1.0	2.0	3.0	4.5	6.0	7.5	24.0
Protoype Parks	1.0	1.5	3.0	4.0	4.0	5.0	5.0	5.0	5.0	5.0	5.0	43.5
Totals	1.0	1.5	3.0	4.2	5.4	7.4	8.5	10.1	11.6	13.1	15.0	80.8

APPENDIX G -- Total projected budget required to implement the National Park Service Servicewide Inventory and Monitoring Program. Table entries are in millions of dollars.

Fiscal Year	Resource Inventory	Long-term Monitoring	WASO & Regional Support	Annual Budget
92		1.0	0.9	1.9
93	2.1	1.5	0.9	4.5
94	5.5	3.0	0.9	9.4
95	9.3	4.2	0.9	14.4
96	13.1	5.4	0.9	19.4
97	16.1	7.4	0.9	24.4
98	16.9	8.5	0.9	26.3
99	13.4	10.1	0.9	24.4
00	13.0	11.6	0.9	25.5
01	10.9	13.1	0.9	24.9
02	9.0	15.0	0.9	24.9
TOTALS	109.3	80.8	9.9	200.0