A Study Plan to the Inventory of Vascular Plants and Vertebrates in the South Florida/Caribbean Network of the National Park Service

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and

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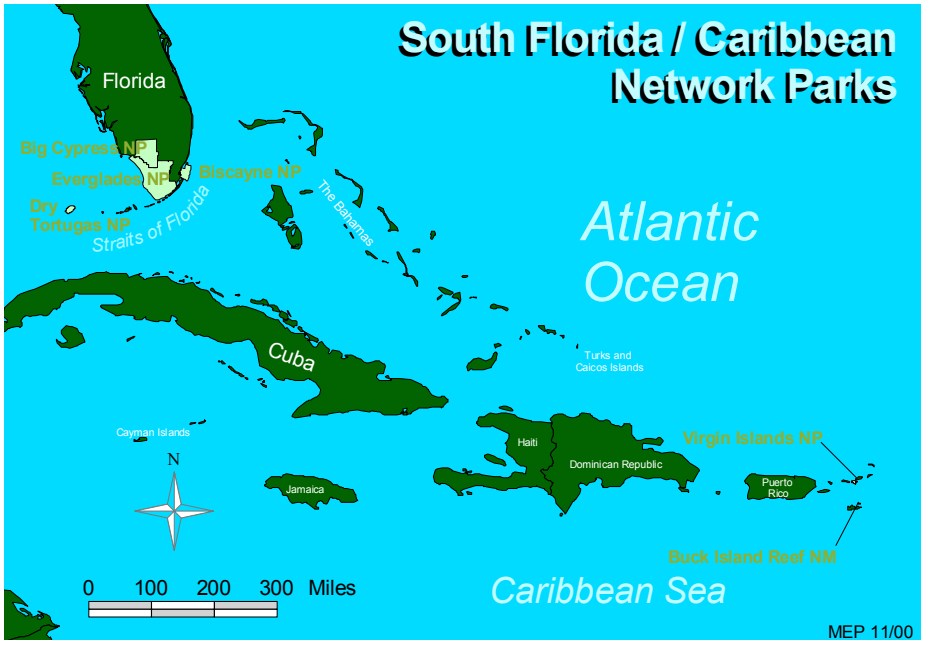
Park Management Approval – South Florida/Caribbean Network

We, the Superintendents of the South Florida/Caribbean Network, hereby fully support this Inventory of Vertebrates and Vascular Plants Study Plan with the understanding that this information will assist the parks, and a network as a whole, in managing this region in a broader scale manner with sound scientific data. We shall support this effort to ensure the success of this project.

Superintendent, Big Cypress National Preserve	Date 10/14/00
Superintendent, Biscayne National Park	Date 11/14/00
Superintendent, Buck Island Reef National Monument	Date 11/17/00
Superintendent, Dry Tortugas National Park	Date 11/14/00
Superintendent, Everglades National Park	Date 11/14/00
for Judy Shafer Superintendent, Virgin Islands National Park	Date 11/21/00

Study Plan to Inventory Vertebrates and Vascular Plants in the South Florida/Caribbean Network

Executive Summary



The South Florida/Caribbean Network includes six parks: Big Cypress National Preserve, Biscayne National Park, Buck Island Reef National Monument, Dry Tortugas National Park, Everglades National Park, and Virgin Islands National Park. Although these six parks are distributed over a distance of more than 1,200 miles, they share a tropical environment, with certain special characteristics making each Park unique. The National Park Service has grouped these six parks together to implement the natural resource Inventory and Monitoring Program. The Vertebrate and Vascular Plant Inventory is a major step towards gaining solid scientific baseline data for use with the long term monitoring program.

Initial research was conducted during 2000 to identify species from all available sources by visiting each of the parks. This research, contracted to the University of Miami, was conducted by a team of biologists who spent time at each park reviewing gray literature, species lists, and all other sources of species information. The intent of this effort was to complete an exhaustive literature, records, and other ancillary data search in order to augment the known composition of each park's NPSpecies database. This data set was reviewed in the last week of September 2000 by network parks resource management

personnel and outside experts to authenticate these records, and flag those records that were questionable in terms of originating from a credible source, or occurring currently in the park. These reviewed species lists have allowed the network to identify data gaps and prioritize network needs. The goal of the Vertebrate and Vascular Plant Inventory is to identify 90% of the species present in each of the following categories (Mammals, Fish, Birds, Reptiles, Amphibians, and Vascular Plants) in each of the parks. Some parks have been well surveyed and have exceeded the 90% level for some categories, while others require in-depth inventories to achieve this goal (Table 1).

The Vertebrate and Vascular Plant Inventory Study Plan addresses meets the network's needs for attaining the 90% goal. This includes the methods used to inventory the data gaps, the proposed staffing and budget, and a timeline. The network has been working with a proposed budget of $1,398,000 for a five year period to accomplish the required inventories, contribute data to servicewide NPS data initiatives, and begin planning for long term monitoring.

Table 1. Levels of Species Knowledge by Park and Category.

TAXA	BICY	BISC	BUIS	DRTO	EVER	VIIS
Mammals	66%	60%	50%	50%	72%	91%
Fish	86%	97%	69%	92%	84%	93%
Birds	99%	99%	73%	98%	90%	99%
Reptiles	88%	48%	88%	57%	96%	99%
Amphibians	88%	38%	N/A	None	99%	99%
Plants	91%	99%	99%	99%	99%	99%

Levels less than the 90% required are in red.

Table 1 provided the information the network used to prioritize which taxa needed to be inventoried during this initiative. Although the plants are all above the 90% level, there were questions about the taxonomy of the species found during the initial literature searches. Also BICY, BISC, and BUIS have areas in the park that have either been poorly or never inventoried, and may hold new species not currently on their lists. Both fish (fresh and marine) and reptiles were below the required 90% level in the majority of the network parks, and became an identified need, as well.

ACKNOWLEDGEMENTS

The South Florida / Caribbean Network has worked to ensure the Vertebrate and Vascular Plant Inventory will be implemented with sound scientific principles and good data management as the most important aspects of this project. This study plan has been an effort by all the parks in the network, through much e-mail, conference calls, and trips. Don Catanzero and Robert Brock have been instrumental from the start of the process to make sure the process maintained forward momentum throughout the year. These two individuals provided constant tracking and oversight of the contractors and the process as a whole that proved for a successful data mining operation. Chris Sasso and his team (Kirsten Nicholson, Tara Greaver, and Mike Robinson) were highly professional and very efficient during the time they conducted the literature searches at each of the parks, and populated the NPSpecies database. The rest of the Steering Committee (Ron Clark, Brian Lockwood, Zandy Hillis-Starr, Sonny Bass, David Jones, Rafe Boulon) have been instrumental in making sure each park is properly represented throughout the process, and the study plan would have never been so detailed without all of their help. Thanks to all the taxa experts that attended the Scoping Meeting to validate the data mining process. Special thanks to Larry West, our Regional I&M Coordinator who was very helpful during the end of the process by explaining the strengths and weaknesses seen in the plans submitted by other networks. Thank you to all the Superintendents for understanding and supporting this very important initiative, and seeing the benefit of all of this work.

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1.0 INTRODUCTION

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

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

1.1 PROGRAM GOALS AND OBJECTIVES

The basic goal of the NPS Biological Inventory Program is to provide park managers with comprehensive scientifically based information about the nature and status of vascular plants and vertebrates occurring within park boundaries. These data should be in a form that increases its accessibility and utility for making management decisions, for scientific research, and for educating the public. The biological inventories will also lay the groundwork necessary for park managers to develop effective monitoring programs and to formulate effective management strategies for resource management and protection. To attain these basic goals, NPS biological inventories will be designed to meet three basic objectives:

1) 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.

2) To describe the distribution and relative abundance of species of special concern, such as Threatened and Endangered species, exotics, and other species of special management interest occurring within park boundaries.

3) 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.

1.2 SOUTH FLORIDA/CARIBBEAN NETWORK

The six parks which make up the South Florida /Caribbean network range over 1,200 miles. The parks range in size with one small park (Buck Island Reef National Monument (880 acres) and five large parks varying in size from Virgin Islands National Park (15,276 acres) to Everglades National Park (over 1.5 million acres). The South Florida Caribbean Network includes Big Cypress National Preserve, Biscayne National Park, Buck Island Reef National Monument, Dry Tortugas National Park, Everglades National Park, and Virgin Islands National Park (Figure 1, Table 1).

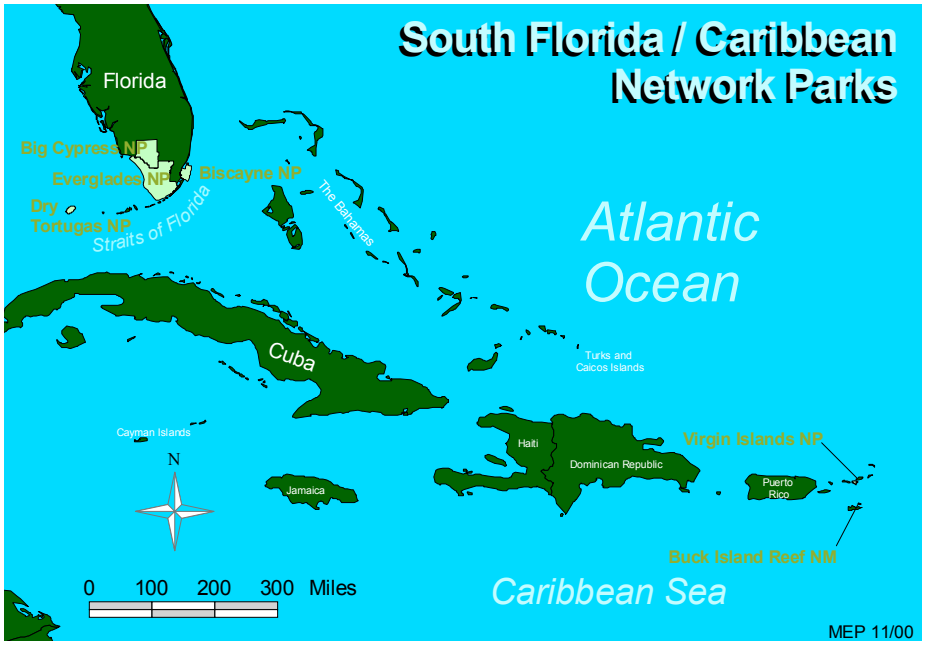


Figure 1. The South Florida /Caribbean Network Parks.

Park Name	Park Alpha Code	Size (Hectares)	Size (Acres)
Big Cypress National Preserve	BICY	295,015	729,000
Biscayne National Park	BISC	73,450	181,500
Buck Island Reef National Monument	BUIS	356	880
Dry Tortugas National Park	DRTO	25,900	64,000
Everglades National Park	EVER	610,497	1,508,570
Virgin Islands National Park	VIIS	6,182	15,276

Table 2. South Florida/Caribbean Network park sizes.

Park Overview

Big Cypress National Preserve
Water is a principal natural resource of the entire south Florida region. Big Cypress National Preserve clearly illustrates this important resource with close to 90 percent of the preserve's area flooded seasonally. Because the 295,015 ha (729,000 acre) preserve is relatively undeveloped, it serves as a large natural reservoir and nutrient filter, permitting natural biological processes to nourish diverse ecological communities distinctive to south Florida. The preserve's ecology is finely tuned to seasonal water flow patterns, and any interference can alter this sensitive habitat. About 80 percent of the current Big Cypress land mass is wetland and is characterized by extensive prairies, freshwater marshes, forested swamps, and shallow sloughs. Most wildlife species native to south Florida occur within the Big Cypress watershed. Ten species are listed by the U.S. Fish and Wildlife Service as threatened or endangered, and 10 species are candidates for threatened or endangered status; an additional 14 species are listed by the state of Florida as threatened, endangered, or of special concern.

Biscayne National Park
Biscayne National Park was established in 1969 as Biscayne National Monument with expansions in 1974 and 1980 when it was re-designated Biscayne National Park. The park is located in southeast Florida, within sight of a major metropolitan area, the City of Miami, and heavily influenced by growth within metro Miami-Dade County. The Park is comprised of 73,450 total ha (181,500 acres) of which 69,767 ha (172,400 acres) are submerged. Biscayne National Park's enabling legislation charges the National Park Service to keep a rare combination of terrestrial, marine, and amphibious life for the inspiration and enjoyment of present and future generations. The park preserves an entire coastal island ecosystem (upland to oceanic), and is home to over eleven federally threatened and endangered species, and over 28 state listed plants and animals in addition to the federally listed species.

Buck Island Reef National Monument
President John F. Kennedy established Buck Island Reef National Monument in 1961. The monument was created to preserve one of the Caribbean's finest marine gardens for scientific and educational interest, and for recreational uses. Buck Island is located 1.5 miles northeast of St. Croix, the largest of the U.S. Virgin Islands. The monument totals 356 ha (880 acres), 71 ha (176 acres) are uninhabited subtropical dry forest island and 285 ha (704 acres) are submerged lands. The park's significance lies primarily in the extensive elkhorn coral barrier reefs surrounding the eastern two thirds of the island. Recent research has identified the Buck Island coral reef ecosystem as critical developmental habitat for the endangered hawksbill sea turtle. The island provides nesting habitat for two endangered species – hawksbill and leatherback turtle– and two threatened species – the green turtle and least tern, as well as several rare native plant species, and one endemic beetle (*Longitarius zandae*).

Dry Tortugas National Park
Almost 70 miles (112.9 km) west of Key West lies a cluster of seven islands, composed of coral reefs and sand, called the Dry Tortugas. Fort Jefferson National Monument was established by Presidential Proclamation on January 4, 1935, to protect historic Fort Jefferson, a military and architecturally significant nineteenth century fort. Congress re-designated the 25,900 ha (64,000 acre) area as a National Park in October 1992 to provide additional management protection for the area's subtropical marine system, including coral reefs, fisheries, nesting birds and sea turtles, and other wildlife (Public Law 102-525). Dry Tortugas National Park possesses one of the greatest concentrations of historic shipwrecks in North America, with some vessels dating back to the 1600's. Because of its isolation, the islands, magnificent subtropical waters and coral reefs serve as an important resting place for migrating birds and a foraging and nesting place for sea turtles. Pristine subtropical waters, lush coral and seagrass habitat, and hundreds of species of birds and fish affords scientists an outstanding opportunity for education and scientific research. Some of the earliest known coral reef investigations date back to the 1880's when the Carnegie Institution operated one of the first subtropical marine science laboratories in the Western Hemisphere on Loggerhead Key.

Everglades National Park
Established in 1947, the Everglades National Park's 610,497 ha (1.5 million acres) include habitats ranging from freshwater marshes in Shark River Slough to Florida Bay, an occasionally hypersaline, seagrass-dominated marine lagoon. Other prominent natural communities are subtropical hardwood hammocks, the last large intact remnant of South Florida upland pineland forests and an extensive mangrove dominated estuary. Everglades National Park is designated as an International Biosphere Reserve (1976), Wilderness

Designation (1976), a World Heritage Site (1979), and a Wetland of International Significance (1987). The Park is the southeast's largest designated wilderness and hosts 14 threatened and endangered species. It is a significant North American breeding ground for subtropical wading birds and contains the largest mangrove ecosystem in the Western Hemisphere. Together with neighboring Big Cypress National Preserve and Biscayne National Park, these protected habitats are almost 1 million hectares (2,471,053 acres) in size and are significant elements of the South Florida ecosystem, a natural continuum that begins in the Kissimmee River Basin and ends at the Gulf of Mexico and Florida Keys.

Virgin Islands National Park
Virgin Islands National Park was established in 1956 with an original boundary of 3,840 ha (9,489 acres). Subsequent expansions in 1962 and 1978 added 2,287 ha (5,651 acres) and 55 ha (136 acres) respectively totaling 6,182 ha (15,276 acres). The primary legislative mandate of Virgin Islands National Park is to protect outstanding scenic values and features of national significance. In 1976, the United Nations Educational, Scientific and Cultural Organization (UNESCO) through its Man and the Biosphere (MAB) program designated the park as a Biosphere Reserve.

Virgin Islands National Park contains examples of most subtropical Atlantic terrestrial, coastal and marine ecosystems. These include various types of subtropical dry to moist forest, salt ponds, beaches, mangroves, seagrass beds, coral reefs and algal plains. Concerted long-term monitoring of biological resources have been ongoing since the 1960s. In 1993 NPS located the South Florida/Virgin Islands Prototype Long Term Ecological Monitoring Program at Virgin Islands National Park and funding for this program was begun in 1997.

1.3 PRELIMINARY LIST OF PARK-SPECIFIC OBJECTIVES

Big Cypress National Preserve
Future needs begin with a baseline inventory of plants and animals, including those threatened and endangered. Realizing that a baseline inventory is a long-term cumulative effort in all respects, emphasis should give priority to threatened and endangered species. Additionally, the park lacks information on freshwater fish and invasive non-native plant and wildlife species, especially in the new addition of 59,084 ha (146,000 acres). As habitats are altered by changing wetland hydrology imposed by the U.S. Army Corps of Engineers and South Florida Water Management District, information on vertebrate populations in these threatened habitats are critically needed.

Biscayne National Park
Hurricane Andrew devastated the park in 1992, and many species of either vertebrate or vascular plants seen prior to the hurricane may be questionable today, especially on the more remote Keys. One major concern is the status of marine fish in the park, which allows commercial fisheries and provides for a significant recreational fishery. In addition, there is little known about freshwater fish along the mainland park boundary and their potential for invasion by non-native freshwater fish. A park priority is to document the status of invasive non-native plant and animal species in the park,

particularly on the keys. Exotic plants may be impacting native plant communities, including threatened and endangered species. A complete vascular plant survey would assist in ground-truthing and obtaining an accurate assessment of the available Geographic Information System (GIS) based vegetation map. Information on herpetofauna in the park is lacking, especially on each of the major Keys. Information on small mammals is lacking including anecdotal reports of the federally listed Key Largo woodrat and cotton mouse, making resource management decisions concerning the limited native fauna resident on the mainland and in the Keys difficult. As habitats are altered by changing wetland hydrology imposed by the US Army Corps and South Florida Water Management District, information on vertebrate populations in these threatened habitats are critically needed.

Buck Island Reef National Monument

Scientific research at Buck Island Reef National Monument has focused on marine ecosystems documenting coral reefs, reef fishes, sea turtle distribution, and recreational activities. Park legislation allows for both recreational and commercial fishing within 1/3 of the park's waters, and fishing pressure immediately outside the park boundaries has intensified greatly since 1961. The impact this level of fishing has had on the marine fish composition in the park is unknown and a complete survey of marine fish in the park including cryptic species is required. Buck Island Reef NM has been subjected to several major hurricanes (Hugo 1989, Marilyn 1995) and constant pressure from exotic predators, tree rat and mongoose. Hurricanes have greatly altered plant communities and these changes need to be documented as part of a vegetation survey. Identification and distribution of exotic plant species is a major concern to the park's native plant restoration program. To fully identify the island's original plant community, a pollen analysis of the salt pond sediment is needed. The island's herpetofauna has never been fully documented, nor has a comprehensive bird survey been conducted. Buck Island Reef NM began an island-wide rat eradication program in 1999. The removal of this exotic species will effect the entire terrestrial ecosystem and it is essential that the island's present biodiversity be established, inventorying all flora and fauna.

Dry Tortugas National Park

Dry Tortugas National Park released a new General Management Plan (GMP) in 2000. The GMP recommended that a Research Natural Area (RNA) be immediately implemented in order to protect and interpret a pristine subtropical marine ecosystem, including an intact coral reef community. The park needs information regarding the habitat preference and distribution of fish both within this RNA and the entire park. A considerable effort is underway to eradicate exotic plant species, clearing the way for native flora to become reestablished. A vegetation resources inventory needs to be implemented on all vegetated islands. Many habitat and associated biological inventories may be decades old (some, such as reef fish species, may be a century old). An updated biological inventory of these remote islands is essential in assessing how accurate these old

inventories are and what updated changes need to be made. Higher level inventories are necessary for park managers to make informed resource management decisions when dealing with sensitive multiple use questions.

Everglades National Park
Threatened and endangered plant species and exotic plants are a major concern. Large-scale changes need to be documented, such as the community shifts in hardwood hammocks and tree islands that have occurred relatively rapidly. Another concern is aquatic vascular plants, which directly affect waterbirds, marine mammals, and fish. For animals, invasive non-native fish and reptiles are a concern, while information on their current spread and impact is not well known. Habitat-based inventories of vertebrates are needed, including birds, mammals, amphibians, and reptiles. As habitats are altered by changing wetland hydrology imposed by the U.S. Army Corps of Engineers and South Florida Water Management District, information on vertebrate populations in these threatened habitats are critically needed. Vertebrate inventories in the mangrove forests of the west coast of the everglades and Florida Bay are needed to update the abundance and distribution of species that were historically recorded as being present. Information on breeding avifauna in the park is needed, particularly in pinelands.

Virgin Islands National Park
Virgin Islands National Park has relatively complete checklists for all major taxons covered by this study plan. However, distribution and status information for bats (the only native terrestrial mammal in Virgin Islands National Park), herpetofauna, freshwater fauna, marine vascular plants, exotic plant and animal species, native and migratory birds, and bait fish are needed. Park priorities also include an inventory of marine benthic habitat types. Population-level inventories are needed for adult fish, juvenile fish, and baitfish. Higher level inventories are necessary for park managers to make informed resource management decisions when dealing with sensitive multiple use questions.

2.0 CURRENT STATUS OF INVENTORIES

Starting in May 2000, current inventory information was pooled together to create a database for the network by the University of Miami. This database was created using NPS reports and published literature provided by each park in the network (see Appendix A for complete list of sources used). A completed first draft database, was provided in August 2000, and was the starting point for determining the completeness of each taxonomic inventory. This database has been provided to the National Inventory & Monitoring Program for addition to the servicewide NPSpecies database.

2.1 TIMELINE OF THE SOUTH FLORIDA/CARIBBEAN NETWORK DATA MINING PROCESS

5/23/00	The Cooperative Agreement between the University of Miami (UM) and the National Park Service is implemented
5/29/00 - 6/04/00	UM visits Everglades/Dry Tortugas National Parks (FL)
6/5-16/00	UM visits Buck Island Reef National Monument (USVI)
7/17-24/00	UM visits Everglades/Dry Tortugas National Parks (FL)
6/25/00 - 7/10/00	UM visits Big Cypress National Preserve (FL)
7/11-25/00	UM visits Biscayne National Park (FL)
8/7- 14/00	UM visits Virgin Islands National Park.
8/18/00	ALL existing information is available on Draft *NPSpecies*
9/26-29/00	Scoping Meeting held in Key Largo to review database and identify gaps in inventory and prioritize projects.
10/30/00	Draft Study Plan sent to South Florida/Caribbean Network Parks for review
12/01/00	Study Plan submitted for review by National I&M Program.

2.2 SCOPING MEETING

The network held a scoping meeting in Key Largo, Florida from September 26 through September 29 to review NPSpecies. In attendance were both NPS personnel and invited taxonomic experts. The scoping meeting's goal was to determine if the network's first objective had been met (document occurrence of at least 90% of vertebrate and vascular plant species in each park). If this objective had not been achieved for any of the taxa, the group was to determine research priorities to attain this goal. Additionally, research priorities were developed to describe distribution and relative abundance for taxa.

2.3 90% SPECIES LISTS

Meeting participants reviewed each record within NPSpecies and corrections were made as needed. During this review, species were categorized, "Probably Present" if the park is within species range and contains appropriate habitat. In other words, documented

occurrences of the species in the adjoining region of the park give reason to suspect that it probably occurs within the park. Those in attendance at the scoping meeting decided which taxa within a park had met the 90% goal, and with some categories, some areas which have never been inventoried may or may not have new species, therefore the table may show that the park may currently exceed the 90% level, but with further investigation, experts expect to possibly encounter additional species. (Table 2). Some of these species lists were built on sampling limited locations of a park (i.e. mammals). Therefore, differences occur between expert opinion and database derived estimates.

Table 3. 90% Status for South Florida/Caribbean Species List.

Taxa	Park	Number of Species Documented	Number of "Probably Present" Species	Predicted % of Species Documented	Expert Opinion on Attainment of 90% goal
Birds	**BICY**	**235**	**3**	**99%**	**Yes**
	BISC	217	3	99%	Yes
	BUIS	49	13	73%	Yes
	DRTO	230	5	98%	Yes
	EVER	344	33	90%	Yes
	VIIS	140	0	99%	Yes
Fish	**BICY**	**43**	**6**	**86%**	**No**
	BISC	545	17	97%	No
	BUIS	253	78	69%	No
	DRTO	261	20	92%	No
	EVER	344	55	84%	No
	VIIS	302	22	93%	No
Amphibian	**BICY**	**17**	**2**	**88%**	**No**
	BISC	8	5	38%	No
	BUIS	N/A	N/A		N/A
	DRTO	None Present	None Present		None Present
	EVER	17	0	99%	Yes
	VIIS	7		99%	Yes
Reptile	**BICY**	**52**	**6**	**88%**	**No**
	BISC	42	22	48%	No
	BUIS	8	1	88%	Yes
	DRTO	7	3	57%	Yes
	EVER	56	2	96%	Yes
	VIIS	16	0	99%	Yes
Mammal	**BICY**	**41**	**14**	**66%**	**No**
	BISC	30	12	60%	No
	BUIS	2	1	50%	No
	DRTO	2	1	50%	No
	EVER	43	12	72%	No
	VIIS	22	2	91%	Yes
Plants	**BICY**	**776**	**73**	**91%**	**No**
	BISC	317	0	99%	No
	BUIS	242	0	99%	No
	DRTO	220	0	99%	Yes
	EVER	1049	1	99%	Yes
	VIIS	740	3	99%	Yes

2.4 NPSpecies DATABASE

The University of Miami (UM) was contracted to populate the NPSpecies database, participate in a scoping meeting to identify data gaps, and deliver a draft study plan to the Caribbean/South Florida Network. UM was supplied with a skeleton version of the database, which had been created using data from NPflora and NPfauna. The database was created/edited using literature supplied during visits to each park.

Species already in the database, for which no documentation could be found, were deleted from the database. Species found in the literature, but not yet in the database, were added. The database was sent to park personnel and reviewed at the scoping meeting in Key Largo.

After the scoping meeting, the draft study plan was created. The draft study plan outlines how gaps in inventory data, which were discussed at the scoping meeting, can be filled. The first priority for this study plan is to ensure that the species list within NPSpecies has the highest level of accuracy. This would be accomplished by populating the database with voucher information and fact checking the plant and fresh water fish records. A museum specialist will be hired to verify vouchers and populate the database with voucher information. Additionally, the plant records in the database should be reviewed by a taxonomist familiar with the flora of the region.

Comment: This area will be merged with other sections, and the individual taxa prioritys will be blended with the individual projects.

It was determined during the scoping meeting that all parks have reached the 90% level for their avifauna. However, data on relative abundance is absent for the majority of species in parks. All parks need information on abundance of avifauna species within their parks. Big Cypress National Preserve would benefit from more thorough surveys of birds. Biscayne National Park and Everglades National Park have little information on breeding birds in the park. Virgin Islands National Park has little data, other than a species list, on wintering birds. These additional data gaps were considered to be on a second level of priority and would be addressed in the future under various other funding possibilities

3.0 STAFFING

The South Florida / Caribbean Network will require staff to ensure the Inventory and Monitoring Program is implemented consistent with National Park Service policy, and in a scientifically sound manner. A full-time, dedicated staff is necessary to make a project of this size and complexity succeed with technical expertise, a solid foundation in ecology and data management, and the ability to orchestrate such an endeavor. Matt Patterson, Inventory and Monitoring Coordinator for Biscayne National Park was designated by the network to fill the role of Network Coordinator for the South Florida / Caribbean network. The network felt that a Coordinator based on the mainland was imperative to the most efficient management of the program. Biscayne National Park complemented an existing 0.4 FTE Geographic Information System Analyst position, with a 0.6 FTE position through Inventory and Monitoring funds to provide a full-time position to assist the Coordinator position with data management and GIS products. A Museum Specialist position was identified as a network priority to update the NPSpecies database with voucher information. The Everglades Regional Collection Center holds many specimens for the four south Florida parks. These voucher specimens would be surveyed to explore which species will need vouchers collected during the inventory process. The Caribbean parks have some voucher specimens on site, and will also need to be added to the database.

South Florida/Caribbean Network Coordinator (stationed at BISC)

This position will coordinate the planning and implementation of the inventories. The coordinator will finalize the scope of work for each study, initiate contracts, and act as a liaison between park resource managers and cooperators. The coordinator will be responsible for ensuring that contractors meet timelines and delivery dates as scheduled, data are synthesized and distributed appropriately, and reports and other data products will be developed within the guidelines of the National Park Service. The coordinator will represent the South Florida/Caribbean Network at regional and national meetings and training. This funding will backfill the Inventory and Monitoring Coordinator position at Biscayne National Park.

Geographic Information Systems Analyst / Data Manager
(0.6 of an GS-11 FTE at BISC)

A GIS specialist would be added to the network to consult with parks about current GIS themes. This analyst would be a pivotal team member during sampling design phases of the inventories, creating stratified sampling grids to be used to ensure random sampling with enough statistical power. Additionally, GIS layers of species coverage and distribution within the network's parks would be created based on data presently available, as well as data from the proposed inventories. GIS will also be used in the sampling design of several of the inventories. The data manager will be responsible for compilation of FGDC compliant metadata and to ensure QA/QC compliance of all data sets.

Museum Specialist

The museum specialist (GS-7) will populate the NPSpecies database with voucher records by contacting/visiting the appropriate museum to verify specimens. The specialist will create a list of needed voucher specimens, procure voucher storage materials, and ensure collected voucher specimens are placed in an appropriate museum collection(s), both locally and possibly at a national repository. This position will be funded from FY01 to FY03.

4.0 COMPLIANCE

Federal law requires that actions, including research, inventory, and monitoring (whether done in-house or under a contract or agreement), that could affect natural or cultural resources on federal lands be preceded by proper assessment and documentation of potential impacts.

The South Florida/Caribbean Network will provide an I & M Inventory Impact Checklist (Appendix D) that will accompany the Request For Proposals (RFP) for all proposed inventory projects. This checklist will enable NPS staff to ensure that the proper compliance pathways are taken to ensure the inventories are accomplished with NPS stewardship as a primary goal.

The checklist will be filled out by the Principle Investigator, and will be reviewed by the Inventory and Monitoring Coordinator. If the checklist, or the inventory proposal indicates a possible NPS policy compliance issue, the Coordinator will schedule a meeting with park Cultural and/or Natural resource specialists, and the Principal Investigator to address the issue, and try to estimate or alleviate the amount of impact. Depending on the impact, park staff will decide if the inventory knowledge gained is worth the damage to the resource(s) and will move forward with either an environmental assessment (EA) or Findings of No Significant Impact (FONSI) if necessary, or denial of the inventory for that park. Park staff may accompany the Principle Investigator to the study area to evaluate alternatives that may reduce impacts to the resources in question. This decision will be made within 3 weeks of the initial meeting to allow for all parties to continue moving forward with the I&M process.

A collecting permit will be issued by each park for inventories occurring in those parks. These permits will instruct the Principal Investigator to the specific terms that are allowed by the NPS and that specific park for the work proposed. Voucher specimens collected will be property of the National Park Service, and will be handled, prepared, stored, delivered and cataloged in accordance with the contract.

It is possible that implementation of one or more inventory projects in each park will not be categorically excludable under the National Environmental Policy Act (NEPA (see 516 DM 6 App. 7.4 C(20), E(1-3) for possible exclusion categories)), and /or the National Historic Preservation Act (NHPA (Section 106 (part IV.B.3 “Installation of environmental monitoring units)). Those actions that are not categorically excluded under

NEPA will require preparation of an environmental assessment (EA) or an environmental impact statement (EIS). For example, use of helicopters to access study areas or resources in wilderness areas requires a documented "minimum tool" determination that very likely could lead to an EIS. Under the NHPA, determination of "effect" on each category of cultural resource must be made by subject matter experts, however, there are several givens which are helpful in the study plan development process. Consideration of Threatened and Endangered species as voucher specimens will be made on a case by case basis. For example, ground-disturbing activities, such as installation of pitfall traps to inventory and or monitor reptiles, amphibians, and shrews require a documented archeological assessment.

The park superintendent for each park has the delegated authority to approve the use of categorical exclusions and to approve EAs for their parks. The authority to approve FONSI's remains with the regional director.

5.0 STUDY DESIGN

Design Structure and Databases. The South Florida /Caribbean Network will work with each project to assist with inventory design to provide a geographic basis for distributing sampling effort, to attempt to combine inventories using a comprehensive multi-disciplinary sampling team where appropriate, and a ensure that each park has the highest resolution inventory that the funding can support. Geographic Information System (GIS) databases will be a key tool for sampling design. Each park's current GIS databases are listed in Appendix E.

These databases will be combined and partitioned to provide a grid overlay for each park. Grid can be characterized by the data in which that cell overlays. Certain combinations of data like habitat, water depth/hydroperiod, or soil type can be combined and identified to focus the inventory effort to areas where the expert might focus on a certain species. The grid will be comprised of three basic elements: the reference frame, the block, and the grid cell. The reference frame is defined as all combined regions of the park targeted for inventory, within which all areas have some probability of being sampled. The block is the primary sampling unit, and is composed of multiple grid cells. The rationale for using a blocked grid, rather than a purely random sample, is that blocking ensures a more uniform distribution of sampling effort across the full geographic extent of the reference frame. The shape and extent of the reference frame, as well as the size of the grid cells, will be determined on a park size basis, and will depend on the amount of area to be inventoried.

In order to provide a comprehensive approach to the spatial partitioning of the reference frame in every park, and to maintain the validity of the probability-based samples, two functional survey categories were defined. These survey categories are referred to as sampling strata and ancillary data.

Sampling Strata. For inventory purposes, we define sampling strata as the predominant vegetation zones within each park. We defined strata by vegetation in order to ensure

that composition and structure are relatively homogeneous within a particular stratum. In marine habitats, benthic composition and depth will be combined as the sampling strata.

We propose a stratified sampling framework for a few important reasons. First, strata provide a reference frame for extrapolation of inventory results and mapping species distributions. For some inventories, it may be appropriate to intensify sampling within selected strata. A random set of coordinates will be drawn from all strata included in a project's reference frame. If select strata are to receive intensive sampling, additional coordinates will be selected and sampled. Increased sampling will be additive so that inventory data will not lose its value as classification systems change, or as succession alters vegetation boundaries.

Ancillary data. This is a strictly functional category describing data collection by non-random and opportunistic means. This approach may be required in special cases where systematic, random sampling will not adequately represent a particular taxon, such as canals or ponds in Biscayne National Park. Emphasis will be placed on specific documentation of the type of efforts applied to obtain these data, with repeatability an important consideration.

6.0 DATA MANAGEMENT

Overview

The South Florida / Caribbean Network shall strive to ensure data management is proactive. Database design and implementation will be a bilateral process that promotes a strong understanding of the data from both the network coordinator and each study's Principle Investigator (PI). Before any data is collected, databases will be designed to ensure consistency within the network. Data on physical and meteorological parameters at the study site will be collected to maximize the data collection efficiency. Inventory project data will be summarized and analyzed through the creation of databases, GIS layers, and annual reporting. Data management responsibilities will be undertaken by the Inventory Coordinator and GIS analyst at Biscayne National Park for the South Florida / Caribbean Network. All data will be distributed to the parks, network, region and service-wide I & M components for full integration on an annual basis.

The quality of the information we gain from this inventory will ultimately be determined by the quality of the data from which it is derived. The network's challenge is to responsibly manage the influx of data so as to insure its usefulness, quality, and integrity. Managers and their successors will use this reliable information for years to come. Data management is a priority for the South Florida / Caribbean network. This commitment has been seen with a budget of nearly $600,000, or about 40% of the total budget for staffing including the Network Coordinator, a GIS Analyst / Data Manager and a Museum Specialist. Continued dedication to data management is exemplified in the data management standards and principles presented below, and long-term data management needs will be met by a permanent data management position funded through monitoring funds

The six South Florida / Caribbean parks have created prioritized lists of taxa and species of concern, which form the basis to consolidate and maximize fieldwork, personnel and related expenses. Multi-disciplinary crews may collect data across several taxa or species where possible and collect data beyond the minimum requirements. Field collected data for inventory (regardless of taxa) shall have a common basic attribute sheet, a coordinated data dictionary and a minimal but common metadata form to deal with standardization of projections, coordinate systems etc. that was to be filled out by all crews.

6.1 DATA FLOW

Data management responsibilities begin prior to data collection. Data management activities involve building relationships among data sets through standardized field forms, site and project codes, and site characterization, and assuring field activities are well documented using Standard Operating Procedures

Data fields will be developed in concert between the Data Management personnel and each PI to maintain relationship integrity between fields from different studies (Consistent date format, character lengths, image types, pre-defined datum for GPS data collection, etc.). Key fields will be developed to link each project with the survey site, taxa type, and date.

Data sheets will closely mirror data entry forms in the database. These forms will use validation rules, combo/list boxes, input masks, look-up tables, and other database validation tools to ease data entry and minimize erroneous data. Stringent Quality Assurance/Quality Control (QA/QC) guidelines will be spelled out for every step of the inventory, from data collection and sampling error estimations, to data entry cleanliness levels of confidence. The Principle Investigators will be required to ensure that the digital data delivered to the Inventory Coordinator is 100% complete and 100% accurate when compared to the original field data sheets. The Principle Investigator will be required to provide an ArcView shape file with sample sites in geographic projection with the Access database to analyze data with spatial context. These shape files will be accompanied by Federal Guidelines for Geographic Data (FGDC) compliant metadata to provide timelessness to the datasets.

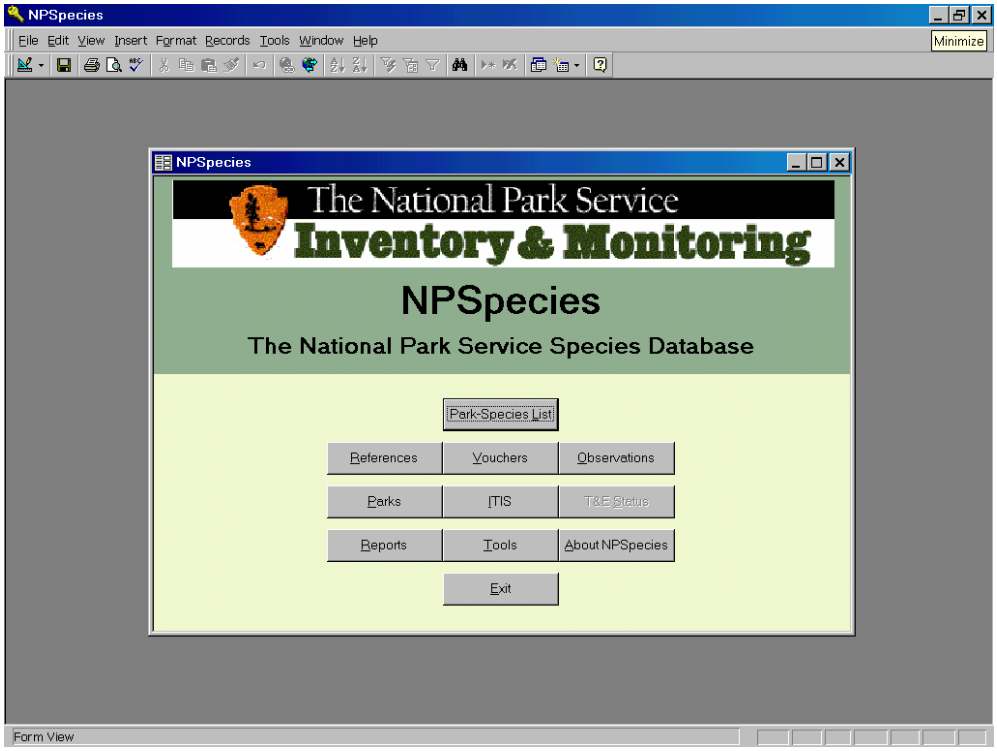
For the data to be fully utilized, relationships among data sets must be designed to accommodate unforeseen needs. The South Florida / Caribbean network will require investigators to document the standard operating procedures used during the course of the study. Documentation should describe step by step the procedure used for data collection, including any modifications or adjustments made to accommodate field conditions, the precision of instruments, etc. While the South Florida / Caribbean network personnel cannot monitor every field trip and observe the sampling techniques, we will take proactive steps to encourage accurate implementation of sampling methods. For example, PI's will be encouraged to develop field guides that assist other survey team members to make proper species identification in the field. To facilitate complete data

collection, standardized data forms that cue investigators to record pertinent data in an appropriate sequence will be developed. Where appropriate, the Access databases will include standard "report" formats for printing field forms, complete with example site coordinates and attributes**.**

6.2 DATABASE DESIGN

Database design is one of the most important tasks to successfully complete this data intensive project. This was highlighted during our scoping meeting when NPSpecies (Figure 2) enabled the network representatives and outside experts to review the species lists on a species by species basis to determine each category's level of completeness. Databases will be developed using Microsoft Access 97 to ensure compliant functionality with all other NPS service-wide databases.

Figure 2. NPSpecies Main Menu Graphic User Interface



http://www.nature.nps.gov/npspp/

The objective of this document is not to define data fields or table structures; rather to describe key elements that will form minimum standards for contracts and the framework for the data management system. These elements include: 1) standardized data fields to promote relatedness among data; 2) data verification and validation requirements including minimum accuracy standards for contracts; 3) a database design that utilizes table relationships to maintain referential integrity between data fields; and 4) a system design that encourages data analysis through inter-relating data through time, space, habitat and taxon.

The process of transcribing data from field forms to digital format inevitably introduces error. Quality control measures built into the database will include such tools as validation rules, input masks, macro calculations, and data entry limitations to listed values in combo boxes. During the data handling phase, data management activities focus on: 1) designing tools for data entry that reduce transcription errors; 2) developing data error-trapping techniques; and 3) independently verifying data transcription. Data verification is the process of comparing the digital data to the original field forms. The principal investigator is expected to compare 100% of the digital data to the original field data sheets. The network will require copies of all original field data sheets from the contractor and the data manager will randomly select a sub-sample of the data to compare to field data sheets. A minimum of 99% accuracy is expected. All corrections to the digital data will be logged. A description of verification procedures and results will be included in the metadata. Actual data entered in the form view is stored in a table or series of related tables. Relationships between these tables will be pre-defined through key fields in order to query linked tables. Measures will be taken to prevent accidental edits to stored data or the database design. Prior to using a database, relevant queries and analysis will be developed, designed, and tested by the project manager or contractor. Anyone performing data entry will have been provided documented training, and will be tested on occasion for accuracy.

The South Florida / Caribbean network will adopt a proactive data management approach that looks beyond the primary purpose of the inventories (i.e. to collect site specific information regarding a species) and promotes data analysis by incorporating relatedness among data through time, space and taxonomic group. A centralized Access database will incorporate one shared set of tables used to identify site, event, habitat, and taxon that are linked to individual data sets. For organizational purposes, standardized site, event and taxon codes will be applied consistently from the field data sheet through the summary report.

The data manager will identify required metadata from each project and principal contractor. In addition to documentation of standard operating procedures, metadata requirements include whom, where, when and the methods employed. Furthermore, metadata should include ancillary information about weather conditions, unique situations (e.g., equipment trouble, injury, canceled trip), verification and validation results, data edit log, etc. Metadata is critical to verifying the accuracy of the data and must be intrinsically secured to the data itself. Data and metadata will be linked using database management tools (e.g., key fields, join types and referential integrity).

Field collected data that meets the field protocol, documentation and format standards will be transferred from the collecting program at the various parks through the PI. After quality control and certification by the individual programs and field teams, the field inventory data, metadata and related project materials will then transfer to the Data Manager /GIS Analyst. The data manager will have check plots created for PI verification to ensure spatial accuracy of GIS data. These plots will be verified and returned back to the Coordinator in a timely manner.

Data for the South Florida / Caribbean parks will be stored in Geographic coordinates, North American 1983 (NAD83) datum. This will allow for individual projections to be made after the fact within ArcView as easily as possible using the projector extension.

6.3 DATA DISTRIBUTION, STORAGE, MAINTENANCE, AND SECURITY

Data for the network will be stored on a computer dedicated to the inventory of the network of parks and at each individual park for which the data are associated. The NPS FTP site, in conjunction with other agreed upon magnetic media, will be used to allow for the transfer of files to and from each of the park sites. Data will be made available as ShapeFiles, Arc/Info coverages or Microsoft Access files. Software upgrades and changes in NPS standards over time will have an impact on requested data formats. Tables will be archived as comma separated value (*.csv) files and documents saved as ASCII text files (*.txt) to ensure long term archival survivability (50 years or more) without an overwhelming maintenance burden as new software replaces older versions. These data will be backed up weekly with redundancy and a copy will be created and stored offsite. Data will be distributed annually with the national and regional inventory coordinators. Data will be stored in secure locations until the Inventory Coordinator feels the data are fit for public use.

Appropriate archiving and dissemination of the data is the final step toward ensuring accessibility to data and maintaining data quality. Servicewide databases developed by WASO I&M are available for this task and the Inventory Coordinator shall be responsible for incorporating inventory data into servicewide databases. This task will be accomplished by including the task in the scope of work or by importing the data in house. Original field data sheets will be stored in the Coordinator's data vault, with a copy stored at the appropriate park. Copies of digital data, metadata, reports and summaries on CD will be distributed to the park, Regional I&M Coordinator, and Servicewide I&M Coordinator.

The NPS Dataset Catalog is a catalog/database that shall contain metadata about datasets available and can be indexed on-line. Only GIS layers are currently entered in the Dataset Catalog, but as information about other datasets from the various parks becomes available, it will be added using the electronic form (Figure 3). In conjunction with the inventory this catalog will be brought up to date over the next few years as more information can be identified, verified and compiled.

Figure 3 . Dataset Catalog Entry Form.

Dataset Catalog Entry Form

All fields must be completed

Completed by: _____ Date: _____

Subject: _____

Keywords: _____

Dataset Title: _____

Version: _____ Project ID: _____

Dataset Description: _____

_____

_____

Related Documents: _____

_____

Begin Date: _____ End Date: _____

Date Notes: _____

Status: New_____ Active_____ Inactive_____ Update Frequency: _____

Places: In_____ Out_____ In&Out_____

Location: _____

Center Longitude: _____ Center Lattitude: _____ UTM Zone: _____

UTM Easting (optional): _____ UTM Northing (optional): _____

Data Type: GEORAS___ GEOVEC___ GEODB___ DIGRAS___ DIGVEC___ DIGDB___ ANADRG___ ANAUNO___

Table/Layer Name(s):_____

_____

Quality: Unknown_____ Not Ver./Val._____ Verified_____ Validated_____ Metadata_____

Scale(s): _____

Data Format: Paper_____ dBASE_____ Lotus_____ WordPerfect_____ ASCII_____

Other (Specify): _____

Data Originator: Name, Position_____

Affiliation, Contact Info _____

_____

Dataset Contact (Park): _____

_____

Distribution: _____

Dataset Location: _____

Access Restrictions: None_____ Restricted_____ (briefly describe below)

6.4 DATA PRODUCTS

The South Florida / Caribbean Network will utilize tools created for the National Inventory and Monitoring Program which include I&M Database Template, NPSpecies, NPBib, the Dataset Catalog, the GIS Theme Manager, and Synthesis. Raw data, summary data, annual reports, GIS layers, and images will be collected and created throughout the inventory process, and will be available in a variety of formats, both hardcopy and digital.

The Database Template will be used as the backbone for each inventory's data compilation. Each particular inventory will be designed to allow for customized tables, queries, forms, and reports to be built for the most efficient data entry, error checking, analysis, and summarization.

NPBib will be used to catalog annual reports, study plans, Standard Operating Procedures, and any other publication that is created from the inventory project. The NPBib ID number will be linked to the appropriate projects to allow connectivity from the data to the reports.

The DataSet Catalog provides a servicewide resource database which all data in the park service can be searched and identified. This database will be used to manage the various project datasets, both tabular and spatial. The updated version of the DataSet Catalog will have an FGDC compliant metadata report that will allow the data from the database to be reformatted and properly tagged to ensure federal metadata compliance.

Spatial datasets will be formatted to allow for full functionality with the GIS Theme Manager. Data for the South Florida / Caribbean parks will be stored in Geographic coordinates, North American 1983 (NAD83) datum. This will allow for individual projections to be made after the fact within ArcView as easily as possible using the projector extension.

Synthesis will be used for information management to efficiently locate, organize, integrate, and disseminate data and information (Figure 4). By working in the Synthesis environment, project data can be viewed by the park, network, National Park Service, and the rest of the world through the Internet. This information management system, with some training, will allow access to all the data from the I&M program, and will encourage all park divisions to utilize this system for a more integrate approach. Once the user is trained on the basic data format and functionality, they will be able to produce reports with data being pulled from multiple formats into a single document including maps, pictures, data, text, and graphs. This will create a more efficient way of doing business in all divisions of the park.

The South Florida / Caribbean Network understands the need for timely distribution of both data and reports, to allow the regional and national program to show how important this biologic inventory is to the park service. All efforts will be made to not only manage a scientifically sound inventory gathering the most competent scientific data, but to turn it

around as efficiently as possible so that it can be used for management and decision making processes.

Figure 4. Synthesis Graphical User Interface.

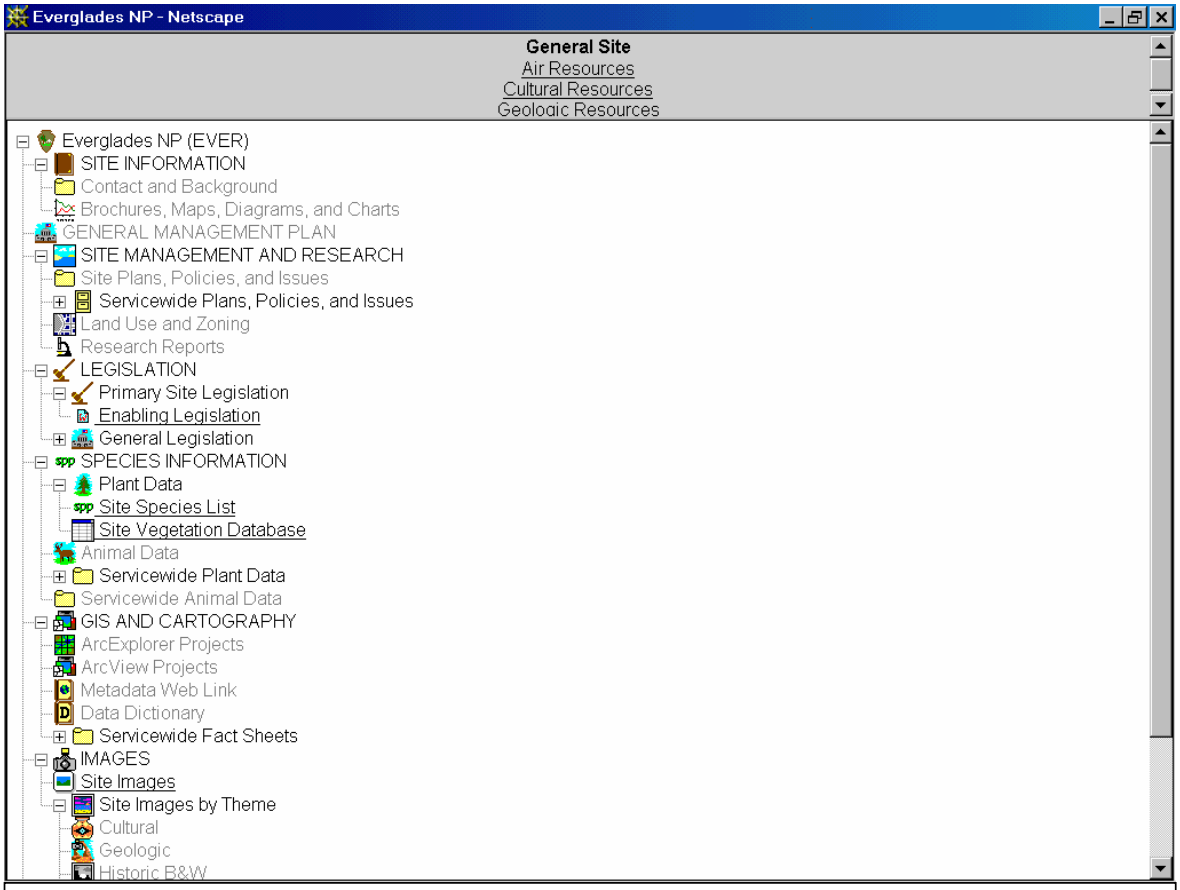


Figure 4

7.0 VOUCHERS

The South Florida / Caribbean Network understands the importance of voucher specimens to a biological inventory. These vouchers act as both proof of existence for an individual species, but also allows the specimen to be used for comparison genetically, physically, spatially, and temporally. Vouchers will be collected when a species has not previously been documented in a park or for which no voucher specimen exists. Species listed as present in a park without any voucher will become known once the Museum Specialist has populated the NPSpecies database with voucher records. Vouchers will only be collected to confirm a species presence in a park, but will not be taken to document the full range of phenotypic variation. Permission to collect rare, threatened, or endangered species will be considered on a case by case basis. Voucher specimens should be prepared according to standard methods for each taxa and placed in an appropriate museum. The South Florida / Caribbean Network is working with the USGS BRD- USGS Patuxent Wildlife Research Center Table 4 displays suggested voucher guidelines for vertebrate taxa developed by the Heartland Network that could be followed in this network.

Table 4 Voucher guidelines for vertebrate taxa.

Taxon	***Suggested Vouchers***
Mammals	
Bats	Wing punch or whole specimens for easily misidentified species, if capture is part of the protocol Morphometric data, photographs, digital sonograms or cassette tapes with reference calls as evidence of rare bats
Mid-sized carnivores	Photographs or hair samples, if possible, to help document species occurrence when inventory based on tracks
Other mid-sized mammals	Whole specimens not necessary
Small mammals	Three of each species (1 per sex & a juvenile); skulls used to differentiate between *Blarina* and *Cryptotis*, and among *Peromyscus*
Deer	Whole specimens not necessary
Birds	Whole specimens not necessary Visual or song identification by qualified observers (common species) Photographs and sound recordings of unusual sittings Complete written description following accepted AOU standards

Amphibians/Reptiles	Whole specimens if identification difficult, or if trap mortality occurs Photographs, if diagnostic features clear Sound recordings (anurans)
Fish	Whole specimens, if required for identification

8.0 COOPERATIVE ECOSYSTEM STUDIES UNITS (CESU)

8.1 BACKGROUND

Cooperative Ecosystem Studies Units (CESUs) provide research, technical assistance and education to federal land management, environmental and research agencies and their partners. Their broad scope includes the biological, physical, social, and cultural sciences needed to address natural and cultural resource management issues at multiple scales and in an ecosystem context. Each CESU is comprised of federal agencies, a host university, and partner institutions. Cooperative and Joint Venture agreements allow each of the participating federal agencies to efficiently transfer funds to university partners while maintaining responsibility for agency-sponsored activities with CESUs. CESUs are organized around biogeographic areas. CESUs are linked together in a CESU Network.

The CESU Network has the following objectives:

- Provide resource managers with high-quality scientific research, technical assistance and education.
- Deliver research and technical assistance that is timely, relevant to resource managers and needed to develop and implement sound adaptive management approaches.
- Ensure the independence and objectivity of research.

- Create and maintain effective partnerships among the federal agencies and universities to share resources and expertise, take full advantage of university resources while benefiting faculty and students.
- Encourage professional development of federal scientists, and manage federal resources effectively.

Federal agencies participate in the CESU Network via a Memorandum of Understanding. The CESU Network is coordinated by a CESU Council that includes representatives of the federal agency partners. The CESU Council meets regularly.

8.2 CURRENT STATUS

In 1999, four CESUs were competitively established in the following biogeographic areas: Colorado Plateau, Rocky Mountains, Southern Appalachian Mountains, and North Atlantic Coast. Agencies participating in these four CESUs include the Bureau of Land Management, the National Park Service, the U.S. Bureau of Reclamation, the U.S. Forest Service, the U.S. Geological Survey, and the Department of Energy. There are 31 universities and other institutions included in these CESUs. Research, technical assistance and education projects are underway. In addition, some federal agencies have located employees at participating universities to increase collaboration.

An additional four CESUs have recently been competitively established in the following biogeographic areas: Pacific Northwest (including Southeast Alaska), Desert Southwest, Great Plains, and South Florida/Caribbean. The new CESUs will be operational in 2000. There are 38 universities and other institutions included in these four additional CESUs.

For the South Florida/Caribbean Network, the South Florida/Caribbean CESU (Host: University of Miami) will be the primary academic contact for Inventory and Monitoring needs because of the established Memorandum of Agreement and the efficiency of funding theses projects with the low overhead rate. The South Florida/Caribbean CESU's federal partners include the Bureau of Land Management, the U.S. Geological Survey, National Oceanic and Atmospheric Administration, and the National Park Service. The CESU is comprised of the following partner institutions : University of Miami (Host Institution), Barry University*, Florida A&M University*, Nova Southeastern University, University of Florida, University of North Carolina-Wilmington, University of Puerto Rico, University of the Virgin Islands*, and Audubon of Florida.

*Minority Institutions

9.0 INVENTORY SCHEDULE

TAXA	FY01	FY02	FY03	FY04
Freshwater Fish	EVER	VIIS	BICY BISC	
Marine Fish		Pilot Study @ BUIS	BISC DRTO VIIS	BISC DRTO
Herpetofauna	BICY BISC BUIS			
Mammals		BICY BISC EVER	VIIS BUIS DRTO	
Plants	BICY BISC BUIS	BICY BISC	BICY BISC	BICY BISC

10.0 INDIVIDUAL PROJECTS

10.1 PLANTS

Network Priorities

Complete surveys of the plant community are needed for Big Cypress National Preserve, Biscayne National Park, and Buck Island Reef National Monument to reach the 90% goal. The other parks in the network are at the 90% level, but would benefit from more in depth survey work. Dry Tortugas National Park needs to have vegetation mapping of the Keys in the park. Everglades National Park needs to have surveys performed in the more remote areas of the park. Additionally, Everglades National Park needs to map distribution of rare/threatened and exotic species. Buck Island Reef National Monument and Virgin Islands National Park would benefit from surveys of seagrass species coverage.

10.1.1 Fact checking NPS database.

Species lists provided to construct the NPS database were often outdated and inconsistent. As a result the NPS database has documented many plants with incorrect and inconsistent nomenclature, nativity, abundance, cultivation, false records and omissions. To create the best current database for the inventory of plants occurring within the National Parks we strongly suggest fact checking the current database. Fact checking the database is the top priority to assure that information about the species is accurate. A correct database will allow subsequent inventories to be optimally efficient.

Methods:

Fact checking the NPS database will include correcting nomenclature, nativity, abundance, false records and omissions. Person(s) charged with the task of fact checking must be experts in the flora of south Florida and the Virgin Islands. The experts must have the following qualification: expertise in the most current nomenclature, distribution, nativity, and abundance of plant specimens. When information contradicts that originally entered into the NPS database, the fact checker must give a reference to support the corrected information. After fact checking the document is completed, new data must be entered into the NPS database.

Personnel:

A fundamental knowledge of plant nomenclature and systematics is a requirement for data entry personnel. Graduate student or field tech with above qualifications would be appropriate.

Budget:

Expert in the flora of South Florida and Virgin Islands		
$1200/wk (x 2 weeks)		$2,400
Data entry personnel $500/wk (x4weeks)		$2,000
	Total	**$4,400**

10.1.2 Provide sufficient Herbarium Materials for collection of Voucher specimens.

Additional storage space and mounting supplies for voucher specimens are a priority for inventory of South Florida National Parks. Inventory of national Parks requires the collection of voucher specimens. Criteria for the collection of vouchers included: specimens not previously collected in the park, specimens not previously collected within the respective community, or specimens not collected in the park since 1965. As vouchers are collected they will be sent to the herbarium in the Everglades National Park and a herbarium accredited by a research institution. Storage of Voucher specimens within the Everglades National herbarium is limited. A holding cabinet for voucher specimens from inventory projects must be purchased. Mounting supplies for voucher specimen includes: mounting paper, labels, glue and drying facilities.

Budget:

Insect proof herbarium cabinet		$1,000
Mounting material		$3,500
	Total	**$4,500**

10.1.3.1 Achieve 90% accurate inventory of vascular plant species within the Big Cypress National Preserve by inventory of the Addition lands, brackish water, salt marsh and hammock islands (113,312 ha).

Big Cypress lacks baseline inventory data for vegetation occurring within the preserve. Less than 90% of species that are thought to occur there are documented on a species list. Vascular plants in the Addition lands and land south of Loop road have never been inventoried and are expected to contain a significant number of species currently not documented on species lists. Therefore inventory of these areas is priority to improve knowledge of species that occur within the preserve to within 90%. The Addition lands constitute 59,084 ha. Habitats that occur in the Addition lands include scrubby flatwoods, oak hammock, marl prairie, strand swamp and disturbed areas. This area is anticipated to contain species at the southern limit of their distribution. Two rare native plants are expected to be found in the Addition Lands, *Burmannia flava* (Burmannaceae), a rare subtropical species only known in the Bear Island unit of Big Cypress and *Cheiroglossa palmata* rare subtropical fern. Brackish water, salt marsh and hammock islands that lie south of Loop Road have not been inventoried.

Methods:

The most effective means to achieve the inventory goals is to conduct a general census. The best survey method to make a general inventory is a meandering census in target areas that are chosen as representatives of all habitats. The inventory crew will systematically explore common and rare habitats by foot and document the species that are discovered. These habitats will represent all habitats found within the Addition lands and lands south of Loop road. Analysis of GIS vegetation maps, aerial photographs, historic aerial photographs, soils maps, and topographic maps will determine location of key habitat and target representative areas within those habitats. This preliminary information will also be used to determine location for survey transects. The inventory group will consist of three people and the leader must be an expert in the flora of South Florida. The expert must be able to identify plants in the field and collect voucher specimens. Voucher specimens should be made for all species not previously collected in the preserve, for species not collected since 1965, or for species occurring in communities where they have not been previously collected. Each specimen should contain GPS information. Voucher specimens should be sent to Everglades National Park herbarium in addition to an accredited herbarium. Voucher specimens intended for the Everglades Nation Park should abide by the standards outlined by the Everglades Regional Collections Center (ERRC). The census should be conducted over several years. The first year's census should be conducted for ten weeks. Censuses should be conducted throughout the year, during the dry and wet seasons, to identify seasonal members of the community. Additional censuses conducted during the four years following the initial census are a priority to identify ephemeral species. The duration of each follow-up census should be eight weeks and these eight weeks should be dispersed throughout the dry and wet seasons. Helicopter and air boats will be necessary to access remote areas of the park, namely areas south of Loop road that include tree hammocks and brackish marshes.

Budget:

INITIAL INVENTORY		
Expert botanist for inventory @ $1,200/week (x10weeks)		$12,000
2 Field technical assistant @ $500/week/ person (x10 weeks)		$10,000
5 days with the helicopter transportation @ $1000/day (x5days)		$5,000
4 weeks airboat travel in the brackish water, salt marsh @ $500 (x4weeks)		$2,000
	Subtotal =	**$29,000**
FOLLOW-UP INVENTORIES (FY02-04)		
Personnel for inventory @ $1,200/ week (x8 weeks)		$9,600
5 days with helicopter transportation @ $1000/day (x5days)		$5,000
	Subtotal =	**$14,600**
Year 3		$14,600
Year 4		$14,600
	Subtotal =	**$43,800**
	Grand total =	**$72,800**

10.1.3.2 Abundance and quantification of rarity for selected endangered species.

Objective is to improve knowledge of abundance and quantify rarity of selected endangered and threatened plant species. Documenting the abundance of selected endanger species within the Addition lands and areas south of Loop road will be achieved by creating distribution maps from information collected during the initial inventory of target habitats within Big Cypress national preserve. We strongly suggest that this project is funded during the same year of the initial inventory to ensure valuable abundance data are not lost.

Target endangered species:

Burmmannia flava, Fakahatchee Bluethread
Calea carthagenensis, shrub, state endangered
Croton emos, sub-shrub, state endangered
Peperomia rotundifolia, epiphyte, state endangered
Maxillaria crassifolia, epiphytic orchid, state endangered
Calopogon multiflorus, terrestrial orchid, state endangered
Asplenium serratum, epiphytic fern, state endangered

10.1.3.3 Abundance of selected exotic species

The goal is to determine the abundance of exotic species that occur in the additional lands and areas south of Loop road. The traditional method used to determine the abundance of exotic species is aerial photography. Big Cypress conducts annual detailed systematic reconnaissance flights over the entire Preserve to map exotic species. This method is not useful when assessing the abundance of species that do not dominate the canopy, for example groundcover species are difficult to spot from airplane. Therefore the abundance of these exotics is unknown. Groundcover and sub canopy exotics pose a threat to native species by out competing them. Abundance of selected exotics occurring in the Additions lands and areas south of Loop road will be determined by creating distribution maps from information collected during the initial inventory of target habitats. We strongly suggest that this project is funded during the same year of the initial inventory to ensure valuable abundance data are not lost.

Targeted exotic species:

Imperata cylindrica, Cogan grass
Panicum repens, Torpedo grass
Hydrilla verticillata, water lettuce
Colubrina asiatica, vine, cover canopy and salt water tolerant, out competing schinus
Neyraudia reynaudiana (Poaceae), grass
Pannisetum purpureum (Poaceae), grass

Methods for 10.3.1.2 & 10.1.3.3:

Location and abundance of selected endangered and exotic species will be recorded during the initial inventory. Criteria for targeting survey areas will include analysis of habitats where selected species are likely to occur. Location of selected endangered and exotic plants within identified communities will be made with GPS. Other environmental variables including soil type, hydrology, depth of limestone, host tree (in the case of epiphytes) will also be noted. This information will be used to create a profile of the habitats where these endangered and exotic species occur. Distribution maps can be easily assembled by overlaying plant locations onto GIS layers that have already been created by the parks. Big Cypress will need an additional computer and personnel to dedicate and to the creation of distribution maps.

10.1.4.1 Achieve 90% accurate inventory of vascular plant species within Biscayne National Park by inventory of mainland and selected islands (3,683 ha)

Biscayne National Park lacks basic presence and absence inventory data for the mainland and many small islands. The total land area is approx. 3,683 hectares with half on the mainland and half on the islands. About 2,792 ha of this is mangrove. The priority areas

for inventory on Biscayne are the upland communities on the mainland and island habitats (1,214 ha), where vascular plants have never been inventoried. The main land and selected islands are expected to contain a significant number of species currently not documented on species lists. Therefore inventory of these areas is a priority to improve knowledge of species that occur within the park to within 90%. Several endangered species are thought to occur in the park, two examples are *Argythamnia blogettii* (Euphorbiaceae), an endemic herb, last collected in the 1930s, and *Nevrodium laceolatum*, an epiphitic fern, native subtropical community member, last documented 50 years ago on Elliott Key. Areas to be inventoried include Adams, Sands, Swan, Boca Chita, Soldier (disturbed), Porgy, Ragged Key number one and the mangrove islands of Reed, Rubicon, Arsenicker Keys. In addition, inventory of select habitats on Elliott Key are priorities, because only selected habitats have been previously inventoried. The target habitats for Elliott are the outlying areas including sand dunes and marshes. These areas were heavily damaged in 1992 when Hurricane Andrew hit the area with sustained winds over 140 miles per hour and gusts over 160, this area was swept clean of most vegetation. The area was surveyed shortly after the storm, however the species that were listed prior to the hurricane may never have fully recovered after the storm.

Methods:

General methods will be similar to those stated in 10.1.3.1. Inventory should be conducted in the winter. The census should be conducted over several years. The first year's census should be conducted for approximately 5 weeks and the estimated time at each location follows. Additional census over the next four years are a priority to inventory rare and ephemeral species, for example, the state endangered species of terrestrial orchid *Mesadenus polyanthus* (Orchidaceae). Limited helicopter transportation will be necessary to access remote areas of the park, namely the southwest mainland.

Park Mainland		7 days
Offshore Keys:		
Ragged Key #1 and Soldier Key		1 day
Boca Chita (13 ha) button wood, coastal prairie		1 day
Sands Key (162 ha) ½ hammock, dune area		3 days
Elliott Key (647 ha)	2 days north end of islands hammock and dunes	
	2 days for the rest of the island	4 days
Adams Key (40 ha)		1 day
Old Rhodes (259 ha)		2 days
Totten (154 ha)		2 days
Little Totten (81 ha)		2 days
Porgy key and small island associates		1 day
Mangrove islands: Reed, Rubicon and Arsenickers		2 days
	Total	**26 days**

Budget:

Initial Inventory

Botany Expert @ $1200/wk (x 5wks)		$ 6,000
Field Tech $ 500/wk (x 5wks)		$ 2,500
Helicopter transportation $600/hr (x3hrs)		$ 1,800
	Subtotal =	**$10,300**

Equipment

GPS upgrade: documenting locations of voucher specimens		$1,000
Off road cart: transportation on Elliot Key		$7,000
	Subtotal =	**$8,000**

Follow-up inventory (FY02-04)

Follow up census 1 week		
Expert @ $1200/ wk x1wk		$1,200
Field tech @ $500/ wk x1wk		$ 500
	Subtotal =	**$1,700**
Year 3		$1,700
Year 4		$1,700
	Subtotal =	**$5,100**
	Total =	**$23,400**

10.1.4.2 Abundance and quantification of rarity for selected endangered species

Objective is to improve knowledge of abundance and quantify rarity of selected endangered and threatened plant species. Documenting the abundance of selected endangered species within the park will be achieved by creating distribution maps from information collected during the initial inventory of target habitats within Biscayne National Park. We strongly suggest that this project is funded during the same year of the initial inventory to ensure valuable abundance data are not lost.

Targeted Endangered Species

Guajacum sanctum (lignum vitae) (Zygophyllaceae)
Eugenia rhombea (red stopper) (Myrtaceae)
Microgramma heterophylla (climbing vine fern) (Polypodiaceae)
Vallesia antillana (tearshrub) (Apocynaceae)
Aristolochia pentandra (marsh's dutchman's-pipe) (Aristolochiaceae)
Argusia gnaphalodes (sea lavender) (Boraginaceae)
Hippomane mancinella (manchineel) (Euphorbiaceae)

Celosia nitida (West Indian cock's comb) (Amaranthaceae)
Okenia hypogaea (beach peanut) (Nyctaginaceae)
Spiranthes polyantha (Florida Keys ladiestresses) (Orchidaceae)
Canella winterana (cinnamon bark) (Canellaceae)
Chrysophyllum oliviforme (satin leaf) (Sapotaceae)
Coccothrinax argentata (silver palm) (Arecaceae)
Crossopetalum rhacoma (maidenberry) (Celastraceae)
Jacquinia keyensis (joewood) (Theophrastaceae)
Nevrodium lanceolatum (ribbon fern) (Polypodiaceae)
Scaevola plumieri (inkberry) (Goodeniaceae)
Suriana maritima (bay cedar) (Surianaceae)
Leiphaimos parasitica (parasitic ghostplant) (Gentianaceae)

10.1.4.3 Abundance and distribution of selected exotic species

The goal is to determine the abundance of exotic species that occur in the coastal habitats of Biscayne National Park. The abundance of these exotics is unknown. Coastal exotics pose a threat to native species by out competing them. Baseline abundance data on selected exotics occurring in Biscayne National Park will be recorded using distribution maps from information collected during the initial inventory of target habitats during the vascular plant inventory.

Targeted Exotic Species

Colubrina asiatica (latherleaf) (Rhamnaceae)
Thespesia populnea (seaside mahoe) (Malvaceae)
Schinus terebinthifolius (Brazilian pepper) (Anacardiaceae)
Casuarina equisetifolia (Australian pine) (Casuarinaceae)
Scaevola sericea (beach naupaka) (Goodeniaceae)
Neyraudia reynaudiana (Burma reed) (Poaceae)

Methods for 10.1.4.2 & 10.1.4.3:

Location and abundance of selected endangered and exotic species will be recorded during the initial inventory. Criteria for targeting survey areas will include analysis of habitats where selected species are likely to occur. Location of selected endangered and exotic plants within identified communities will be made with GPS. Other environmental variables including soil type, hydrology, depth of limestone, host tree (in the case of epiphytes) will also be noted. This information will be used to create a profile of the habitats where these endangered and exotic species occur. Distribution maps can be easily assembled by overlaying plant locations onto GIS layers that have already been created by the park.

Personnel: Crew should consist of one expert botanist and two field assistants. The abundance data should be collected over 10 days. Final product will be maps for each endangered and exotic species that illustrate % cover of the habitat.

Budget:

Botanist $1200/wk (x2wks)		$2,400
Field Assistant $500/wk (x2wk)		$1,000
Field Assistant $500/wk (x2wk)		$1,000
	Total	**$4,400**

10.1.5.1 Achieve 90% accurate inventory of vascular plant species on Buck Island Reef National Monument.

Methods:

The most effective means to achieve the inventory goals is to conduct a general census. The best survey method to make a general inventory is a meandering census in target areas that are chosen as representatives of all habitats. The inventory crew will systematically explore common and rare habitats by foot and document the species that are discovered. Analysis of GIS vegetation maps, aerial photographs, historic aerial photographs, soils maps, and topographic maps will determine location of key habitat and target representative areas within those habitats. This preliminary information will also be used to determine location for survey transects. The inventory group will consist of three people and the leader must be an expert in the flora of the Virgin Islands. The expert must be able to identify plants in the field and collect voucher specimens. Voucher specimens should be made for all species not previously collected in the park, for species not collected since 1965, or for species occurring in communities where they have not been previously collected. Each specimen should contain GPS information. Voucher specimens should be sent to Virgin Islands National Park herbarium in addition to an accredited herbarium.

Budget:

Botanist $1200/wk (x2 wks)		$2,400
Field Assistant $500/wk (x2wk)		$1,000
	Total	**$3,400**

10.2 FRESHWATER FISH

Network Priorities

Big Cypress National Preserve, Biscayne National Park, and Virgin Islands National Park need complete surveys of their freshwater fish communities. Everglades National Park has documented the freshwater fish, but the species list should be verified through a review by an appropriate expert.

10.2.1 Fact checking NPS database.

Species lists provided to construct the NPS database were often outdated and inconsistent. As a result the NPS database has documented some fish with incorrect and inconsistent nomenclature, nativity, abundance, false records and omissions. To create the best current database for the inventory of fresh water fish occurring within the National Parks we strongly suggest fact checking the current database. Fact checking the database is the top priority to assure that information about the species is accurate. A correct database will allow subsequent inventories to be optimally efficient.

Methods:
Fact checking the NPS database will include correcting nomenclature, nativity, abundance, false records and omissions. Person(s) charged with the task of fact checking must be freshwater fish experts of south Florida and the Virgin Islands. The experts must have the following qualification: expertise in the most current nomenclature, distribution, nativity, and abundance of freshwater fish. When information contradicts that originally entered into the NPS database, the fact checker must give a reference to support the corrected information. After fact checking the document is completed, new data must be entered into the NPS database.

Total $1,000

10.2.2 Document fish species in the freshwater habitats of Big Cypress National Preserve and Biscayne National Park

Methods:

Sampling sites would be selected based on the grid design for Big Cypress National Preserve using the appropriate aquatic habitats as strata. In addition, canals will need to be specifically targeted for sampling, as will under-represented areas such as short-hydroperiod wetlands and at ecotones. Site selection will be non-random in Biscayne National Park as the freshwater habitats are canals and small ponds on the Keys.

Surveys would be necessary in both the wet (May to October) and the dry (November to April) seasons. Potential sampling methods would include seining, electrofishing, passive minnow-trap sampling, drift-net trapping, and possibly angling with baited hooks. Each site will be located by GPS for repeated sampling. Voucher samples of the fishes should be taken to ensure proper identification of the species. Tissue samples of a few specimens for genetics work shall be collected to establish the geographic and taxonomic affinities of the South Florida fish species. This guidance was provided by Bill Loftus, Research Ecologist from the Everglades National Park Field Station of the Florida/Caribbean Science Center, United States Geologic Survey, Biologic Resources Division (USGS BRD).

Budget: **$50,000**

10.2.3 Document fish species in the freshwater habitats of Virgin Islands National Park

Methods:

The primary task would require the Principal Investigator to work with the parks Resource Management staff to identify the various freshwater systems within the park boundaries, the seasonality of these systems, and the possibility of remnant pools and possible subterranean refuges following the wet season. Following these investigations, determination of the suite of sampling methods amenable to use in the island's habitats would be in order. Because the fish in inland waters will be subtropical peripheral-freshwater (TPF) species that spend their larval lives in saltwater, trapping the influx of post-larvae as they ascend into the streams would be particularly valuable in assessing potential recruiting species.

The study plan can not be designed without this important first hand knowledge. In any environment with seasonal water regimes, it is necessary to sample several times during a water-year to catch changes in species composition and relative abundance. In Virgin Islands National Park, inventories shall be conducted at the beginning and end of wet periods and in the dry season. A proper inventory may necessitate a second year of sampling if the initial year occurs during a drought. The annual rainfall in any year may have a direct correlation with the kinds of fish present and the degree that the community will develop.

The sampling methods would include backpack electrofishing, passive minnow-trap sampling, drift-net trapping, and possibly angling with tiny baited hooks. Depending on the number of sites sampled, each sampling period would probably take a week to accomplish. Each site will be located by GPS for repeated sampling. Voucher samples of the fishes should be taken to establish the identification of the species. Tissue samples of a few specimens for genetics work will be collected to establish the geographic and taxonomic affinities of the Virgin Islands National Park fish.

This guidance was provided by Bill Loftus, Research Ecologist from the Everglades National Park Field Station of the Florida/Caribbean Science Center, United States Geologic Survey, Biologic Resources Division (USGS BRD).

Budget: **$10,000**

10.3 MARINE FISH

Network Priorities

A list of the common and scientific names of marine fish species/families of Everglades National Park and Dry Tortugas National Parks recorded from fishery studies evaluated in this study plan can be found in Loftus 2000 and Schmidt et al. 1999, respectively. A historical compilation of the fishery studies conducted at Everglades National Park and Dry Tortugas National Park can be found in Cantillo et al. (1995) and Schmidt and Pikula (1997), respectively.

Biscayne National Park, Buck Island Reef national Monument, Dry Tortugas National Parks, and Virgin Islands National Park lack information on cryptic fish species. Visual census surveys tend to underestimate the abundance of species that are small, cryptic or wary of divers. This is especially true in highly complex habitats such as coral reefs. Destructive censuses using chemicals such as rotenone vary in effectiveness for various species , are difficult to quantify and cause considerable disturbance to the community. This makes destructive sampling non-repeatable and unsuitable for examining temporal variation by site. However destructive sampling may be the best way to estimate the abundance of small/cryptic species.

Information is deficient on species inhabiting seagrass communities in Dry Tortugas National Park and Virgin Islands National Park. In addition, more information is needed on the status and distribution of species in channels/sand bottom habitats as well as the offshore/pelagic species in Dry Tortugas National Park and Biscayne National Park.

10.3.1 Use comprehensive methods to inventory cryptic reef fish for Biscayne National Park, Buck Island Reef National Monument, Dry Tortugas National Park, and Virgin Islands National Park.

Cryptic reef fish have not been well documented in the parks. Coral reefs provide many niches where cryptic fish species live and are rarely seen. Sites should be selected based on the distribution of reefs and reef types within a park. There should be a sufficient number of reefs sampled to ensure all species will be seen. However, due to the possible destructive nature of some of this sampling, the number of reefs surveyed should be kept as small as possible.

Methods:

A three staged approach will be employed to inventory cryptic reef fish. First, species lists will be obtained and reviewed from a thorough review of the literature on destructive sampling of reefs in the Atlantic and Caribbean. This list will be compared with the data currently being collected by experts using visual census techniques. This comparison will assist in making predictions of how many new fish species will be obtained from comprehensive sampling.

Second, one of the five parks with coral reef resources will volunteer to host a pilot study to determine the most effective sampling method. Many methods can be utilized to inventory cryptic reef fish. Nighttime sampling of the reef will be employed to inventory fauna not seen during the daytime. Some species may be crepuscular in nature, so twilight censuses will be made. A comprehensive agent and/or anesthetic will be tested, such as MS222, clove oil, or rotenone to survey cryptic reef fish using a blocked grid approach on a patch reef. This will be a one-time effort to completely survey the cryptic reef fish. A review of the literature and a pilot study on comprehensive vs. visual methods will be performed in FY02 to determine the most effective way to sample cryptic species. Upon completion of the pilot study, the least invasive and destructive method will be used in order to document the occurrence of cryptic reef fish.

Budget: **$120,000**

10.3.2 Inventory fish of the seagrass communities of Dry Tortugas National Park and Virgin Islands National Park.

Methods:

The most effective method for sampling fish in the seagrass community would be to use trawls. The area to be studied is examined using Geographic Information System (GIS) data to establish seagrass strata, with complimentary data such as salinity zones, and depth contours. A roller frame trawl is used from random starting points in the appropriate strata for a predetermined length to ensure consistent area sampled. The roller frame trawl uses a weighted roller that chases the animals from the seagrass beds into the water column. The animals are collected in the net once in the water column, and then the net is emptied, and the catch is examined and identified. Sampling station number is based on the extent of the study area. Trawling sampling protocols are derived from Ault et al. (1999, North Amer. J. Fisheries Mgmt 19(3):696-712. Additional sampling gear may be used to offset sampling bias from a single sampling method.

Budget: **$50,000**

10.3.3 Inventory pelagic fish species within Biscayne National Park and Dry Tortugas National Park in the deeper channels and offshore.

Methods:

Multiple sampling gear types will have to be used to properly inventory the shallow water channels and near shore water column, during both day and night. A multi-panel gill net for the shallow water channels during day and night shall be used. Inventories conducted in deeper water may use a combination or all of the following for inventory work; night lighting, mid-water trawls, longlines, and lampera nets. Methods used for night lighting are night light for up to an hour or so, dim the lights slowly to tighten the bait fish school, set the multi-panel gill net around the school and turn the lights off. This method usually yields more baitfish then necessary, however many of the predatory species move in on

the fringes of the light. For mid-water trawls, large, 90' or longer multi-panel gill nets towed from near bottom in a diagonal fashion to the surface is one of the most productive methods. This technique requires a large vessel. The National Marine Fisheries Service (NMFS) of the National Oceanic and Atmospheric Administration (NOAA) has used this gear with success.

Surface longlines using various length leaders and hooks and live bait are effective for inventorying pelagic fish species. Lampera nets are typically used for schooling baitfish like ballyhoo but can be modified to fish the first several meters of the surface. Sampling will be conducted all four seasons and replicate the gear until the species area curves exceed the 90% goal for the species in each park.

Multi-panel gill nets and in conjunction with night lighting and small longlines are the most cost effective methods for inventory work of this type. Sampling of this type can be accomplished from one vessel approximately 30' in length in conjunction with a smaller outboard powered skiff. Even with these methods the likelihood is that with these gear types will miss some of the deep water, more cryptic species and some short term inhabitants like tuna.

This guidance was provided from the State of Florida's Senior Fisheries Biologist, Stu Kennendy, Florida Marine Research Institute, Florida Fish and Wildlife Conservatrion Commision, St. Petersburg, Florida.

Budget: **$50,000**

10.4 HERPETOFAUNA

Network Priorities

Big Cypress National Preserve, Biscayne National Park, and Virgin Islands National Park need complete surveys of their amphibians and reptiles in order to reach the 90% goal. Currently, the USGS Biological Resources Division (BRD) is performing a survey of amphibians and reptiles in Everglades National Park and Virgin Islands National Park. With additional funds the following proposal describes the work the USGS-BRD would perform at Big Cypress National Preserve and Biscayne National Park.

10.4.1 Inventory of the Amphibians and Reptiles of Big Cypress National Preserveand Biscayne National Park

Introduction

In response to concerns about the lack of basic knowledge of the amphibians and reptiles inhabiting Department of Interior (DOI) lands, inventory programs are being instituted nationwide. This document describes the goals and objectives, sampling methods,

complicating factors, and the expected outcomes of a proposed amphibian and reptile survey in Big Cypress National Preserve and Biscayne National Park. The Florida Caribbean Science Center of the U.S. Geological Survey, Biological Resources Division will perform these functions in cooperation with the Florida Cooperative Fish and Wildlife Research Unit.

Big Cypress National Preserve and adjacent Everglades National Park represent a contiguous expanse of 2.2 million acres. This landscape, unique in the United States, is a diverse array of different wetland and upland habitats. Biscayne National Park is primarily an aquatic park with a small island component. Amphibian fauna of the EVER/BICY region are comprised of 16 native species derived from the temperate zone, and two non-indigenous species from the tropics. There are 55 reptile species in the area, of which 7 are introduced. It is not known exactly which members of the south Florida herpetofauna assemblage occur in Biscayne National Park. Although some historical and current survey and inventory studies have been done in Everglades National Park (i.e. Duellman and Schwartz 1958; Meshaka et al. 2000), no formal list has ever been published on the herpetofauna of Big Cypress National Preserve. There is currently a study being funded to inventory the amphibians of Everglades National Park. The proposed project will add Biscayne National Park and Big Cypress National Preserve to complete the survey of amphibians and reptiles in the South Florida Parks.

Taxonomic Review

Amphibians

Only 16 amphibian species are known to occur in Everglades National Park (Meshaka et al. 2000). Four more species currently occur in South Florida (Duellman and Schwartz 1958; Bartlett and Bartlett 1999) and might be found in either Everglades National Park, Big Cypress National Preserve, or Biscayne National Park. Appendix 9.3.I lists all the species of amphibians known or thought to occur in EVER/BICY and BISC.

Order Caudata:

Five species of salamanders from four different families are likely to occur in Everglades National Park and Big Cypress National Preserve. None of the species are endemic to the DOI lands of South Florida, but two occur only in southern or peninsular Florida. The Everglades dwarf siren (*Pseudobranchus axanthus belli*) is restricted to the greater Everglades ecosystem. The peninsula newt (*Notopthalmus viridscens piaropicola*) is a subspecies found only in peninsular Florida. There are no introduced salamander species in the southeastern United States, and there are no threatened or endangered species of salamander in South Florida. It is unlikely that any species of salamander occurs in Biscayne National Park.

Order Anura:

On the DOI lands of South Florida there are potentially 12 species of native frogs representing four families. There are no frog species endemic to South Florida, but the Florida chorus frog (*Pseudacris nigrita verrucosa*) only occurs in peninsular Florida. The Florida cricket frog (*Acris gryllus dorsalis*) and the Florida leopard frog (*Rana sphenocephala*) both have ranges that do not extend far beyond Florida. There are potentially three introduced frog species in Everglades National Park and Big Cypress National Preserve *(Bufo marinus, Osteopilus septentrionalis,* and *Eleutherodactylus coqui*). All three of the introduced species also occur in the U.S. Virgin Islands where they are also introduced. There are no threatened or endangered frogs in South Florida.

Reptiles

At least 55 species of reptiles occur in Everglades National Park (Meshaka et al. 2000). The species list for Big Cypress National Preserve and Biscayne National Park are not complete, but it is likely that a subset of these species occur in those parks. Appendix 9.3.II lists all of the reptiles known or thought to occur in Everglades National Park, Big Cypress National Preserve, and Biscayne National Park.

Order Serpentes:

On the DOI lands of south Florida there are at least 28 species of snakes from 4 different families. Two subspecies of snakes are endemic to south Florida, the Everglades racer (*Coluber constrictor paludicola*) and the Everglades rat snake (*Elaphe obsoleta rossalleni*). Two species of snakes are introduced in the region, the Brahminy blind snake (*Ramphotyphlops braminus*) and the reticulated python (*Python molorus bivittatus*). One snake in south Florida is a federally listed threatened species, the eastern indigo snake (*Drymarchon corais couperi*).

Order Lacertilia:

There are nine species of lizards on the DOI lands of south Florida, four of which are introduced. Three of the introduced lizards are geckoes most commonly found on buildings. The other introduced species, the brown anole (*Anolis sagrei*), is nearly ubiquitous in the forested habitats of Everglades National Park and is probably common in Biscayne National Park and Big Cypress National Preserve. No threatened or endangered species of lizards are present in the area.

Order Testudines:

There are 18 species of turtles in south Florida including five species of marine turtles, and three subspecies of the brackish water diamondback terrapin (*Malaclemys terrapin spp.*). These turtles are likely to occur in the marine habitats of Everglades National Park and Biscayne National Park. There are no introduced turtles on DOI lands in south Florida, and only the five sea turtles are threatened or endangered species.

Distribution and Habitats

In the following section, the types of habitats inhabited by South Florida amphibians and reptiles are briefly discussed. A more comprehensive discussion with references to the published scientific literature is in Dodd (1997).

Aquatic Habitats:

Reptiles and amphibians are found in all aquatic wetland types. Few species are associated with the saline waters of the coast, but even there some species occasionally are found in brackish habitats. South Florida aquatic environments include man made ponds (e.g. borrow pits), wetlands in pine flatwoods, cypress domes, bayheads, wet prairies, sawgrass marshes, and mangrove forests. Much information on amphibian and reptile use of aquatic habitats is contained in state or regional literature (e.g. Bartlett and Bartlett 1999).

The salamanders *Siren*, *Pseudobranchus*, and *Amphiuma* inhabit various types of vegetated ponds and mucky swamps. Adults of *Notopthalmus* in South Florida usually remain in the aquatic adult form and terrestrial efts are rarely observed. These species all require permanent water or have adapted to dormant periods buried in mud during the dry winter months.

As with salamanders, frogs use a variety of wetlands for reproduction. Temperate frog species have tadpoles which develop within ponds, lakes, wet prairies or other lentic waters. Some frogs are very habitat specific, such as *Hyla gratiosa*, which require fishless temporary ponds for reproduction. Some species, such as *Bufo terrestris*, breed in a wide variety of wetland habitats.

Use of aquatic habitats by reptiles is also common. Many snakes use aquatic habitats and some even specialize in feeding on fish. The water snakes of the genus *Nerodia* and the eastern cottonmouth (*Agkistrodon piscivorous*) are specialists on aquatic habitats. Some lizards, especially anoles (*Anolis spp.*) are commonly found on emergent vegetation and in trees and shrubs fringing wetlands. Turtles, of course, are specially adapted to aquatic habitats. All of the south Florida species except the box turtle and gopher tortoise are aquatic and may be found in almost any body of water.

Terrestrial Habitats:

Although amphibians are usually associated with water, most species spend a substantial amount of time in terrestrial habitats. Individuals of some species often can be found at great distances from the nearest breeding ponds (Dodd 1996). Greenberg (1993) captured southern toads (*Bufo terrestris*), eastern narrow-mouthed toads (*Gastrophryne carolinensis*), and eastern spadefoot toads (*Scaphiopus holbrooki*) in Florida sand pine scrub between 5 and 6 km from the nearest known water source.

Terrestrial refugia include caves, burrows of tortoises, pocket gophers, crayfish and other invertebrates, tree roots, rock crevices, surface debris, and probably many other subterranean habitats. Treefrogs often use arboreal retreats. Selected references on the use of terrestrial habitats by amphibians that require water to breed are found in Dodd (1997).

Reptiles are common in all terrestrial and upland habitats. Almost all snake species can be encountered on land. The gopher tortoise occurs on Cape Sable and is an important species because so many other animals use the burrows it constructs. Box turtles are commonly found in the Long Pine Key and Cape Sable areas of Everglades National Park. The lizards, especially the ground skink (*Scincella lateralis*) are most often found in terrestrial habitats.

Objectives

The primary goal of this project is to inventory the amphibians and reptiles of Big Cypress National Preserve and Biscayne National Park. This will provide information on the status and distribution of the species of amphibians and reptiles on these DOI lands. Sampling at these parks will involve a multi-tiered approach. We will be collecting data for three specific models:

1. Species Richness - To use the species richness model, many plots will be used that may be visited only once during the study.

2. Proportion of area occupied - For the proportion of area occupied model, some of the plots used for species richness will be visited several times within a given season.

3. Detection Probability - On a sub sample of the plots that are visited repeatedly we will also gather data that will allow us to estimate the detection probability of some species using models like dual observer and mark and recapture.

Additional research will be conducted to develop sampling protocols and appropriate methods to collect and analyze data across the different habitats of South Florida. Ancillary biological and physical data will also be collected so that the relationship between animal detection probabilities and environmental covariates can be examined. Should emergency situations be detected, such as the presence of disease or malformations, research will assist in the determination of cause and methods of containment. Finally, information will be made available to cooperating agencies, the scientific community, and the public.

The specific goals of this project are:

1. Create a georeferenced inventory of the amphibians and reptiles of Big Cypress National Preserve and Biscayne National Park.

2. Estimate variation in species richness through time and among different sites and habitats.

3. Estimate the proportion of area occupied by each species.

4. Estimate the detection probability of a subset of the species in certain habitats.

Methods:

The amphibian inventory in this project will be accomplished using standard survey methods across the three parks. This project will be divided into two types of work, extensive surveys and intensive surveys. Extensive surveys will be designed to efficiently sample for the presence of all species of amphibians and reptiles in an area in a short time so that many areas can be sampled in each park. This will provide distribution information but will not effectively quantify the abundance of amphibian species. The intensive survey portion of this project will be designed to provide information on the proportion of area occupied by the species and the detection probability of some species at a subset of the survey locations. These sites will be sampled in a repeatable way to provide comparable data for comparison during the course of this one-year study

The reptile assemblage will be somewhat less targeted by this approach. Reptiles will be captured whenever possible and identified to species, and the date, time, and location noted. Many reptiles are extremely cryptic or crepuscular and are difficult to sample with visual methods, even at night. Some reptiles, especially snakes, are only present in low numbers, so encounter rates will be very low. This project will survey reptiles so that presence can be determined for as many species as possible. It is impossible to determine if a reptile is absent from a park if it is simply not encountered. Some species, like anoles, are common and will be sampled easily along with the amphibians. Other species will probably never be encountered (e.g. sea turtles).

We will identify major habitat types that will serve as our strata for sampling in south Florida. We will use two methods of choosing sampling points. The sites that are visited once will be chosen randomly within each stratum. Sites used for multiple visits will be selected in a stratified systematic way. These sites will be located in places that are accessible throughout the year. We are assuming that the animals within these strata are randomly distributed. Based on our knowledge of the amphibian and reptile species in south Florida, this is probably a valid assumption.

Sampling the entire assemblage of amphibians and reptiles will be accomplished using time constrained searches within a plot or transect. We will use the plot or transect to constrain the area searched as well, and this will allow us to return to the same place to do repeated sampling. The exact size of the plot/transect will have to be determined, and it will probably depend on the stratum. The number of plots or transects will be related to the amount of area that each stratum contains, but will also have to be limited by the logistics of getting to remote sites.

Additional methods will be used to capture certain groups of taxa that are difficult to sample with the time constrained search methods. Aquatic funnel traps will be used to sample aquatic salamanders. Tree frogs (2-4 spp., depending on location) will be sampled with PVC traps. Mark-recapture may also be used on animals caught in PVC traps to determine population size and capture probability.

We will be collecting data on which species of frogs we hear calling whenever or wherever we are sampling. This will provide two types of information. It will allow us to get an idea of the phenology of calling for each of the different species (some call all year, others have restricted breeding times). It will also add to our species richness-by-stratum analysis. We can use these data, along with data from time-constrained searches to estimate the total species richness for a plot or a stratum.

Table 5. Proposed number of strata, study sites, and visits.

Number of strata:	4
Number of plots per stratum:	15-30
Number of repeated visit plots per stratum:	5-10
Number of visits:	12
Total number of plots:	~80
Total number of visits:	~180

Extensive Surveys

The location of sites for extensive amphibian surveys will be chosen in a stratified random method using GIS vegetation maps. The parks will be stratified based on habitat type, and sites will be chosen randomly within habitats. Some sites will have to be excluded or sampled only during certain times of year depending on their accessibility. For instance, many freshwater marsh sites will not be accessible during low water events. Additional sites, not chosen randomly, will be added that represent unique habitats or geological features.

A total of 30 to 40 individual locations in the EVER/BICY region and 10 to 15 locations in Biscayne National Park will be visited during the course of this project. Each location will be visited for about four hours with a team of at least two people for a total of about eight person-hours per site. Each species observed would be identified to species and GPS coordinates will be recorded. This will be used to create a georeferenced inventory of amphibians and reptiles within the parks. The observers will use a variety of standard methods at each site:

- **Time–constrained searches –** This method involves actively searching for amphibians for a pre-determined amount of time. Observers should be familiar with the type of habitat and habits of the species likely to be encountered in it. This type

of search could include turning over logs and rocks, raking leaf litter, dip-netting, searching on tree trunks other appropriate methods of actively searching for amphibians.

- **Visual encounter surveys (VES) –** VES sampling is similar to time-constrained searches except the area searched is constrained rather than the time spent searching. VES will be conducted on transects and trails in sampled upland and shallow aquatic habitats. A single observer will walk the predetermined path for as long as it takes to carefully observe and record all amphibians that can be seen from the path.

- **Call counts –** Vocalizations of frogs will be used to document the presence of species during surveys. When conducting inventories using calls, it may be necessary to categorize the numbers of animals calling categorically, for example: 1 (1 calling), 2 (2-5 calling), 3 (6-10 calling), 4 (>10 calling), 5 (large chorus). This is because it is often very difficult to determine how many frogs are calling when a chorus is in progress. This method will only be effective for species during breeding seasons at breeding sites.

- **Opportunistic collecting –** During travel to and from survey locations all amphibians observed will be recorded. These records will potentially add species other than those sampled with the other methods and will help to document the distribution of the species within park boundaries.

All of these sampling techniques employ some variation of a time or area constraint approach whereby search or trap effort is quantified and results are expressed in catch per unit effort of sampling. In all cases, sampling conditions and the characteristics of the environment/habitat will be recorded. The date and time, air temperature, substrate or water temperature, relative humidity, weather conditions, and habitat type will be recorded for each survey.

Intensive Surveys

A total of three sites in Big Cypress National Preserve and one or more sites in Biscayne National Park will be set up for intensive surveys. Two or three replicate plots will be established within each monitoring site. The placement of plots, transects, and drift fences will be chosen randomly within areas subjectively chosen to be representative of certain habitats and accessible throughout the year. In Big Cypress National Preserve a site will be selected to represent short hydroperiod marsh, cypress forest (cypress domes), and upland pine forest. Location of the intensive site at Biscayne National Park will be coordinated with NPS resource managers to best represent the fauna of Elliot Key.

Each of the four intensive survey sites will be visited for one week during each season. The order each is visited within in a season will be randomized to eliminate bias. During the week a site is being monitored many of the methods described under extensive surveys will be used, as well as several trapping methods:

- **Drift fences –** Drift fences will be constructed in some habitats and funnel traps or pitfall traps will be open during the week of intensive sampling. Drift fences are expensive in terms of construction time, but provide a very standardized sample for temporal comparisons. In upland habitats that lack surface bed rock (i.e. in VINP) pitfall traps may be used to capture moving amphibians. In shallow wetland environments and in rock areas (i.e. pine rockland in Everglades National Park) funnel traps can be used to capture aquatic amphibians like *Amphiuma* and *Siren* (Fronzuto and Verrell 2000) or more terrestrial species like *Bufo*.

- **Coverboards –** Coverboards of identical size, shape, and material may be used in some habitats to attract amphibians (Smith and Petranka 2000). Coverboards will be inspected daily during the intensive sampling periods.

- **PVC pipe –** Recently PVC pipe has been described as a standard method for trapping frogs, especially tree frogs (*Hyla, Osteopilus,* etc.) (Boughton 1997). Like coverboards, frogs use the pipes as refugia and are easily observed and captured. Different sizes of pipe and different pipe positions and locations can be used to attract different frog species.

- **Permanent transects –** The VES method described above will also be used at the intensive monitoring sites. This might be on specific hiking trails or permanently established transects. VES might also be used by driving roads or airboat trails at night for specified distances. This method is easily standardized for repeatability.

No single method will be appropriate for all habitats or all times of year. Some methods might not be effective at all. The initial part of this project will involve pilot research into the effectiveness of different methods in the different habitats. The objective of the intensive sampling will be to measure the presence and abundance of amphibian species for comparisons during long-term monitoring.

Data Analysis

Estimating variation in species richness through time and among different locations is one means of tracking the status of amphibians as a group, and may be more effective than focusing on abundance measures of individual species, which have been shown in most studies to lack statistical power. We will use species richness estimates to detect differences in the amphibian assemblage among plots, habitats, and seasons.

In the past the main hindrance to making valid inferences about variation in species richness has been the inability to count all species present in an area during a survey. Weather conditions, the behavior of different species, cryptic coloration, and observer skill are just some factors affecting detection. Invariably some species will be missed, thus biasing the estimates (Boulinier et al. 1998). However, methods are now available which account for variation in detection probabilities and which estimate not only species richness, variation as well (Nichols and Conroy 1996). These methods have been extended to estimate several important vital rates in animal communities that bear on

amphibian status, e.g., rates of local species extinction, turnover, and colonization (Nichols et al. 1998a). They have been used to test hypotheses concerning factors affecting temporal (Boulinier et al. 1998) and spatial variation (Nichols et al. 1998b.) in species richness as well. This approach can also be extended to estimate the proportion of habitat occupied by species (J.D. Nichols pers. comm.)

Estimation of species richness is only one analytical tool to assess amphibian status. Therefore, populations of specific target species will be more intensively studied at index sites. Based on the results of initial inventories we will identify species for further study and determine the best available field protocols for sampling those species, such as mark-recapture techniques. Changes in abundance over time and across habitat types will be examined for the target species.

Interagency Cooperation

This project will only be successful if the NPS staff at these parks provide assistance. Transportation to the islands of Biscayne National Park will be critical for survey work there. The majority of the land in that park is Elliot Key, an island roughly nine miles from the mainland. In this case park transportation will be requested. Big Cypress National Preserve is in a relatively remote location with few nearby accommodations. Temporary housing and volunteer help would greatly expedite field work at that park. Swamp buggies may be required to reach certain remote areas, especially when water levels are too low to make airboats a viable alternative. Transportation assistance from Big Cypress National Preserve would make this project better and more efficient. Both parks have agreed to assist in this manner.

Budget:

	FUNDING SOURCE	
	NPS I&M Funds	Contributed by BRD
PERSONNEL:		
BRD Co-PI Rice (1 mo.)		$6,000
Coordinator Waddle (6 mo.)	$20,000	
Technician (12 mo.)	$25,000	
Total Personnel	**$45,000**	**$6,000**
SUPPLIES AND EQUIPMENT:		
BRD - Rice	$8,000	$1,000
Total Supplies and Equipment	**$8,000**	**$1,000**
TRAVEL:		
BRD - Rice	$12,000	$5,000
Total Travel	**$12,000**	**$5,000**
PROJECT TOTAL DIRECT COSTS:	**$65,000**	**$13,000**
TOTAL PROJECT COST	**$78,000**	

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Appendix 9.3.I

List of amphibians known or thought to occur in the DOI lands of South Florida.

Order Caudata – Salamanders		EVER/BICY	BISC
Sirenidae	*Pseudobranchus axanthus belli*	X	
	Siren lacertina	X	
Amphiumidae	*Amphiuma means*	X	
Salamandridae	*Notopthalmus viridescens priapocola*	X	
Plethodontidae	*Eurycea quadridigitata*	?	

Order Anura – Frogs		EVER/BICY	BISC
Microhylidae	*Gastrophryne carolinensis*	X	?
Ranidae	*Rana grylio*	X	?
	Rana sphenocephala	X	?
Bufonidae	*Bufo marinus*	Introduced	Introduced
	Bufo quercicus	X	?
	Bufo terrestris	X	Mainland
Hylidae	*Acris gryllus dorsalis*	X	?
	Hyla cinerea	X	X
	Hyla femoralis	?	
	Hyla gratiosa	?	
	Hyla squirella	X	?
	Osteopilus septentrioinalis	Introduced	Introduced
	Pseudacris nigrita verrucosa	X	
	Pseudacris occularis	X	
Leptodactylidae	*Eleutherodactylus planirostris planirostris*	Introduced	Introduced

Appendix 9.3.II

List of reptiles known or thought to occur in the DOI lands of South Florida.

Order Serpentes – Snakes		EVER/BICY	BISC
Colubridae	*Cemophora coccinea coccinea*	X	
	Coluber constrictor paludicola	X	X
	Diadophis punctatus punctatus	X	X (Mainland)
	Drymarchon corais couperi	X	X
	Elaphe guttata guttata	X	?
	Elaphe obsoleta quadrivittata	X	X
	Elaphe obsoleta rossalleni	X	?
	Farancia abacura abacura	X	
	Lampropeltus getula floridana	X	
	Lampropeltus triangulum elapsoides	X	
	Nerodia clarkii compressicauda	X	?
	Nerodia fasciata pictiventris	X	?
	Nerodia floridana	X	?
	Nerodia taxispilota	X	
	Opheodrys aestivus	X	
	Regina alleni	X	
	Seminatrix pygea cyclas	X	
	Storeria dekayi victa	X	
	Thamnophis sauritus nitae	X	
	Thamnophis sauritus sackenii	X	
	Thamnophis sirtalis similis	X	?
	Thamnophis sirtalis sirtalis	X	?
	Ramphotyphlops braminus	Introduced	?
Elapidae	*Micrurus fulvius fulvius*	X	?
Viperidae	*Agkistrodon piscivorus conanti*	X	X (Mainland)
	Crotalus adamanteus	X	X
	Sistrurus miliaris barbouri	X	?
Boidae	*Python molorus bivittatus*	Introduced	

Order Lacertilia – Lizards		EVER/BICY	BISC
Iguanidae	*Anolis carolinensis*	X	X
	Anolis sagrei	Introduced	Introduced
			Introduced (Mainland)
Scincidae	*Scincela lateralis*	X	?
	Eumeces inexpectatus	X	X
Anguidae	*Ophiosaurus compressus*	X	?
Gekkonidae	*Sphaerodactylus notatus notatus*	X	X
	Gekko gecko	Introduced	?
	Hemidactylus garnotii	Introduced	Introduced
	Hemidactylus mabouia	Introduced	Introduced
	Hemidactylus turcicus turcicus		Introduced

Order Testudines - Turtles		EVER/BICY	BISC
Chelydridae	*Chelydra serpentina osceola*	X	
Emydidae	*Deirochelys reticularia chrysea*	X	
	Malaclemys terrapin macrospilota	X	
	Malaclemys terrapin rhizophorarum	X	?
	Malaclemys terrapin tequesta	X	?
	Pseudemys floridana peninsularis	X	
	Pseudemys nelsoni	X	
	Terrapene carolina bauri	X	?
Testudinidae	*Gopherus polyphemus*	X	? (Mainland)
Kinosternidae	*Kinosternon baurii*	X	?
	Kinosternon subrubrum steindachneri	X	?
	Sternotherus odoratus	X	?
Trionychidae	*Apolone ferox*	X	
Chelonidae	*Caretta caretta*	X	X
	Chelonia mydas	X	X
	Eretmochelys imbricata imbricata	X	X
	Lepidochelys kempii	X	?
Dermochelyidae	*Dermochleys coriacea*	X	?

10.5 MAMMALS

Network Priorities

Big Cypress National Preserve, Biscayne National Park, and Everglades National Park need a complete mammalian survey to achieve the 90% goal. Virgin Islands National Park needs a survey of the bat community to confirm the species list.

10.5.1 Complete survey of mammals in Big Cypress National Preserve, Biscayne National Park, and Everglades National Park to document occurrence and distribution of species.

Inventory sampling sites will be selected using the methods described in Section 5.0. Marine habitats will not be a primary strata for sampling. No single capture method will be used due to the variability in size and mobility of mammals. Each sampling site will be surveyed twice, once in the dry season and once in the wet season.

Vouchers will only be collected for small and some medium mammals for which none exists in a park. Collection of specimens is necessary for species that are difficult to identify in the field (i.e. shrews and bats) or species about which little is known (i.e. Everglades mink). Specimens should be labeled with the following: 1) a unique ID number, 2) date and time, 3) name of collector, 4) taxonomic identification, and 5) Standard measurements. Vouchers will be placed in the collection of an appropriate museum by the principal investigators.

Methods:

Small Mammals

The best way to inventory small mammals is through the use of transects (Jones et al. 1996). Transects have equally spaced traps along a line. At each sampling site, four transects, will be run. Each transect will have 10 trap stations, spaced 15 meters apart. Traps should be placed at habitat features, such as logs or burrows, as long as it is within 2 m of the station point. Every station should have two live-traps (Sherman traps) for capturing small mammals.

In addition to Sherman traps, one pitfall trap should be placed at each trapping station. Pitfall traps are the most effective way to capture shrews (Kalko and Handley 1992). Pitfall traps will be more effective if used in conjunction with a drift fence, and should be at least 40 cm deep for live captures. Pitfall traps can be made from PVC pipe or buckets.

Live traps will be baited with crimped oats and run four nights at each location. Live and pitfall traps should be set in the afternoon and checked in the morning.

Medium Mammals

Box traps can be used to capture both medium sized carnivores and herbivores (Jones et al. 1996). Traps for carnivores need to be baited with meat and scents (fish oil) should be used as an attractant. Traps for herbivores will be baited with a mash made from Purina Rabbit Chow and water.

At each sampling site, two carnivore and two herbivore transects will be used. Each transect will be composed of ten traps spaced 100 m apart. Transects should be checked twice a day and operated for seven days.

Large Mammals

Generally, large mammals are well documented in the parks. Large mammals can be difficult to capture and handle. An alternative to capture is the use of photography to document species. Photographs have been found to be a useful method for inventorying large species living in an area (Seydack 1984).

To document species through photographs, each sampling point will have five stations with infrared-triggered cameras, such as the Trailmaster. Stations should be located on trails or at water sources to increase likelihood of encountering animals (Wemmer et al. 1996). The use of attractants, such as scent or bait, may be useful to lure targeted animals to the stations. Some experimentation will be necessary to perfect the use of cameras to document species. Each camera should remain in place for seven days.

10.5.2 Survey of bats in Big Cypress National Preserve, Biscayne National Park, Buck Island Reef National Monument, Everglades National Park, and Virgin Islands National Park.

Methods:
The most effective way to sample bats is to mist net at roosting sites as bats emerge or return. Kunz, Tidemann, and Richards (1996) discuss a variety of mist netting arrays. Bats will be in better physiological condition in they are captured after they have returned from feeding (Kunz, Tidemann, and Richards 1996). When sampling at roost sites, attention needs to be paid to the nature of the roost (e.g. maternity, transient) and the sensitivity to disturbance. Some experimentation will be needed to determine the most appropriate method for mist netting bats at roosting sites.

In addition to roost sites, sampling should be directed toward expected or potential foraging and drinking sites. Increased likelihood of capture at potential sites may be achieved through the use of acoustic surveys of habitat. Once bats have been acoustically detected in an area, mist nets can be set in place following the protocol of Kunz, Tidemann, and Richards (1996). Some species can even be identified through ultrasonic recordings due to their unique echolocation calls (Kunz et al. 1996). Bats will be recorded as captured in a park if they are detected ultrasonically but not captured.

Sampling should occur in the wet and dry seasons to ensure a complete inventory. Some species may not be year-round residents in parks and would be missed if each park were only sampled once.

The same team performing the other mammal inventory could perform the bat work as well. At least one member of the team must have experience with trapping bats. No additional budget would be necessary if one team performed all mammal surveys.

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Budget:

Principal investigator (1 year)		$46,000
Field Assistants (1 year)	$24,000 x 4 =	$96,000
Equipment and Transportation		$58,000
	Total	**$200,000**

APPENDIX A. LITERATURE CITED

The South Florida/Caribbean Network literature sources used to evaluate the accuracy of the NPSpecies database are listed below by park:

Big Cypress National Preserve

Amphibian Species List for Big Cypress National Preserve.

Bird Species List for Big Cypress National Preserve.

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Reptile Species List for Big Cypress National Preserve.

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Biscayne National Park

Amphibian Species List for Biscayne National Park, from 1983 GMP, Final EIS.

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APPENDIX B. BUDGET FOR THE SOUTH FLORIDA/CARIBBEAN NETWORK

Taxa/Position	Project	FY01	FY02	FY03	FY04	TOTAL
Fish (Freshwater)	VIIS		$10,000			$10,000
	Fact Check EVER NPSpecies	$1,000				$1,000
	BICY, BISC			$50,000		$50,000
Fish (Marine)	Cryptics			$20,000	$100,000	$120,000
	Seagrass				$50,000	$50,000
	Pelagics and Channels				$50,000	$50,000
Herpetofauna		$65,000				$65,000
Mammals			$100,000	$100,000		$200,000
Plants	Fact Check NPSpecies	$4,400				$4,400
	Herbarium Specimens	$4,500				$4,500
	BICY	$29,000	$14,600	$14,600	$14,600	$72,800
	BISC	$22,700	$1,700	$1,700	$1,700	$27,800
	BUIS	$3,400				$3,400
Staffing	Coordinator	$58,317	$60,067	$61,869	$63,725	$243,978
	travel	$8,000	$8,000	$8,000	$8,000	$32,000
	Museum Specialist	$40,000	$41,200	$42,236		$123,436
	travel	$5,000	$5,000			$10,000
	GIS	$42,000	$43,260	$44,558	$45,895	$175,713
	equipment	$15,000				$15,000
Travel for VIIS and BUIS		$7,100	$7,100	$7,100	$7,100	$28,400
Total		**$305,417**	**$390,927**	**$250,063**	**$341,020**	**$1,287,427**

The initial budget for the South Florida/Caribbean Network was $1,398,877. This study plan budget is based on that figure minus $111,450 spent during FY00 for the initial literature search, scoping meetings and draft study plan contract. This results in a budget for four years of $1,287,427.

APPENDIX C UNFUNDED INVENTORIES

Birds

Data on relative abundance is absent for the majority of species in all parks. All parks need information on abundance of species within each park. Big Cypress National Preserve would benefit from more thorough surveys of birds. Biscayne National Park and Everglades National Park have little information on breeding birds in the park. Virgin Islands National Park has little data, other then a species list, on wintering birds. The methods below were proposed by the Heartland network and would be useful here as well to address the above questions.

Methods

General Bird Survey Information

No single sampling method adequately samples all groups of bird species due to differences in habitat use and life histories. Therefore, a combination of two sampling methodologies will be used to obtain a complete picture of the avian fauna inhabiting each park. Given the fact that no voucher specimens will be collected for birds, it is critical that investigators be knowledgeable of all bird species they are likely to encounter on a survey. Since density estimations depend on the quality of distance estimates recorded in the field, it is also imperative that each investigator posses the skills to estimate distances to birds accurately. Distance estimation with a range-finding instrument is the preferable; however, logistic constraints will frequently require visual estimation. Both visual and audio identification of birds as well as distance estimating must be practiced and tested prior to field surveys, regardless of the skill level of the investigator.

To ensure that all habitats within parks are sampled adequately, the overall grid-based study design will be employed for bird inventories. Sampling efforts in each stratum should reflect its frequency within a park. For statistical purposes a minimum of 32 points will be sampled in each habitat type. Areas with species of special interest or areas of concentrated bird usage, such as water impoundments, will receive additional sampling effort. Nocturnal species and other birds not easily detected by the standard sampling methods may also require additional sampling effort.

UTM coordinates and standard habitat attributes will be described for all survey points. While the funded inventories are primarily breeding season surveys, some parks may be able to augment the survey data by visiting a subset of the inventory points during other seasons.

Weather conditions may prohibit bird surveys from being conducted if there is fog, steady drizzle, prolonged rain, and/or wind speeds exceeding 13-19 km/h (8-12 m/h) or number 3 on the Beaufort Scale. However, occasional light drizzle or brief rain showers will not disrupt a survey enough that it should be discontinued or cancelled. If local

weather is such that winds in excess of 13-19 km/h (8-12 m/h) or number 3 on the Beaufort Scale are the norm, then surveys should be conducted when other weather parameters permit and wind speeds are at a minimum.

General Bird Surveys

General bird surveys will be conducted using variable circular plot (VCP) sampling following the recommendations of Steve Fancy. This method permits estimation of detectability in addition to collecting data on the traditional population parameters. Bird surveys should coincide with the peak breeding activity of most bird species or mid-winter, depending on the question. However, if migrants are still present during the start of a survey period, and if the presence of migrants poses a problem to correct species identification of residents, this should be documented and the survey suspended until all migrants have moved on.

All surveys will be conducted within 4 hours of official sunrise, weather permitting. Birds seen or heard at each plot will be recorded during a 5-min sampling period. Data recorded during the first three minutes will be recorded separately from that recorded during the last two minutes to facilitate comparisons with both the 3-min Breeding Bird Surveys and traditional 5-min. bird surveys. Sex (male, female, undetermined), age (adult, juvenile), and distance from plot center will be recorded for each bird seen or heard at a plot. Fledging young will be recorded as juveniles when observed.

Generally, plots will be no closer than 250 m apart in a particular habitat type. However, should the scarcity of a habitat type dictate placing plots closer than 250 m, plots will be located no closer than 200 m. In either case, individuals should be recorded from only one plot. Also, plots will be located no closer than 125-m from a habitat edge, road, or building. If an observer is uncertain as to whether or not the same individual is being heard from two different plots then the individual will be recorded only from the first plot in which it was heard. Observers will record unique species of birds in the note section of a data sheet as they travel from one plot to another if the species is not routinely recorded during the surveys. However, excessive time should not be spent trying to locate and identify unique species at the expense of completing a survey route.

Additional data collected at each sampling point will minimally include: observer name, date, plot number, plot location (habitat type), habitat type for each individual, cloud cover, wind speed (Beaufort Scale), precipitation, and status of vegetation as wet or dry. Only one qualified investigator will identify birds and record their locations at a given sample point; however, qualified investigators may conduct surveys at alternating points. The observer conducting the survey at a specific point must record their name as the observer for that point.

Plants

Everglades National Park - 90% inventory achieved

A. Presence/absence inventory by habitat of North Shore of Florida Bay, shores of the coastal lakes, Shores of Florida Bay

Approximate size: 1,000+ acres

Habitat: tropical hardwood hammocks, coastal prairie, buttonwood forest, mangrove forests
Two seasons (wet and dry) over two years

Budget:
Initial inventory

1expert Botanist @ $2,400/wk (x4 wks)		$ 9,600
Field assistant @ $800/wk (x4 wks)		$ 2,400
Field assistant @ $800/wk (x4 wks)		$ 2,400
Boat costs @ $75/day (x15)		$ 1,125
	Subtotal =	$15,525
Follow-up inventory		
Follow up census 1 week		
Expert @ $2400/ wk x1wk		$2,400
Field assistant @ $800/ wk x1wk		$ 800
Field assistant @ $800/ wk x1wk		$ 800
	Subtotal follow-up 1st yr =	$4,000
	2nd year	$ 4,000
	3rd year	$ 4,000
	4th year	$ 4,000
	Subtotal follow-up yrs 2-4 =	$12,000
	Grand total =	$31,525

B. Presence/absence inventory by habitat of East Everglades

Approximate Size: 107,000 acres

Habitat: Tree islands, rocky glades, marl prairie, many disturbed areas, freshwater marsh, sawgrass marsh. This area is poorly explored because of its remote location, which is accessible only by helicopter. Native and endemic species have been reported, however these reports are vague and need to be validated. Two inventory priorities of the East Everglades are: 1) General census of target habitats and 2)Determine presence or absence of native and endemic species within the target areas.

Target areas will be chosen to represent a sample of habitats that occur in the East Everglades that have been poorly explored and/or areas that reports have suggested contain native or endemic species. Tom Armentano and Dave Jones will be responsible for identifying approximately ten target areas.

Methods: The most effective means to achieve the inventory goals is to conduct a general census, while simultaneously searching for endemic species. The best survey method to make a general inventory and search for endemic species is a meandering census. The person(s) charged with this task will explore various habitats by foot and document the species that are discovered. The inventory must be conducted by an expert in the flora of South Florida, and the expert must be able to identify plants in the field. The inventory specialist will be taken by helicopter to remote target areas within the East Everglades. The census should be conducted for two-three weeks. Follow-up censuses in subsequent years is not a priority

Budget:

Botany Expert $2,400/wk (x3wks)	$7,200
Field assistant $800/wk (x3 wks)	$2,400
Field assistant $800/wk (x3 wks)	$2,400
Helicopter transportation to tree islands @ $825/day (x5days)	$4,200
Subtotal =	$16,200

C. The Stairsteps to Mahogoney hammock (including lost man's pines, Big Cypress National Preserve)

Approximate Size: 39,900 acres

Habitat: tropical hardwood hammocks, button –mixed hardwood forests, graminoid marshes, red mangroves. These are remote areas with limited exploration. Namely tree islands.

Budget:

3 weeks initial census 1st year

Botany Expert $2,400/wk (x3wks)	$ 7,200
Field assistant $800/wk (x3 wks)	$ 2,400
Field assistant $800/wk (x3 wks)	$ 2,400
Helicopter transportation @ $825/day (x15days)	$12,375
Subtotal =	$24,375

Follow-up inventory (1wk)

Expert @ $2400/ wk x1wk	$2,400
Field assistant @ $800/ wk x1wk	$ 800
Field assistant @ $800/ wk x1wk	$ 800
Helicopter transportation @ $825/day (x5days)	$ 4,125
Subtotal follow-up 1st yr =	$ 8,125
2nd year	$ 8,125
3rd year	$ 8,125
4th year	$ 8,125
Subtotal follow-up years 2-4 =	$24,375

D. Shell mound islands within 10,000 islands census = $2200

Approximate Size: 1,000 acres

Habitat: artificial uplands, tropical hardwood hammock

Possibility for locating rare plants: *Celtis iguanaea, Celtis pallida, cheilanthes microphylla, acacia tortuosa* (thought to be extinct, but may be present), *Cyperus floridanus*. 1 time census

1-2 large shell mounds in Everglades National Park, one week meandering census($1,500), boat time= $75/day ($450)

Budget:

Botany Expert $2,400/wk (x3wks)	$ 7,200
Field assistant $800/wk (x3 wks)	$ 2,400
Field assistant $800/wk (x3 wks)	$ 2,400
Boat transportation $75/day (x6days)	$ 450
Subtotal	$12,450

E. Long pine key (4weeks)

Habitat: High density vegetation, Tropical hardwood hammocks, pine rockland, marl prairie

Budget:

Botany Expert $2,400/wk (x4wks)	$ 9,600
Field assistant $800/wk (x4 wks)	$ 3,200
Field assistant $800/wk (x4 wks)	$ 3,200
Subtotal	$16,000

F. Cape Sable (2 weeks)

Habitat: Dunes, freshwater swale, Tropical hardwood hammocks, Buttonwood forest, mangroves and graminoid prairie.

Budget:

Botany Expert $2,400/wk (x2wks)		$ 4,800
Field assistant $800/wk (x2 wks)		$ 1,600
Field assistant $800/wk (x2 wks)		$ 1,600
	Subtotal	$8,000

G. Abundance and quantification of rarity for selected endangered species.

Objective is to improve knowledge of abundance and quantify rarity of selected endangered and threatened plant species. The abundance of these species are rare, however the extent of their rarity is unknown. Documenting the abundance of selected endanger species within the target habitats selected by Everglades National Park will be achieved by creating distribution maps from information collected during the initial inventory of target habitats within Biscayne National Park. We strongly suggest that this project is funded during the same year of the initial inventory to ensure valuable abundance data are not lost.

Selected endangered species

Kosteletzkya depressa (Malvaceae), shrub, berm hammocks, buttwood hammock
Ponthieva brittoniae (Orchidaceae), herb, pine rockland
Aeschynomene pratensis (Fabaceae), herb, marl prairie
Digitaria pavciflora (Poaceae), herb, marl prairie, pine rocklands
Argthamnia blodgettii (Euphorbiaceae), herb, pine rocklands
Dalea carthagenensis var. *floridana* (Fabaceae), shrub, marl prairie
Chamaesyce garberi (Euphorbiaceae), herb, sand dunes
Rhipsalis baccifera (Cactaceae), epiphytic herb, button wood hammock
Oncidium luridum (Orchidaceae), epiphytic herb, buttonwood forest, berm hammock
Cheiroglossa palmata (Ophioglossaceae), epiphytic fern, tree island
Chromolaena frustrata (Asteraceae), herb, buttonwood forest, berm hammock
Lomariopsis kunziana (Lomariopsidaceae), fern, rockland hammock
Adiantum melanoleucum (Adiantaceae), fern, rockland hammock
Pavonia paludicola (Malvaceae), shrub, stream banks, near coast, mangrove forest
Prescottia oligantha (Orchidaceae), herb, rockland hammock

H. Abundance and distribution of selected exotic species.

The goal is to determine the abundance of exotic species that occur in the selected habitats of Everglades national Park. Baseline abundance data on selected exotics occurring in Everglades determined by creating distribution maps from information collected during the initial inventory of target habitats. We strongly suggest that this project is funded during the same year of the initial inventory to ensure valuable abundance data are not lost.

Selected exotics species

Agave sisalana, Sansevieria hyancinthoides (Agavaceae) succulent
Dioscorea bulbifera (Dioscoreaceae), vine, hardwood hammocks and pine rocklands
Panicum maximum (Poaceae),grass, coastal prairie and pine rockland,
Neyraudia reynaudiana (Poaceae),grass, Pine rocklands,
Pennisetum purpureum (Poaceae),grass, pine rockland,
Terminalia catappa (Combretaceae),tree, North Florida Bay
Albizia lebbeck (Fabaceae), tree, pine rockland
Leucaena leucocephala (Fabaceae), tree, pine rockland
Scaevola taccada var. *sericea* (Goodinaceae), shrub, coastal habitats
Thespesia populnea (Malvaceae), tree, Florida Bay and Cape Sable
Lantana camara (Verbenaceae) woody herb, mainly upland habitats

Dry Tortugas National Park

Mapping vegetation communities, specifically mapping plant species associations ex. Sea oat (uniola panicum), Sea side spurge (Chamasyce mesembryanthemifolia), Painted leaf (Poinsettia cyathaphora)

Budget:
Aerial photography, Low altitude area photographes= 12,000
Precision mapping, contract Precision Mapping = $15,000

Inventory/Abundance and distribution for selected potential marine fish species of special concern in DRTO.

In the Dry Tortugas there are a variety of marine fish species that are of potential concern. Reasons for this concern are due to: (1) lack of information about the population status of these species, (2) perceptions that these populations are declining in size (Schmidt et al. 1999), (3) historical surveys (60-100 years old) (Longley and Hildebrandt 1941) have indicated their occurrence in Park waters, and (4) recent global/national initiatives to categorize risks of extinction for marine fish stocks (Musick et al. 2000). It is recognized that some of these species have been included in recent/ongoing visual fish census surveys (Ault et al. 1999, Bohensack et al. 1999, and

summarized in Schmidt et al. 1999), and in proposals included here for individual projects , however much of the work included in this statement will require additional funding. These species apparently represent a large proportion of the endemic biological diversity of the Tortugas Region, one of the World's most ecologically diverse areas and home to over 60 marine fish species that are currently protected by federal/state regulations as well as those species that are under evaluation for protection. Species included are 10 seabasses of the genus *Epinephelus, Mycteroperca,* and *Serranus* ; 9 clinids of the family Clinidae, and 8 gobies of the family Gobiidae. Of the 62 species (summarized in Table 9, Schmidt et al. 1999) 47 show critically small population sizes associated with life history/habitat limitations while 15 have undergone overexploitation.

Objectives of this project include acquiring all available historical information on the status and occurrence of these species, obtain voucher specimens, conduct field studies in those areas where the species are likely to occur, create distribution maps, evaluate for long-term monitoring, and produce a final report. It is suggested that this project is funded (to be determined) during the same year(s) of the other marine fish projects listed for DRTO in section 10.3

Submitted by T. W. Schmidt, Marine Biologist, Everglades/Dry Tortugas National Parks, Homestead, FL

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Appendix D. I & M Inventory Impact Checklist

I & M Inventory Impact Checklist

DATE:			
CLEARANCE CHECKLIST: (Answer all questions.) Does the project . . .	**YES**	**NO**	**UNKNOWN**
Disturb the natural environment/scenic views?			
Disturb cultural resources?			
Require soil disturbance?			
Require certification (pesticides, explosives, etc.)?			
Affect any endangered/rare species?			
Does study use untested methods?			
Involve concession operations or park neighbors?			
Require permits from or affect other agencies?			
Comply with air/water/handicap laws/regulations?			
Comply with NPS policies (wilderness, IPM, etc.)?			
Present any safety concerns?			
Appear in approved plans (GMP, RMP, IP, etc.)? Specify:			
Adequately identify the area(s) of impact?			
Include anything that will create controversy?			
Use the minimum tool necessary?			

OUTLINE OF PLANNING REQUIREMENTS AND/OR REVISIONS (Use attached sheet if necessary and check box☐)			

COMMITTEE RECOMMENDATION:	SIGNATURE			DATE
NETWORK I&M COORDINATOR:				
CULTURAL RESOURCE SPECIALIST:				
RESOURCE MANAGEMENT CHIEF:				
PROJECT PRINCIPAL INVESTIGATOR:				
AD HOC MEMBER:				
AD HOC MEMBER:				

Appendix E. Geographic Information Systems (GIS) data by park.

GIS coverages for Buck Island Reef National Monument

1999 aerial photography by NOAA/NOS as part of the coral reef mapping initative.
The island is geo referenced within this layer as well.
T & E as well as native plants of special concern (lignum vitae in particular) is being developed. Bathymetry - almost complete; NOS would like better resolution but it will serve.
Topographic /elevation coverage in process from the coordinates taken during the rat eradication program.
Vegetative cover info was collected at over 420 bait station locations covering the entire island.

GIS Coverages for Big Cypress National Preserve

The listed species/GIS coverages in the Big Cypress are:
Bald Eagle - some (probably conclusive)
The endangered species/coverages are:
Cape Sable seaside sparrow - many point coverages, comprehensive
Florida panther - many, point, polygon, comprehensive, since 1989
Wood stork - some point coverages, recent
Red cockaded woodpecker - many point coverages, a few years of data
Snail kite - no data, but UofF has substantial data
West Indian manatee - - no data, but FWS has substantial data
A state species of critical concern:
Liguus snails, point coverages by species and genus, comprehensive
The biologists have sparse black bear, bittern, and white-tailed deer population data in GIS formats.
Management area unit boundaries, South Florida
One-foot DEM, compiled from various sources
1989 vegetation interpretation, Denver Service Center, 30 meter (about 28 classes)
1995 vegetation interpretation, University of Georgia, 10 meter (about 78 classes)
Reclassification of the above vegetation mapping (7 classes)
Two different backcountry trails interpretations, line data
1 sheet of about 5, which have BICY coverage, of soils mapping in the GIS
(Getting the remainder digitized is a current project, combined with a future soils survey.)
All historical prescribed fire and wildfire burn boundaries since 1987
A merged SPOT image, 10 meter panchromatic
A merged DOQ, 5 meter natural color, with about 85% coverage of the Preserveas image
burn data on the Raccoon Point USGS Research Project

GIS Coverages for Biscayne National Park

(ADID) - ADvanced IDentification of Wetlands
Annotation – Place names, Water body names, reef names, etc.
Base Covers – Land and water, shorelines, park boundaries, other legal boundaries, etc.
Bathymetry
Birds – Eagle nests, stork sites, osprey nests
Bottom Communities – Benthic habitats, coral reefs 1983, 1993, NOAA, University of Miami
Buffer Zone – Salt intrusion, vegetation
Butterfly zones
Buoys – Aids to Navigation, Slow speed, Swim area, mooring buoys
Cultural Resources – Tequesta Indian sites, Offshore Reef Archeological District
Exotic Plants
Fishing Area grid
Five acre grid
Landsat TM Images
Landuse 1988, 1994
Noise Monitoring
Regatta area
Sea Turtle Monitoring Beaches
Submerged Cultural Resources (Sensitive)
USGS 1:24,000 Quads
Vessel Groundings
Water Quality Stations

GIS Coverages for Dry Tortugas National Park

Benthic Habitats
Shoreline
Submerged Cultural Sites

GIS Coverages for Everglades National Park
None Available

GIS Coverages for Virgin Islands National Park
None Available

Appendix F. South Florida / Caribbean Network Steering Committee

BIG CYPRESS NATIONAL PRESERVE (BICY)

Ron Clark	Chief Resource Management Specialist

BISCAYNE NATIONAL PARK (BISC)

Matt Patterson	Ecologist and Park I&M Coordinator
Brian Lockwood	Biological Science Technician

BUCK ISLAND REEF NATIONAL MONUMENT (BUIS)

Zandy Hillis-Starr	Chief Resource Management Specialist

EVERGLADES/DRY TORTUGAS NATIONAL PARKS (EVER/DRTO)

Sonny Bass	Supervisory Wildlife Biologist
Robert Brock	Supervisory Marine Biologist
David Jones	Supervisory Botanist

VIRGIN ISLANDS NATIONAL PARK (VIIS)

Don Cantanzaro	Prototype I & M Coordinator & Network Chair
Rafe Boulon	Chief Resource Management Specialist

UNIVERSITY OF MIAMI (NETWORK COOPERATOR)

Chris Sasso	Network Program Coordinator
Kirsten Nicholson	Database Manager for Vertebrates
Tara Greaver	Database Manager for Vascular Plants
Mike Robinson	Database Manager for Fish

REGIONAL OFFICE (SERO - ATLANTA)

Larry West	Regional I&M Program Manager