FY 2002 Annual Report

Inventory and Monitoring Program

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Inventory and Monitoring Program

Introduction

To fulfill the National Park Service's mission of preserving the nation's heritage, it is essential that park managers know the nature and condition of the resources placed under their stewardship. Because of the importance of information on resources, the National Park Service commenced an Inventory and Monitoring (I&M) Program in 1992. However, although periodic small increases for this program were received, there was not enough funding to complete basic inventories in a reasonable timeframe or to monitor the condition in even the selected prototype monitoring parks. Therefore, the Natural Resource Challenge made the acceleration and expansion of these efforts a keystone.

The table below shows funding for the Inventory and Monitoring Program, as it existed in FY 2001 and in FY 2002. The program encompasses 287 parks (270 administrative units for the purpose of the program) that have a significant amount of natural resources. Inventory and monitoring data are needed for park management in these areas. Specific park units included in the I&M Program are identified in Appendix I.

Inventory and Monitoring Funding:

Available in FY 2001	$ 18,465,000
Uncontrollable Change to Base	8,000
Streamlining Change to Base	(2,000)
Transferred permanently to Prototype parks	(916,000)
Park Vital Signs Monitoring Increase	4,200,000
FY 2002 TOTAL	$ 21,757,000

Inventory and Monitoring Funding Categories:

Resource Inventory Projects	$ 10,834,000
Monitoring and other projects	8,575,000
Database Development	755,00
Regional Coordinators	605,000
Program Administration	988,000
TOTAL	$ 21,757,000

Major Program Highlights For FY 2002

Baseline Inventory Highlights

Baseline inventory accomplishments are reported against NPS Strategic Planning Goal 1b1 – *Natural Resource Inventories*. The Service's target for this goal in FY 2002 was completion of 1,121 (44 percent) of the 2,527 outstanding datasets identified in 1999. The number of outstanding datasets was increased to 2,767 in 2002 when vegetation maps were added to the baseline inventories. The Service completed an additional 597 datasets in FY 2002, bringing the total to 49 percent of the outstanding datasets, thereby exceeding the goal target. Included in that total were: base cartographic data 12 parks; species lists 60 parks; vegetation maps 5 parks; soils maps 20 parks; baseline water quality 45 parks; and meteorology data 197 parks.

The natural resource inventories being conducted as part of the Natural Resource Challenge are revealing many new and exciting insights into the natural resources contained in parks. Not only are the investigations increasing our knowledge and understanding about park resources, but the information being provided is also being used to address a wide variety of resource management issues and activities. Some highlights from FY 2002 inventory efforts are briefly described below.

- Staff from the Northern Colorado Plateau Network, Dinosaur NM, and Utah State University developed new methods for mapping the distribution of invasive exotic plants that pose serious threats to park resources. These methods involve the application of GPS (satellite Global Positioning System) and GIS (geographic information system) technologies to greatly increase the accuracy, accessibility, and value of exotic-plant inventory data. GIS analyses of exotic-plant distributions in relation to environmental factors such as soil type may improve the ability of park staff to control, predict, and prevent exotic-plant invasions.

- Both I&M program and park base funds supported operation of smolt traps in two creeks in Point Reyes NS. More than 250 Coho smolts left the Pine Gulch Creek watershed in 2002. Until the previous year, no Coho had been documented in this creek since 1968. In addition, 25 chunky Coho salmon juveniles showed up at the Stinson Beach, Easkoot Creek monitoring location. This was the first time Coho have been documented at this location in Golden Gate NRA.

- Stream reaches at Pipestone NM, Minnesota and Tallgrass Prairie Npres., Kansas were recently listed by U.S. Fish and Wildlife Service as critical habitat for the Topeka shiner (*Notropis Topeka*). The Prairie Cluster Prototype Monitoring Program, Heartland I&M Network and the Kansas Department of Wildlife and Parks teamed up to conduct initial inventories for the Topeka shiner and develop a baseline for long-term monitoring. At Tallgrass Prairie NPres., 81 Topeka shiners were recorded, including juveniles, suggesting the species is successfully reproducing within prairie streams on the preserve.

- Avian and mammal inventory at two small cultural parks Fort Necessity NB and Friendship Hill NHS in western Pennsylvania illustrated the importance of protected areas for species of concern. Bird inventories at Fort Necessity NB, documented two state vulnerable species. At Friendship Hills NHS, 126 bird species were documented, highlighted by three state vulnerable species. Mammal inventories documented 19 species of mammals at Fort Necessity NB, including one state unrankable species (fox squirrel [*Sciurus niger*]) and one species recently reintroduced into Pennsylvania (fisher [*Martes pennanti*]).

- During intertidal fish inventory surveys at Olympic NP, the park documented 54 of a possible 84 intertidal fish species (64%). Forty-five of the 54 species found had never been documented in the park. The park also documented one range extension (the spotfin surf perch) that had not been documented north of Seal Rock, Oregon.

- Prior to the field survey in 2002, only six amphibian species were known from Fort Clatsop NHM. The survey increased the documented inventory to at least eight. In 2002, both the Columbia torrent salamander (*Rhyacotriton kezeri*), a state listed critical species, and giant salamanders (*Dicamptodon* sp.) were located in forested streams in the park.

- Only three fish species at Fort Clatsop NHM were verified in park rivers and streams prior to the February 2002 survey conducted in cooperation with staff from Olympic NP. During this survey, several sloughs and streams were seined or electro-shocked, yielding juvenile Coho salmon (*Oncorhynchus kisutch*) and cutthroat trout (*Oncorhynchus clarki*), both federally listed species.

- In September 2001, May and June 2002, an NPS Ecologist, from National Capital Parks-East, conducted a three-day survey of vascular plants at Thomas Stone NHS. During this survey he also gathered information on butterflies, damselflies, reptiles and amphibians as well as noteworthy records of breeding birds. These three days of survey effort added a total of 178 vascular plant species, including nine Maryland state listed species, 23 butterfly species, including one state listed species, 15 species of dragonflies (including one state listed species and one county record) and a damselfly to the park's species listing.

- During the 2002 field season, a crew from the Wildlife Conservation Society, under a cooperative agreement to inventory amphibians and reptiles, recaptured a box turtle on Fire Island NS that had been originally marked by J.T. Nichols in 1921. The same turtle had previously been discovered back in 1991. J.T. Nichols had described the turtle as mature, about 20 years old, when he first marked it, making the turtle at least 100 yrs old!!

  A series of spectacular discoveries have been made at Tumacacori NHP as part of that park's biological inventory effort. Bird surveys in 2000 & 2001 located what is believed to be the highest concentration of yellow-billed cuckoos in the Western U.S. This extremely rare species has been proposed for listing under the Endangered Species Act. Fish surveys in 2002 identified large numbers of Gila topminnow in a swale near the Santa Cruz River. These extremely rare and endangered fish are typically located only near springs. Further investigation of the "swale" revealed the presence of a spring, likely the Tumacacori Spring that attracted and sustained the settlement of the Tumacacori Mission.

- The tiny shrew (*Sorex yukonicus),* previously known in North America from only six locations (12 specimens in Alaska), was captured in Wrangell-St. Elias NPP, Yukon-Charley Rivers NP and Denali NP during the 2001/2002 Small Mammal Inventory efforts. This species was not expected to occur in the network and the records represent significant eastward range extensions for this extremely rare and poorly known species.

- Over 190 plant species that had not been known to Yukon Charley Rivers NPres. were verified during the 2002 plant inventory effort. The most exciting discovery was *Tricophorum pumilum*, which is known from only one other location in Alaska. Twenty-two plant species that are currently ranked by the Alaska Natural Heritage program as rare were documented.

- A vascular plant inventory was initiated on 8000 acres of newly acquired lands for Pinnacles NM from the Bureau of Land Management. Twenty-four new plant species were documented for the Monument, including one new species to science!! The new species of mustard (genus *Streptanthus*) is likely a rare species.

  A network-wide amphibian and reptile inventory effort was conducted in the Greater Yellowstone Network during FY 2002, focusing mostly on remote, previously un-surveyed, backcountry areas. A new Boreal Toad breeding site, a species, which has suffered dramatic declines in its western U.S. range, was found despite recent and persistent drought conditions.

- A total of 523 vascular plant specimens were collected, recorded, and pressed for Katmai NPP and Alagnak Wild River. Approximately 130 species are new records and previously undocumented species. A number of discoveries represent significant

range expansions. Two rare plant species, an arctic grassland primrose (*Primula tschuktschorum)* and Aleutian cress (*Aphragmus eschscholtzianus)* were found near Mirror Lake.

- The freshwater mussel inventory at Mississippi River NRA, showed that waters of the Mississippi corridor are sufficiently clean to harbor healthy populations of several mussel species including some that are threatened and endangered. The data suggest that water quality regulations have helped improve habitat for mussels. Because freshwater mussels can act as the "canary in the coal mine" for aquatic environments, the healthy mussel populations may have good implications for human health as well.

- Documentation of the Massassagua rattlesnake at Indiana Dunes NL, while contributing little to species verification, provided valuable and timely information on a species of special concern to the park. The documented presence of this snake species will be of value to the U.S. Fish & Wildlife Service in their deliberations over listing and may have implications for management far into the future.

- Inventories of hybridized fish at Pictured Rocks NL have major significance for resource managers. These fish show physical traits indicative of successful backcrossing between lake trout and brook trout. Hatchery reared hybrids of lake trout and brook trout, commonly known as splake, continue to be stocked into the Great Lakes by both Wisconsin and Michigan Departments of Natural Resources. It has been argued that these hybrids are non-reproducing thus relatively harmless. Mounting evidence, including the individuals captured in this study, suggest they do successfully reproduce. This finding, if it holds true, is a significant contribution towards on-going arguments against the continued introduction of splake into the Great Lakes.

  Surveys of amphibians, fish and aquatic invertebrates in high-elevation in Sequoia, Kings Canyon and Yosemite National Parks have documented a severe decline in the mountain yellow-legged frog populations native to these lakes. The decline is directly related to presence of non-native, introduced fish species that prey upon the frogs and fragment their habitat; other important factors in this decline may be pesticides and disease. The surveys have provided park managers valuable information about amphibian decline and have recommended sites where restoration of mountain yellow-legged frogs is most likely to be successful.

Park Vital Signs Monitoring Highlights

The Park Signs Monitoring component of the Inventory and Monitoring Program reports to NPS Strategic Planning Goal 1b3, *Park Vital Signs.* The Service's goal for park vital signs was that, by September 30, 2002, 20% (54) of 270 parks with significant natural

resources, would have identified their vital signs for natural resource monitoring. By the end of FY 2002, 46 parks (17 percent) had identified their vital signs, compared to the annual goal of 54 parks. The 1b3 goal was not met during FY 2002 because the first 12 monitoring networks were given additional time to plan and design their monitoring program to meet more stringent requirements. However, the Service is on target to exceed this goal in FY 2003. Some major accomplishments associated with park vital signs monitoring in FY 2002 included: providing funding, guidance, and technical support to 17 vital signs monitoring networks (153 park units) for development of an integrated monitoring program; providing full funding to 11 prototype monitoring programs (22 park units); and the development and implementation of an activity-based accountability report for all monitoring networks, including a budget-tracking component.

The natural resource management and protection efforts carried out by parks and park networks benefit tremendously from information about their resources derived form long-term ecological monitoring. Long-term monitoring needs to be the cornerstone of any effective natural resource management program. Profiled below are several examples of how these studies have benefited parks during FY 2002.

- At Channel Islands NP, monitoring of reptiles and amphibians on Anacapa Island is being carried out in conjunction with the eradication of rats from that island. Rats were eradicated from East Anacapa in Fall 2001; Middle and West Anacapa will be treated in Fall 2002. The monitoring data is already showing a response by Channel Islands slender salamanders, an endemic species, and side-blotched lizards. Twice as many juvenile salamanders and lizards were found on East Anacapa as on Middle Anacapa. In past years the numbers were comparable between the two islets.

- The National Capital Region network hosted a 3-day monitoring workshop designed to develop and enhance existing partnerships in order to preserve the region's most significant natural resources. The workshop sparked a huge interest and was attended by over 100 participants representing over 30 different partnering agencies, including universities, state and other federal agencies, non-government agencies, and individuals, as well as several divisions within the National Park Service. Participants prioritized the region's most significant resources, their threats, ecological effects, and potential vital signs to monitor ecosystem health. Continued collaboration will likely allow the network to leverage additional resources into monitoring the region's complex ecosystems.

- Monitoring of northern spotted owls was implemented in 1998 at Point Reyes NS, Muir Woods NM, and Golden Gate NRA as indicators of forest condition. Preliminary data from 32 federal sites in 2002 indicate that of 29 pairs, 17 fledged young. A total of 23 fledglings were reported adding to an overall season fecundity of 0.41, which is about average for this population.

- Hemlock woolly adelgids have caused a steady decline in the health of eastern hemlocks (Tsuga canadensis) in Shenandoah NP. Hemlocks had full healthy, green crowns in the late 1980s. When Hemlock woolly adelgids problems were noted in 1990/91 with the park's first hemlock health monitoring, over 87% of hemlock crowns were in excellent condition. FY 2002 monitoring indicates that most crowns are in very poor conditions. Less than 5% now have excellent crowns and tree mortality is apparent in all stands across the park.

- On October 23, 2002, The California Fish & Game Commission approved the agencies' preferred alternative for a network of 11 fully protected marine reserves in Channel Islands National Park and Marine Sanctuary. The reserves will take effect January 1, 2003 in state waters. The Federal process for phase two in Sanctuary waters will likely take an additional 2-3 years. The park's kelp forest, tide pool, sea bird, and pinniped monitoring programs were instrumental in the design and creation of the reserve network. Without the baseline information they provide, the Commission would not have taken this action

- The bull trout is a threatened species under the Endangered Species Act but very little is known regarding its abundance, life history, or spawning areas or behavior. Developing cost-effective methods to monitor listed species is an important component of Olympic NP's monitoring program. In 2002, in cooperation with the Washington Department of Fish and Wildlife, park biologists documented bull trout spawning in the uppermost reaches of the Queets River in Olympic NP. This area is very remote with steep gradients and may be typical of bull trout spawning habitat in Olympic Peninsula rivers.

- Monitoring Avian Productivity and Survivorship (MAPS) stations in Yosemite NP, operated by The Institute for Bird Populations have provided valuable long-term data on bird populations. Stations were established between 1990 and 1993 and were funded by the Yosemite Fund through 2002. Overall, bird populations have decreased slightly over the nine-year period of analysis, with slightly more species decreasing than increasing. Substantial nine-year declines were observed in seven species and substantial increases observed in only five species. Data analyses indicate that declines in productivity related to weather may have caused some of the observed declines, while overall low productivity is a factor contributing to decline in other species, unrelated to weather.

- Research conducted to support development of an amphibian monitoring protocol found that Cape Cod NS supports the most significant population of eastern spadefoot toads *(Scaphiopus holbrooki holbrooki)* in Massachusetts and possibly in the entire Northeastern United States. This State-listed species is an irruptive breeder, emerging from underground burrows to breed on warm, rainy summer nights.

- Over the past decade, the exotic species Sericea lespedeza *(Lespedeza cuneata)* and undesirable native shrubs like Sumac *(Rhus glabra and R. copallinum)* and Buckbrush *(Symporicarpos orbiculatus)* have invaded areas of restored tallgrass prairie at Wilson's Creek NB, Missouri. In 2001, park managers began experimenting with goats as a tool to control exotic species and woody shrubs in prairie restorations. Monitoring sites were established inside the enclosure and in similar areas adjacent to the enclosure that are conventionally managed with fire. Preliminary data indicate that both grazed and burned sites experienced a decrease in the relative cover of Sericea lespedeza; although, the decline in the grazed site was only slight.

Baseline Resource Inventories: Discovering America's Natural Heritage

In FY 2000, the first year of the Natural Resource Challenge, the Service received a base increase of $7,309,000 for inventories. An additional $1,750,000 was received in FY 2001 specifically for vegetation mapping. Using that additional funding, the Service is continuing to complete inventories of the basic natural resource placed under its' stewardship. Those basic inventories are listed in the following table. Appendix II-A illustrates how funding was distributed across major inventory efforts during FY 2002. A description of selected inventory projects is provided in provided below.

The inventories are being closely coordinated to ensure that they satisfy several important criteria:

- Collectively, the inventory data represent the "core" set of information park managers need to deal effectively with park planning, management, and protection,

- The inventories are being conducted in accordance with clearly defined protocols and quality-assurance standards, and

- Data obtained through the inventories will be compatible to allow for synthesis and analysis at ecosystem and other broad levels.

Inventories of natural resources are undertaken to gather the most relevant scientific information needed to make sound decisions regarding their access or protection. The National Park Service is conducting inventories using a network approach (described in the section on Park Vital Signs Monitoring) to ensure cost efficient sharing of researchers and methods. Parks must make a decision about their most vital inventory needs based on the context of resources and their larger ecosystem.

The 12 Basic Natural Resource Inventories

- Natural Resource Bibliography
- Species List
- Vegetation Map
- Base Cartography Data
- Species Occurrence and Distribution
- Soils Map
- Geology Map
- Baseline Water Quality Data
- Water Body Location and Classification
- Air Quality Data
- Air Quality Related Values
- Meteorological Data

Inventory Projects Receiving Emphasis in FY 2002

The increased funding for natural resource inventories received through the Natural Resource Challenge in FY 2000 and FY 2001 is allowing the National Park Service to significantly increase the rate at which the basic natural resource inventories are completed. By combining that funding with funds previously available for inventories, the Service now estimates that it will complete the basic resource inventories for all 270 natural resource parks over a period of approximately ten years, rather than the 20-25 years projected to complete the inventories prior to receiving the additional funding through the Natural Resource Challenge.

The Washington Office has worked closely with park resource managers and others to obtain information about which of the 12 basic natural resource inventories are of highest priority to the parks for addressing various resource management and protection issues, as updating resource management plans and developing management actions to respond to a particular threat to park resources. Those priorities were revised in fiscal 1997 and are currently being used to establish the service-wide strategies for completing the inventories. Appendix II-B provides a detailed listing of the number of inventories in all categories completed through the end of FY 2002 and a projected schedule for completion of the outstanding inventories.

In FY 2002, inventory funding was devoted primarily to five of the basic inventories: species occurrence and distribution, vegetation mapping, soils mapping, geologic mapping, and baseline water quality data inventories. A brief summary of each of those

efforts during FY 2002 appears below. A listing of inventory projects undertaken during FY 2002 appears in Appendix II-C.

Species Occurrence and Distribution Inventories
FY 2002 Funding Allocation: $6,353,700

The basic goal of the species occurrence and distribution inventory program is to provide park managers with comprehensive, scientifically based information about the nature of selected biological resources occurring within park boundaries. The information will be presented in a form that increases the accessibility and utility for making management decisions 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 goals, these inventories have been designed to meet three fundamental 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 (T&E) 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.

Conducting field inventories for biological resources can be very costly and time consuming. Therefore, major attention is being given to conducting the inventories in the most cost-effective manner. One way costs are being minimized is by conducting the inventories in networks of parks, rather than in individual parks. Previous efforts have shown that significant cost savings and efficiency can be realized by working simultaneously in several parks in close proximity to each other. Therefore, the 270 natural resource parks included in the species occurrence and distribution inventory program have been organized into 32 separate park networks. These networks (Fig. 1) are the same as those being utilized for park vital signs monitoring efforts described in a later section.

Funding for Network Species Occurrence and Distribution Inventories in FY 2002

In Fiscal year 2002, the National Park Service allocated $6,353,7 for conducting network-based species occurrence and distribution inventories Service-wide. The manner in which those funds were allocated on an individual park network basis is illustrated in Appendix II-D. The total amount of funding allocated to each network over the lifetime of the inventory effort (about four years for most networks) was developed through a

formula with took into consideration the amount of staffing needed to conduct inventories within all parks included in the network, the geographic separation of parks within the network, and a relative cost of living for the area of the county the network occurs in. The amount of funding allocated to a network during any given year is in accordance with detailed study plans produced by each network and submitted to the Washington Office for review and approval. At the end of Fiscal 2002, all 32 networks had approved species occurrence and distribution inventory study plans.

Leveraging and Out-Sourcing With Network Species Occurrence Inventory Funds

During FY 2002, the 32 park networks conducting network species occurrence and distribution inventories used those funds in a wide variety of ways, including supporting NPS personnel and out-sourcing. The amount of funding used for external contracts and/or Interagency Agreements was as follows: U.S. Geological Survey $715,314, Other Federal Agencies $ 329,208, Universities $2,256,929, and other non-Federal cooperators $1,059,633. In addition to the funding provided through the Natural Resource Challenge, the networks also received approximately $105,000 from various partners and cooperators. Approximately $251,000 of park base or other existing NPS funds was also expended on the network biological inventories during FY 2002.

Museum Voucher Searches

Another way that costs of the vertebrate and vascular plant inventories can be minimized is by making maximum use of existing information, especially that available from examination of voucher specimens in parks and non-NPS museum and herbaria collections. The NPS has spent considerable amounts of funding in previous years conducting inventories for many species of vertebrates and vascular plants in parks. In this respect, it will be important for the NPS to be able to provide "evidence" that these particular species occur in parks or at least have been known to occur in parks at some time in the past. Information about the historical presence in parks is critical, especially if more recent surveys do not find the species in the park. Information on vouchers is being gathered through both centralized efforts and by the efforts of individual parks or park networks and entered into the NPS servicewide species database, NPSpecies.

During FY 2002, parks in all networks were actively collecting historical information on vouchers and species occurrence in parks and entering the data into the NPSpecies database. By the end of FY 2002, 225,630 vouchers and 301,169 species listings had been entered into NPSpecies. Taken as a whole, the number of parks having inventories in progress for each of the major taxa during FY 2002 was: birds 271 parks, mammals 259 parks, fish 208 parks, amphibians and reptiles 246 parks, and vascular plants 282.

Overview of Network Species Occurrence and Distribution Inventory Field Projects

During FY 2002, each of the 32 park networks received funding for species occurrence and distribution inventories. The type of field inventories conducted by each network

during FY 2002 depended upon a number of considerations, including the completeness of park inventories as revealed by voucher searches, the priority of information needed to meet park management needs, and the availability of contractor or other personnel to perform the field work. A brief summary of several of those field inventory projects follows. Collectively, the summaries provide a good overview of the types of efforts underway and progress made by the 32 networks conducting field species occurrence and distribution projects during FY 2002.

Arctic Network – This network, formerly known as the Northwest Alaska Network, consists of Bering Land Bridge Npres, Cape Krusenstern NM, Gates of the Arctic NPP, Kobuk Valley NP, and Noatak Npres.

In FY 2002, the network initiated inventories throughout the network for vascular plants, small mammals, and montane-nesting birds. A task agreement was established with researchers at Idaho State University for the small mammal inventories and with the University of Alaska-Fairbanks for the vascular plant inventories. In addition, field inventories of montane –nesting birds continued in Kobuk Valley NP and Noatak Npres.

Central Alaska Network – The Central Alaska network includes Denali NPP, Wrangell-St. Elias NPP, and Yukon-Charley Rivers Npres.

During FY 2002, field inventories for freshwater fish, vascular plants and small mammals continued. Likewise, the logistics for water quality sampling were again combined with the freshwater fish field efforts. As part of those efforts, freshwater fish inventories were conducted in six bodies of water in Yukon-Charley Rivers NPres and 45 bodies of water in Wrangell- St. Elias NPP. Major efforts were also focused on inventories of vascular plants. During FY 2002, vascular plant inventories at Yukon-Charley Rivers NPres were conducted at 72 separate sites and more than 2,500 voucher specimens were collected.

Southeast Alaska Network - This network, which includes Glacier Bay NPP, Klondike Goldrush NHP, and Sitka NHP, finalized an interagency agreement with the U.S. Geological Survey Alaska Science Center to perform inventories of marine/estuarine fish in all three parks.

During FY 2002, a total of 180 specimens of vascular plants from Klondike Goldrush NHP and Sitka NHP were collected, recorded and pressed. Duplicate or triplicate sheets were produced for many of the specimens. Roughly 100 separate taxa are represented, and 20-40 represent new records for the parks. Although final determinations are not complete, no new significant range extensions or collections of species of conservation concern are apparent in the collected materials at this time.

At Sitka NHP, a brief but intensive field survey was conducted during the summer. Sitka NHP is a relatively small park whose flora has been well studied and documented. Nonetheless, this brief inventory effort documented five new species to the park. Most

noteworthy was a species of bluegrass listed by the U.S. Forest Service as a sensitive species for the Tongass National Forest and known from fewer than 15 sites in Alaska.

Southwest Alaska Network – This network includes five park units containing diverse landscapes and ecosystems. The units are: Alagnak WR, Aniakchak NM, Katmai NPP, Kenai Fjords NP, and Lake Clark NPP.

In FY 2002, the network applied for and received a Public Land Grant for a Student Conservation Association (SCA) Intern to gain training in fisheries fieldwork and to assist in the fish inventory efforts throughout the network. As part of this effort, 14 species not previously documented for Alagnak WR were considered to be possible residents and were targeted during the field inventories. Of those 14 species, nine were found to occur, and the remaining five species, considered possible, yet unlikely to occur, were indeed not found in the park. The high elevations and steep gradients of the waterways are suspected of excluding these species from the park.

Great Lakes Network - This network includes nine national park units in four states surrounding the Great Lakes. National park units contained in this network include: Apostle Islands NL, Grand Portage NM, Indiana Dunes NL, Isle Royale NP, Mississippi National River and Recreation Area, Pictured Rocks NL, Saint Croix NSR, Sleeping Bear Dunes NL, and Voyageurs NP.

This network sets aside a "Challenge / Contingency Fund" to assist in documenting the presence of specific vertebrates and vascular plants in network parks. Under this program, the network determines which taxonomic groups need funding most. The network obtains concurrence from the parks where work needs to be done and then locates appropriate contractors. Projects meet three basic criteria: 1) each project has the approval of the selected park, 2) the study is directed at a taxon that is below 90% verification, and 3) the project has a reasonable chance of documenting additional species. One such project was conducted in the Lake Superior waters of Pictured Rocks NL where no known inventory of fish species has ever been conducted. Fieldwork conducted by the U.S. Fish and Wildlife Service suggests that at least six previously undocumented species were collected. Of particular interest is the collection of several hybridized fish (lake trout X brook trout) that previously were thought to be non-reproducing. However, results of this study suggest that these hybrids do in fact reproduce. If these preliminary results are supported by additional investigation, they could contribute to on-going arguments against the continued introduction of these hybrids.

Heartland Network - The Heartland Network includes 15 national park units located in eight states of the central USA. The Heartland network parks are: Arkansas Post NM, Buffalo NR, Cuyahoga Valley NRA, Effigy Mounds NM, George Washington Carver NM, Herbert Hoover NHS, Homestead NMA, Hopewell Culture NHP, Hot Springs NP, Lincoln Boyhood NM, Ozark NSR, Pea Ridge NMP, Pipestone NM, Tallgrass Prairie NP, and Wilson's Creek NB.

Species occurrence and distribution inventories conducted by this network during FY 2002 included amphibian and reptile inventories, vascular plant inventories, and four exotic plant inventories in a total of ten different network parks. One of those inventories consists of a 2-year project initiated during June 2002 between the NPS and the Cleveland Metropolitan Park District that places special emphasis on Threatened and Endangered species inventories. Through this project, 380 bats of seven species have been encountered at 22 sites during 200 mist-net nights during which the federally listed endangered Indiana bat was found in an upland setting. Park staff from Cuyahoga Valley NRA generated a press release, which prompted significant local media interest and attention regarding the capture of this endangered species.

Northern Great Plains Network - This network includes 13 parks located in Nebraska, North and South Dakota, and eastern Wyoming. Park units included in the network are: Agate Fossil Beds NM, Badlands NP, Devils Tower NM, Fort Laramie NHS, Fort Union Trading Post NHS, Jewel Cave NM, Knife River Indian Villages NHS, Missouri NRA, Mount Rushmore NMEM, Niobrara National Scenic Riverway, Scotts Bluff NM, Theodore Roosevelt NP, and Wind Cave NP.

The Northern Great Plains Inventory Study Plan was approved by the Washington Office during FY 2002 and fields efforts were undertaken. Species occurrence inventory funding was used primarily for field projects involving fish, mammals, birds, and herptofauna. No field projects for vascular plants was conducted during FY 2002. During these efforts, the fish inventories were completed and a final report received. Investigators conducting the fish inventories expressed surprise that additional species were not detected in spite of apparently suitable habitat conditions. At Wind Cave NP, seven species were sampled, one of which was the non-native brook trout but the Plains Minnow, a species of concern to park staff, was not found in the survey effort. The investigators concluded that the species was most likely not to be present in the park. In their final report, the investigators noted that 20% of the species they found and documented were not on the expected species lists for the park.

Coastal and Barrier Network – The Northeast Coastal and Barrier network includes eight parks located in Virginia, Maryland, New York, New Jersey, and Massachusetts. Cape Cod NS, one of the NPS prototype monitoring programs is located in the network along with Assateague Island NS, Colonial NHP, Fire Island NS, Gateway NRA, George Washington Birthplace NM, Sagamore Hill NHS, and Thomas Stone NHS.

During FY 2002, field inventory projects focused mammals, herptofauna, and vascular plants. During the mammal inventory effort, researchers from Frostburg University obtained historical records, outlined inventory strata and established sampling sites within those strata. Researchers from the University of Richmond began field inventories of herptofauna (reptiles and amphibians) at Colonial NHP, George Washington Birthplace NM, and Thomas Stone NHS. Field Work at three other parks (Sagamore Hills NHS, Fire Island NS, and Gateway NRA) was conducted as part of a cooperative agreement

with the Wildlife Conservation Society that was established in FY 2000. During FY 2002, a completed floristic inventory for Thomas Stone NHS was obtained. In addition to vascular plant species, the report also provided information on butterflies, dragonflies, birds, reptiles, and amphibians.

Northeast Temperate Network –This network includes ten national parks and historic sites with significant natural resources covering a wide range of temperate forest, from coniferous to mixed deciduous woodlands to transitional forests, across Maine, New Hampshire, Vermont, Massachusetts, New York, Connecticut, and New Jersey.

During FY 2002, this network established a cooperative agreement with researchers from the University of Rhode Island who conducted an extensive catalog of verifiable records of birds occurring within Weir Farm NHS, Roosevelt-Vanderbilt NHS, Saratoga NHP, Minute Man NHP, Morristown NHP, and Saugus Iron Works NHS park boundaries. Through these efforts, an expected species list was developed for each park, sampling schemes were established, and experienced birders were hired and trained to conduct the inventories utilizing well-established field protocols. The network also completed an interagency agreement with the Patuxent Wildlife Research Center to complete mammal inventories in eight network parks.

National Capital Region Network –This network includes 11 national park units with significant natural resources in the District of Columbia, Virginia, Maryland, and West Virginia. Included in the network are: Antietam NB, Catoctin Mountain Park, Chesapeake and Ohio Canal NHP, George Washington Memorial Parkway, Harpers Ferry NHP, Manassas NBP, Monocacy NB, National Capital Parks – East, Prince William Forest Park, Rock Creek Park, and Wolf Trap Farm Park.

In FY 2002, this continued field inventories for amphibians, reptiles, small mammals, and birds. New inventories for fish and vascular plants were also initiated in several network parks. In addition, the network devoted considerable effort to populating the Service-wide NPSpecies database with legacy data from all parks in the network. That database now contains a total of 22,013 records for the network parks, supported by 284 references, 3,730 voucher entries, and 24,698 observations. The network was also able to record five Federal T&E species, 209 State T&E species, and 433 exotic species as currently present in the parks. Field sampling for small mammals was completed during the year at Antietam NB, Catoctin Mountain Park, Chesapeake and Ohio Canal NHP, George Washington Memorial Parkway, Harpers Ferry NHP, National Capital Parks - East, Rock Creek Park, and Wolf Trap Farm Park. In an effort to achieve cost efficiency, the network also enlisted the assistance of volunteers in bird inventories at several network parks. Analysis of data collected by volunteers revealed that no additional bird inventories are needed at Antietam NB, Cactoctin Mountain Park, Manassas NBP, and Prince William Forest Park.

Southeast Coast Network – This large network includes 17 parks with significant natural resources and extends along the Atlantic Coast from the North Carolina-Virginia border

down to Cape Canaveral, Florida and inland as far as Atlanta, Georgia and the Alabama coastal plain.

In FY 2002, the Southeast Coast network received $310,600 in funding from the Service-wide Inventory and Monitoring Program to continue conducting inventories of vertebrate and vascular plant occurrence and distribution. That funding was supplemented with an additional $46,000 provided by the Southeast Regional Office. Herptofaunal inventories were continued in 16 network parks while small mammal inventories were initiated during FY 2002 in 18 park units in the network. Vascular plant inventories were initiated during the year at 3 parks, Canaveral NS, Ocmulgee NM, and Congaree Swamp NM.

Gulf Coast Network - This network includes eight national park units with significant natural resources in states that border the Gulf of Mexico. Included in the network are Palo Alto Battlefield NHP, Padre Island NS, San Antonio Missions NHP, Big Thicket NPres, Jean Lafitte NHPP, Vicksburg NMP, Natchez Trace Parkway, and Gulf Islands NS. The network has also provided limited assistance for natural resource issues to Cane River Creole NHP.

In FY 2002, the network continued inventories that began during FY 2001 and initiated several new inventories. Park units in which inventories were being conducted included: vascular plants – Big Thicket Npres., Palo Alto Battlefield NHP, and San Antonio Missions NHP; herptofauna – Jean Lafitte NHPP, Padre Island NS, Palo Alto Battlefield NHP, San Antonio Missions NHP, Vicksburg NMP, and Cane River Creole NHP. During the year, the network also issued a Request for Proposals to complete all remaining Gulf Coast Network inventories. Sixteen proposals were received, including several from local universities. Most of those projects will be initiated during FY 2003.

Northern Colorado Plateau Network – This network comprises 16 arid land parks located in Utah, western Colorado, southwest Wyoming, and northern Arizona. Included in the network are: Arches NP, Black Canyon of the Gunnison NP, Bryce Canyon NP, Canyonlands NP, Capitol Reef NP, Cedar Breaks NM, Colorado NM, Curecanti NRA, Dinosaur NM, Fossil Butte NM, Golden Spike NHS, Hovenweep NM, Natural Bridges NM, Pipe Spring NM, Timpanogos NM, and Zion NP.

In FY 2002, inventory funding was used to support the second field season of vertebrate and vascular plant inventories with a variety of cooperators. Inventories of reptiles, amphibians, mammals and/or vascular plants were conducted in 14 parks during the FY 2002 field season. Results from the vascular plant inventory were entered into the servicewide NPSpecies database. Researchers form Brigham Young University also completed a review and annotation of approximately 3,700 herbarium specimens for Canyonlands NP, Arches NP, National Bridges NM, and Hovenweep NM. A new two-year inventory project was launched at Dinosaur NM, focusing on invasive and T&E species. The project is being conducted by researchers from Utah State University and has resulted in field-testing of a network invasive plant inventory protocol. Based on initial work conducted during FY 2001, the network also developed a memorandum of

agreement documenting a network-wide approach to research permitting for inventory and monitoring projects. The agreement was signed and approved by all 16 of the network park superintendents.

Rocky Mountain Network - The Rocky Mountain Network is comprised of six disperse parks located in Colorado and Montana. The parks in this network include: Florissant Fossil Beds NM, Glacier NP, Grant-Kohrs Ranch NHS, Great Sand Dunes NP, Little Bighorn Battlefield NM, and Rocky Mountain NP.

Field inventories conducted by this network during FY 2002 focused on inventories of vascular plants and vertebrates in four park units – Grant-Kohrs Ranch NHS, Great Sand Dunes NP, Florissant Fossil Beds NM, and Little Big Horn Battlefield NM. Dr. Al Zale and Dr. Robert Bramblett of the Montana Cooperative Fishery Research Unit, USGS, Department of Ecology, Montana State University, completed fish inventories at all four park units. The Colorado Natural Heritage Program, Colorado State University completed vascular plant inventories at Great Sand Dunes NP and Florissant Fossil Beds NM while Dr. Erin Muths from the U.G. Geological Survey -Biological Resources Division, completed inventories of amphibians and reptiles at Great Sand Dunes NP and Florissant Fossil Beds NM during the year. Final reports for all of these completed projects will be submitted by the investigators during FY 2003. During FY 2002, the network also signed an agreement with the Rocky Mountain Bird Observatory to conduct bird inventories in Grant-Kohrs Ranch NHS, Florissant Fossil Beds NM, and Grand Sand Dunes NP. Fieldwork for those projects will not begin until FY 2003.

Greater Yellowstone Network – The Greater Yellowstone Network consists of three units of the National Park Service: Yellowstone NP, Grand Teton NP, and Bighorn Canyon NRA. During FY 2002, this network continued to inventory the distribution and abundance of non-native vascular plants and amphibians and reptiles. Inventories for amphibians and reptiles continued under the direction of principal investigators from Idaho State University in all three network parks. At Yellowstone NP, investigators Bruce Maxwell and Lisa Rew implemented a probabilistic survey design in the park's northern range. This inventory will provide both the distribution and abundance of non-native vascular plants and will also yield data to predict distribution of non-native plants in other backcountry locations within the park boundary. The Wyoming Fish and Game Department completed the first year of a two-year fish inventory of alpine lakes at Grand Teton NP. Fourteen alpine lakes were inventories and Yellowstone Cutthroat Trout, a species of special concern for the park, were found in two of those lakes.

Southern Plains Network – The Southern Plains Network includes ten parks with significant natural resources in Colorado, Kansas, New Mexico, Oklahoma, and Texas. Inventories of species occurrence and distribution were completed at two parks within the network, Bent's Old Fort NHS and Fort Larned NHS. Field inventories for vertebrates and/or vascular plants were completed in a number of the network park units during FY 2002. Vascular plant inventories were completed by the New Mexico Natural Heritage Program at Capulin Volcano NM. The Nature Conservancy and the Botanical Research

Institute of Texas completed fieldwork involving herbarium reviews, voucher collection and identification for Lyndon B. Johnson NHP. Results of these efforts will be instrumental in determining whether previous inventories have satisfied the 90 percent completion goal or whether additional field projects will be needed. In addition to the vascular plant inventories, mammal inventories were completed in two parks, and bird inventories completed in three network parks.

Sonoran Desert Network - The Sonoran Desert Network includes 11 park units in southern Arizona and western New Mexico. During FY 2002, the location and evaluation of existing data on vertebrates and vascular plants was completed by early in the year. Field inventory efforts conducted at network parks were the most intensive to date. By the end of the fiscal year, field data on birds, bats, small mammals, large mammals, herpetofauna, and vascular plants had been collected on eight of the eleven network parks. FY 2002 funding was also used to address information gaps in the original study plan. The additional funding supported inventory efforts (vascular plants, herpetofauna, mammals, and birds) in the backcountry of Saguaro NP, vascular plant surveys on the proposed expansion lands of Tumacacori NHP, and bat surveys at Tuzigoot NM.

North Coast and Cascades Network – The network consists of seven parks within the states of Washington and Oregon. Together, they preserve areas of tremendous natural diversity, historic significance and scenic beauty. Parks in the network include: Fort Vancouver NHS, Mount Rainier NP, Ebey's Landing NHR, Olympic NP, San Juan Island NHP, North Cascades NP, and Fort Clatsop NM.

During FY 2002, work focused on data mining for all seven network parks with an emphasis on geo-referencing species verifications and coordinating efforts with network geographic information system (GIS) programs. The network continued to work with the University of Washington to data mine for records of plant specimens in the university's herbarium. Two thousand records were recovered documenting plant collections the seven network parks. With respect to field investigations, contractors completed beach seining at six representative sites in the intertidal zones and 21 tidepools of Olympic NP to assess intertidal fish populations. Native vascular plant inventories also received considerable effort at Mount Rainier NP, North Cascades NPP, San Juan Island Island NHP, and Ebey's Landing NHR. At Mount Rainier NP, surveys were conducted in 31 locations to document the status of 14 state listed sensitive species. Rare plant populations were found at eight locations, seven of which were new sites. Several observations documented records more than 50 years old. At North Cascades NP, field surveys of ten rare plant species were conducted using the field sampling protocols developed at Mount Rainier NP. These surveys documented rare plants in five previously known sites and three new locations. However, rare plant populations could not be located at three previously reported locations.

San Francisco Bay Area Network - This network includes eight parks with significant natural resources in the coastal northern California area. Included in the network are:

Eugene O'Neil NHS, Fort Point NHS, Golden Gate NRA, John Muir NHS, Muir Woods NM, Pinnacles NM, Point Reyes NS, and the Presidio.

In FY 2002, inventories were continued or initiated using the priorities established in the network's inventory study plan. Inventories for vascular plants, small mammals, amphibians, reptiles, bats, landbirds, rare plants, hymenoptera, freshwater shrimp, and riparian fish and invertebrates were conducted during the year. Wetland and coastal mapping were initiated in two parks to assist those parks with future vital signs monitoring design and implementation. The contracted inventory of vascular plants at Eugene O'Neal NHS and John Muir Woods NHS, first initiated in FY 2001, continued during FY 2002 and are now 90 percent completed. The inventories for small mammals, amphibians, and reptiles at those same two parks is being performed by the U.S. Geological Survey - Biological Resources Division (USGS-BRD), and are now 85 percent completed.

Sierra Nevada Network - The Sierra Nevada Network includes Devil's Postpile NM, Sequoia and Kings Canyon NP, and Yosemite NP.

Habitat models and a sampling strategy for detecting and determining the distribution and abundance of high priority species in network parks was due to be completed by consultants at the firm of Jones and Stokes. However, a satisfactory product was not received from the consultants and the lack of an acceptable product delayed the start of field sampling for vascular plant species during the FY 2002 field season. In response, Yosemite and Sequoia-Kings Canyon NP ecologists held a planning meeting with USGS-BRD scientists to design field efforts that would be conduct this project at a later date. Surveys of fish, amphibians, and aquatic invertebrates in the high elevation lakes of Yosemite NP and Sequoia and Kings Canyon NP's continued during FY 2002. The primary focus of these inventories is mountain yellow-legged frogs, a severely declining species in the Sierra Nevada. Park Fee demo funds were obtained to supplement these inventory efforts and allowed the investigators to conduct surveys of fish, frogs, invertebrates, and habitat characteristics in 500 water bodies of Sequoia-Kings Canyon NP.

Pacific Island Network - This network includes seven national park units in Hawaii plus three other units in Saipan, Guam, and American Samoa. For purposes of conducting inventories of species occurrence and distribution, the six Hawaiian parks (excluding USS Arizona Memorial) were funded as a group, with separate funding going directly to the three other Pacific parks.

During FY 2002, mammal inventories were initiated in the Ka'apahu area of Haleakala NP. NPS personnel surveyed for mammals at 22 stations for four nights. A total of six rats and three mongooses were caught. The Service also planned to initiate bat inventories in the park, coordinating those efforts with the U.S. Fish and Wildlife Service, Hawaii Department of Land and Natural Resources, Bat Conservation International, and private landowners. However, acting upon advice received from the Department of Land

and Natural Resources, the Service postponed bat inventories pending the development of effective survey techniques by the bat consortium. Vascular plant inventories were also initiated in the Ka'apahu area of Haleakala NP during the fiscal year. For this inventory, historic locations of rare plants were overlaid on baseline GIS maps coverages and the actual areas to be sampled were identified. These inventory efforts will allow the park to determine if rare plant populations known to occur in the park during the past are still present or if those populations have been eradicated thorough some intervening factor(s).

Vegetation Mapping
FY 2002 Funding Allocation: $2,250,000

Vegetation information is another high-priority inventory need for most parks and is arguably the most important piece of information needed for park resource management and protection. Vegetation assemblages integrate diverse information on air quality, soils, topography, hydrology, meteorological conditions, and animal interactions to provide park managers with a key measure on the status of the natural systems they are managing. Vegetation maps are vital for (1) the management and protection of wildlife habitat, (2) modeling vegetation flammability and fuel implications for fire management, (3) analyses for site development suitability, and (4) evaluation of resources at risk.

Vegetation Mapping Process and Products

A standard process is followed for each park mapping project using documented, peer reviewed protocols which include a national vegetation classification system, and field method, and map accuracy assessment procedures. Although much of the actual field work, including vegetation classification, mapping, and accuracy assessment are conducted by non-government contractors, the entire process is closely monitored by U.S. Geological Survey and NPS staff. The oversight of this group provides a baseline of experience and helps assure consistency in products developed for a wide range of parks and monuments that vary considerably in size, vegetation type, and management needs. The process followed for each park can be summarized by grouping essential activities as follows: planning meetings and discussions with park staff, collection and analysis of existing data, development of a vegetation classification, development of a sampling strategy, field work, data input and analysis, photo interpretation, cartography, validation and accuracy assessment. The 28 final products prepared for each park unit mapped are provided digitally on the U.S. Geological Survey web site. Generally, products include: classification reports, keys and descriptions, aerial photography and overlays, spatial data, and accuracy assessment data.

FY 2002 Funding For Vegetation Mapping

As noted previously, in FY 2001, the NPS received a base increase of $1,750,000 through the Natural Resource Challenge for vegetation mapping. These funds were added to the $500,000 the NPS has been providing for vegetation mapping in Alaska, bringing the total FY 2002 allocation for vegetation mapping to $2,250,000. A small percentage of the

Natural Resource Challenge funds were used to pay staff salary and other miscellaneous, non-mapping expenses. In addition to the NPS finds, the USGS-BRD provided $985,000 towards these efforts and the NPS Fire Program committed $1,418,500. Of the $1,750,000 provided through the Natural Resource Challenge, 94.2 percent was used to support park specific projects and database development and 5.8 percent was used for national vegetation mapping program administration. Appendix II-E illustrates how Natural Resource Challenge funding for vegetation mapping was distributed across parks and activities during FY 2002.

Overview of Selected Vegetation Mapping Projects

Vegetation mapping funding received through the Natural Resource Challenge allowed the Service to greatly accelerate the rate at which parks are being mapped. By combining the funding provided through the Natural Resource Challenge with other funding provided by the USGS and NPS Fire Program, the Service was able to complete 12 vegetation mapping projects, continue 45 ongoing projects, and initiate 22 new park mapping projects. A brief description of the vegetation mapping efforts in a selected number of the parks is provided below.

Alaska Landcover Mapping - The Alaska Landcover Mapping Program is funded through the inventory portion of the Servicewide I&M Program and has as its goal providing basic vegetation information on a park-wide basis for all National Parks in Alaska Landcover mapping is intended to provide data tat are useful for the design and implementation of other I&M Programs as well as facilitate general resource management decisions within parks. During FY 2002, the Service allocated $500,000 to these efforts. Landcover mapping products provide baseline information about vegetation and have been used as input for ecological assessments as habitat evaluation and fire fuels modeling.

Because of the remote character and large size of Alaskan parks, it is recognized that landcover mapping must be done at a courser resolution than other non-Alaskan vegetation mapping. However, the Alaskan Landcover Mapping Program is designed to conform to Servicewide standards and can be expected to contribute to more detailed mapping efforts in the future. Landcover mapping has contracted for technical services with private firms for aerial photography and remote sensing analysis. The Service has also partnered with a variety of entities to conduct cooperative projects. Cooperators have included the U.S. Geological Survey - EROS Field Office, Ducks Unlimited, National Wetlands Inventory, and the University of Alaska.

The Landcover Mapping Program has identified a consistent suite of products that are produced for each of the park units. Landcover products are provided in digital format for use with the ARCview Data Browser and also in hardcopy format. The products and number of park units for which they have been completed as of FY 2002 include: landcover map (four parks), Field Data Viewer (six parks), User's Guide (four parks). Each of these products is also under development in a number of other Alaska park units.

Mapping efforts are expected to be either completed or initiated in all of the Alaskan parks by FY 2004.

Santa Monica Mountains National Recreation Area – The vegetation/fuels mapping effort at Santa Monica Mountains NRA will provide information for park fire management while following NPS national standards and guidelines. Work began in early FY 2002 and the final digital map should be completed by the end of FY 2004. The project is a cooperative effort between the NPS, the California Department of Fish and Game, and several private contractors. Aerial Information Systems (AIS) is completing aerial photo interpretation and map automation. Park staff is collecting detailed field-based data for the vegetation classification and accuracy assessment. During FY 2002, a preliminary classification was developed. The park hired five biological technicians into term positions to assist with field data collection.

Sequoia-Kings Canyon National Parks - Funding was provided to Sequoia-Kings Canyon NP during FY 2002 to continue the vegetation sampling, ecological characterization, and photo interpretation efforts there. By the end of the fiscal year, field sampling and characterization of the vegetation communities had been completed, along with the acquisition of aerial photography. The park has contracted with a private firm to map the vegetation within one watershed as a test of the level of mapping that can be expected throughout the park. An analysis of this activity will determine the remaining actions for completing the project.

Yosemite National Park – Vegetation sampling, characterization and mapping had been completed in Yosemite NP by the end of the fiscal year. The accuracy assessment phase of the project was initiated during FY 2003 and should be completed within about one year.

Glacier National Park - During FY 2002, field sampling had been completed in the east and west portions of the park and initial mapping had been completed on the east side. Accuracy assessment and initial mapping on the west side of the park will be undertaken during FY 2003.

Grand Teton National Park - Initial field sampling efforts were initiated at Grand Teton NP during FY 2002 with approximately 155 plots sampled. More sampling and initial mapping will be undertaken during the next fiscal year.

Rocky Mountain National Park - Preliminary field sampling efforts were initiated in Rocky Mountain NP during FY 2002 with approximately 400 plots sampled and entered into the park's project database. Analysis of those data will be undertaken during FY 2003, along with initial mapping efforts.

Bandelier National Monument - The initial field sampling and mapping efforts that were scheduled for Bandelier NM during FY 2002 had to be delayed due to dry

conditions that resulted in uncommon vegetation conditions within the park. These efforts will be re-initiated during FY 2003 once normal vegetative conditions return to the park.

Florissant Fossil Beds National Monument - All vegetation mapping efforts were completed at Florissant Fossil Beds NM during FY 2002. Copies of all products were provided to the park as well as being entered into the NPS archive.

Northern Colorado Plateau Parks - With financial assistance from the NPS, the USGS-BRD Vegetation mapping program, and the Fire Program, the Northern Colorado Plateau Network initiated a multi-park, multi-year vegetation-mapping project during FY 2002. A proposal was prepared in September 2001 that describes the overall program. The following park units are included in this mapping effort: Dinosaur NM, Capitol Reef NP, Black Canyon of the Gunnison NP, Curecanti NRA, Bryce Canyon NP, Cedar Breaks NM, Colorado NM, Canyonlands NP, Arches NP, Hovenweep NM, and Natural Bridges NM. During FY 2002, color aerial photography was acquired for the parks through the U.S. Department of Agriculture - Farm Services Aerial Photo Field Office and also through a separate agreement with the U.S. Bureau of Reclamation. During the fiscal year, a contract was also negotiated with a private contractor to produce individual vegetation classification and mapping workplans for six parks in the network. These very detailed workplans summarize and evaluate existing vegetation plot data, vegetation types, and species lists for each park and provide a detailed description of the work tasks and timelines needed to complete each project.

Northeast Region Parks - A major vegetation mapping project initiated during FY 2001 involves a 39 park units located throughout the NPS Northeast Region. By the end of FY 2002, vegetation mapping efforts had been initiated in 29 (76 percent) of those parks. Plans are initiate mapping in the remaining parks during FY 2003. During FY 2002, the Servicewide I&M Program provided $393,900 to the region to support vegetation-mapping projects. But, in addition to the I&M program funds, funding was also obtained from a number of other sources, including regional network funds, regional science program funds, park base funds, fee demo funding, and Fire Program funding. The region was also able to cost share project expenses with other agencies, including the U.S. Fish and Wildlife Service and NatureServe. While only in the second year of effort, the project has already provided a number of interesting results that contribute to an understanding of park vegetation resources and management including: 1) a plant species new to science was discovered during the vegetation sampling activities at Thomas Stone NHS and 2) an exemplary occurrence of the Montane Basic Seepage Swamp natural community was documented at Appomattox Courthouse NHP and could become a new community association for the U.S. National Vegetation Classification. This is the first recorded occurrence of a Basic Seepage Swamp in the Virginia Piedmont and may result in modification of the state description of that association.

Baseline Water Quality Data
FY 2002 Funding Allocation: $235,000

Perhaps few resources in parks are more impacted or influenced by activities outside park boundaries than are water resources. Park managers urgently need information about the current status of water quality in the parks as well as "benchmarks" against which they can compare future information. In that context, the primary goal of this inventory is to provide descriptive water quality information in a format useful to park managers. Drawing on existing Environmental Protection Agency (EPA) databases, particularly STORET, the national water quality database, a Baseline Water Quality Data Inventory and Analysis Report is being prepared for each of the 270 park units containing significant natural resources. These reports provide a complete inventory of all water quality data; descriptive statistics and graphics characterizing annual, seasonal, and period-of-record central tendencies and trends; and comparisons of park data with relevant EPA national water quality criteria and standards. The entire report (text, tables, and graphics) and all databases (water quality data, hydrography; and water quality station, stream gage, facility discharge, drinking intake, and water impoundment locations) are being provided to the parks in both analog and digital format to encourage additional analysis and incorporation of the information into park geographic information systems. Additional field-based water quality inventories (Level I inventories) are also being conducted where park coverage is incomplete and data gaps need to be filled. In addition to benefiting parks, the information obtained through these inventories is being used to support activities under the Clean Water Act and other national programs.

By the end of FY 2002, Baseline Water Quality Assessment Reports had been completed, or were in the final stages of completion, for all 270 natural resource park units. In addition, Level I field-based inventories had been implemented in 52 parks. A brief overview of field projects and the level of effort initiated in several of those parks during FY 2002 follows.

Chiricahua National Monument. - Water quality samples and analysis were conducted at Shake Spring.

Coronado National Memorial - Water Quality sampling and analysis were conducted at Blue Waterfall Seep, Yaqui Spring, Joe's Spring, East Forest Lane Seep, Crest Trail Mine #24, and the Clark Smith Tank.

Fort Bowie National Historic Site. - Water quality sampling and analysis were conducted at Apache Spring.

Gila Cliff Dwellings National Monument. - Water quality sampling and analysis were conducted at the West and Middle Forks of the Gila River.

Montezuma Castle National Monument. - Water Quality Sampling and analysis were conducted at Wet Beaver Creek, Beaver Creek, and Montezuma's Well.

Organ Pipe Cactus National Monument. - Water sampling and analysis were conducted at Dripping Springs and Williams Spring.

Saguaro National Park - Water quality sampling and analysis were conducted at Chimenea Creek, Madrona Creek, Rincon Creek, Loma Verde Creek, Wild Horse Creek, Spud Rock Creek, Italian Spring, Manning Camp Spring, King Canyon Seep, Old Spring Windmill, and at an unnamed wildlife watering hole.

Tumacacori National Historical Park - Water Quality sampling and analysis will occur at an unnamed spring inside the park boundary.

Soil Mapping
FY 2002 Funding Allocation: $985,500

Detailed information about the physical and chemical properties of soils found in parks is essential for park natural and cultural resource management protection. Soil inventories and maps provide basic information needed to manage soil sustainability and to protect water quality, wetlands, vegetation communities, and wildlife habitats. Soil inventories also provide managers with the ability to predict the behavior of a soil under alternative uses, its potential erosion hazard, its potential for ground water contamination, its sustainability for control exotic species and establishment of native communities, and its potential for preservation of cultural sites and landscapes.

Soil Mapping Process and Cooperators

The NPS works cooperatively with the U. S. Department of Agriculture's Natural Resources Conservation Service (NRCS) to provide park managers with basic information about soil resources throughout the parks as well as more detailed information for potentially high-use or developed areas in the park (e.g. visitor centers, campgrounds, trails, access roads, etc.). These inventories provide an orderly, on-the – ground, scientific inventory of soil resources present in these NPS units, and consist of digital maps of the locations and extent of soils, data about the physical, chemical, and biological properties of those soils, information pertaining to the use and management of these soils, as well as information and education products such as a soil survey manuscript, fact sheets, and image galleries. The information is in sufficient detail for application by park managers, planners, engineers, scientists, and researchers to specific areas of concern. Although these soil resource inventories follow procedures identified by the National Cooperative Soil Survey, it is important to note that the actual work plans are developed or "customized" by local park personnel to meet their soil resource management needs, as part of local soils scoping sessions.

In addition to working cooperatively with the NRCS, the NPS is also pursuing the possibility working with the private sector, including the National Society of Consulting Soil Scientists and other interests, to get NPS parklands mapped in areas in instances

where NRCS soil scientists are not available. The NPS sees cooperative efforts with the private sector as an important way of obtaining the technical expertise it needs to complete projects at the national level.

During FY 2002, The NPS allocated approximately $500,000 of Natural Resource Challenge funding to soil survey projects. These funds were combined with existing funding the Service had available for soil mapping projects, bringing the total amount of funding allocated to soil mapping during FY 2002 to $985,500. An overview of three representative soils projects conducted during FY 2002 follows.

Denali National Park – At Denali NP, the soil resources inventory is being developed to provide a resource data baseline to assist land use decision-making. The inventory will be used to better understand the distribution of soil resources and soil-landscape processes. A focus will be on the relationships of soil types to vegetation communities and subsequent potential wildlife habitats. Ecologically sensitive areas and information regarding natural landscape disturbances such as fire and flooding, thermokarst, and predicting subsequent vegetative succession may also be derived. In support of the prototype monitoring program currently underway at the park, this inventory can be used to select representative landscapes for monitoring and other research purposes as well as to determine the extent of similar landscapes to which research may be extrapolated.

The soil resources inventory will provide two separate products designed to be produced at two levels of detail to support variable management needs. The first product will be an Ecoregions Map to the Subsection level, at 1:250,000 scale, with a minimum delineation size of approximately 5,000 acres. This map will divide the project area into Ecoregions to the subsection level and contain units separated as per similar: (1) surficial geology, (2) lithology, (3) geomorphic processes, (4) landform and soil groups, (5) potential natural plant communities, and (6) subregional climate. The map will be compiled from air photo interpretation and other sources as available. Included will be a brief description of subsections and the methodology used to separate them. Complete descriptions of soil and site characteristics will be provided for each subsection in the final manuscript. The second product will be a soil map at 1:63,360 scale with a minimum delineation size of 40 acres. Detailed information regarding the physical, chemical, and biological properties of the soils will be collected, and presented in a soil survey report. A three-phase approach will be used to build the soil maps including: (1) selecting and pre-mapping representative study sites for each subsection using air photo interpretation, (2) field investigation of pre-mapped soil boundaries and data collection, and (3) extrapolating information obtained from study sites to the remainder of the subsection using available tools.

Great Smoky Mountains National Park – The Soil Resources Inventory currently in progress at Great Smoky NP is providing park staff and researchers valuable information on the role that soils play within ecosystems. To date, approximately 50 percent of the park has been mapped, and soil scientists have encountered 21 new "species" of soils that previously had never been recognized. The majority of these soils are located in the

higher elevations (above 4,600 feet) and are occurring due to the interaction of the unique geologic parent materials as well as climatic factors present at these higher elevations.

Once completed, the inventory will provide Great Smoky NP with a powerful tool for ongoing management and research efforts. One of the greatest limitations to the management of natural resources across a large area is a poor understanding of species distributions and their relationship to the underlying physical environment. Physical and chemical properties of soils are known to be critical to the distribution of forest types and vascular plants. However, these properties are also major factors determining the distribution of the vast, but poorly understood, number of species that comprise the flora and fauna of the park's soils. Currently, an All Taxa Biodiversity Inventory (ATBI) is being conducted to identify all species of life in the park and determine their distributions. Soil and litter samples have revealed many species not only previously unknown in the park, but new to science as well. To date, 37 new species of springtails (primitive insects), 14 species of slime molds, four species of earthworms, and three species of land snails have been identified. Information from the soil inventory will allow scientists to understand the habitat needs of species identified by the ATBI and predict their distribution and abundance throughout the park.

Although still in progress, the soils inventory has already revealed new areas for scientific study. For example, the unusual properties of the organic soils formed under heath balds have spawned a cooperative study with Western Carolina University to determine the age and paleo-ecology of these unique areas. Soil samples collected at various depths throughout the soil profile will be analyzed to determine the age of soil deposits and their rate of accumulation. Hopefully, this information will help solve the long-standing puzzle of how and when these unique vegetation communities were formed.

Big Bend National Park – At Big Bend NP, the soil resources inventory workplan was developed to address issues concerning restoration of landscapes and vegetation communities which have been severely impacted by soil erosion which has been accelerated by past activities such as livestock overgrazing, introduction of invasive plant and animals, as well as improperly maintained water control structures. Soil moisture and soil temperature will be monitored, as well as salinity and sodicity levels, to better understand potential impacts to soil resources and vegetation communities. Correlation of soil types to several threatened and park staff is pursuing endangered species. Soil samples have been taken in several locations to assist in the development of chrono-sequences to better understand the age of several landscapes in regards to cultural resources that have been found there. Specific information regarding the distribution and ecological significance of soil biological crusts is also being collected.

Geology Mapping
FY 2002 Funding Allocation: $600,000

Geology is a dynamic, broad ranging study and a critical component of natural resource management in the National Park Service. The inventory of significant, often sensitive,

geologic features and the eventual monitoring of on-going processes are essential for an understanding of interrelations in ecological communities. To deal effectively with resource management issues, park managers require inventories of geomorphic processes and surficial geology, disturbed lands, unique geologic features, fossils, and bedrock geology, depending on which are applicable and appropriate for each park.

Geology Mapping Process and Budget for FY 2002

The geologic inventory and mapping process (GRI) for a given park begins with an on-site scoping workshop involving an interdisciplinary team of technical specialists and the park resource management staff. Individuals from the U.S. Geological Survey, Bureau of Land Management, Natural Resource Conservation Service, U.S. Forest Service, state geologic surveys, academic institutions, and the private sector have participated in these on-site scoping sessions. In addition to learning about the park's resource management needs and priorities involving geologic resource information, the scoping sessions also serve the function of educating park staff on geologic science, geologic processes, and geologic resources in general.

The Geologic Resource Inventory provides parks with information on their geologic resources using four major products:

- A bibliography of geologic literature and maps,
- An evaluation of park geologic resources and issues,
- A digital geologic map
- A geologic report

The digital map is obtained through a variety of sources, including existing digital coverage, digitizing existing paper maps, or leveraging NPS funds with other agencies to produce new maps. All map and bibliographic information is provided in a format compatible with the park's other inventoried data sets. The evaluation is obtained through on-site scoping meetings involving NPS staff and authorities on a park's geology from the U.S. Geological Survey, state geological surveys, or academic institutions. Reports are taken from existing literature whenever possible or, if not available, through a contracted geologic report writer.

During FY 2002, the NPS used approximately $400,000 of Natural Resource Challenge funding to supplement geologic resource inventory projects servicewide. Those funds were combined with funding previously available to the NPS for geologic inventories and mapping, bringing the total NPS funding to $600,000. In addition, the funds for geologic inventories and mapping were leveraged considerably through the efforts of partners, principally the U.S. Geological Survey and state geologic agencies.

Status of Geologic Mapping in FY 2002

Through the end of November 2002, 78 parks in 23 states have had scoping meetings to evaluate geologic resources and issues. Summaries are posted on the NPS website.

Of the 273 GRI parks, 25 have completed GIS maps (98 actual maps) that are posted and downloadable on the NPS website. "Preliminary" digital coverage exists for another 46 parks, and many of the other scoped parks have maps at some stage of completion, either in the digitizing process (24 map sheets complete) or underway in the field with cooperating government agencies or academic institutions.

Bibliographies have been completed for 235 of the 273 natural area parks and are posted on the NPS website. The remaining 38 parks have bibliographic data and should be completed in FY 2003. The bibliographies are being integrated with other natural resource bibliographies and will be updated during FY 2003.

Reports are complete for 11 Utah parks, six in Colorado, and one in Alaska. An overview report of the regional geology for parks in the western U.S. is currently in work. A publication on the geology of the 13 New Mexico parks will be funded in FY 2003 in partnership with the New Mexico Bureau of Mines and Geology.

Park Use of Geologic Inventory and Mapping Products

Parks are using the types of geologic products provided by the inventory in three basic ways. First, parks are using the information to add to their understanding of the park's geology for scientific, educational, or interpretive purposes. Next, parks are using the information in traditional geologic applications, such as dealing with landslides, rockfalls, or human health and safety issues. Finally, parks are integrating geologic map data with other, non-geologic, information to assist in management decisions. Some examples of how parks utilize this type of inventory information are briefly summarized below.

Geologic Resource Inventory for Coastal Parks – Geologic Resource Inventory and NPS Geologic Resources Division staff members coordinated and funded a Coastal Mapping Protocols workshop on June 25-27, 2002 at Canaveral NS to address coastal park mapping needs and coastal management issues related to low relief and barrier island coastal systems. This workshop brought together 38 federal, state, academic, and private industry employees including park managers, coastal geologists, resource specialists, information technology specialists and inventory & monitoring coordinators, to establish coastal mapping protocols for Atlantic and Gulf coastal parks within the National Park Service. Workshop participants discussed coastal park management issues and formulated a draft list of Coastal Landform Mapping (CLM) units that should be incorporated into coastal geology mapping products. Geologic Resource Inventory staff

members will integrate the identified coastal mapping units into the NPS Geology-GIS Data Model, the documented standard for digital geologic maps within the NPS.

The participants of the Coastal Mapping Protocols Workshop strongly encouraged a "holistic" ecosystem approach for the effective management of our Nation's coastal parks. To understand the broad range of multi-faceted coastal issues commonly confronting coastal park managers, coastal geologic landform maps should be integrated with biological and physical system components, including vegetation, species habitat, and oceanographic variables. Park infrastructure, boundary information, shoreline engineering, and cultural resources may also be integrated with the final geologic map products. GRI staff members will work with coordinators of other Natural Resource inventories and their partners to identify and initiate possible integrated data collection and mapping projects. Cooperative projects may allow significant cost savings for the inventories and higher quality data products for park managers. These additional mapping components will increase understanding of complex coastal environments, allowing park managers to make better-informed and more effective management decisions

In FY 2003, a pilot project with one or more coastal parks will be initiated to develop mapping protocols and standards for low relief and barrier island coastal parks. The pilot project and standards will leverage lessons learned from current cooperative mapping projects at Cape Lookout and Cape Hatteras NS. Also in FY 2003, Geologic Resource Inventory staff members and cooperators may host a second workshop to address mapping protocols and standards for parks with high relief and rocky shorelines.

Ozark National Scenic Riverways, Wind Cave National Park, Jewel Cave National Park – NPS Geologic Resource Inventory funds have been used to support ongoing geologic mapping in these three cave parks by supporting either NPS personnel in the field or supplementing a U.S. Geological Survey mapping program. Detailed geologic maps are essential to natural and cultural resources management within the parks. They provide better interpretation of the dynamics of and threats to cave and karst systems, including regional concerns extending beyond park boundaries. The geological components of local or regional geohydrologic systems link geology to park and regional ecosystem processes and provide for analyses of the potential impacts of mineral extraction. In order to understand the regional hydrologic system, bedrock geology characteristics must first be identified through mapping.

Theodore Roosevelt National Park – Underground lignite (a very low-grade coal-like substance) seam fires are a significant resource concern for park management. These fires usually ignited though lightening strikes but occasionally through human activities, provide a convenient ignition source for overlying vegetation during prolonged dry spells. Once ignited, they are virtually impossible to extinguish and may burn for decades. Subsurface seams that have burned out are then susceptible to large-scale subsidence or collapse. The park, partnering with the U.S. Geological Survey and North Dakota Geologic Survey, has used geologic maps and LANDSAT imagery of the park to identify the spatial distribution of clinker beds, bedrock that has been metamorphosed by the heat

generated by the underlying lignite fires. With this information, areas of historic fires have been delineated and areas susceptible to new fires are identified. Park management then incorporates this information into their fire management plans. Using GRI funds, expansion of the mapping to include the Elkhorn Ranch Unit in the park and Fort Union and Knife River Indian Villages NHS is planned for FY 2003.

Lake Meade National Recreation Area – With Geologic Resource Inventory funds provided to the U.S. Geological Survey, the park is using geologic maps and multispectral LANDSAT analysis to delineate the habitat distribution of the threatened California Bearpaw Poppy. This plant thrives only on soils particularly rich in gypsum ($CaSO_4$) that are derived from the underlying gypsum-bearing bedrock. The imagery is first used to identify areas rich in gypsum that produce a distinct spectral signature. These areas are then ground-truthed and specific bedrock units are identified. Once the bedrock formations are known, the geologic map is used to identify a specific formation's presence elsewhere in the park that may not produce a similar spectral signature. In turn, these areas are investigated as to the occurrence of poppy habitat.

Landform Mapping in North Cascades National Park – While bedrock geologic map coverage in the North Cascades is complete, mapping of soil and surficial features is lacking. Yet these parameters are of significant importance to park resource management. Park staff has developed a program mapping and digitizing surficial data at three map scales, which has been tested in individual watersheds in both North Cascades NP and Mount Rainier NP. Identification of geologic hazards such as landslides and debris flows as well as springs and groundwater distribution is by-products of this series of landform maps. Because it is an integrated effort to combine soil and surficial geologic information, both the Geologic Resource Inventory and the Soil Resource Inventory are providing matching funds to complete mapping in the park. The program is also linked with the U.S. Forest Service Ecological Unit Inventory and thus provides seamless map coverage between NPS and U.S. Forest Service lands in Washington. Efforts are under way to expand the program to use surficial geology data to improve soil models for other wilderness areas in Washington State. These landform mapping protocols are being reviewed and considered for their applicability to other parks in the North Cascade and Coastal network.

Big Bend National Park – The existing geologic map at Big Bend NP was completed in the late 1950s. While an excellent product for its time, much has been learned about the science of geology since then. The park is interested in obtaining an up-to-date map to use in resource management and interpretation. Subsequent to a Geologic Resource Inventory sponsored meeting, the U.S. Geologic Survey recognized the opportunity to investigate a variety of mineralogical and contamination issues through renewed study of the park's geology. Prior to the park's establishment, the mercury bearing mineral cinnabar was mined in and around the area. Additionally, the park lies downwind of several extensively industrialized areas. The U.S. Geological Survey is interested in studying the cinnabar occurrence relating to the volcanoes in the park and also in the role of dust contamination originating in those areas upstream. The park provides a relatively

undisturbed environment to investigate these occurrences and will require an up to date map to accomplish this task. Additionally, a consortium of Texas colleges and universities has been formed to cooperatively map different parts of the park. The NPS Geologic Resource Inventory will provide support funding to the U.S. Geological Survey and possibly the academic consortium in FY 2003.

Park Vital Signs Monitoring: A Commitment to Resource Protection

Americans expect the National Park Service to preserve and protect the nation's heritage, including the living and non-living features of ecosystems. However, protection of national parks is an extremely complicated and difficult task. Park ecosystems are complex and constantly changing over time and space. Managers must be capable of determining whether the changes they observe in park resources are the result of natural variability or the effects of human activity. To sustain the health of these systems, to diagnose threats and to mitigate those threats, park managers need to identify and constantly monitor changes in vital signs of park, just as physicians monitor the vital signs of their patients.

Natural resource monitoring identifies and tracks "the most significant indicators of ecological condition and the greatest concerns of each park," known as vital signs, to provide park managers with the broad-based, scientifically sound information they need to effectively manage park resources. Monitoring focuses on the natural resources that park managers are directed to preserve "unimpaired for future generations," including water, air, geological resources, plants and animals, and the various ecological, biological, and physical processes that created the parks and continue to act upon them.

Simply put, monitoring provides a basis for understanding and identifying meaningful change in natural systems characterized by complexity, variability, and surprises. Knowledge and understanding result in better management decisions and allow park managers to work more successfully with the public and other agencies to protect park resources. Additionally, the credible scientific information that results from monitoring can help to resolve contentious and difficult resource issues. For example, the challenge of sustaining a natural system is even more complicated when natural areas have been so highly altered that physical and biological processes no longer operate (e.g., control of fires and floods in developed areas). In these situations, monitoring can help managers understand how to develop the most effective approach to restoration.

In FY 2001, as a major component of the Natural Resource Challenge, the Service initiated "park vital signs" ecological monitoring in 32 park networks representing 270 park units with significant natural resources. This section describes the progress the Service has made to date in implementing those network monitoring programs

Park Vital Signs Monitoring Implementation Process

The overall strategy for implementing long-term ecological monitoring in parks with significant natural resources involves two components: 11 experimental or "prototype" monitoring programs begun in 1992, and 32 vital signs monitoring networks of parks linked by geography and shared natural resource characteristics. Parks within each of the 32 networks will work together and share funding and professional staff to plan, design, and implement an integrated, long-term monitoring program.

The complicated task of developing a network monitoring program requires an initial investment in planning and design to guarantee that monitoring meets the most critical information needs of each park and produces scientifically credible data that are readily accessible to managers and researchers. These front-end investments also ensure that monitoring will build upon existing information and understanding of park ecosystems and make maximum use of leveraging and partnerships with other agencies and academia. The Service has adopted a seven-step process for developing park vital signs monitoring programs. Those steps are: 1) form a board of directors and technical advisory committee, 2) summarize existing monitoring data and understanding, 3) conduct a monitoring scoping workshop, 4) write the workshop report and have it widely reviewed, 5) decide on monitoring priorities and implementation approaches, 6) draft the network monitoring strategy, and 7) have the monitoring strategy reviewed and approved by the Washington Office. Once the Board of Directors for the network has been formed, that group is required to develop a network charter that outlines how the board will function with respect to decision-making and insuring the accountability of the monitoring program. A critical component of step 2 in the process is formulation of a conceptual model that summarizes structure and functioning of the ecological systems being monitored.

The seven steps required for the development of a network's monitoring plan are being completed in three distinct phases described as follows:

- During Phase 1, networks prepare a report which includes the results of summarizing existing data; defining goals and objectives; beginning the process of identifying, evaluating and synthesizing existing data; developing draft conceptual models; and completing other background work required before the initial selection of ecological indicators. Phase 1 reports must be peer reviewed and approved at the regional level before the network proceeds to the next phase.

- Phase 2 of the process involves conducting a series of meetings and scoping workshops designed to prioritize and select the indicators that will be included in the network's initial integrated monitoring program.

- Phase 3 entails formulating the detailed design work needed to implement monitoring, including the development of sampling protocols, a statistical sampling design, a plan for data management and analysis, and details on the type and contents of various products of the monitoring effort such as reports and websites.

Implementation Timelines For The Various Phases

At the end of FY 2002, the first 12 networks had completed Phase 1 of the three-phase planning and design and completed other background work that must be done before the initial selection of ecological indicators. The following table provides the timeline established for the networks currently receiving monitoring funding to complete the three-phase planning process.

Name of Network	# of Parks	Phase 1 Due Date	Phase 2 Due Date	Phase 3 Final Plan
North Coast and Cascades Network	7	1-Oct-02	1-Oct-03	1-Oct-05
Northeast Coastal and Barrier Network	8	1-Oct-02	1-Oct-03	1-Oct-05
Heartland Network	15	1-Oct-02	1-Oct-03	1-Oct-05
Sonoran Desert Network	11	1-Oct-02	1-Oct-03	1-Oct-05
Cumberland/Piedmont Network	14	1-Oct-02	1-Oct-03	1-Oct-05
Central Alaska Network	3	1-Oct-02	1-Oct-03	1-Oct-05
National Capital Region Network	11	1-Oct-02	1-Oct-03	1-Oct-05
Northern Colorado Plateau Network	16	1-Oct-02	1-Oct-03	1-Oct-05
San Francisco Bay Area Network	6	1-Oct-02	1-Oct-03	1-Oct-05
Greater Yellowstone Network	3	1-Oct-02	1-Oct-03	1-Oct-05
Appalachian Highlands Network	4	1-Oct-02	1-Oct-03	1-Oct-05
Mediterranean Coast Network	3	1-Oct-02	1-Oct-03	1-Oct-05
Total number of Parks	**101**			

Network Monitoring Funding and Accomplishments

Since FY 2001, park networks involved in the planning and design of monitoring programs have received assistance from numerous federal and state agencies, non-governmental organizations such as NatureServe, private contractors, Cooperative Ecosystem Study Units, and academic scientists from more than 100 universities. The efforts of these entities to develop an integrated, system-based monitoring program have catalyzed the development of a number of interagency partnerships. The following sections summarize the current status for each of the 17 networks of parks receiving

Natural Resource Challenge funding during FY 2002 and also identifies some of the cooperators the networks have worked with. In each instance, the network's major objectives for FY 2002 are identified and their accomplishments relative to those objectives described. In many cases, the major monitoring protocols being developed by the network are also highlighted. Appendix III-A contains a summary of the number of parks included in the first 12 vital signs monitoring networks that were actively engaged in protocol development and/or implementation during FY 2002.

FY 2002 Funding for Vital Signs Network Monitoring

During FY 2002, the National Park Service I&M Program allocated a total of $6,851,000 to 17 of the 32 networks for park vital signs monitoring. The amount of funding provided to each network during the year is summarized in Appendix III-B. The total amount of funding allocated to each monitoring network was derived through a formula that took into consideration the amount of staffing needed to conduct monitoring in all parks in the network, the geographic separation of parks within a network, and a cost of living adjustment for the area of the country in which the network occurs.

Leveraging and Out-Sourcing With Network Monitoring Funds

During FY 2002, the 17 vital signs monitoring networks receiving funding used those funds in a wide variety of ways, including supporting NPS personnel and out-sourcing. The amount of funding used for external contracts and/or Interagency Agreements was as follows: U.S. Geological Survey $152,466, other federal agencies, $271, 337, universities, $1,832,854, and other non-federal cooperators $2,303,868. In addition to the funding provided to the networks by the Servicewide I&M Program, the monitoring networks also received funding from a variety of other sources, including: NPS parks or regions $2,457,430, U.S. Geological Survey – Biological Resources Division $847,588, and other Partners $583,370.

A. Accomplishments of Monitoring Networks Receiving Full Funding

The following sections describe the major accomplishments achieved by the first 12 monitoring networks to receive their full allocation of operational monitoring funding. These 12 networks include a total of 101 individual park units.

North Coast and Cascades Monitoring Network **-** This network of seven parks in the Pacific Northwest includes two prototype monitoring programs, Olympic NP and North Cascades NPS Complex, as well as Mount Rainier NP, Ebey's Landing NHR, San Juan Island NHP, Fort Clatsop NM, and Fort Vancouver NHS. By the end of FY 2002, all seven parks in the network had completed initial scoping workshops and held meetings with the adjacent national forests and other agencies to discuss potential collaborative efforts. Several scientists from the U.S. Geological Survey are working closely with the network parks to plan and design the monitoring program. The network coordinator in

2002 was an employee of the Environmental Protection Agency on loan to the NPS, who has since returned to the EPA.

FY 2002 Network Objectives for Vital Signs Monitoring - Specific monitoring objectives and tasks for FY 2002 differed among parks in the network. Nonetheless, the objectives are the same for the developmental stages of each of these programs. Those objectives are to:

1. Complete (90% documentation) inventory goals for vertebrates and vascular plants.
2. Based on conceptual models for ecosystems within network parks, develop a Network Vital Signs Monitoring Plan that identifies monitoring questions, priorities, indicators, measurable objectives, and a sampling framework for integrated monitoring, and lists associated research needs.
3. Develop inventory and monitoring databases, and natural resource base data layers to support long-term ecological monitoring, research, management, and public information.
4. Evaluate and conduct ongoing monitoring that is expected to remain part of the operational program. Work with USGS-BRD (or other scientists) to complete pilot studies and design protocols for additional monitoring components.
5. Recruit and fill vacant positions.

Summary of Major Network Accomplishments During FY 2002 - Most of the work accomplished by the North Coast and Cascades monitoring network during FY 2002 involved identifying high-priority issues and data needs for the seven parks; reviewing protocols and objectives of existing monitoring efforts within the parks as well as those used by the Forest Service, EPA and other agencies in the region; and beginning the process of identifying, cataloging, and evaluating existing data sets. Some of the monitoring funding obtained through the Natural Resource Challenge was used to accelerate high-priority inventories of vascular plants and vertebrates to provide data needed for the design of the monitoring program. Interagency agreements and cooperative agreements to assist the network with monitoring design were also established with and work initiated by the USGS, U.S. Forest Service, EPA, Army Corps of Engineers, University of Washington, Western Washington University, Portland State University, and the Institute for Bird Populations. Some of the funding for vital signs monitoring in FY 2002 was also used to continue or complete inventories of key resources to provide a basis for planning and designing the monitoring program. As one example of those inventories, the Falcon Research Group provided documentation for all raptor nests on master map of the Reserve, with data on each nest including location determined by GPS, and a photo of each nest tree and environs. The contractor spent approximately 109 hours of field time locating nests, recording GPS position, and noting species type and nesting behavior. Approximately 18 hours of office time was used to prepare contracts and reports, for a current total of 127 hours. The contractor has located

a total of 25 nests within the Reserve, and identified species as follows: ten Bald eagle nests, thirteen Red-tail hawk nests, and two American Kestrel nests.

Based on conceptual models for ecosystems within network parks, the network developed a "Network Vital Signs Monitoring Plan" that identifies monitoring questions, priorities, indicators, measurable objectives, and a sampling framework for integrated monitoring, and lists associated research needs. A technical committee workgroups (air/climate, water, vegetation, wildlife, geology/ soils/ landscapes, marine) met on February 26-27, 2002 to present summaries and conceptual models derived from network park vital signs scoping sessions. Based on these summaries, the Technical Committee and Network Coordinator identified an initial set of indicators that may be monitored within the network, and prepared the Phase I Report. During the next fiscal year, the Network Technical Committee will host an Outreach Workshop to identify opportunities for collaboration among regional monitoring programs and those of the network. Based on results of this and all previous scoping sessions, the network will recommend a final suite of vital signs (monitoring components) to include in the network monitoring program.

During FY 2002, the network also achieved significant accomplishments relative to the development of a network-wide data management plan. The network held GIS-Data Management meetings to plan and coordinate efforts of personnel at different park unit in order to develop a Network Data Management Plan that combines input from networks that have completed their plans and guidance from I&M leadership. Another major accomplishment was the development of a North Coast and Cascades Network webpage to share information. As a part of these activities, the network developed a "data stewards" list for I&M projects occurring at multiple park units within our network to assign responsibility for insuring data consistency.

During FY 2002, the network also evaluated and conducted a number of monitoring monitoring projects that are expected to remain part of the operational program. The network worked with USGS-BRD (or other scientists) to complete pilot studies and design protocols for additional monitoring components. The network initiated mass balance measurements on Nisqually and Emmons glaciers and measured snow accumulation and melt using snow probing. Network and BRD staff met with University of Washington Atmospheric Sciences staff to discuss the application of models to Network Parks. A climate workshop will be held in FY 2003. Monitoring funds were used to purchase two new remote area weather stations for Mount Rainier NP and North Cascades NP and to upgrade two existing manual weather stations. Mount Rainier NP staff partnered with National Intertagency Fire Center staff to purchase these units at a 50% price reduction to the Network. The biological technician and data manager stationed at Mount Rainier NP initiated mapping of existing weather stations in Network parks. This information will be used to determine where to locate additional weather monitoring equipment for long-term monitoring. Photographic monitoring was conducted at San Juan Island NHP to document current air pollution conditions as viewed from American Camp. The historic vista is being significantly impacted by local air pollution

sources. Funding was obligated to continue to the monitoring program at San Juan Island NHP for one additional year.

Network monitoring funding was utilized in FY 2002 to identify *characteristics of landscape change* that could be utilized for long-term monitoring. Three time periods between 1850 and the present were chosen for documentation. These time periods were selected based on historic events and major changes in land-use patterns. Historic and current aerial photographs and maps are being digitized and entered into GIS databases. Funding was also obligated through the Cooperative Ecosystem Study Unit to initiate establishment of permanent vegetation plots in the prairies of American Camp.

Northeast Coastal and Barrier Island Monitoring Network - This network of eight parks includes Cape Cod NS, Assateague Island NS, Colonial NHP, Fire Island NS, Gateway NRA, George Washington Birthplace NM, Sagamore Hill NHS, and Thomas Stone NHS. As part of its Vital Signs Monitoring efforts, the network is expanding upon the monitoring design and protocol development work initiated by the Cape Cod NS Prototype Monitoring Program, and includes active participation from scientists with the USGS, EPA, and a number of universities in the northeast region.

FY 2002 Network Objectives for Vital Signs Monitoring:

1. Develop an issue-based, Network Vital Signs monitoring program.
2. Review and assess Network staffing needs.
3. Hold scoping and program review workshops for identified monitoring components.
4. Develop a Network water quality monitoring plan.

Summary of Major Network Accomplishments During FY 2002 - The network held an initial scoping workshop in FY 2001 in which they identified high-priority issues and data needs. Subsequent to that scoping workshop, nine interagency workgroups were formed on topics including shoreline change, water quality, estuarine nutrient enrichment, and data management to evaluate existing information, develop specific monitoring questions and objectives, and to summarize existing sampling protocols and potential partnerships. Monitoring funds received by the network during FY 2002 were also used to initiate vegetation mapping and accelerate biological inventory projects that are needed for developing a spatial sampling design for monitoring resources in the parks. Cooperative agreements were established and funding was provided to the University of Rhode Island, Rutgers University, North Carolina State University, and the U.S. Geological Survey to assist with the identification and evaluation of existing information and data needs for the network parks.

Work during FY 2002 included a data mining element for specific issues in the Network's monitoring program such as contaminants, estuarine nutrient enrichment, shoreline change, visitor impacts and species and habitats monitoring. A plan for shoreline change monitoring, and a proposal to begin testing a protocol for monitoring

salt marsh communities that was developed for Cape Cod NS long-term monitoring program, was accepted and funded. The network executed a cooperative agreement with USGS St. Petersburg for the processing and delivery of existing LIDAR data sets for Assateague Island NS, Cape Cod NS, Fire Island NS, Gateway NRA, and George Washington Birthplace NM and renewed an existing cooperative agreement with USGS St. Petersburg for additional LIDAR surveys and the development of value added products from existing and future surveys (e.g. dune features, edge of vegetation, rectification of co-incident aerial photographs).

During the fiscal year, the network developed a draft data management plan including data standards and standard operating procedures for network ocean parks using Assateague Island NS data as pilot and initiated efforts to survey and assess analysis procedures for geomorphologic data sets with NPS Geologic Resources Division and the University of Rhode Island. Agreement was also to cover compilation and documentation of historic shorelines for above-mentioned parks.

Another FY 2002 accomplishments identified *Saltmarsh as a key habitat for monitoring* in the Coastal and Barrier Network. Two existing monitoring protocols, developed, tested and implemented as part of the Cape Cod Prototype Monitoring are being considered for the network. These protocols have been successfully implemented in six Fish and Wildlife Refuges along the Atlantic Coast. Implementation of these protocols in network parks would allow coordination with U.S. Fish and Wildlife Service refuges in implementing monitoring and comparing data. A cooperative agreement with the University of Rhode Island was established to begin protocol development on saltmarsh vegetation and nekton community monitoring in the Northeast Coastal and Barrier Network parks. The purpose of this project is to develop a sampling design, test protocols and determine a long-term implementation strategy.

Also during FY 2002, an interagency agreement was established with the USGS to conduct Phase I data mining on existing *nutrient enrichment monitoring* in the network parks and to identify candidate vital signs. A draft report was submitted to the Network by the USGS and University of Rhode Island principal investigators in July 2002. This report identifies monitoring variables for regional testing that were selected by assembling and synthesizing information from diverse sources, including technical workshops and meetings, existing programs, and site visits to North Atlantic parks.

A two-phase proposal was submitted by Sterling College and North Carolina State University to begin the data mining process for development of a *visitor impact monitoring protocol*. A cooperative agreement was established with Sterling College to fund Phase I. The first progress report was submitted in September 2002, that included information gathered during site visits to George Washington Birthplace NM, Thomas Stone NHS, Sagamore Hills NHS, Assateague Island NS and Gateway NRA, through extensive meetings and interviews with these park's natural resource managers and field staff, and the initiation of a thorough literature review.

A cooperative agreement was established with the University of Rhode Island (James-Pirri and Roman) to complete a two year project titled, "Wetland and Water Quality Issues for Parks of the Northeast US: A Scoping Report for the Coastal and Barrier Network". This report was intended to summarize threats and establish how those threats are altering structure and function of wetlands within the Network parks. In addition, existing monitoring programs are to be evaluated and improvements suggested if appropriate. Information from state 305(b) and 303(d) reports will be summarized and discussed in light of our need to identify pristine as well as impaired waters in the network. Unfortunately, this project has been delayed and was not initiated until August 2002. The cooperative agreement ends in FY 2003, and a no-cost extension has not yet been made.

During FY 2002, an amendment to a cooperative agreement with the University of Rhode Island was established, to fund Task 1 of a larger proposal to develop techniques to *monitor potential sources of nutrients* in park watersheds. Task 1 of this project, funded with Network Water Resource Division funds, will conduct a baseline inventory of potential sources of nutrients within watersheds of each of the Network parks. This project will provide an inventory of recent changes in nutrient loading proxies at 10-year intervals back to 1970, as well as interpretation for each park. A manual of procedures for updating this inventory at each location, including detailed data source guides, will be developed as part of the final deliverables. The following list of agents of change will be reviewed for each park:

- Human population numbers derived from census tract data. Since the census tracts will not be perfectly aligned with watershed boundaries, this will be prorates on an area basis or corrected using more site specific detailed information on population distribution.

- Human population served by municipal sewage treatment systems vs individual on-site sewage treatment. These data will collected from local sources.

- NPDES permits for point source discharges as well as sewage treatment plant monitoring records for N where they are available. These should be available from state environmental agencies and the plants themselves.

- Permitted water withdrawals for agriculture and domestic consumption. These data should be available from state sources.

- Fertilizer consumption. These data are available at the county level from the Fertilizer Institute and U.S. Dept. of Agriculture. This will be prorated for the watershed on the basis of agricultural land use.

- Livestock populations. These data are available at the county level from the Census of Agriculture. Again, will be prorated to the watershed on the basis of agricultural land area or more site specific information from Agricultural

Extension agents knowledgeable about local practices.

- Land use inventories. This information is often more problematic that assumed because of differences in defining land use and a lack of field verification. The cooperators believe that NOAA C-CAP land cover data are available for all the parks and the Multi-Resolution Land Characteristics Consortium has analyzed 1991-92 land cover for all the parks as well. If any of the park watersheds are not available through C-CAP, the cooperators will work directly with the USGS National Land Cover Data, which provide land cover in the Anderson Level II classification at 30m by 30m pixel resolution. Either the USGS or the C-CAP data can be input directly to our ArcView GIS system using the ESRI software associated with C-CAP. The cooperators anticipate assembling an aggregated classification emphasizing major differences only. For example, because of the obvious importance of impervious surface in generating runoff, they may work with a simple scheme of high intensity developed, suburban or low intensity developed, field crops, pasture, forest, wetland, and open water. For three of the parks (Assateague NS, Gateway NRA, and Cape Cod NS) they will also have an opportunity to compare the whole watershed land cover with an independent analysis, by Wilfred Rodriguez and Peter August of the University of Rhode Island Environmental Data Center, that is nearing completion. Their project has analyzed land cover data from 1976,1984, 1990-93, and 1999 for each of the three parks, but only for a 4 km wide buffer around the estuarine portion of each system. They will be comparing land cover in the buffer zone with environmental indicators in the water analyzed by the U.S. EPA EMAP program.

- Atmospheric deposition. Blaine Kopp of the USGS has already determined that wet deposition monitoring of direct nitrogen flux (as part of the NADP program) has been in place since the 1980's within three of the parks (Assateague, Cape Cod, and Acadia) and that monitoring sites are located close to Gateway NRA and Boston Harbor Islands NRA. If the cooperators can't identify any independent monitoring stations close to the remaining parks, they will interpolate N deposition from the nearest sites.

Heartland Monitoring Network - This network of 15 parks in the Midwest Region includes Arkansas Post NM; Buffalo National River; Cuyahoga Valley NP; Effigy Mounds NM; George Washington Carver NM; Herbert Hoover NHS; Hopewell Culture NHP; Homestead National Monument of America; Hot Springs NP; Lincoln Boyhood NM; Ozark National Scenic Riverways; Pea Ridge NMP; Pipestone MN; Tallgrass Prairie NPres; and Wilson's Creek NB. Sampling protocols developed by the Prairie Cluster Prototype Monitoring Program are being extended to additional prairie parks in the network.

<u>FY 2002 Network Objectives for Vital Signs Monitoring</u>

1. Hire and train key personnel to design and implement the Heartland Network

monitoring program
2. Develop and maintain working and decision-making process that engage technical staff and managers of network parks
3. Assemble parks' monitoring priority information, compile and summarize existing monitoring data, and develop stressor-based conceptual models
4. Identify vital signs indicators, boundaries, and thresholds
5. Determine protocols, experimental design, sampling location, and administration
6. Develop the Network's Data Management Plan

Summary of Major Network Accomplishments During FY 2002 - During FY 2001 and FY 2002, the Heartland Network received $684,400 from the I&M program towards long-term monitoring program development. The funds were applied to developing the Heartland Network monitoring program, as documented in the draft Heartland Network Monitoring Plan Developed for the National Park Service Inventory and Monitoring Program: Phase I. The FY 2002 program development focused on NPS and park-specific monitoring background information and the development of stressor-based conceptual models. This information will be utilized in FY 2003 for determining appropriate monitoring vital signs (indicators) and subsequent monitoring protocols, which will be documented in Phase II (to be completed in FY 2003) and Phase III (to be completed in FY 2004) of the Monitoring Plan.

Some parks in the network have identified a need to undertake forest community monitoring. During the fiscal year, network personnel and research scientists developed a list of potential indicators and alternative protocols that could be considered in *forest community monitoring*. Over-abundant deer populations were discussed in relation to impacts on vegetation. A recommendation was made that monitoring for this issue would be two-fold including both population density monitoring and vegetation impact assessment monitoring. Similar discussions on *exotic plant monitoring* highlighted that early warning monitoring for exotic plants will involve reconnaissance in potential invasion corridors. A standard method for this type of monitoring does not appear to be available so protocols will have to be developed.

During FY 2002, the Heartland Network formed a number of 'theme' groups to oversee their monitoring efforts. Those theme groups are: Plant Communities, Exotic Plants, Aquatics, and Land Use Change. The need for other theme groups is still under consideration. Theme group participants include network and regional I&M staff, park personnel, and outside scientists, and will serve in an advisory capacity to the network as a whole.

The Heartland Network placed major emphasis on outreach activities during FY 2002. Park staff participation included maintenance, interpretation, rangers, superintendents, resource managers, etc. The goal was to increase understanding of the program and the relevance of the activities to each park employee. These presentations were generally

incorporated with information gathering meetings.

Conceptual models represent the cornerstone of any long-term monitoring program. During FY 2002, the Heartland Network focused upon the development of a stressor-based forest ecosystem model and literature review of forest ecosystems in network parks by contracting with Dr. David Weinstein of the Boyce Thompson Institute for Plant Research. In similar manner, the network finalized cooperative agreements with Dr. Charles Rabeni of the USGS-BRD, in Columbia, MO, for development of a stressor-based Ozark Region river ecosystem model and literature review and Dr. Daren Carlisle, NPS Midwest Region Aquatic Ecologist for the development of a stressor-based wetland ecosystem model, particularly relevant to wetlands ecosystems representative of Cuyahoga Valley NHP. Through a cooperative agreement, Dr. Andy Hansen of Montana State University began working with the Heartland Network on the development of a land use change conceptual model. This model, to be completed in winter of 2003, will show: (a) how parks function within the landscape, (b) which parks are most vulnerable to land use change, and (c) the best indicators to use to detect land use change.

Laying the groundwork for future monitoring protocol development also represents a major component of the Heartland network's activities during FY 2002. The land use, plant community, exotic plant, aquatic, and wildlife theme groups are preparing an overview of each sampling protocol that will be used to monitor the vital signs. The overview will summarize the material in the Protocol Narrative for each protocol, including an overview of the resource issue being addressed, specific measurable objectives, sampling design, field methodology, data analysis and reporting, personnel requirements, and operational requirements. Standard Operating Procedures (SOPs) will that insure that the data is comparable with other large regional data sets, to the extent possible. Protocols will also include a detailed discussion of Quality Assurance/Quality Control measures used to insure that data collected will be considered credible by the scientific community and those who will be using them, including NPS managers, state agencies, and other federal agencies.

Sonoran Desert Monitoring Network - The Sonoran Desert network consists of 11 small parks in southern Arizona: Casa Grande Ruins NM; Chiricahua NM; Coronado NM; Fort Bowie NHS; Gila Cliff Dwellings NM; Montezuma Castle NM; Organ Pipe Cactus NM; Saguaro NP; Tonto NM; Tumacacori NHP; and Tuzigoot NM. The network has developed a strong partnership with USGS and university scientists through the Cooperative Ecosystems Studies Unit, and has held planning meetings with adjacent protected areas in Mexico. All parks in the network have active relationships with local entities including other state and federal government agencies, educational institutions, municipalities, the general public, non-profit conservation groups, and Mexican protected areas and communities.

<u>FY 2002 Network Objectives for Vital Signs Monitoring:</u>

1. Organize Network, Science Advisory Committee and Board of Directors
2. Compile existing inventory and monitoring information for identified management issues, develop conceptual models and monitoring strategy.

Summary of Major Network Accomplishments During FY 2002 - A network coordinator and data manager were hired in FY 2001, and the Network's Board of Directors and technical advisory committee were organized. Parks in the network began listing and prioritizing their issues and data needs, and the network coordinator began compiling information on existing monitoring being conducted in and near network parks. The network has a particularly strong partnership with the USGS-BRD field station and Cooperative Ecosystems Studies Unit established at the University of Arizona; more than 25 graduate students from the university have been actively involved in inventory and monitoring work for the network. Work began on conceptual modeling related to exotic plant monitoring, which was initially identified as the leading issue for network parks.

The second iteration of the network Board of Directors took place in early FY 2002 to replace the interim Board appointed in FY 2001. Many of the original interim board members were re-elected to the current Board. The Board met formerly three times during FY 2002 to decide funding and network administrative priorities, review the planning approach for vital sign selection, and revisit the network charter.

In early FY 2002, Sonoran Desert Network park staff completed surveys of agents of change (AOC) and their subsequent stresses on park ecosystems. Identified AOC's were reviewed by collaborators from other agencies, non-governmental organizations, and scientists familiar with Sonoran Desert ecosystems. The consensus on leading AOC's for Sonoran Desert Network parks were: encroachment of exotic plants, altered fire regimes, urban/park interface, undocumented immigrant (UDI) impacts, and recreational impacts. Secondary land-use issues such as adjacent agricultural and pastoral activities, and the legacy of past land use impacts (including mining) were also identified. FY 2002 funds were used to support a cooperative project with the University of Arizona, Pima County (AZ), US Army – Ft. Huachuca Military Reservation, and the Sonoran Desert Conservation Plan. The goal of the project is to evaluate the potential effectiveness of "threat-based" monitoring (using the AOC's identified above), and determine which biotic parameters and respective field methods best detect these changes in Sonoran Desert ecosystems. A primary theme in this project is data mining and meta-analysis combined with field experimentation. A PhD student has been hired to begin the data mining and analysis phase of the project.

The network coordinator began reviewing and synthesizing existing ecological knowledge on Sonoran Desert ecosystems in early FY 2002. A simple conceptual model based on this review was developed in late Spring of FY 2002, and presented to network park staff and cooperators during May of 2002. The model was subsequently revised and presented with a comprehensive annotated overview of the existing knowledge of Sonoran Desert ecosystems in the Sonoran Desert Network Phase I Monitoring Plan draft at the end of FY 2002.

Cumberland/Piedmont Monitoring Network - This network includes Mammoth Cave NP and 13 small parks in the Appalachian Mountains: Abraham Lincoln Birthplace NHS; Carl Sandburg Home NHS; Chickamauga & Chattanooga NMP; Cowpens NB; Cumberland Gap NHP; Fort Donelson NB; Guilford Courthouse NMP; Kings Mountain NMP; Little River Canyon NPres; Ninety Six NHS; Russell Cave NM; Shiloh NMP; and Stones River NB. The network is working closely with the Appalachian Highlands network and staff from the Great Smoky Mountains NP Prototype Monitoring program to plan and design a monitoring program for all of the Appalachian Mountains parks. A network coordinator was hired in August 2001 and began the process of identifying high-priority issues and data needs for the parks and compiling and summarizing existing natural resource information. Through a cost-sharing agreement with the U.S. Forest Service, funding was provided to obtain aerial photography, and cooperative agreements were established with the University of Georgia and Association for Biodiversity Information to begin developing vegetation maps that will assist with the monitoring design.

FY 2002 Objectives for Vital Signs Monitoring

1. Hire key personnel to implement the network monitoring program.
2. Conduct park scoping workshops for input on management issues, monitoring needs and significant natural resources, leading toward the selection process in Phase II.
3. Conduct Conceptual Modeling meeting with interdisciplinary team of outside experts.
4. Finalize planning and development of a Water Quality Monitoring Plan.
5. Begin preliminary work on "High" priority issues identified by parks in Phase I.

Summary of Major Network Accomplishments During FY 2002 - In FY 2002, the network held three workshops to obtain park input on significant resources and management issues, and a fourth was held to develop conceptual models. One of the more important steps in developing a monitoring strategy is identifying, summarizing, and evaluating the existing information on park ecosystems. To accomplish this step: 1) literature and management plans for each park were reviewed, 2) existing datasets and current monitoring were summarized, and 3) resource management issues were ranked. Due to the inactive status of many Resource Management Plans, park managers were asked (by electronic survey) to prioritize management issues. The gathered data were then presented at a series of three workshops by park staff and subject-matter experts. Mammoth Cave NP hosted a fourth workshop specific to their Prototype Monitoring Program. The fifth and final workshop was held jointly with the Appalachian Highlands Network to develop conceptual models.

Conceptual ecological models for general aquatic and terrestrial ecosystems were developed with the Appalachian Highlands Network at a workshop conducted by the University of Tennessee in July 2002. The workshop was attended by a interdisciplinary group of park resource managers, regional university scientists, and other federal land

managers. The participants formed two groups, one for each model, and brainstormed on attributes, stressors, effects, and indicators for two days. In addition to the general terrestrial and aquatic models developed at the July workshop, specific models for cave and karst ecosystems are being developed by Mammoth Cave's Prototype Monitoring Program.

During FY 2002, Mammoth Cave National Park Hydro-geologist, Joe Meiman, finished the *water quality monitoring* plan for the network and that plan is currently under review. The water laboratory at Mammoth Cave continued obtaining the necessary equipment using a combination of park and network funding. Phase I workshops were also held in order to develop a prioritized list of park issues, related to monitoring, that require additional data gathering and coordination with other entities.

Central Alaska Monitoring Network - The Central Alaska Network includes three national park units that encompass 21.7 million acres of land. The Network includes Denali NPP, Yukon-Charley Rivers NPres, and Wrangell-St. Elias NPP.

FY 2002 Objectives for Vital Signs Monitoring

1. Hire key personnel and implement the network monitoring program.
2. Summarize existing data and understanding of network parks.
3. Hold the Vital Signs Scoping workshop, write a report of the workshop and have it widely reviewed.
4. Develop a network water quality monitoring plan.
5. Initiate protocol development for projects identified from the Vital Signs Scoping workshop.

Major Network Accomplishments During FY 2002 - In FY 2002, the biological inventories for freshwater fish, vascular plants and small mammals continued. Likewise, the logistics for water quality sampling were again combined with the freshwater fish field efforts. Monitoring staff focused on working with the Technical Committee to develop thinking on the monitoring program, planning the Vital Signs Scoping Workshop and determining what relevant current and historic monitoring data exist for each park.

Monitoring workshops that all park employees were invited to attend were held at Wrangell- St. Elias NPP and Yukon-Charley Rivers NPes. A similar workshop was not held for Denali NPP because that park is a prototype program with an existing monitoring program. To avoid duplication of effort and utilize staff as efficiently as possible, it was determine that the Denali NPP prototype monitoring program would be integrated with the rest of the network. A document was prepared that outlines the nature of the integration of the programs, which the network's Board of Directors reviewed and approved. This document lays out such things as a decision making process for the two programs, but did not address some administrative details, such as supervision, etc.

A Vital Signs Scoping Workshop was held by the network during April 2-3rd, 2002. In preparation for that workshop, the network's Technical Committee drafted "strategy" statements of what they want to monitor and how. Invited experts reviewed the strategies that provided the forum for discussion about the program. Primary results from the Scoping Workshop indicate that a strong level of integration among program components is desired, a common probabilistic sample design will form the basis for the program, and that there are foundation physical environment data that are desired by all other subject areas. As a result of the workshop, a contract to conduct color infra-red aerial photography of Yukon-Charley Rivers NPres. and portions of Wrangell-St. Elias NPP were established. Remaining portions of Wrangell-St. Elias NPP and Denali NPP will be sampled in successive years. A contract with Western EcoSystems Technology, Inc. (WEST, Inc.) was established to determine an overall sampling framework for the network that includes water quality sampling, vegetation, fauna and the physical environment.

Thus far, the water quality work has been integrated with the freshwater fish inventory. In developing the water quality monitoring plan, the network has chosen to integrate the plan with the rest of the Vital Signs Monitoring program. The contract to develop the sample design for the entire network is being designed to encompass aquatic resources.

National Capital Region Monitoring Network - The National Capital Network includes 11 national park units with significant natural resources in the District of Columbia, Virginia, Maryland, and West Virginia: Antietam NB; Catoctin Mountain Park; Chesapeake and Ohio Canal NHP; George Washington Memorial Parkway; Harpers Ferry NHP; Manassas NBP; Monocacy NB; National Capital Parks - East; Prince William Forest Park; Rock Creek Park; and Wolf Trap Farm Park.

FY 2002 Network Objectives for Vital Signs Monitoring

1. Hire key personnel to implement the network monitoring program.
2. Establish Board of Directors and Science Advisory Committee.
3. Summarize existing data and understanding and prepare for vital signs scoping workshops.
4. Host a Monitoring Workshop.
5. Develop a comprehensive long-term monitoring plan.
6. Complete vegetation mapping for the network.
7. Develop a network water quality-monitoring plan.

Summary of Major Network Accomplishments During FY 2002 - Priority monitoring activities for FY 2002 included working with the Science Advisory Committee to develop conceptual models, holding a vital signs monitoring workshop, and preparing the Phase I monitoring report. Board of Director meetings were held in June and September 2002. The board formally approved changes to the Science Advisory Committee, four network goals to guide the Monitoring Plan, the draft Phase I report of the Monitoring Plan, and this document. The four network goals are: 1) Identify and monitor indicators of

ecosystem health over the long-term using scientific protocols to detect changes in the region's natural resources and landscapes in support of resource protection, 2) Identify and monitor resource threats and develop mitigation options to support ecosystem management, 3) Manage, maintain, and analyze regionally common data sets in accessible and usable forms in support of long-term resource preservation, protection, and education, and 4) Establish collaborative relationships among National Park Service divisions, educational institutions, partnering agencies, and organizations to gather and share information.

The network's Science Advisory Committee (SAC) met four times during Fall/Winter 2001 and Spring 2002. Day-long meetings with breakout sessions prepared the I & M Team for the Monitoring Workshop by developing conceptual models for the region's important resources, key threats, their ecological effects and potential vital signs. The SAC invited ad-hoc participants to the meetings to provide expertise not represented on the SAC. The SAC will meet during winter and spring of FY 2003 to finalize monitoring goals and objectives and prioritize vital signs for the network.

The National Capital Network hosted a three-day Monitoring Workshop at the National Conservation Training Center, Shepherdstown, WV in July, 2002. Over 100 participants attended, representing approximately 30 partnering agencies and NPS divisions. The network used the workshop to develop partnerships and receive technical input into the planning process through a series of breakout sessions. Participants identified the region's most significant resources, their threats, ecological effects, and potential vital signs to monitor ecosystem health. Priority monitoring goals and objectives were developed. The results of the workshop are now being integrated into the first two chapters of the network's monitoring plan.

Northern Colorado Plateau Monitoring Network - The Northern Colorado Plateau Network includes 16 parks in Utah, western Colorado, southwest Wyoming and northern Arizona: Arches NP; Black Canyon of the Gunnison NP; Bryce Canyon NP; Canyonlands NP; Capitol Reef NP; Cedar Breaks NM; Colorado NM; Curecanti NRA; Dinosaur NM; Fossil Butte NM; Golden Spike NHS; Hovenweep NM; Natural Bridges NM; Pipe Spring NM; Timpanogos Cave NM; and Zion NP. Five parks within the network are designated as prototype parks: Dinosaur NM, Canyonlands NP, Natural Bridges NM, Arches NP and Capitol Reef NP. The network is actively developing and managing an integrated natural resource inventory, vital signs and prototype monitoring program.

Objectives for Vital Signs and Prototype Monitoring

1. Expand network staff to support network and prototype monitoring program development and data management.
2. Establish and execute an administrative and organizational framework for effective operation of the Northern Colorado Plateau Network's I&M Program.
3. Develop and implement a network data management plan including data

inventory, data mining and overall organization of inventory and monitoring data management within network parks to support both the inventory and monitoring portions of the program.

4. DevelopVital Signs Network and Prototype Monitoring Plan.
5. Develop water quality component of Network and Prototype Monitoring Plan.
6. Develop protocols for prototype monitoring themes.
7. Develop and implement an approach for completing vegetation mapping and classification for network parks.
8. Conduct additional inventories needed to support development of the monitoring program.
9. Develop internal and external partnerships to accomplish inventory and monitoring program objectives.
10. Develop outreach and communication component of program.
11. Provide professional development and training opportunities for NCPN network and park staff.
12. Provide expertise to other networks, national and regional program efforts and complete special assignments.

Summary of Major Network Accomplishments During FY 2002 - Combined NPS and USGS prototype and vital signs monitoring funding was used to continue documentation of past and current monitoring in and around parks, develop conceptual framework and models, host vital signs scoping meetings, and initiate protocol development for high priority monitoring themes. Water quality funding was used to continue work on data gathering, synthesis and analysis to provide a basis for selection of vital signs. Monitoring planning work led to the production of the Network's Phase I – Monitoring Plan that was completed October 1, 2002. The network initiated a network-wide vegetation mapping and classification program in FY 2002 using a combination of network and service-wide funding. This funding was used to complete acquisition of aerial photography and digital orthophotos for most network parks and to launch field work and photo interpretation work in five parks. Network staffing was increased to accommodate the expanding program workload (one permanent, one term and four seasonals). Network and prototype funding received in FY 2003 will be used to complete data gathering and analysis, conceptual model development, conduct expert scoping in support of vital signs process, select vital signs, continue and initiate new protocol development, and prepare the network's Phase II – Monitoring Plan. USGS funding for the Northern Colorado Plateau Prototype Cluster will be used to advance development of protocols for ecosystem, invasive species and threatened, endangered and sensitive species monitoring. Some monitoring funding will be utilized to conduct high priority inventories needed as a basis for the network's monitoring program, these include: vegetation mapping, invasive plant mapping, condition assessments, and a spring/seep inventory.

The Northern Colorado Plains Network is in the position of initiating both a vital signs monitoring network and prototype monitoring program simultaneously. To clarify the relationship of the prototype to the network, the network conducted a planning process

over the winter months culminating in a January 2002 Plan for Development of Long-term Natural Resource Monitoring in the Northern Colorado Plateau With concurrence of the Washington Office I&M Program, the network has decided to fold the prototype and network efforts into a single combined program and planning process. Prototype parks are distinguished from other network parks in that the prototype serves as a center of excellence with a focus on protocol development for high priority monitoring themes identified by the network. Three themes have been selected for emphasis *of prototype protocol development efforts: ecosystems, invasive species, and threatened, endangered and sensitive species.*

Several approaches were taken to summarizing information on past and current monitoring work in and around network parks. For each park, detailed narrative summaries with related NatureBib and Dataset Catalog citations were completed for each of 13 resource categories: invertebrates; fish; reptiles and amphibians; mammals; vascular and non-vascular plants; earth sciences; water quality and water quantity; climate; air quality; soundscape; nightsky; and paleo resources. The network also compiled a series of tables summarizing natural resource and stressor monitoring projects and needs for each park. Products from these various information summarization efforts have been incorporated into Volume II of the Network's Phase I Monitoring Report.

In spring of 2001, the network developed a monitoring needs database designed to obtain park resource manager input on resource-stressor relationships and monitoring needs. Database population occurred over a year-long period. The database was used along with additional analysis to identify management and science issues of concern to network parks. Network staff reviewed existing park general and resource management plans, statements for management and strategic plans for each network park. As needed, park superintendents and staff were interviewed for additional input. Results of this management and science issue identification work are presented in the Phase I Monitoring Report.

Water quality monitoring represents an important component of the network's monitoring needs. During FY 2002, cooperators from Colorado State University (CSU) were tasked with compiling, reviewing, and synthesizing existing water-quality information for the network parks. The desired end product was a set of recommendations concerning how to proceed with the development of a water-quality monitoring plan for the entire network. Unfortunately, a lack of faculty engagement and limited interaction with network staff resulted in a suite of poor-quality products from the university. In their current form, database and written products delivered by CSU are of limited value. Consequently, additional funding was used to fund cooperators from Western State College and USGS Water Resources Division in Grand Junction to salvage information from CSU products and proceed with the development of high-quality summaries of existing water quality information. The cooperator from Western State College delivered narrative summaries of existing water-quality monitoring and significant water bodies in network parks for inclusion in the Phase I Monitoring Report.

In addition to the work on water quality monitoring described above, the network is also working with scientists at the USGS, Canyonlands Field Station in Moab, UT on the development of monitoring protocols. Three monitoring themes have been selected for emphasis for prototype protocol development.

The network adopted a conceptual framework in FY 2002 to guide the selection of vital signs and the development of *protocols for ecosystem monitoring*. The framework identifies four controls of ecosystem structure and function that should be included in a monitoring program oriented towards ecosystem sustainability. These are (1) *soil and water resources* (including water quality for aquatic ecosystems), (2) *atmospheric resources and conditions* (including air quality and climate), (3) *disturbance regimes*, and (4) *biotic functional groups*. Healthy, sustainable ecosystems conserve soil and water resources and are characterized by functional and structural characteristics that confer resistance and resilience to disturbances. Primary processes that must be functional to ensure the sustainability of terrestrial ecosystems are (a) the capture and retention of water (hydrologic function), (b) the capture and retention of nutrients (nutrient cycling), and (c) the capture and retention of photosynthetic energy in organic materials. Degraded ecosystems are characterized by accelerated rates of water, nutrient, and organic-matter losses compared with similar ecosystems relatively unaffected by human activities.

Although all four controls interactively affect the functioning of these three primary processes, soil and biological soil crusts play disproportionate roles and thus are essential for the sustainability of terrestrial ecosystems. Soil is a fundamental resource because it functions as a medium for water capture and retention, nutrient cycling and retention, and primary production. Soil properties that affect functioning of primary ecosystem processes and are effected by management activities (hence subject to monitoring for change detection) include stability (susceptibility to erosion by wind and water), structure, organic-matter content, biotic activity, surface roughness, and surface crusting (biotic or physicochemical). Because of their capacity for change in relation to management, these are referred to as dynamic soil properties. In most arid-semiarid ecosystems, biological soil crusts composed primarily of cyanobacteria, mosses, and lichens are integral to proper soil functioning due to major effects on dynamic soil properties. For this reason, biological-soil-crust organisms represent a key biotic functional group in ecosystems where they occur.

To date, protocol-development work for ecosystem monitoring has focused on arid-semiarid terrestrial ecosystems and questions associated with dynamic soil properties and biological soil crusts. Work conducted in FY 2002 by existing USGS-BRD staff in Moab investigated indicators of soil stability and erosion susceptibility. Several questions were addressed in field and lab studies, as follows:

Indicators of soil stability

- Can an existing field technique for rating soil aggregate stability be modified for monitoring changes in stability of soil types found in network parks?

- What is the natural range of variability in aggregate-stability ratings of soils relatively unaffected by human impacts?
- What biotic components and processes (e.g., polysaccharide production by bacteria, cyanobacteria, and microfungi) are responsible for spatial and temporal variations in observed values of soil aggregate stability?
- What other measures might be used to indicate variations in soil stability (particularly emphasizing non-destructive techniques)?

Susceptibility to wind erosion

- How does soil susceptibility to wind erosion (as measured by threshold friction velocities in a wind tunnel) vary in relation to soil-surface characteristics that might be used as indicators in a monitoring program (e.g., surface roughness, soil aggregate stability, soil-surface cover, chlorophyll a content, polysaccharide content)?
- Does the relationship between soil susceptibility to wind erosion and measured soil-surface characteristics vary among soil types (i.e., among soils of varying physical and chemical composition)?
- What are the maximum wind velocities (frequency, magnitude and duration) that occur at the soil surface, and how do these vary by season and in relation to vegetation structure (i.e., aerodynamic friction)?
- Do airborne soil particles attributable to nearby surface disturbances affect the susceptibility of undisturbed soils to wind erosion?

Susceptibility to water erosion

- How does soil susceptibility to water erosion (as measured by sediment production) vary in relation to soil-surface characteristics that might be used as indicators in a monitoring program (e.g., surface roughness, soil aggregate stability, soil-surface cover, chlorophyll a content, polysaccharide content)?
- Does the relationship between soil susceptibility to water erosion and measured soil-surface characteristics vary among soil types (i.e., among soils of varying physical and chemical composition)?
- Can plastic silt fences be used to monitor changes in soil movement by fluvial processes?

Field studies of indicators for monitoring soil susceptibility to water erosion were hampered by limited access to a rainfall simulator in FY 2002. However, funds were acquired during FY 2002 for the design and construction of a rainfall simulator. In addition to field studies of soil-stability and erosion-susceptibility indicators, work was initiated in FY 2002 to investigate modeling approaches for improved climate monitoring. Current climate monitoring at network parks is conducted at a small number of point locations. Modeling can be used to estimate spatial and temporal variations in water and energy balances across landscapes of network parks. Spatially explicit water and energy balance models can be used for stratification of monitoring designs,

predicting ecosystem sensitivity to drought conditions, and predicting variations in soil resistance and resilience to disturbance as a function of moisture availability.

Protocol-development funds were combined with funding from the Amphibian Research and Monitoring Initiative (ARMI) to continue testing methods for selecting areas to *monitor amphibians*. Surveys were conducted to identify all potential habitat patches in drainages of two 6th-level hydrologic units in Canyonlands NP. The objective of this approach was to identify the entire set of potential habitat patches in these hydrologic units and to select a random subset of patches for future amphibian surveys to be conducted with ARMI funding. An alternative method for survey-site selection was tested in Arches NP. This method involved the random selection of survey points in drainages identified in GIS. Comparison of alternative approaches for survey-site selection is on-going.

Funding obtained during FY 2002 from the USGS was used to hire Dr. Rich Alward to begin work associated with protocol development for *monitoring Threatened and Endangered Species.* Dr. Alward also will be involved in protocol-development work associated with *monitoring of invasive exotic plants.*

San Francisco Bay Area Monitoring Network - The San Francisco Bay Area Monitoring Network includes six parks with significant natural resources in the coastal central California area: Fort Point NHS; Golden Gate NRA; John Muir NHS; Muir Woods NM; Pinnacles NM; and Point Reyes NS. The superintendents for two additional parks, Eugene O'Neill NHS and the Presidio of San Francisco have also been participating with the network's Board of Directors and are contributing resources to the network to develop a network inventory and monitoring program. Fort Point NHS, Muir Woods NHS, and the Presidio are within the boundaries of Golden Gate NRA and are included as part of Golden Gate NRA for the purposes of this report.

FY 2002 Network Objectives for monitoring:

1. Hire key personnel to implement the Network monitoring program,
2. Summarize existing data and understanding and prepare for the Network vital signs scoping workshop,
3. Complete vital signs scoping and indicator selection,
4. Develop a Network Monitoring Plan,
5. Develop a Data Management Plan as part of the Network Monitoring Plan, and
6. Support existing monitoring.

Summary of Major Network Accomplishments For FY 2002 - In order to do proper scoping for development of monitoring programs, an information base is needed. Planning documents and enabling legislation provide basic information identifying some park significant resources. Other legislation, park staff and studies identify remaining important resources and needs for information. A comprehensive examination of monitoring through the region containing the network parks is needed. All information needs to be condensed into tables and maps as and provided to workshop participants in

advance. During FY 2002, the network organized and held three park scoping workshops utilizing these types of information. Parks benefited from a group of specialists concentrating on their resources and needs for several days. The information obtained during the workshops is being used in several ways: background information and initial scoping for the Network vital signs workshop, vital information about monitoring indicators needed for each park unit, and interested specialists and allies to work with the park in developing monitoring for items that the network does not select.

A monitoring scoping workshop for Pinnacles NM was held during September 2001. The workshop summary and conceptual model were developed from January through April. The summary was sent to a wider peer-review. Park indicators and priorities were selected and a monitoring plan is being developed. The network completed similar scoping workshops during the fiscal year for Eugene O'Neil NHS, John Muir NM, Golden Gate NRA. The Servicewide I&M Program has established specific deadlines for portions of the network's monitoring plan. The first portion, Phase I Report, was submitted in FY 2002. The next two phases will be in FY 2003. Each phase will be peer-reviewed using Servicewide or Regional guidelines.

Protocol development by the San Francisco Bay Area Network will concentrate on high priority indicators. Many protocols will be "off-the-shelf", standard protocols only needing sampling locations, schedules and frequencies. Other protocols may be new and need development and testing. Since the scale of the monitoring may be larger than normal, even standard protocols may need evaluation and adjustment. A protocol is currently being written for *monitoring landbirds* for all network parks based on national standards. Researchers from Oikonos, a non-profit research group, are working on *protocols for harbor and elephant seals*.

Over a period of several years, parks in the network have identified a number of resources needing to be monitored. However, they usually continue only with monitoring the heroic, long-term efforts of particular individuals. Most of the projects supported by the Network I&M program monitor threatened and endangered species and their habitat. In many cases, monitoring is used to adjust management protection strategies. Some of the resources monitored by the San Francisco Bay Area Network during FY 2002 and results of those efforts include:

- *Monitoring of northern spotted owls* was conducted at Golden Gate NRA, Muir Woods NM and Point Reyes NS. Collaborators include Point Reyes Bird Observatory, the Marin Municipal Water District, Marin Open Space District and the California Department of State Parks. Preliminary data indicate that of 29 pairs, 17 fledged young. A total of 23 fledglings were reported adding to an overall season fecundity of 0.41, which is about average for this population.

- Monitoring by the network indicates that the number of *northern elephant seal* pups born at Point Reyes NS continued to increase to 449, the highest number in

22 years of monitoring. The number of pupping locations remained unchanged at six. Harbor seal populations remained stable over the past two years. A total of over 4000 seals included around 1075 pups were counted at 12 locations. Over 30 trained volunteers surveyed seals contributing an average of 54 hours per person and totaling over 1500 hours. Both of these projects are collaborations with the National Marine Fisheries Service and the NOAA National Marine Sanctuary program. Data were used to identify areas to modify park visitor use, to improve protection of breeding sites and for national and state stock assessments.

- *Western snowy plovers*, a threatened species, have been monitored at Point Reyes NS since the 1970's. Monitoring documented a dramatic decline of nesting success. In response, the park now erects exclosures around many nests to protect eggs and newly hatched chicks. Monitoring data now indicate that fledging success increased in 2002, however predation of chicks remains high.

- Pinnacles NM conducted the 3rd annual *butterfly count* in coordination with the North American Butterfly Association. Four new butterfly species were recorded in the Monument bringing the total to 67 species.

Greater Yellowstone Monitoring Network - The Greater Yellowstone Network includes four units of the National Park System with significant natural resources: Yellowstone NP, Grand Teton NP, John D. Rockefeller National Parkway, and Bighorn Canyon NRA. Administratively, the network consists of staff, a Board of Directors, a Technical Planning Committee, and a Science Committee. Two major functional components of the network's efforts are program and data management. The I&M Program Manager for the network began work in July 2002 and the data manager position will be filled during the first quarter of 2003. Network headquarters were moved from the Yellowstone Center for Resources to the USGS Northern Rocky Mountain Science Center at Montana State University during the summer of 2002.

Summary of Major Network Accomplishments During FY 2002 - In FY 2002, the Greater Yellowstone network made significant progress in building a strong science foundation and institutional framework to guide the network in identifying network wide and park specific vital signs for monitoring. The network began building conceptual models, identified its most important related scientific literature resources and completed the second phase of a Delphi scoping process. The 1st draft of "phase I' of the VSM plan was completed in September 2002.

Lists of current and historic monitoring programs were used to identify datasets to be entered into the network's Dataset Catalog. Existing records were updated to current standards. The network now has 719 datasets with potentially useful data for monitoring. These records are at least 75% complete with the purpose field absent for most records. At Yellowstone NP, datasets were stratified by priority to divide the workload. Forty-one high priority datasets were identified and emphasis was placed on ensuring the

completeness and accuracy of these records. Several important datasets were identified by park staff and analysis of these data sets have been proposed for funding by the network.

Dr. Duncan Patten, Montana State University, through a Cooperative Ecosystem Study Unit task agreement, helped the network complete a first set of draft conceptual models. Dr. Patten worked closely with park staff to solicit feedback and choose sub-models. Three different models were involved: the first two models are hierarchical, comprehensive ecosystem models illustrating the complex interrelationship between resources whereas select sub-models illustrate specific elements of the comprehensive model. The third model depicts examines the spatial and temporal importance of ecological indicators. The conceptual models are included in the 1st draft of the phase I monitoring plan.

Ecological stressors were identified and reported in the network's phase I monitoring report. Agents that change the abundance, distribution or resiliency of park natural system resources are thought to be significant. Two separate exercises, the first and second rounds of Greater Yellowstone Network Vital Signs Delphi Survey and conceptual modeling by Patten et.al, generated lists of ecosystem stressors. In addition, descriptive paragraphs of park specific management and scientific issues were developed for the Phase I report

The network held two water quality workshops in FY 2002, both with broad interagency participation. The network supported two efforts related to water quality monitoring in order to closely examine the application for vital signs monitoring and to evaluate existing protocols. During the fiscal year, the Yellowstone aquatic macro-invertebrate inventory was expanded to include both Bighorn Canyon NRA and Grand Teton NP. Seasonal employees under the direction of Jeff Arnold, Yellowstone Aquatic Ecologist, completed inventory for macro-invertebrates at several monitoring stations across the network.

The Greater Yellowstone Network also supported an ecosystem-wide stream reference reach inventory that was partially funded by the Greater Yellowstone Coordinating Committee. An interagency agreement was completed to transfer funds to the Beaverhead – Deerlodge National Forest for this project. The scope of the original project was changed, somewhat, to include sites at Bighorn Canyon NRA.

A Delphi survey was used to elicit input on potential vital signs monitoring needs from park staff and other experts. Unfortunately, the Department of the Interior shut down DOI Internet activities while these activities were in progress, causing a several month delay in both the questionnaires availability and results. The Delphi process asked participants to rank the top 5 important ecological indicators and comment on which indicators each park should monitor. Initial results indicate that the Delphi process will be a valuable tool to help illuminate ecological indicators, but will not replace the need for park involvement in setting priorities for the network.

A review of the literature most pertinent to our understanding of the ecosystems and physical characteristics of the network parks was conducted during the last quarter of FY 2002. A wide variety of subject area experts from within and outside the parks were contacted and their input was used to screen a wide body of literature for the Yellowstone Ecosystem into a smaller list of the most important works.

Appalachian Highlands Monitoring Network - The Appalachian Highlands Network includes five National Park Service units in five southeastern states: Big South Fork NRRA; Blue Ridge Parkway; Great Smoky Mountains NP; and Obed WSR. The network has worked closely with the Cumberland Piedmont Network during the vital signs planning process, and in developing biological inventory projects. In FY 2002, the network received $266,347 in funding to support its vital signs planning efforts, $120,000 for biological inventories, and $70,000 to continue with water resources assessment and planning.

Vital Signs planning included conducting scoping sessions and interviews with park personnel and subject matter experts, researching and summarizing past and current monitoring efforts, and developing ecosystem-level conceptual models, with the eventual goal of identifying a prioritized list of Vital Signs for long-term monitoring.

FY 2002 Network Objectives for Vital Signs Monitoring:

1. Approve a network charter and appoint a Science and Technical Committee
2. Implement Vital Signs planning
3. Implement data management activities
4. Implement water quality assessment and planning
5. Complete vegetation mapping for the network

FY 2002 Summary of Major Accomplishments - The network drafted its charter in FY 2001. It was not finalized, however, because of unresolved questions among a network technical working group concerning the makeup and role of the science and technical committee. In FY 2002, the network charter was completed, approved and signed by the network Board, the Regional I&M Coordinator, and the Washington Office. The technical working group recommended, and the network board approved, a permanent science technical committee, composed of network park resource managers, network staff, prototype park staff, and Cooperative Ecosystem Study Unit and USGS-BRD representatives, as ad hoc members. The Board also approved a joint committee to advise both the Allegheny and the Cumberland/Piedmont Networks on aspects of vital signs planning and inventory development, where the two networks have identified mutually beneficial projects.

During the fiscal year, a questionnaire was circulated to park divisions asking about significant resources and threats, current and past monitoring, and how the vital signs

program might mesh with park interpretive efforts. A follow-up scoping meeting was held, attended primarily by park resource managers and network staff. The meeting's intent was to orient park and network staff to the significant resources and threats in other network parks, to conduct a preliminary assessment of resource issues and threats of primary concern to park managers, and to create a preliminary list of resource categories that should be considered priorities for the vital signs monitoring program.

A workshop was held jointly with the Cumberland/Piedmont Network at the Appalachian Highlands Science and Education Center, Great Smoky Mountains NP to solicit input from outside experts about the issues that should be considered in designing a network Vital Signs monitoring program. Participants focused on the entire southern Appalachian ecosystem, from South Carolina to West Tennessee – an area encompassing both the Appalachian Highlands and Cumberland Piedmont Networks. Invited participants from outside NPS included ecosystem modelers, specialists in freshwater ecology, forest health, conservation genetics, plant biogeography, soils, geology, air quality, nutrient cycling, invasive species, entomology, herpetology, ornithology, and population ecology. They represented ten academic institutions, as well as Oak Ridge National Laboratory, US Geological Survey, US Fish and Wildlife Service, US Forest Service, Natural Resources Conservation Service, and The Nature Conservancy. The workshop was facilitated by Southern Appalachian Cooperative Ecosystem Study Unit director, Dr. Jack Ranney, and Dr. Robb Turner, Executive Director, Southern Appalachian Man and the Biosphere. Products from the workshop included a series of draft conceptual models, showing components of network ecosystems, including a comprehensive list of ecosystem stressors, and a compilation of Vital Signs that might be used to effectively measure ecosystem changes.

With the assistance of the NPS Air Resources Division, data have been compiled on existing and needed air quality monitoring stations for each park within the network, and high-priority air quality monitoring issues have been identified. A proposal for assistance from the Air Resource Division with ozone monitoring in the network parks has been developed.

Under a two-year cooperative agreement with the U. S. Geological Survey, Water Resources Division (USGS-WRD), the network initiated a project to gather, evaluate, and analyze existing long-term monitoring data for water resources and develop a long-term water resources monitoring plan for three network parks. Great Smoky Mountain NP's long-term monitoring data will not be analyzed by the USGS-WRD, but existing analyses will be incorporated into the network Vital Signs planning effort.

As part of the water resources planning effort, park resource management staff are in the process of evaluating their aquatic resources in detail, looking at individual water bodies and identifying those which contain significant biological resources, or which are of concern to park management. In the fall of 2002, parks will develop monitoring objectives, and continue to refine monitoring questions. Examples of questions that have been raised so far, include:

- What are the impacts of agricultural leases on adjacent streams?
- What is the water quality of headwater streams and seeps?
- What is the role of wetland/bog hydrology in supporting T&E species populations?
- Are septic leach fields at certain locations affecting water quality?
- What are the status and trends of atmospheric inputs, and how are these affecting the distribution of aquatic species?

Mediterranean Coast Monitoring Network - The Mediterranean Coast Network is composed of three parks in coastal southern California: Cabrillo NM, Channel Islands NP, and Santa Monica Mountains NRA. These parks protect and manage an increasingly rare example of a Mediterranean coastal ecosystem. Inventorying the diversity of plants and animals in the Mediterranean Coast Network is the first critical step in protecting and managing network ecosystems. The long-term monitoring of selected park resources to determine the range of normal ecosystem variation and provide indication of ecosystem health will follow the completion of resource inventories, and will meld with existing monitoring programs already implemented in the parks.

In FY 2001, the network received funding to plan and initiate a Vital Signs monitoring program. These planning funds were used to supplement existing monitoring programs at Cabrillo NM and Santa Monica NRA and through a cooperating agency, to support a Vital Signs workshop for Santa Monica Mountains NRA. Channel Island NP's monitoring program was funded earlier through the I&M Prototype program.

FY 2002 Network Objectives for Vital Signs Monitoring:

1. Hire key personnel to implement the network-monitoring program.
2. Develop and implement network organizational structure.
3. Design integrated network Vital Signs monitoring program.
4. Develop a network Vital Signs monitoring plan to fill gaps and meet network goals.
5. Support ongoing inventory and monitoring activities consistent with Vital Signs.
6. Conduct the prototype monitoring program at Channel Islands NP. Implement network Vital Signs Monitoring.

Summary of Major Network Accomplishments During FY 2002 - Since the signing of the network charter in April of 2001 the network has had consistent and regular meetings of the Board of Directors and Technical Committee to discuss and implement a long-term monitoring program within Cabrillo NM and Santa Monica Mountains NRA, and to coordinate monitoring activities with Channel Islands NP. The network has benefited from the experiences of Channel Islands NP's Prototype Monitoring Program.

The technical committee consists of the resource management chiefs at all three network parks, the network monitoring coordinator, the network biological inventory coordinator, and several natural resource managers or science advisors from each of the network parks as necessary. The excellent working relationship, which has been established among the parks, has built a foundation of trust and cooperation that will be expanded upon in the future.

The network has fully embraced the program design concepts recommended by the Washington Office I&M Program and the phased approach to developing a monitoring plan. FY 2003 will see a vigorous and aggressive program to meet programmatic expectations in implementing the vital signs monitoring program within the Mediterranean Coast Network.

Monitoring funds provided through the Natural Resource Challenge supported field inventory of reptiles and amphibians needed to develop baseline data for future Vital Signs monitoring.

- The Cabrillo NM *rocky intertidal monitoring* program has directly resulted in significant researcher interest in related issues. New projects initiated in just the last year include an investigation of the effects of trampling and sand on turf communities (Tonya Huff, Scripps Institution of Oceanography), study of the size and growth rates of owl limpets and a full inventory of the park's mollusk populations (Dr. Kaustav Roy and students, University of California San Diego), and research into the disappearance of ochre seastars at Cabrillo (Corrina Marote, University of California Los Angeles), lobster life history and habitat use (Dr. Kevin Hovel and students, San Diego State University), and population genetics of surfgrass limpets (Emina Begovich, University of California Berkeley).
- Conducted *monitoring of tidepools, vegetation communities, and air quality* at Cabrillo NM
- A tidepool monitoring workshop was held in November 2001. Funding support for the workshop came from the Cabrillo Marine Institute. A report will be available in FY 2003.

During FY 2002, Channel Islands NP and Cabrillo NM worked with seven other partners from the government, academic institutions, and the private sector as part of a monitoring group, MARINE, to develop and implement a regional program for rocky intertidal monitoring. Comprehensive baseline surveys were conducted. The group also created standardized protocols and developed a centralized database for the regional monitoring data.

- The Channel Islands NP *kelp monitoring* program was expanded to include San Clemente Island through contract with the U.S. Navy.
- Sampling protocols for ongoing *reptile and amphibian inventory/monitoring* followed those developed by Robert Fisher of the USGS, Biological Resources

Division and will feed into a broad regional data base of reptile and amphibian distribution throughout mainland southern California

At Santa Monica Mountains NRA, *water quality monitoring* funds supported field assessment of stream biological and physical characteristics needed to develop baseline data for future Vital Signs monitoring. Channel Islands NP completed a water quality monitoring project assessing vegetation and stream morphology on Santa Rosa Island with the goal of documenting changes in water quality since cattle were removed from the island in 1998. The project included conducting Level II characterization of the Old Ranch Watershed (Rosgen Channel Classification); monitoring fifty-six nested-rooted frequency and cover riparian transects established in the Quemada Stream drainage; re-surveying nine precise cross-section profiles in the Old Ranch stream to measure changes in channel morphology; and establishing a 1,000 meter stream condition assessment transect (using R5 Forest Service Stream Condition Assessment Protocol) in Arlington Stream. Components of the project included inorganic and bacteria water sampling, measurement of channel morphology, vegetation sampling, and installation of photopoints.

B. Accomplishments of Monitoring Networks Receiving Only Initial Planning Funding for Development of Monitoring Programs

The following sections describe the major accomplishments achieved by five monitoring networks that received only the initial allocation of $150,000 for planning during FY 2002. These five networks include a total of 52 individual park units. Additional funding will be required for these networks to fully implement operational monitoring programs.

Southwest Alaska Monitoring Network - The Southwest Alaska Network is composed of five National Park System units containing marine, coastal, freshwater, and terrestrial ecosystems of regional and national significance: Alagnak WR; Aniakchak NM & Preserve; Katmai NPP; Kenai Fjords NP; and Lake Clark NPP. The Network Board of Directors and Technical Committee for Vital Signs Monitoring was formed in FY 2002 and work initiated on assembling information on park resources, defining park management issues that need to be considered in designing the program, identifying data management considerations, and holding a scoping workshop held for coastal ecosystems. Scoping workshops will and information synthesis will continue in FY 2003 and a Phase I report produced. Baseline surveys and resource mapping in support of long-term monitoring will be conducted. Preliminary design work and protocol development will be initiated for coastal near-shore and freshwater system monitoring.

FY 2002 Network Objectives for Vital Signs Monitoring

1. Hire key personnel to initiate planning the Vital Signs Monitoring Program in the network.
2. Form a network Board of Directors and a Technical Committee
3. Summarize existing data and understanding, hold scoping workshops, select

vital signs
4. Develop and test Protocols for monitoring
5. Conduct baseline surveys and resource mapping in support of long-term monitoring

Summary of Major Network Accomplishments During FY 2002 - The network's Inventory and Monitoring Coordinator reported for duty during November 2001 and the network data manager entered on duty during February, 2002. The network's Board of Directors was created and the charter approved during January, 2002.

During FY 2002, park resource management plans reviewed and technical committee held meeting to identify core areas for monitoring, assembled information on network ecosystems, identified other NPS technical specialists to serve on the workgroups, reviewed monitoring efforts of other agencies that may be pertinent to the network, identified information gaps and began to construct food webs and conceptual models, and identified specialists outside of NPS that can participate in workshops to review and assist in the construction of models and identification of attributes to monitor. The network also held a coastal near-shore scoping workshop in August that focused on refining conceptual ecosystem models, identifying drivers of nearshore coastal change in network parks, and defining candidate attributes for long-term monitoring.

Northeast Temperate Monitoring Network - The Northeast Temperate Network includes ten national parks and historic sites with significant natural resources as well as a portion of the Appalachian Trail: Acadia NP; Boston Harbor Islands NRA; Marsh-Billings-Rockefeller NHP; Minute Man NHP; Morristown NHP; Roosevelt-Vanderbilt NHS; Saint-Gaudens NHS; Saugus Iron Works NHS; Saratoga NHP; and Weir Farm NHS. The Appalachian Trail holds large tracts of fee owned NPS land within the Network from Maine to the Pennsylvania border and is included for monitoring purposes. Collectively, these parks cover a wide range of temperate forest, from coniferous to mixed deciduous woodlands to transitional forest across Maine, New Hampshire, Vermont, Massachusetts, New York, Connecticut and New Jersey. Two of the parks in the network have important coastal resources.

FY 2002 Network Objectives for Vital Signs Monitoring

1. Hire key personnel to track inventories, develop and implement the "vital signs" monitoring program.
2. Form a Board of Directors and Science Advisory Committee
3. Summarize existing data and understanding and prepare for vital signs scoping workshops

Summary of Major Network Accomplishments During FY 2002 - In FY 2002 the Northeast Temperate Network received funding to hire staff and begin planning the Network's "Vital Signs" monitoring program. An initial meeting to discuss and introduce the "Vital Signs" program to the network's resource managers was held at Marsh-Billings NHP in Woodstock Vermont, on May 1-2, 2001. A list of potential

members for the Network's Science Advisory Committee was developed, position descriptions and duty stations for both a Network Coordinator and Data Manager were discussed as well as organizing the Board of Directors and writing a Network Charter. The group identified park natural resource management issues and current monitoring programs. By the end of the meeting a list of monitoring issues and questions had been developed for the network to be used as a starting point for discussion by the Science Advisory committee. It took many months after the start-up funds were received to decide on a duty station for the Network Coordinator and Data Manager so the positions could be advertised. Network superintendents identified the pros and cons of locating staff within the Network. Marsh-Billings-Rockefeller was selected as the duty station and two positions were advertised late in the fiscal year. The Network Coordinator was hired in October 2002 and the Data Manager will be hired by November 2002. A preliminary list of candidates for the science advisory committee was developed at a meeting of the Network in May 2001. Some individuals have agreed to participate.

Since estuaries and salt marshes are important habitats in Acadia NP and Boston Harbor Islands NRA, the Northeast Temperate Network shared in the cost of a Northeast Coastal and Barrier Network project with the USGS and the University of Rhode Island to summarize existing data and understanding for these ecosystems. In the phase 1 portion of the estuarine eutrophication component, data mining for nutrient enrichment monitoring also included Acadia NP and Boston Harbor Islands NRA. Data were assembled and synthesized from diverse sources including technical workshops and meetings, existing programs and site visits to parks. Many programs are Gulf of Maine programs and include Cape Cod NS. The cooperators from the University of Rhode Island and USGS will also compile and evaluate existing data on nutrient inputs in 10-year intervals back to 1970. In addition to estuarine water quality, the Northeast Temperate Network will be following the salt marsh monitoring protocol testing in Coastal and Barrier Network parks with an eye toward adding Northeast Temperate coastal parks in the future. Protection of the viewshed, especially the estuaries at Acadia NP is a fundamental purpose of the park.

Southern Colorado Plateau Monitoring Network - The Southern Colorado Plateau Network includes parks and monuments that are located throughout the diverse landscapes of northern Arizona, northwestern New Mexico, southwestern Colorado, and southeastern Utah: Aztec Ruins NM; Bandalier NM; Canyon de Chelly NM; Chaco Culture NHP; El Malpais NM; El Morro NM; Glen Canyon NRA; Grand Canyon NP; Hubbell Trading Post NHS; Mesa Verde NP; Navajo NM; Petrified Forest NP; Petroglyph NM; Rainbow Bridge NM; Salinas Pueblo Missions NM; Sunset Crater Volcano NM; Walnut Canyon NM; Wupatki NM; and Yucca House NM. The 19 park units in the Southern Colorado Plateau Network range from 166 acres to over one million acres in size.

FY 2002 Network Objectives for Vital Signs Monitoring

1. Form a Board of Directors and Science Advisory Committee (SAC)
2. Acquire infrastructure and administrative support for network.
3. Acquire and summarize existing data and prepare for Vital Signs scoping meetings and workshops.

Summary of Major Network Accomplishments During FY 2002 - In FY 2002, the network received funding from the Servicewide I&M Program for initiating the monitoring program. The network used the funds to hire a permanent data manager. During FY 2002, the network approved a charter, and formed a Board of Directors and a Technical Committee. The network is assembling and evaluating existing information, surveying resource managers and superintendents, and conducting meetings, in order to develop priorities for vital signs monitoring of ecosystem health in parks and monuments of the southern Colorado Plateau.

The network, in cooperation with Northern Arizona University, has begun populating the Dataset Catalog and contacting regional scientists regarding inventory and monitoring related work they have been involved in on the Colorado Plateau. Next year, the Network Program Manager and Database Manager will review Resource Management Plans and summarize current and historical monitoring programs in the region including fire effects, threatened and endangered species, water quality, air quality, physical processes, and other resources. Superintendents and resource managers will be interviewed from each park in the network to identify current and needed monitoring activities. Monitoring conducted by neighboring agencies, partners, and parks will be summarized for the region. This information will provide essential background information for the monitoring plan and scoping sessions.

Pacific Island Monitoring Network - The Pacific Island Network includes nine national park units with significant natural resources in Hawaii, Samoa, Guam and Saipan: American Memorial Park; Haleakala NP; Hawaii Volcanoes NP; Kaloko-Honokohau NHP; Kalaupapa NHP; National Park of American Samoa; Puukohola Heiau NHS; Pu'uhonua o Honaunau NHP; and War in the Pacific NHP. For monitoring planning, the network includes two member parks not officially recognized at the national level: the USS Arizona Memorial signed the network charter and the superintendent of the new Ala Kahakai Trail NHP will do so soon. The network parks cover an enormous sweep of the Earth (across four time zones and two hemispheres), yet the member parks have striking similarities:

- they are all small,
- they are all island ecosystems,
- they all have unique endemic biodiversity and ecosystems that have been severely damaged,
- their native ecosystems are all dangerously vulnerable to invasive exotics,
- their native ecosystems all require active hands-on, manipulative management if their unique native biodiversity is to survive, and
- they are all woefully understaffed and cannot manage their island ecosystems effectively.

These Pacific Islands parks are a special challenge to manage. Because of their ecosystem similarities and shared management concerns, the creation of a network of Pacific Island Parks was a logical solution in order to share limited staff and knowledge. The network relies heavily on electronic interchange rather than frequent face-to-face meetings.

FY 2002 Network Objectives for Vital Signs Monitoring:

1. Establish a Board of Directors, a Technical Committee, and Working Groups focused on specific natural resources.
2. Hire key personnel (coordinator, ecologist, and data manager) to implement the network monitoring program.
3. Hire temporary assistants for data mining to summarize existing data and understanding and to prepare for vital signs scoping workshops.

Summary of Major Network Accomplishments During FY 2002 - A Board of Directors was established to provide overall guidance and oversight to the I&M program. The Board consists of the Superintendents from each of the Parks in the network. At that time, a charter outlining the operating procedures of the Board of Directors was developed by I&M staff and signed by members representing each of the ten parks in the Pacific Island Network. A Technical Committee was formed to provide technical recommendations to the board and to assist with data gathering and scoping sessions. The Technical Committee is composed of resource managers, scientists at USGS and at University of Hawaii who are familiar with the parks in the region, agency staff from USFWS, state Dept of Land and Natural Resources, private non-profit groups (e.g., The Nature Conservancy), and I & M staff. Workgroups leads were chosen from the Technical Committee and membership of the groups finalized. Workgroup topics: air quality/climate, geologic resources, water quality, marine environment, freshwater and aquatic biology, vegetation, landscape processes, fauna, and invasive species.

The network's I & M staff developed a questionnaire and mailed it to each of the parks in the network. The questionnaire was designed to assess monitoring priorities, summarize key park resources, evaluate current monitoring programs, and identify key partners in each of the parks in the network. The summarized responses to these questionnaires are posted on our website.

Great Lakes Monitoring Network - The Great Lakes Network includes nine national park units in four states surrounding the Great Lakes: Apostle Islands NL; Grand Portage NM; Indiana Dunes NL; Isle Royale NP; Mississippi National River & Recreation Area; Pictured Rocks NL; Saint Croix National Scenic Riverway; Sleeping Bear Dunes NL; and Voyageurs NP. Water, and the aquatic and wetland ecosystems it supports, is the ecological link that binds the nine Great Lakes Network parks.

Summary of Major Network Accomplishments During FY 2002 - In fiscal year 2002 the Network received funds to hire permanent staff and begin planning for Vital Signs monitoring.

The Regional Office and Network Steering Committee (currently the Technical Committee) hired the Network I&M coordinator in November. The Network coordinator hired the data manager/GIS specialist (information manager) in April and the inventory specialist in June. The Network Office has developed position descriptions and outsourcing waivers for an administrative assistant, an aquatic ecologist, and four data specialists.

The Network held scoping workshops at all nine network parks and created a database of the parks desired monitoring programs and accompanying monitoring questions. Pervasive monitoring issues were then organized into themes.

After reviewing numerous reports and publications on modeling for monitoring programs, the network chose a stressor-based model similar to the one used at the Everglades. The Network Technical Committee recommended that six or seven models should be developed: northern forest, Great Lakes, inland lakes, large streams, wetlands, and sand-scapes with a potential follow-up of a landscape model to reinforce the importance of land use as a major driver of all ecosystems. Daren Carlisle, Midwest regional aquatic ecologist, prepared a draft wetland model for the Heartland Network. Great Lakes Network staff is in the process of revising this model for our use. Jerry Belant, wildlife biologist, Pictured Rocks NL, and Phyllis Adams, Midwest regional I&M coordinator, prepared a draft northern forest model.

The network also obtained lists of potential indicators and justifications for their use from two major monitoring efforts around the Great Lakes: "The state of the lakes ecosystem conference " and a Canadian effort - the "Water Use and Supply Project". Both efforts incorporated large numbers of scientists, managers, government policy makers, and public (>200 scientists) to generate extensive indicator lists (>1,000 listed and evaluated). Most of these indicators were based on the aquatic environment.

Appendices

Appendix I. Natural resource units included in the NPS Inventory and Monitoring Program during FY 2002

PARKCODE	PARKNAME	Region	State
ABLI	Abraham Lincoln Birthplace National Historic Site	Southeast	KY
ACAD	Acadia National Park	Northeast	ME
AGFO	Agate Fossil Beds National Monument	Midwest	NE
ALAG	Alagnak Wild River	Alaska	AK
ALFL	Alibates Flint Quarries National Monument	Intermountain	TX
ALPO	Allegheny Portage Railroad National Historic Site	Northeast	PA
AMIS	Amistad National Recreation Area	Intermountain	TX
AMME	American Memorial Park	Pacific West	CM
ANIA	Aniakchak National Monument and Preserve	Alaska	AK
ANTI	Antietam National Battlefield	National Capital	MD
APCO	Appomattox Court House National Historical Park	Northeast	VA
APIS	Apostle Islands National Lakeshore	Midwest	WI
APPA	Appalachian National Scenic Trail	Multi	
ARCH	Arches National Park	Intermountain	UT
ARPO	Arkansas Post National Memorial	Midwest	AR
ASIS	Assateague Island National Seashore	Northeast	MD
AZRU	Aztec Ruins National Monument	Intermountain	NM
BADL	Badlands National Park	Midwest	SD
BAND	Bandelier National Monument	Intermountain	NM
BELA	Bering Land Bridge National Preserve	Alaska	AK
BEOL	Bent's Old Fort National Historic Site	Intermountain	CO
BIBE	Big Bend National Park	Intermountain	TX
BICA	Bighorn Canyon National Recreation Area	Intermountain	MT
BICY	Big Cypress National Preserve	Southeast	FL
BIHO	Big Hole National Battlefield	Pacific West	MT
BISC	Biscayne National Park	Southeast	FL
BISO	Big South Fork National River & Recreation Area	Southeast	TN
BITH	Big Thicket National Preserve	Intermountain	TX
BLCA	Black Canyon of the Gunnison National Park	Intermountain	CO
BLRI	Blue Ridge Parkway	Southeast	NC
BLUE	Bluestone National Scenic River	Northeast	WV
BOHA	Boston Harbor Islands National Recreation Area	Northeast	MA
BOWA	Booker T. Washington National Monument	Northeast	VA
BRCA	Bryce Canyon National Park	Intermountain	UT
BUFF	Buffalo National River	Midwest	AR
BUIS	Buck Island Reef National Monument	Southeast	VI
CABR	Cabrillo National Monument	Pacific West	CA
CACH	Canyon de Chelly National Monument	Intermountain	AZ
CACO	Cape Cod National Seashore	Northeast	MA

CAGR	Casa Grande Ruins National Monument	Intermountain	AZ
CAHA	Cape Hatteras National Seashore	Southeast	NC
CAKR	Cape Krusenstern National Monument	Alaska	AK
CALO	Cape Lookout National Seashore	Southeast	NC
CANA	Canaveral National Seashore	Southeast	FL
CANY	Canyonlands National Park	Intermountain	UT
CARE	Capitol Reef National Park	Intermountain	UT
CARL	Carl Sandburg Home National Historic Site	Southeast	NC
CASA	Castillo de San Marcos National Monument	Southeast	FL
CATO	Catoctin Mountain Park	National Capital	MD
CAVE	Carlsbad Caverns National Park	Intermountain	NM
CAVO	Capulin Volcano National Monument	Intermountain	NM
CEBR	Cedar Breaks National Monument	Intermountain	UT
CHAT	Chattahoochee River National Recreation Area	Southeast	GA
CHCH	Chickamauga / Chatanooga National Military Park	Southeast	GA
CHCU	Chaco Culture National Historical Park	Intermountain	NM
CHIC	Chickasaw National Recreation Area	Intermountain	OK
CHIR	Chiricahua National Monument	Intermountain	AZ
CHIS	Channel Islands National Park	Pacific West	CA
CHOH	Chesapeake & Ohio Canal National Historical Park	National Capital	MD
CIRO	City of Rocks National Reserve	Pacific West	ID
COLM	Colorado National Monument	Intermountain	CO
COLO	Colonial National Historical Park	Northeast	VA
CORO	Coronado National Memorial	Intermountain	AZ
COSW	Congaree Swamp National Monument	Southeast	SC
COWP	Cowpens National Battlefield	Southeast	SC
CRLA	Crater Lake National Park	Pacific West	OR
CRMO	Craters of the Moon National Monument	Pacific West	ID
CUGA	Cumberland Gap National Historical Park	Southeast	KY
CUIS	Cumberland Island National Seashore	Southeast	GA
CURE	Curecanti National Recreation Area	Intermountain	CO
CUVA	Cuyahoga Valley National Recreation Area	Midwest	OH
DENA	Denali National Park and Preserve	Alaska	AK
DEPO	Devil's Postpile National Monument	Pacific West	CA
DETO	Devils Tower National Monument	Intermountain	WY
DEVA	Death Valley National Park	Pacific West	CA
DEWA	Delaware Water Gap National Recreation Area	Northeast	PA
DINO	Dinosaur National Monument	Intermountain	CO
DRTO	Dry Tortugas National Park	Southeast	FL
EBLA	Ebey's Landing National Historical Reserve	Pacific West	WA
EFMO	Effigy Mounds National Monument	Midwest	IA
EISE	Eisenhower National Historic Site	Northeast	PA
ELMA	El Malpais National Monument	Intermountain	NM
ELMO	El Morro National Monument	Intermountain	NM
EVER	Everglades National Park	Southeast	FL
FIIS	Fire Island National Seashore	Northeast	NY
FLFO	Florissant Fossil Beds National Monument	Intermountain	CO

FOBO	Fort Bowie National Historic Site	Intermountain	AZ
FOBU	Fossil Butte National Monument	Intermountain	WY
FOCA	Fort Caroline National Monument	Southeast	FL
FOCL	Fort Clatsop National Memorial	Pacific West	OR
FODA	Fort Davis National Historic Site	Intermountain	TX
FODO	Fort Donelson National Battlefield	Southeast	TN
FOFR	Fort Frederica National Monument	Southeast	GA
FOLA	Fort Laramie National Historic Site	Intermountain	WY
FOLS	Fort Larned National Historic Site	Midwest	KS
FOMA	Fort Matanzas National Monument	Southeast	FL
FONE	Fort Necessity National Battlefield	Northeast	PA
FOPO	Fort Point National Historic Site	Pacific West	CA
FOPU	Fort Pulaski National Monument	Southeast	GA
FOSC	Fort Scott National Historic Site	Midwest	KS
FOSU	Fort Sumter / Fort Moultrie National Monument	Southeast	SC
FOUN	Fort Union National Monument	Intermountain	NM
FOUS	Fort Union Trading Post National Historic Site	Midwest	ND
FOVA	Fort Vancouver National Historic Site	Pacific West	WA
FRHI	Friendship Hill National Historic Site	Northeast	PA
FRSP	Fredericksburg Spotsylvania National Military Park	Northeast	VA
GAAR	Gates of the Arctic National Park and Preserve	Alaska	AK
GARI	Gauley River National Recreation Area	Northeast	WV
GATE	Gateway National Recreation Area	Northeast	NY
GETT	Gettysburg National Military Park	Northeast	PA
GEWA	George Washington Birthplace National Monument	Northeast	VA
GICL	Gila Cliff Dwellings National Monument	Intermountain	NM
GLAC	Glacier National Park	Intermountain	MT
GLBA	Glacier Bay National Park and Preserve	Alaska	AK
GLCA	Glen Canyon National Recreation Area	Intermountain	UT
GOGA	Golden Gate National Recreation Area	Pacific West	CA
GOSP	Golden Spike National Historic Site	Intermountain	UT
GRBA	Great Basin National Park	Pacific West	NV
GRCA	Grand Canyon National Park	Intermountain	AZ
GREE	Greenbelt Park	National Capital	MD
GRKO	Grant-Kohrs Ranch National Historic Site	Intermountain	MT
GRPO	Grand Portage National Monument	Midwest	MN
GRSA	Great Sand Dunes National Park	Intermountain	CO
GRSM	Great Smoky Mountains National Park	Southeast	TN
GRTE	Grand Teton National Park	Intermountain	WY
GUCO	Guilford Courthouse National Military Park	Southeast	NC
GUIS	Gulf Islands National Seashore	Southeast	FL/MS
GUMO	Guadalupe Mountains National Park	Intermountain	TX
GWCA	George Washington Carver National Monument	Midwest	MO
GWMP	George Washington Memorial Parkway	National Capital	VA
HAFE	Harpers Ferry National Historical Park	National Capital	WV
HAFO	Hagerman Fossil Beds National Monument	Pacific West	ID
HALE	Haleakala National Park	Pacific West	HI

HAVO	Hawaii Volcanoes National Park	Pacific West	HI
HEHO	Herbert Hoover National Historic Site	Midwest	IA
HOBE	Horseshoe Bend National Military Park	Southeast	AL
HOCU	Hopewell Culture National Historical Park	Midwest	OH
HOFU	Hopewell Furnace National Historic Site	Northeast	PA
HOME	Homestead National Monument of America	Midwest	NE
HOSP	Hot Springs National Park	Midwest	AR
HOVE	Hovenweep National Monument	Intermountain	CO
HUTR	Hubbell Trading Post National Historic Site	Intermountain	AZ
INDU	Indiana Dunes National Lakeshore	Midwest	IN
ISRO	Isle Royale National Park	Midwest	MI
JECA	Jewel Cave National Monument	Midwest	SD
JELA	Jean LaFitte National Historical Park & Preserve	Southeast	LA
JODA	John Day Fossil Beds National Monument	Pacific West	OR
JOFL	Johnstown Flood National Memorial	Northeast	PA
JOMU	John Muir National Historic Site	Pacific West	CA
JOTR	Joshua Tree National Park	Pacific West	CA
KAHO	Kaloko Honokohau National Historical Park	Pacific West	HI
KALA	Kalaupapa National Historical Park	Pacific West	HI
KATM	Katmai National Park and Preserve	Alaska	AK
KEFJ	Kenai Fjords National Park	Alaska	AK
KEMO	Kennesaw Mountain National Battlefield	Southeast	GA
KIMO	Kings Mountain National Military Park	Southeast	SC
KLGO	Klondike Gold Rush National Historical Park	Alaska	AK
KNRI	Knife River Indian Villages National Historic Site	Midwest	ND
KOVA	Kobuk Valley National Park	Alaska	AK
LABE	Lava Beds National Monument	Pacific West	CA
LACL	Lake Clark National Park and Preserve	Alaska	AK
LAME	Lake Mead National Recreation Area	Pacific West	NV
LAMR	Lake Meredith National Recreation Area	Intermountain	TX
LARO	Lake Roosevelt National Recreation Area	Pacific West	WA
LAVO	Lassen Volcanic National Park	Pacific West	CA
LIBI	Little Bighorn Battlefield National Monument	Intermountain	MT
LIBO	Lincoln Boyhood National Memorial	Midwest	IN
LIRI	Little River Canyon National Preserve	Southeast	AL
LYJO	Lyndon B. Johnson National Historical Park	Intermountain	TX
MABI	Marsh-Billings-Rockefeller National Historical Park	Northeast	VT
MACA	Mammoth Cave National Park	Southeast	KY
MANA	Manassas National Battlefield Park	National Capital	VA
MANZ	Manzanar National Historic Site	Pacific West	CA
MEVE	Mesa Verde National Park	Intermountain	CO
MIMA	Minute Man National Historical Park	Northeast	MA
MISS	Mississippi Nat'l River and Recreation Area	Midwest	MN
MNRR	Missouri National Recreational River	Midwest	NE
MOCA	Montezuma Castle National Monument	Intermountain	AZ
MOCR	Moores Creek National Battlefield	Southeast	NC
MOJA	Mojave National Preserve	Pacific West	CA

MONO	Monocacy National Battlefield	National Capital	MD
MORA	Mount Rainier National Park	Pacific West	WA
MORR	Morristown National Historical Park	Northeast	NJ
MORU	Mount Rushmore National Memorial	Midwest	SD
MUWO	Muir Woods National Monument	Pacific West	CA
NABR	Natural Bridges National Monument	Intermountain	UT
NACE	National Capital Parks East	National Capital	DC
NATR	Natchez Trace Parkway	Southeast	MS
NAVA	Navajo National Monument	Intermountain	AZ
NEPE	Nez Perce National Historical Park	Pacific West	ID
NERI	New River Gorge National River	Northeast	WV
NIOB	Niobrara National Scenic Riverway	Midwest	NE
NISI	Ninety Six National Historic Site	Southeast	SC
NOAT	Noatak National Preserve	Alaska	AK
NOCA	North Cascades National Park	Pacific West	WA
NPSA	National Park of American Samoa	Pacific West	HI
OBRI	Obed Wild and Scenic River	Southeast	TN
OCMU	Ocmulgee National Monument	Southeast	GA
OLYM	Olympic National Park	Pacific West	WA
ORCA	Oregon Caves National Monument	Pacific West	OR
ORPI	Organ Pipe Catcus National Monument	Intermountain	AZ
OZAR	Ozark National Scenic Riverways	Midwest	MO
PAAL	Palo Alto Battlefield National Historic Site	Intermountain	TX
PAIS	Padre Island National Seashore	Intermountain	TX
PECO	Pecos National Historical Park	Intermountain	NM
PEFO	Petrified Forest National Park	Intermountain	AZ
PERI	Pea Ridge National Military Park	Midwest	AR
PETE	Petersburg National Battlefield	Northeast	VA
PETR	Petroglyph National Monument	Intermountain	NM
PINN	Pinnacles National Monument	Pacific West	CA
PIPE	Pipestone National Monument	Midwest	MN
PIRO	Pictured Rocks National Lakeshore	Midwest	MI
PISP	Pipe Spring National Monument	Intermountain	AZ
PORE	Point Reyes National Seashore	Pacific West	CA
PRWI	Prince William Forest Park	National Capital	VA
PUHE	Puukohola Heiau National Historic Site	Pacific West	HI
PUHO	Pu'uhonua o Honaunau National Historical Park	Pacific West	HI
RABR	Rainbow Bridge National Monument	Intermountain	UT
REDW	Redwood National Park	Pacific West	CA
RICH	Richmond National Battlefield Park	Northeast	VA
ROCR	Rock Creek Park	National Capital	DC
ROMO	Rocky Mountain National Park	Intermountain	CO
ROVA	Roosevelt-Vanderbilt National Historic Site	Northeast	NY
RUCA	Russell Cave National Monument	Southeast	AL
SAAN	San Antonio Missions National Historical Park	Intermountain	TX
SACN	Saint Croix National Scenic Riverway	Midwest	WI
SAGA	Saint-Gaudens National Historic Site	Northeast	NH

SAGU	Saguaro National Park	Intermountain	AZ
SAHI	Sagamore Hill National Historic Site	Northeast	NY
SAIR	Saugus Iron Works National Historic Site	Northeast	MA
SAJH	San Juan Island National Historical Park	Pacific West	WA
SAMO	Santa Monica Mountains National Recreation Area	Pacific West	CA
SAPU	Salinas Pueblo Missions National Monument	Intermountain	NM
SARA	Saratoga National Historical Park	Northeast	NY
SCBL	Scotts Bluff National Monument	Midwest	NE
SEKI	Sequoia-Kings Canyon National Park	Pacific West	CA
SHEN	Shenandoah National Park	Northeast	VA
SHIL	Shiloh National Military Park	Southeast	TN
SITK	Sitka National Historic Park	Alaska	AK
SLBE	Sleeping Bear Dunes National Lakeshore	Midwest	MI
STRI	Stones River National Battlefield	Southeast	TN
SUCR	Sunset Crater Volcano National Monument	Intermountain	AZ
TAPR	Tallgrass Prairie National Preserve	Midwest	KS
THRO	Theodore Roosevelt National Park	Midwest	ND
THST	Thomas Stone National Historic Site	Northeast	MD
TICA	Timpanogas Cave National Monument	Intermountain	UT
TIMU	Timucuan Ecological and Historic Reserve	Southeast	FL
TONT	Tonto National Monument	Intermountain	AZ
TUMA	Tumacacori National Historical Park	Intermountain	
TUZI	Tuzigoot National Monument	Intermountain	AZ
UPDE	Upper Delaware Scenic & Recreational River	Northeast	PA
VAFO	Valley Forge National Historical Park	Northeast	PA
VICK	Vicksburg National Military Park	Southeast	MS
VIIS	Virgin Islands National Park	Southeast	VI
VOYA	Voyageurs National Park	Midwest	MN
WABA	Washita Battlefield National Historic Site	Intermountain	OK
WACA	Walnut Canyon National Monument	Intermountain	AZ
WAPA	War in the Pacific National Historical Park	Pacific West	GU
WEFA	Weir Farm National Historic Site	Northeast	CT
WHIS	Whiskeytown National Recreation Area	Pacific West	CA
WHMI	Whitman Mission National Historic Site	Pacific West	WA
WHSA	White Sands National Monument	Intermountain	NM
WICA	Wind Cave National Park	Midwest	SD
WICR	Wilson's Creek National Battlefield	Midwest	MO
WOTR	Wolf Trap Farm Park	National Capital	
WRST	Wrangell St. Elias National Park and Preserve	Alaska	AK
WUPA	Wupatki National Monument	Intermountain	AZ
YELL	Yellowstone National Park	Intermountain	WY
YOSE	Yosemite National Park	Pacific West	CA
YUCH	Yukon-Charley Rivers National Preserve	Alaska	AK
YUHO	Yucca House National Monument	Intermountain	CO
ZION	Zion National Park	Intermountain	UT

Appendix II-A. Amount of funding allocated to basic natural resource inventory projects by the National Park Service Inventory and Monitoring Program during FY 2002.

Program Component	Funding in FY 2002
Bibliographies	$ 50,000
Base Cartography Data	80,000
Biological Inventories	
Network-Based	6,353,700
Non-Network	63,800
Vegetation Mapping	2 ,104,030
Climate Data	178,800
Water Quality Data	235,885
Soil Surveys	985,500
Geology Inventories	600,000
Total	**$ 10,651,715**

Appendix II-B. Projected completion schedule for baseline natural resource inventories being conducted by the National Park Service Inventory and Monitoring Program.

Basic Data Sets	End Of FY 2002		End Of FY 2003		End Of FY 2004	End Of FY 2005	FY 2005-10 1/
	Underway	Completed	Underway	Completed	Completed	Completed	To be Completed
Natural Resource Bibliographies	2	263	**0**	**270**	**270**	270	0
Base Cartography Data	10	260	**0**	**270**	**270**	270	0
Species Lists	0	270	**0**	**270**	**270**	270	0
Species Occurrence and Distribution	**270**	0	**270**	**0**	**230**	270	0
Vegetation Maps	45	28	**36**	**37**	**52**	95	175
Soils Maps	**97**	57	**89**	**63**	**100**	130	140
Geology Maps	**227**	14	**215**	**26**	**38**	70	200
Water Body Location and Classification	**50**	220	**0**	**270**	**270**	270	0
Baseline Water Quality Data	0	270	**0**	**270**	**270**	270	0
Air Quality Data	0	250	**0**	**250**	**250**	250	0
Air Quality-Related Values	0	0	**0**	**0**	**50**	75	195
Meteorological Data	53	196	**20**	**250**	**270**	270	0

1/ The Servicewide program acquires basic inventory data sets for about 270 parks with significant natural resources. However, some parks have acquired some of these data sets and a few parks may not need all 12 sets. The number of parks to complete reflects the number Servicewide with outstanding needs.

Appendix II-C. Allocations by the Inventory and Monitoring Program for inventories other than network biological inventories and vegetation mapping during FY 2002.

Organization	Title	FY 2002 Funding
BIOTIC INVENTORIES		
NPS – I&M Agreements	IT IS Support	25,000
Alaska NP's	Landcover	500,000
Olympic NP	Amphibian Inventory	24,000
Appalachian Trail	Biological Inventory	39,800
ABIOTIC INVENTORIES		
NPS- I&M Agreements	Base Cartography	80,000
NPS – I&M Agreements	Climate	178,800
NPS – WRD Agreements	Water Body Classification	50,000
Chiricahua NM	Water Quality	14,300
Coronado NM	Water Quality	42,000
Fort Bowie NHS	Water Quality	9,100
Gila Cliff Dwelling NM	Water Quality	19,500
Montezuma Castle NM	Water Quality	19,500
Organ Pipe Cactus NM	Water Quality	19,000
Saguaro NP	Water Quality	61,600
Columbia-Cascades SO	Bibliography	50,000
Intermountain Region Parks	Soils	7,400
Denali NPP	Soils	90,500
Denali NPP (NRCS)	Soils	26,500
Big Bend NP	Soils	84,500
Channel Islands NP	Soils	150,000
Redwoods NP	Soils	99,700
Grand Canyon NP	Soils	175,000
Padre Islands NP	Soils	75,500
Apostle Islands NL	Soils	10,000
Saint Croix NSR	Soils	43,000
North Cascades NP	Soils	20,000
Great Smoky Mountains NP	Soils	203,400
NPS – GRD Agreements	Geology	199,000
NPS – GRD (Multi Parks)	Scoping Wkshops	208,000
National Capital Region Parks	Geology	23,000
Great Smoky Mts. NP	Geology	10,000
Ozark NSR	Geology	15,000
BlueRidge Parkway	Geology	50,000
Lake Meade NRA	Geology	20,000
Wupatki NM	Geology	25,000
Craters of Moon NM	Geology	10,000
Cape Lookout NS	Geology	20,000
Cape Hatteras NS	Geology	20,000
	TOTAL	**$ 2,718,100**

Appendix II-D. Amount of funding provided to park networks during FY 2002 for conducting biological inventories.

Network	Total Budget	FY 2002 Allocation
Southwest Alaska Network	1,331,828	225,500
Northwest Alaska Network	1,437,470	409,700
Central Alaska Network	942,915	233,600
Southeast Alaska Network	404,648	201,400
Great Lakes Network	1,181,860	225,800
Heartland Network	788,301	295,300
Northern Great Plains Network	782,749	197,100
Mid-Atlantic Network	424,635	74,900
Eastern Rivers and Mountains Network	602,551	173,400
Northeast Coastal and Barrier Network	866,885	248,300
Northeast Temperate Network	579,880	75,000
National Capital Network	686,257	163,800
Cumberland/Piedmont Network	565,541	98,200
Southeast Coast Network	1,163,014	310,600
Gulf Coast Network	852,881	221,300
Appalachian Highlands Network	675,657	120,000
South Florida/Caribbean Network	1,398,877	390,900
Northern Colorado Plateau Network	1,037,439	299,300
Rocky Mountain Network	580,733	180,000
Greater Yellowstone Network	665,742	177,100
Southern Colorado Plateau Network	1,185,253	255,200
Southern Plains Network	310,302	24,900
Sonoran Desert Network	615,521	15,000
Chihuahuan Desert Network	709,820	197,200
North Coast and Cascades Network	787,636	318,600
Northern Semi-Arid Network	481,769	176,400
San Francisco Bay Network	682,333	131,900
Mojave Desert Network	780,669	246,800
Mediterranean Coast Network	731,032	265,600
Sierra Network	602,002	146,000
Pacific Islands Network (Hawaiian parks)	900,000	94,900
Klamath Network	731,392	160,000
Totals	**25,487,592**	**6,353,700**

Appendix II-E. Amount of funding for major NPS vegetation mapping projects during FY 2002 and associated expenditures by partnering entities.

Vegetation Mapping Project	NPS-I&M Funding	FirePro	USGS Funding	Other NPS
Sequioa /Kings Canyon NP	$ 127,200	$ 75,000		
Yosemite NP	$ 250,000			
Glacier NP	$ 6,500		$ 306,000	
Grand Teton NP		$ 180,000		$ 15,000
Rocky Mountain NP	$ 138,800	$ 100,000		
Bandelier NM	$ 264,500			
Effigy Mounds NM			$ 96,600	
Northeast Region Parks	$ 130,750			
Wupatki NM			$ 15,000	
Whiskeytown NRA		$ 75,000		
Santa Monica Mts. NRA		$ 400,000		
Point Reyes NS		$ 100,000		
Shenandoah NP		$ 15,000		
North. Colo. Plateau Parks	$ 200,000	$ 200,000	$ 150,600	$ 505,000
Cumberland/Piedmont Parks	$ 100,000			$ 144,500
Appalachian Highlands Parks	$ 100,000			$ 29,000
National Capital Parks	$ 64,000			$ 61,000
Ozark NSR		$ 56,800		
Cape Cod NS	$ 44,700			
Eastern River/Mts. Network	$ 218,500			
Virginia Parks		$ 216,700		
Other Costs:				
NatureServe Agreement			$ 110,000	
USMESC Support			$ 37,500	
Program Administration	$ 102,000		$ 269,300	
Totals	**$1,746,950**	**$ 1,418,500**	**$985,000**	**$ 754,500**

Appendix III-A. Number of parks from the first 12 vital signs monitoring networks in various phases of protocol development and implementation during FY 2002.

	Air Quality	Water Quality	Water Quantity	Geologic Resources	Plants	Animals	Landscapes
Planning/ Design	18	39	14	21	37	37	12
Protocol Implemented	25	33	13	18	46	63	17
Analysis/ Synthesis	16	23	7	6	19	37	5

Appendix III-B. Amount of funding provided to Park Vital Signs Monitoring Networks during FY 2002 by the Servicewide Inventory and Monitoring Program.

	Vital Signs Networks	Funding
1.	North Coast and Cascades	$345,100
2.	Northeast Coastal and Barrier	$776,500
3.	Heartland	$684,400
4.	Sonoran Desert	$670,000
5.	Cumberland/Piedmont	$476,700
6.	Central Alaska	$580,000
7.	National Capital Region	$597,000
8.	Northern Colorado Plateau	$385,500
9.	San Francisco Bay Area	$592,800
10.	Greater Yellowstone	$574,600
11.	Appalachian Highland	$266,400
12.	Mediterranean Coast	$152,000
13.	Southwest Alaska	$150,000
14.	Northeast Temperate	$150,000
15.	Southern Colorado Plateau	$150,000
16.	Pacific Island	$150,000
17.	Great Lakes	$150,000
	Total	**$6,851,000**