



The National Park Service **Inventory & Monitoring**

GUIDELINES FOR BIOLOGICAL INVENTORIES

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Inventory and Monitoring Program National Park Service

INTRODUCTION

The National Park Service's primary mission is to conserve unimpaired the natural and cultural resources and values of the national park system for the enjoyment of this and future generations. In 1998, Congress passed the National Parks Omnibus Management Act, which recognized the need for good scientific information to manage parks by mandating a "program of inventory and monitoring of National Park System resources to establish baseline information and to provide information on the long-term trends in the condition of National Park System resources". Currently, the Service is unable to attain its mission in many parks, owing to a serious lack of scientific information about the nature and condition of resources in those parks, especially biological resources. In addition to a lack of basic information about what biological resources occur in the parks, the Service also generally lacks credible information about the current status of those resources and how they are changing over time in response to the myriad threats and issues impacting those resources.

To address this general lack of credible information about park resources and the new congressional mandate, Congress funds the Servicewide Inventory and Monitoring (I&M) Program of the National Park Service. This national program coordinates systematic efforts to acquire 12 basic data sets for 265 parks with significant natural resources, including basic information on air and water quality; base cartography; weather data; geology, soil, and vegetation maps for the park; a natural resource bibliography; and information about the occurrence, distribution, and relative abundance of vertebrate and vascular plant species in the parks. The I&M Program views these inventories as an iterative process, whereby the national program funds the initial efforts in all parks to compile and organize existing data and fill data gaps through targeted field investigations, after which further additions and refinements to these initial inventories can be made during more in-depth field investigations funded by various sources including the national program. This document defines the general guidelines that the Servicewide I&M Program will follow to conduct those inventories in the 265 parks participating in the program.

PROGRAM GOALS AND OBJECTIVES

The basic goal of the NPS biological inventory program is to provide park managers with comprehensive, scientifically-based information about the nature and status of selected biological resources occurring within park boundaries in a form that increases its accessibility and utility for making management decisions, for scientific research, and for educating the public. The inventories will also lay the groundwork necessary for park managers to develop effective monitoring programs

and to formulate effective management strategies for resource management and protection. To attain these basic goals, NPS biological inventories will be designed to meet three basic objectives:

- ◆ To document through existing, verifiable data and targeted field investigations the occurrence of at least 90 percent of the species of vertebrates and vascular plants currently estimated to occur in the park.
- ◆ To describe the distribution and relative abundance of species of special concern, such as Threatened and Endangered species, exotics, and other species of special management interest occurring within park boundaries.
- ◆ To provide the baseline information needed to develop a general monitoring strategy and design that can be implemented by parks once inventories have been completed, tailored to specific park threats and resource issues.

Geographic Information System (GIS) technology has proven to be a powerful and useful tool for organizing, displaying, analyzing, and integrating natural resource information, and most parks routinely use GIS in park management. Many of the 12 basic inventory data sets are GIS themes (maps), and even information such as species lists and tabular information can be organized and integrated by presenting them as tables in GIS themes. To promote the usefulness and accessibility of natural resource information to managers and scientists, the Servicewide I&M Program will support the development and refinement of Arcview GIS tools and training for their use by parks, and wherever possible will provide information in a form that is compatible with or can be downloaded into a GIS format.

GUIDELINES FOR STUDY PLAN DEVELOPMENT

The Servicewide I&M Program will eventually fund inventories of vertebrates and vascular plants in all 265 parks with significant natural resources, and will use several approaches to allow parks to obtain credible, organized information in a cost-effective manner. Our initial experience has shown that there are considerable advantages, in terms of cost-efficiency and the consistency and interpretability of inventory data, to conducting inventories for all vertebrates and vascular plants in a group of parks working together rather than funding inventories of each taxa on a park-by-park basis.

Therefore, the I&M Program will search for opportunities to minimize duplication of effort and increase efficiency and the quality and consistency of park information by providing funding to efforts involving groups of parks or regional efforts. Funding may also be provided to individual parks if better results cannot be obtained through a multi-park approach. In FY2000, the I&M Program will request a pre-proposal from groups of parks that are next in line to receive funding. Once the pre-proposal has been reviewed and accepted, funding will be provided so that the group of parks can initiate the steps leading to and including the development of a full study plan. The format for the pre-proposal and full study plan are as follows.

Pre-proposal

Initial project evaluation and acceptance will be based upon consideration of a 4-10 page pre-proposal that provides an overview of the proposed inventory project. The pre-proposal should describe how the group of parks and their partners will work together to complete the initial steps of the inventory leading up to and including development of the full study plan. The pre-proposal should succinctly describe for each park: (1) the park's general situation and resources, including a summary of any previous biological inventories conducted in the park; (2) a preliminary list of park-specific objectives for the current inventory, including species and habitats of special concern (including sound justification for why more detailed information is needed for these species) and key management issues relating to biological resources in the parks; (3) the principle members of the inventory team (including phone numbers and email addresses) and a description of how the parks and their partners plan to organize themselves and make decisions about funding allocations and completion of the inventories; (4) a description of how the initial steps of compiling existing information and holding a scoping workshop to determine priorities will be completed, including who will do the work and a proposed schedule; (5) the proposed budget, including any cost-share, to complete the initial steps including development of the full study plan; and (6) specific deliverables, such as summaries of existing information entered into the Dataset Catalog or in tabular form, a report on findings from the scoping workshop, and the full study plan, including delivery dates for these products.

Full Study Plans

The pre-proposal will be reviewed by the I&M Program and discussed with the group of parks or their contractors, after which partial funding will be provided to complete the initial steps (Steps 1-4 in the appendix) of the inventory that lead to the development of the full study plan. The full study plan will define the technical aspects of the proposed inventory in considerably more detail, and is an important component of the overall quality assurance for the project. The following outlines the basic format for sections to be included in full study plans.

Section I: Introduction

The first section of the full project study plan should provide a general introduction to the park ecosystems and biological resources, any completed and ongoing resource management efforts including inventories, monitoring, and research projects, major unresolved management issues and concerns, and how the proposed inventory will address those issues and concerns.

Section II: Project Description

Biological inventories are to be completed through a 7-step process as described in more detail in the Appendix to these guidelines. Section II of the study plan must provide detailed information for Steps 1-6 (Step 7 in the appendix dealing with deliverables are described in Section VIII of the study plan), indicating how the investigators propose to accomplish the stated requirements. A summary of the information from the first six steps to be included in the study plan is as follows:

1. The full study plan should list sources of existing information on vertebrates and vascular plants in each park, including the format (report, paper map, GIS theme, dBase file, Access file, photographs, voucher specimens, wildlife observation cards) and physical location of each item.

Step 1 includes a data inventory, and the results of this inventory should be presented as tables or text descriptions in the study plan. The study plan should also present the list of species that is expected to occur in the park that will be used to determine whether the 90% goal has been reached.

2. Park-specific objectives for the biological inventories that resulted from the scoping workshop should be included in the full study plan, including a listing of management and scientific issues for each park. This section should list the species or habitats of special concern for which more detailed information is required, and provide strong justification for why more detailed information such as distribution maps and relative abundance are required for those species. Decisions made at the workshop regarding the level of detail required for different species or habitats should be presented here.
3. A description of the habitats or strata that have been delineated for each taxa (vegetation, mammals, birds, herps, fish) is to be included here. Special consideration should be given to how these strata will be used with the park GIS and existing GIS themes.
4. For many parks, the actual field work and analysis will be done by different contractors for each taxa, and the following information can be organized by taxa in the full study plan if different contractors or survey teams are responsible for the field work. For each taxa, the study plan should describe the overall sampling strategy for the park, taking into account both spatial and temporal factors. What is the sampling frame for each survey, and how are sample sites to be selected? Are specialized searches planned for rare species or habitats?
5. A description of the specific methods to be used during field surveys should be described for each taxa. Methods that are compatible with other well-established local, regional, or national inventory and monitoring efforts are preferred. For species of special concern for which relative abundance data are required, we recommend multi-scale plot sampling for vegetation (as opposed to a single plot size), and distance estimation methods for birds (as opposed to fixed-radius point counts). For herps, it should be recognized that methods such as cover boards and time-constrained searches do not give good measures of relative abundance, but can be used to obtain abundance categories such as "abundant" or "rare". Additional guidance on field methodology will be developed during FY2000.
6. The study plan should describe how existing data and data collected during field surveys are to be analyzed. How will distribution maps be generated from presence/absence data for some species or relative abundance data for others? Are predictive models to be developed using methods such as logistic regression or discriminant analyses, and who will do the work? How will you determine whether the goal of 90% of vertebrates and vascular plants occurring in the park has been reached?

Section III: Coordination and Logistical Support

This section of the full study plan should provide a general description of how the contractor plans to keep park personnel informed of their activities in the park, as well as conduct other general coordination activities. Also included should be a description of any logistical support the contractor's field crews are likely to require from the park staff. This should include any needs related to housing, transportation, or equipment. Park managers should be aware of these requirements and agree to provide those needs prior to submitting the full study plan for final approval.

Section IV: Budget

The full study plan must include a detailed, itemized budget for the entire project in tabular format. In addition, the budget must also include a written narrative section that describes the basis for calculating the personnel, fringe benefits, travel, equipment, supplies, contractual support, and other costs identified in the itemized budget and explain the basis for their calculation. This should also include an explanation of how indirect costs were calculated. The I&M Program will not provide funding for the purchase of GIS hardware and/or software.

Section V: Resumes

Brief resumes of approximately 1-3 pages in length should be included for all principal investigators and key coworkers. The resumes should emphasize the investigator's experience and familiarity with other projects that relate specifically to the approach and methodologies to be used in the park inventories.

Section VI: Project Completion Schedule

A timeline needs to be included in the full study plan that illustrates when major events are to occur during each year of the project, as well as the final completion date. Report submission dates also need to be indicated.

Section VII: Voucher Specimens

Voucher specimens are to be collected for all species that are identified through the inventory, except where park vouchers already exist or for species that are readily identified through photographs or other documentation. Voucher specimens for threatened, endangered, or candidate species are not to be collected. This section of the full study plan must describe how those specimens will be catalogued in NPSpecies and ANCS+ and made available for future reference and use.

Section VIII: Products and Deliverables

Required project deliverables include: (1) annual progress reports, (2) a final report, and (3) Arcview GIS themes and Microsoft Access databases of all information collected during the project stored on CD media. The Servicewide I&M Program will provide specifications for GIS products to ensure that they are compatible with other data sets and the Arcview GIS data browser extension that is being developed by the program for use in each park. The study plan should also describe the structure of any MS Access databases that are to be developed, and should show how these are compatible with those developed for other taxa so that data can be integrated among inventory components. Investigators will be required to use their findings for the park to update the NPS Servicewide biological data bases maintained by the I&M Program, including NPSpecies, the Natural Resource Bibliography, and the Dataset Catalog. Metadata, in accordance with FGDC standards, is required for GIS products. Copies of these products must be submitted to the park, the Regional I&M Coordinator, and the Servicewide I&M Program Manager. In the case of multi-year projects, funding will not be provided until an acceptable progress report for the previous year has been received by the I&M Program Manager.

STUDY PLAN SUBMISSION AND REVIEWS

The NPS goal is to complete biological inventories for all 265 parks with significant natural resources. The major focus of the review process is to make sure that the inventories meet park needs and provide specific products that will be useful to park management, are conducted in accordance with accepted technical standards by qualified personnel, are consistent with other local or regional approaches where appropriate, and achieve as much cost efficiency as possible.

Pre-proposals should be submitted to the Servicewide I&M Program Manager by December 31, 1999, after which it will be reviewed by personnel from the I&M Program, parks, and USGS/BRD. Parks will be informed of the outcome of the review and given an opportunity to address any noted deficiencies.

Full study plans are to be submitted to the Servicewide I&M Program Manager according to the schedule outlined in the pre-proposal and agreed upon by the park and the I&M Program, which will generally be within six months after partial funding is received. The study plan will undergo technical peer review by individuals from the NPS, the USGS-BRD, or universities. Study plans found to be technically or economically unacceptable will be returned for revision.

APPENDIX

Basic Steps to be Completed for Biological Inventories of Vertebrates and Vascular Plants

Step 1: Compile and Verify Historical and Predicted Species Data

Considerable information on vertebrates and vascular plants exists for most parks, but the information is usually stored in numerous locations and formats such that it is not readily accessible to park managers, interpreters, scientists, and the public. Also, much of the existing information needs to be evaluated for its accuracy and consistency before it can be relied upon for making management decisions. Field investigations to obtain distribution and abundance information for all vertebrates and vascular plants in a park would be prohibitively expensive, and for many species the level of information that is already available from past field studies, museum and herbarium collections, regional field guides, and park observation records are adequate for park planning and public education if the information can be compiled, verified, and made available in a useable format. Also, information on the historical occurrence of species in parks has considerable value to park managers as well as the scientific community. The first step in conducting biological inventories is to compile and organize existing information of what is known from the park and areas adjacent to the park, and to use this information to identify gaps that can be filled by targeted field investigations. A software tool that can be used to complete this "data inventory" is the Dataset Catalog, which is available in both a distributed MS Access version and a web-based version from the I&M Program. The park should compile relevant information relevant from existing species lists, data available from other Federal and/or state resource management agencies, museum and herbarium collections, information in reports and publications from previous field investigations, wildlife observation cards and similar information available in the park, and from regional and national databases such as the Biota of North America Project, State Heritage Programs of The Nature Conservancy (TNC), Breeding Bird Survey,

NPFlora/NPFauna databases, and other sources.

The Servicewide I&M Program will assist with this first step and provide a more complete, consistent, and cost-effective approach by funding national and regional searches of museum and herbarium collections, TNC databases, and the NPFlora/NPFauna database for verifiable records of voucher specimens and other documented occurrences of species in each park. The I&M program has developed a species database called NPSpecies, which will be available as both a distributed MS Access version and a web-based version linked to other NPS databases. The I&M program has already begun to develop a draft species database for each park based on existing species lists, voucher specimens, primary literature, and data from TNC and county records. Each park or their contractor should build upon and refine this initial database provided by the I&M Program by adding information from park records and other local sources not already included in the database, and by verifying each record and making necessary corrections and additions to the database using existing sources. The taxonomic authority for all vertebrates and vascular plants will be that accepted by the interagency Integrated Taxonomic Information System (ITIS), available on the internet at <http://www.itis.usda.gov/plantproj/itis/index.html>.

Step 1 will also generate the list of species that are expected to occur in the park that will serve as the master list to determine whether the goal to document 90% of vertebrate and vascular plant species has been achieved. This list will be generated from existing records from the park and adjacent counties, and regional guides and other range maps in conjunction with determining if the appropriate habitat for a species occurs in the park.

Step 2: Park-Specific Objectives

Each park will have specific objectives for the biological inventories based on the species and habitats occurring in the park, and different levels of information may be needed for each species or group of species to address park management issues. For example, for some parks, spring-migrant birds might be an important resource for which more detailed information is needed, whereas other parks may decide that the additional effort and funding needed to obtain more detailed information should be directed at some other species group or season. Park-specific objectives should be formulated from existing species information and data gaps identified in Step 1 during the compilation of existing information, input from park managers and other knowledgeable individuals about management and scientific issues of special concern, the park's natural resource management plan, reports from previous investigations conducted in the park, and other appropriate sources. This step should determine the level of information needed for various species given funding and personnel constraints, and identify the species of special concern for which more intensive field investigations are needed to determine their distribution and relative abundance. The proposal should include sound justification for the species or habitats that have been identified as a priority. For example, local rarity, in and of itself, does not translate into conservation/management priority. Rarity must be placed within the context of the species-wide distribution patterns to determine its conservation/management priority. The proposal should explain *why* more detailed information is needed for particular species.

Different degrees of inventory intensity will result in four basic levels of information: (1) presence/absence; (2) abundance categories; (3) relative abundance; and (4) absolute abundance. The goal of the Servicewide I&M Program is to document the occurrence of 90% of the vertebrates and vascular plants in each park, and for most species this can be done with existing information. For species of special management concern to the park, more detailed information on distribution and

relative abundance in different habitats will be required, but for most species, only presence/ absence level information is required. It would be cost prohibitive to obtain relative or absolute abundance data for all vertebrates and vascular plants in a park, and this level of inventory intensity is not needed for every species by park managers. (Note: most indices, such as those obtained by fixed-radius point counts for birds, or cover boards or time-constrained searches for herps, usually do not provide relative abundance information that is adequate for making important management decisions upon because there is no measure of differences in detectability among species, habitats, and observers; however, these methods do provide data that can be summarized in abundance categories such as "common" or "rare"; see recommended protocols for bird and herp surveys for more information). Presence/absence information is often associated with habitat information, and can be used to determine species richness for each habitat as well as to develop distribution maps. For many species, it is possible with little additional field investigation to assign an abundance category to each species for each habitat, such as abundant, common, or rare, rather than just documenting species occurrence. Whenever possible, it is better to attempt some quantitative approach to estimating abundance and to summarize these numerical estimates into abundance categories such as common or rare, than to initially collect the data in loosely-defined abundance categories. For species of special concern to the park, a well-designed field inventory using methods such as multi-scale plots for vegetation or distance-estimation methods for birds may be needed to provide the level of information needed.

Based on park-specific objectives and the habitats delineated in Step 3, determine the level of inventory intensity needed for each species identified in Step 1. Use existing data compiled in Step 1 to determine whether each species occurs (or probably occurs) in each habitat type, and where possible, assign an abundance category (e.g., abundant, common, rare) for each species/habitat combination. Document in the database the source of information for each species. For species for which the level of information needed is already available from existing sources, proceed to the analysis and evaluation phase (Step 6). For species requiring additional field investigation, proceed to Step 4.

Step 3: Habitat Delineation

This step will usually involve bringing together all of the relevant GIS themes, aerial photographs, and other existing information needed to develop a basic habitat cover map for the park that delineates the appropriate habitat types for the taxa to be inventoried. This step essentially takes the information from Steps 1 and 2 and puts it into the context of statistical strata for planning the inventory. For many parks, rare habitats are of more interest or concern than common habitats, and some parks may identify a large number of habitats for which they want to summarize information. Habitats will probably differ for different taxa, such as for fish, herps, and plants. Management issues (e.g., fire management zones) and administrative boundaries should also be considered in this step. Decisions about the number and type of habitats to delineate should be based on information collected in Steps 1 and 2, with special consideration to the usefulness of the data summarized for each habitat type when used with the park GIS.

Step 4: Sampling Strategy, Sampling Frame and Sample Selection

Based on information from Steps 1-3, determine the appropriate habitats, season, and protocols to be used in conducting the inventory for the species requiring field investigations. The inventory design must take into consideration both spatial (habitat) and temporal (season and time of

day) factors. This section of the study plan must also indicate which habitat variables will be collected in association with the inventories, keeping in mind that variables for which GIS themes exist or can be created will be most useful for future modeling and analysis. More specific guidelines regarding inventory design to obtain relative abundance information are provided in protocol documents for each separate taxa that will be provided directly to parks undertaking those inventories.

Using the habitat cover map developed in step 3, develop a sampling frame by identifying all potential search plots or paths and those selected to be sampled. In accessible areas with relative homogenous habitat, a systematic grid with a random start should be considered. If there are distinctly different habitat types, habitat stratification should be considered, with separate samples taken in each major habitat type. For species with very specialized habitat requirements and a spotty distribution, potential plots may be limited to patches of appropriate habitat. In each case, include a random component in selecting which sample units are to be sampled and collect independent samples so that statistical inferences can be made to the entire habitat or area. Keep in mind that systematic grids and random sampling in proportion to the area of each strata tend to capture common species, and that multi-scale plots for vegetation and specialized searches of rare habitats and species may be required depending on park objectives. In mountainous terrain, there may be only a few paths where it is possible to climb. In such situations, identify a relatively large number of feasible sample plots or paths and then randomly select those to be inventoried. Additional guidance regarding statistical design and data analysis may be found in *National Park Service Inventories: Statistical Methods* that is available on the internet at <http://www.mpl-pwrc.usgs.gov/fgim/istat.htm>.

Step 5: Field Survey

Sample the randomly selected plots or transects for the species of interest, recording habitat information at each sampling location. Use methods that are compatible with other well-established local, regional, or national inventory or monitoring efforts wherever possible to increase the comparability and interpretability of the park's data.

Step 6: Data Analysis and Evaluation

Using a combination of information collected in Step 1 and new data from targeted field sampling, evaluate whether the goal of 90% of species has been reached, and whether additional sampling is needed to meet park objectives for the inventory. Conduct preliminary analyses of the data to determine where additional sampling is needed. For species for which only presence/ absence or abundance category information is needed, develop GIS themes based on the habitats delineated in Step 3. For species targeted for field sampling, use the habitat information collected at locations where a species was found in analyses such as discriminant function or logistic regression analysis to develop predictive models of species occurrence that can be extrapolated to the appropriate habitats. For each species of special concern, use these models with appropriate GIS themes to produce a "probable distribution map", indicating areas of the park where the species is likely to occur. For species requiring relative abundance information, analyze the results and develop GIS themes describing relative abundance in different habitat types and seasons, including links to tables that summarize mean values and their standard errors.

Step 7: Database Development and Reporting

A report should be prepared each year that summarizes the progress of the inventories and documents key decisions in the process, such as park-specific objectives, habitat delineation, and the sampling frame and layout of sampling plots or transects. At the end of the project, the contractor should prepare a report in Microsoft Word format that describes the work in enough detail that another person could conduct the inventory based on the written report and associated GIS products. All data should be archived in a Microsoft Access database, the structure of which should be described in the written report (e.g., explain what each field and "pick list" item represents). All GIS products should be in a format compatible with Arcview GIS software, and metadata compatible with FGDC standards should be prepared by the contractor. Finally, the contractor should obtain the latest version of the appropriate species databases for the park from the park or Servicewide I&M program, and use information generated by the inventory to update the Servicewide species database for the park. Copies of all products will be delivered to the park, to the appropriate Regional I&M Coordinator, and to the Servicewide I&M Program Manager.

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