

Study Plan for Conducting Biological Inventories FY 2001-2004

Great Lakes Network

**US Department of Interior
National Park Service**

**Prepared by:
Bill Route
National Park Service
Great Lakes Network
Ashland, WI**

Draft submitted September 2000
Finalized December 2000

Credits:

Project coordinator, managing editor: Bill Route

Technical editor: Suzanne Gucciardo

Executive Committee: Roger Andrascik, Steve Cinnamon, Jack Oelfke, Bill Route, Julie Van Stappen

Steering Committee: Phyllis Adams, Roger Andrascik, Jerry Belant, Peter Budde, Steve Cinnamon, Dave Cooper, Nancy Duncan, Dale Engquist, Steve Fancy, Randy Knutson, Robin Maercklein, Jack Oelfke, Bill Route, Julie Van Stappen, Steve Yancho

Inventory & Monitoring Advisory Group: Phyllis Adams, Ralph Grundel, Suzanne Gucciardo, Mike Hoff, Larry Kallemeyn, Bruce Leutscher, Walter Loope, Robin Maercklein, Noel Pavlovic, Bill Richardson, Bill Route, Jim Schaberl

GIS/Data Management Team: Phyllis Adams, Lou Brennan, Mike Broschart, Peter Budde, Dan Ehrke, Suzanne Gucciardo, Mike Hyslop, Lora Loope, Jim Schaberl, Geoff Smith, Kim Struthers, Wayne Wold, Sharon Woods, Maryanna Young.

Designers/authors of project statements: Jerry Belant, Mike Davis, Ralph Grundel, Mike Hoff, Melinda Knutson, Karin Kozie, Dan Mason, Noel Pavlovic, Bill Richardson, Bill Route, Jim Schaberl

Graphics: Peter Budde

Data Compilers: Mike Broschart, Beth Hoaglan, Byron Karns, Kristi Link, Lora Loope, Geoff Smith, Sharon Woods

Acknowledgements: Many other individuals helped with this effort. Mark Wotawa was instrumental in putting together the NPSpecies database and helping with our use of it. Many scientists and taxon experts attended our scoping workshop (Appendix F) and their input was invaluable. Others provided critical review of project statements (Appendix B) and made valuable contributions to this document.

APPROVALS

Superintendent, Apostle Islands National Lakeshore	Date
--	------

Superintendent, Grand Portage National Monument	Date
---	------

Superintendent, Indiana Dunes National Lakeshore	Date
--	------

Superintendent, Isle Royale National Park	Date
---	------

Superintendent, Mississippi National River and Recreation Area	Date
--	------

Superintendent, Pictured Rocks National Lakeshore	Date
---	------

Superintendent, Sleeping Bear Dunes National Lakeshore	Date
--	------

Superintendent, St. Croix National Scenic Riverway	Date
--	------

Superintendent, Voyageurs National Park	Date
---	------

TABLE OF CONTENTS

INTRODUCTION.....	1
National Inventory and Monitoring Program	1
Scope of This Plan	1
Parks of the Great Lakes Network	2
Ecological Overview.....	6
The Great Lakes Network as an Entity	9
GOALS AND OBJECTIVES	13
Servicewide Program	13
Great Lakes Network	14
CURRENT KNOWLEDGE AND CRITICAL NEEDS	15
Assessing the Current Information Base.....	15
Prioritizing Inventories Needs	20
NEW FIELD INVENTORIES	21
Overall Strategy	21
Individual Project Statements	23
DATA MANAGEMENT	27
VOUCHER SPECIMENS	30
QUALITY CONTROL	32
LITERATURE CITED	35
APPENDICES.....	38
A. Inventory projects	38
B. Reviewers of inventory projects.....	106
C. Park summaries	107
D. Great Lakes steering committee.....	135
E. Inventory and monitoring advisory group.....	136
F. Participants in the scoping workshop	137
G. Spreadsheet structure for projects database.....	142

LIST OF TABLES

Table 1: Implementing the NPS Inventory and Monitoring Initiative	2
Table 2: National Park Service Units in the Great Lakes Network	3
Table 3: Climate of the Great Lakes Network Parks	7
Table 4: Waters of the Great Lakes	8
Table 5. FY2000 Budget for the Great Lakes Network	12
Table 6: FY 2001-2004 Budgets for the Great Lakes Network	13
Table 7: Status of Cataloging Natural Resource Information in NPSpecies	16
Table 8: NPSpecies :Summary for the Great Lakes Network.....	17
Table 9: Status of Citations in the NPS NRBib	18
Table 10: Status of GIS Data Themes	19
Table 11: Schedule and Costs for FY 2001-2004	23
Table 12. Principle Investigators and Cooperators	24
Table 13: Responsibilities for Products and Deliverable Results	29

Study Plan for Conducting Biological Inventories FY 2001-2004 Great Lakes Network

**US National Park Service
Great Lakes Network**

Prepared by:
Bill Route
National Park Service
Great Lakes Network
Ashland, WI

INTRODUCTION

National Inventory and Monitoring Program

The National Park Service's (NPS) servicewide inventory and monitoring (I&M) program provides funding and technical support to 269 national park units to conduct basic inventories and long-term monitoring of natural resources. In fiscal year (FY) 2000, these parks were organized into 32 biome-based networks that share similar natural resources and management issues (NPS 1999). By funding I&M efforts through 32 networks, the NPS hopes to minimize redundancy and maximize cost effectiveness by: fostering the exchange of information and resources between parks with similar issues, reducing per park costs through multi-park studies, and providing network-based expertise which would not be affordable to each park.

The servicewide I&M program is taking a 3-phased approach to getting the 32 networks organized and functioning (Table 1). Each network has the opportunity to devise and implement different inventory and monitoring programs according to the unique characteristics of the parks within the network.

Scope of This Plan

This study plan details how the Great Lakes Network (GLN) is organized, briefly describes the critical resources of each park in the network, assesses the current baseline information on vertebrates and vascular plants, and prescribes future biological inventories to be conducted to fill critical information gaps. It touches upon future monitoring efforts where it is necessary to do so, but focuses on the role and function of the network during the inventory phase and the details of additional field investigations to be conducted. Detailed plans for long-term monitoring is left for future planning efforts.

Table 1. Implementing the NPS Inventory and Monitoring Initiative. Funding phases for conducting inventories and long-term monitoring of biological resources in national parks. The 269 national park units with substantial natural resources are divided into 32 biome-based networks.

Funding Phase	Fiscal Year	Program Goal
One	FY 2000	Start-up funds for: - network organization - hiring critical network staff - preliminary baseline information assessment - development of five-year study plan
Two	FY 2001-2004	Term funding for all networks for: - continued assessment, updating and cataloging of available information - field studies to fill data gaps
Three	FY 2001 for some networks Subsequent FYs for others	Permanent funding to networks for: - long-term monitoring programs

Parks of the Great Lakes Network

The Great Lakes Network is made up of nine national park units in four states associated with the Great Lakes (Table 2, Figure 1). These parks extend from the boreal forest of northern Minnesota to the sand dunes of southern Lake Michigan, a distance of > 650 miles. Six park units, including all four National Lakeshores, are directly adjacent to a Great Lake. Grand Portage National Monument (GRPO), Apostle Islands National Lakeshore (APIS), Isle Royale National Park (ISRO), and Pictured Rocks National Lakeshore (PIRO) are on the shores of Lake Superior, while Sleeping Bear Dunes National Lakeshore (SLBE) and Indiana Dunes National Lakeshore (INDU) are on Lake Michigan. Voyageurs National Park (VOYA) along the Rainy River, and St Croix National Scenic Riverway (SACN), and Mississippi National River and Recreation Area (MISS) in the Mississippi River drainage share common geological features, vegetation patterns, and human use history with the Great Lakes region. Most importantly, the parks collectively represent the major freshwater ecosystems of North America. The Great Lakes form the largest freshwater lake system in the world and the Mississippi River and its tributaries form the continent's largest river system.

The following descriptions provide a brief introduction to the nine Great Lakes Network parks. Further information can be found in Appendix C or by consulting the Resource Management Plan (RMP) for a specific park.

Voyageurs National Park (VOYA) comprises 218,054 acres of which 38% is water. It preserves the landscapes and scenic waterways that shaped the route of the North American fur traders along the border between the United States and Canada. The park protects Precambrian and glacial geological features, southern boreal forests and a complex of 30 lakes, over 1000 islands, and several thousand beaver ponds and wetlands.

Table 2: National Park Service Units in the Great Lakes Network. NPS ALPHA code acronyms for the nine parks in the Great Lakes Network, arranged by land area.

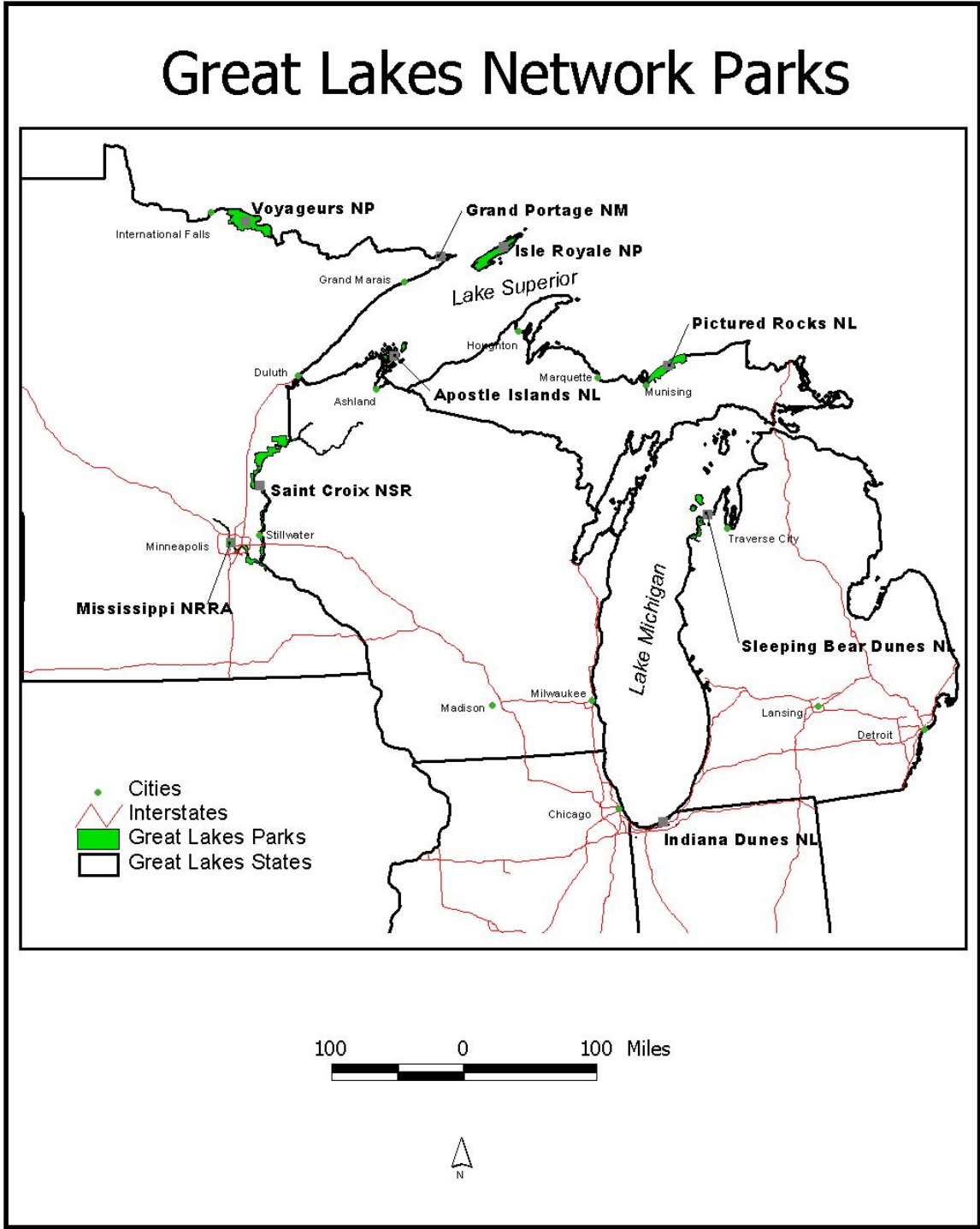
Park	ALPHA	Size	
		Acres	Hectares
Grand Portage National Monument	GRPO	710	287
Indiana Dunes National Lakeshore	INDU	15,000	6,075
Mississippi National River and Recreation Area	MISS	53,776	21,762
Apostle Islands National Lakeshore	APIS	69,372	28,073
Sleeping Bear Dunes National Lakeshore	SLBE	70,996	28,731
Pictured Rocks National Lakeshore	PIRO	71,397	28,893
St. Croix National Scenic Riverway	SACN	92,735	37,528
Voyageurs National Park	VOYA	218,054	88,242
Isle Royale National Park	ISRO	571,790	231,392
Totals		1,163,830	470,983

Grand Portage National Monument (GRPO) encompasses a historic fur trade portage and stockade of the North West Company. It is 710 acres in size with mixed northern hardwood/coniferous forest and a section of Lake Superior shoreline. In addition to significant archaeological sites, GRPO contains a number of rare plant species and spawning habitat for coaster brook trout. The 13.6 km Grand Portage trail corridor and surrounding Grand Portage Indian Reservation preserve a semi-wilderness setting which continues to harbor populations of southern boreal species utilized by native peoples and early fur traders.

Isle Royale National Park (ISRO) is a remote wilderness archipelago located in the northwest corner of Lake Superior. The park includes 571,790 acres of boreal and hardwood forests, numerous inland lakes, and the cold clear waters of Lake Superior. The special nature and variety of Isle Royale's terrestrial and aquatic resources was recognized by Congress when designated a federal wilderness in 1976 and as a Global Biosphere Preserve under the United Nation's Man and the Biosphere Programme in 1980. ISRO hosts the world-renowned wolf/moose study with over 40 years of data. The study is a classic examination of predator/prey and island biogeography theories.

Apostle Islands National Lakeshore (APIS) comprises 69, 372 acres, which includes 42,308 acres of land surface stretching from the coastal mainland across 21 islands, and 27,064 acres of submerged area. It is situated at the transition zone between the northern hardwood hemlock forest and the boreal forest. The Lakeshore has a diverse collection of sandscapes (sand spits, cusped forelands, tombolos, barrier spits), coastal features

Figure 1: Great Lakes Network. Location of the National Park Service units in the Great Lakes Network for inventory and monitoring of biological resources.



(sandstone cliffs, sea caves), and old-growth forest remnants. It contains important habitat for migratory and breeding birds, as well as for a wide variety of other terrestrial and aquatic fauna and flora.

St. Croix National Scenic Riverway (SACN) is one of the original components of the National Scenic River System and protects 403.2 km (252 mi) of the St. Croix and Namekagon rivers in northwest Wisconsin and eastern Minnesota. Popular with anglers, boaters and canoeists, the Riverway preserves a wide range of aquatic and terrestrial habitats as it travels through three major biomes. Within the 92,735 acres are oak and pine savanna, northern hardwood forest, boreal forest and extensive riparian forest and wetlands.

Mississippi National River and Recreation Area (MISS) is a 115.2 km (72-mi) long corridor following the Mississippi River from the confluence of the Crow River in the north, south through Minneapolis/St. Paul to the Goodhue County line. This stretch contains the only true gorge on the Mississippi River and is an important segment of a major migratory flyway. Many areas in the 53,776-acre corridor still contain significant high quality natural habitat.

Pictured Rocks National Lakeshore (PIRO) contains 71,397 acres, approximately half of which is an inland buffer zone with mixed federal, state, corporate timber company and private ownership. Multicolored sandstone cliffs, for which the park is named, tower 200 feet above Lake Superior for 24 km (15 mi) and are the most prominent geological features of the park's 64 km (40 mi) of shoreline. The park is a mix of both the southern boreal and eastern deciduous forest biomes with many wetlands, clear streams, spectacular waterfalls, and a pristine dune ecosystem.

Sleeping Bear Dunes National Lakeshore (SLBE) encompasses 70,996 acres on the eastern shore of Lake Michigan and two offshore islands. The park was established to preserve outstanding natural features, including forests, beaches, dune formations and ancient glacial phenomena. The area is known for dense beech-maple forests, rugged bluffs towering 460 feet above Lake Michigan and a diversity of landscapes, wildlife and vegetation. The park contains 102.4 km (64 mi) of Lake Michigan shoreline, 20 inland lakes and four streams.

Indiana Dunes National Lakeshore (INDU) includes 15,000 acres along the southern Lake Michigan shoreline. Biological diversity is one of the most significant features of this national lakeshore and was a primary reason for its establishment. This diversity is many times greater than that of most areas of similar size because Indiana Dunes is in several ecological transition zones where northern conifer forests meet the temperate hardwood forests and tallgrass prairies of the Midwest.

Ecological Overview

Cultural history

The parks in the Great Lakes Network share a common history. Over the past three centuries, fur trade, logging, mining, farming, industrial development, and urbanization have dramatically changed the character and ecology of the areas the parks now protect (Nute 1931, Wells 1978). Fur traders began establishing posts in the area in the mid-1600s (Ray 1987). Over the next two centuries, Native American and European trappers removed a staggering number of beaver (*Castor canadensis*) and other furbearers from the region (Schorger 1970).

Large-scale logging began in the 1800s and most of the lands now within parks were eventually logged to some degree (Callison 1967, Wells 1978). Dams were constructed in the 1800s to aid the transportation of logs and later for power generation and navigation. Intense fires often followed logging and they destroyed seed sources and organic matter in the soil. Market hunting to supply food for logging camps sharply reduced the number of ungulates and led to the local extinction of woodland caribou (*Rangifer caribou*) and eastern elk (*Cervus canadensis*). Logging also created habitat more favorable for white-tailed deer (*Odocoileus virginianus*). The resulting range expansion for deer has significantly altered forest composition in some areas (Blouch 1984). Deer also harbor a parasitic brainworm, *Pneumoststrongylus tenuis*, which may be limiting the recovery of moose (*Alces alces*) and woodland caribou (Karns 1967). Some lands now protected within parks were also mined: brownstone at APIS, clay and gravel at SACN, copper at ISRO, gold at VOYA, and sand and gravel at SLBE.

Current human uses

Water levels continue to be controlled by dams within SACN, MISS, and VOYA which affects sediment transport, water temperatures and chemistry, and migration and dispersal of aquatic species. Visitors utilize parks in the region for a variety of recreational activities including canoeing, motor boating, kayaking, sailing, fishing, hunting, camping, swimming, hiking, cross-country skiing, snowmobiling, wildlife viewing, and to experience solitude. The aquatic environment tends to be a focal point of many current human activities.

The parks offer opportunities for scientists and resource managers to better understand natural processes and to compare protected lands with more disturbed landscapes.

Climate

The region has primarily a mid-continental climate with seasonal temperatures that vary widely between summer highs and winter lows. Parks adjacent to the Great Lakes are subject to both moderation of high temperatures and lake effect precipitation. Mean annual precipitation ranges from 25 to 36 in (650–910 mm) and temperatures can vary greatly from – 40°F in winter to 90°F in summer (Table 3). Annual snowfall differs greatly ranging from 50 to 400 inches (1250–10,160 mm) due to lake-effect snowfall near the Great Lakes.

Table 3: Climate of the Great Lakes Network Parks. Ecological sections based on McNab and Avers (1994); Jack Oelfky pers. comm. for ISRO.

Ecological Section	Parks	Mean Annual Temperature	Mean Annual Precipitation	Mean Annual Snowfall	Average Growing Season
212H - Northern Great Lakes	PIRO, SLBE	39–40 °F (4–6 °C)	27–34 in (680–856 mm)	70–250 in (1800–8330 mm)	90–155 days
212I – Lake Superior	ISRO, APIS	34 °F (1 °C)	26 in (650 mm)	25–30 in (635–762 mm)	
212J – Southern Superior Uplands	APIS, SACN	37–43 °F (3–6 °C)	26–36 in (660–910 mm)	60–400 in (1530–10160 mm)	80–145 days
212K – Western Superior Uplands	SACN	39–45 °F (4–7 °C)	26–32 in (650–810 mm)	50–70 in (1250–1750 mm)	120–140 days
212L – Northern Superior Uplands	VOYA, GRPO	36–38 °F (2–3 °C)	26–31 in (660–780 mm)	Mean = 65 in (1650 mm)	80–123 days
222J – South Central Great Lakes	INDU	45–60 °F (7–10 °C)	29–36 in (750–930 mm)		140–180 days
222L – North-Central Driftless and Escarpment	MISS	45–50 °F (7–10 °C)	29–35 in (740–890 mm)	55–60% of total precip. is snow	136–160 days
222M – Minnesota and NE Iowa Morainial	MISS	39–48 °F (4–9 °C)	25–33 in (650–850 mm)	55–65% of total precip. is snow	120–160 days

Vegetation

The GLN parks span two ecological provinces of McNab and Avers (1994), the Laurentian mixed forest and eastern broadleaf forest. Blouch (1984) also describes a transitional vegetation zone between the northern boreal forest and the broadleaf forests to the south.

Disturbed areas are commonly dominated by quaking aspen (*Populus tremuloides*) and paper birch (*Betula papyrifera*). Otherwise, forest types tend to reflect the regions soil and moisture regimes. Sugar maple (*Acer saccharum*), yellow birch (*B. alleghaniensis*), American beech (*Fagus grandifolia*), white pine (*Pinus strobus*), and eastern hemlock (*Tsuga canadensis*) occupy the more fertile soils, while jack pine (*Pinus banksiana*) typically grows in the more nutrient-poor and arid sandy soils. Oak (*Quercus* spp) stands are common in moderately poor and dry soils. Black and white spruce (*Picea mariana* and *P. glauca*) and balsam fir (*Abies balsamea*) are prevalent in moist northern areas and conifer swamps are dominated by black spruce, northern white cedar (*Thuja occidentalis*) and alder (*Alnus* spp). In the southern areas, sand dunes and beaches are commonly dominated by beachgrass (*Ammophila breviligulata*), little bluestem (*Andropogon scoparius*), and sand cherry (*Prunus pumila*). Riparian areas are typically dominated by silver maple (*Acer saccharinum*), American elm (*Ulnus americana*), and cottonwood (*Populus deltoides*) where exposed soil is present and cattail (*Typha latifolia*) where there is standing water.

Fauna

Although disturbed by past human activities, the ecosystems represented by the GLN parks still contain most pre-settlement wildlife. Over 500 vertebrate species probably occur within the borders of network parks (NPS unpublished data). The aquatic environment supports a variety of fishes, amphibians, reptiles, semi-aquatic mammals and waterfowl. White-tailed deer, which have greatly increased in number and range, are the dominant ungulates. Black bear (*Ursus americana*), coyote (*Canis latrans*), and red fox (*Vulpes vulpes*) are typical terrestrial carnivores. Gray wolves (*Canis lupus*), which were extirpated from all GLN parks except ISRO and VOYA, have steadily increased; they now occur regularly in GRPO and SACN and occasionally in APIS and PIRO. Bald eagles (*Haliaeetus leucocephalus*), osprey (*Pandion haliaetus*) and other avian species high on the food chain are recovering from declines in the mid-1900s caused by DDT and other pollutants (Gerrard and Bortolotti 1988). Beaver, which were once decimated by the fur trade, have returned in great number and are again a major force in shaping the landscape in some GLN parks.

Surface water

Lakes - The Great Lakes consist of five large lakes: Superior, Michigan, Huron, Erie, and Ontario (Table 4). These lakes flow 2,200 miles from Lake Superior, east through Lake Ontario with a total drop of 600 feet. Together the Great Lakes and connecting riverways makeup the world's largest freshwater system, with one-fifth of the world's fresh surface water and 95% of the U.S. fresh surface water (www.great-lakes.net, 9/15/00).

Table 4: Waters of the Great Lakes.

	Superior	Michigan	Huron	Erie	Ontario
Surface area (mi ²)	31,700	22,300	23,000	9,910	7,340
Volume (mi ³)	2,900	1,180	850	116	393

Tens of thousands of smaller lakes ranging from < 10 to > 10,000 hectares in size dot the region, their density generally increasing in northern Wisconsin and Minnesota. These lakes vary greatly in productivity, but are generally ringed with aquatic plants (macrophytes) and provide habitat for fishes, amphibians, reptiles, semi-aquatic mammals, and a variety of waterfowl and other birds (LaBounty 1986).

Rivers - The Upper Mississippi River and its tributaries, including the St. Croix and Namekagon Rivers, span a latitudinal distance of over 1,280 km (800 mi) (Theiling 1996). Numerous smaller rivers and creek systems drain the region's surface waters down the Mississippi River to the Gulf of Mexico (SACN and MISS), northeast through the Great Lakes (GRPO, APIS, ISRO, PIRO, SLBE, and INDU), or north to Hudson's Bay (VOYA).

Ponds and other wetlands - Hundreds of thousands of ponds and wetlands are interspersed through the region, again becoming more frequent in the more northerly regions. Often these ponds and wetlands are associated with the activities of beaver. Beaver ponds and

associated wetlands form some of the most productive wildlife habitats in the region (Omart and Anderson 1986, Weller 1986).

Stressors

The aquatic systems of the Great Lakes Region are subject to intense recreational and commercial use. They are contaminated with aerial deposition, surface runoff and direct discharge from agriculture, industry, and urban landscapes (Carson 1962, Colborn et al. 1996). Other human-caused stressors to the Great Lakes ecosystem include: habitat loss and forest fragmentation, introduction of exotic species, high levels of recreational use, and over harvest of terrestrial and aquatic fish and wildlife. Natural stressors include: lake level fluctuations (Kallemeyn and Cole 1990), flooding (Theiling 1996), fires, wind throw, insect invasions, drought, and extreme cold.

The combined effect of these anthropogenic and natural stressors on the biological resources of the Great Lakes Region are evident. Of 68 avian species on the Federal list of endangered and threatened species in 1987, 22 (32%) were wetland species (USFWS 1987). Additionally, of 30 avian species on the list of migratory nongame birds that are of “management concern” in the U.S., seven (23%) are marsh-nesting or wading birds (Smith 1996). Freshwater mussels are now believed to be the most endangered animal assemblage in the world (Stolzenburg 2000). Zebra mussels (*Dreissena polymorpha*) (Snyder et al. 1994) and purple loosestrife (*Lythrum salicaria*) (Thompson et al. 1987) are two examples of exotic species that have impacts on aquatic systems of the Great Lakes Region.

The Great Lakes Network as an Entity

A Great Lakes Network Office (GLNO) has been organized under the direction of a steering committee to coordinate I&M projects for the nine network parks.

Role and function

GLNO is accountable to each of the nine network parks, the Midwest regional office, and ultimately to the servicewide I&M program, for all products funded under the NPS I&M initiative. GLNO facilitates and coordinates the planning and design of such I&M efforts with advise from the network parks, regional and servicewide I&M staff, and the scientific community. GLNO conducts or oversees the completion of I&M projects and ensures principal investigators submit quality deliverables that are retrievable through NPSpecies, NRBib, the GIS Theme Manager, and the NPS Dataset Catalog.

Staffing

Bill Route has been hired as a fulltime coordinator (GS-11, NTE 4-year term appointment) to facilitate the planning, development and coordination of the network’s I&M program. The network coordinator works on a daily basis with little or no direct supervision and has wide discretion to carry out GLNO business within NPS policies and guidelines, the overall direction set by a steering committee, and goals of regional and servicewide I&M programs (see *Decision making process* below). Administratively, the coordinator is supervised by the resource management specialist at APIS. This position is expected to be permanent once the network is fully funded for long-term monitoring.

Beginning in FY2001 the GLN will retain the services of Mike Hyslop, GIS/Data Management Specialist with Michigan Technological University (MTU). Mike will provide technical advice and create pre-inventory guidelines for contractors. These guidelines will be a proactive step to ensure all GIS and database products are compatible with servicewide programs. Mike will also lead a GIS/data management team that will critically review pre- and post- inventory submissions from all principal investigators to ensure compatibility and accuracy of GIS and database products. This team will consist of regional and park-based GIS and data management staff (see *Data Management* section for more details).

Biological technicians (GS-5/7/9) will be hired, or current park-based technicians will be extended, to assist the network coordinator, the GIS/data management team leader, and individual parks up-date and organize NPSpecies, NRBib, and the Dataset Catalog. These individuals will work with the GIS/data management team to ensure GIS data sets are compatible with the GIS Theme Manager and correctly cataloged for easy retrieval. These positions will be jointly supervised by park resource managers and the network coordinator. They will be park-based.

When the network is fully funded for long-term monitoring, a fulltime data manager will be hired and additional positions and/or contracted consultants will ensure the network's goals for monitoring are realized.

Steering committee and the decision making process

A network steering committee (Appendix D), including representatives from each park, the regional office and the servicewide I&M program, is actively involved in network decisions. As chair of the steering committee, the network coordinator recommends GLN goals and objectives, annual budgets, work plans and other documents that affect program direction and the use of fiscal resources. The coordinator bases such recommendations on frequent communications with steering committee members, national and regional I&M staff, coordinators from other NPS networks, and the scientific community. The coordinator advances recommendations to the steering committee during semi-annual meetings (spring and fall) and through e-mail or teleconferencing, as needed.

The steering committee can amend, alter or reject such recommendations. The park representatives are the only voting members of the steering committee. Remaining members have only an advisory role. A two-third's quorum (6) of voting members must vote, appoint a proxy or abstain from voting before a recommendation is passed or rejected. Passage or rejection of a recommendation is by simple majority; however, the committee strives to reach consensus whenever possible. All committee members may advance ideas, suggestions and concerns directly to the coordinator on an informal and unrestricted basis. The aim is to have an open dialogue, whereby all committee members are included. If a member's concerns are not satisfied, he/she can force discussion and a vote on an issue by gaining concurrence from at least three members of the full steering

committee. The steering committee has authority to form an executive committee, task forces, or other groups to deal with urgent business or technical issues.

An inventory and monitoring advisory group (IMAG), consisting of NPS staff with subject matter expertise and key scientists from US Geological Survey - Biological Resources Division (USGS-BRD), serves to advise the network in developing scientifically valid I&M programs (Appendix E).

Facilities

The coordinator works from a home-based office and has been provided a computer, printer, workstation, office supplies and access to phone, e-mail and the Internet.

In early FY 2001, GLNO will share facilities with the USGS and the US Fish & Wildlife Service (FWS) Office of Fisheries Assistance at the Great Lakes Science Center in Ashland, Wisconsin. The Ashland location is reasonably central to the network parks and has most essential support services. The Great Lakes Science Center has access to the Department of Interior's communications network through a high speed data transmission line, ample parking space, and sufficient office space for current needs. A rental agreement through the Government Services Administration (GSA) is already in-place for the other agencies, thus streamlining the NPS contractual process.

Partnerships, technical assistance and the exchange of information resulting from sharing office space with BRD and FWS will help the network fulfill its goals. Initially, the GLNO will have one office and a shared multipurpose meeting room; however, the site has ample room for expansion. The construction of office space is provided for under the current GSA contract and the building owner has agreed to add office space for GLNO as needed.

Administrative support

The MWRO funnels servicewide I&M funds to GLNO and provides fiscal oversight. GLNO may obtain technical advice on contracting, purchasing and personnel issues from any of the network parks or MWRO, as needed. However, APIS will be the primary advisor and administrator of the network's base budget for salaries, travel, and office expenses. GLNO will provide funds to APIS for the cost of administering this portion of the budget.

Monies for individual field projects may also be administered by APIS, but other parks are expected to administer projects that are conducted solely in their park or where it is deemed prudent or necessary (i.e. when a contracting officer with a higher warrant level is required). This will distribute the workload and permit management of fiscal resources at the park level. The contracting specialist at ISRO is warranted for contracts in excess of \$100,000, and the position was originally funded to provide support to the Great Lakes Cluster (now Network) (S. Jordan personal communication).

Table 5. FY2000 Budget for the Great Lakes Network.

Item	Amount
<i>Wages, benefits and awards:</i>	
Network Coordinator, GS-11, pp 10-21a	27,941.32
NPSpecies - MISS & SACN, GS-5, 13 pp ^a	13,000.00
NPSpecies - PIRO, SLBE, & ISRO, GS-5, 10 pp	10,000.00
NPSpecies - VOYA, GS-5, 6 pp	6,614.40
NPSpecies - APIS & GRPO, GS-5, 5 pp	5,500.00
NPSpecies - INDU, GS-5, 2 pp	2,000.00
subtotal	65,055.72
<i>Workshops, meetings, and other travel:</i>	
Scoping workshop, Ashland (includes travel & supplies)	4,444.89
NPSpecies workshop for park bio. techs. (travel)	700.00
Steering Committee, fall meeting (travel for all)	1,181.82
Misc. travel and conference fees (estimate ^b)	1,638.31
subtotal	7,965.02
<i>Equipment and supplies:</i>	
Computer	4,513.00
Printer	1,539.95
Fax machine	137.04
Copy machine (estimate ^b)	1,535.01
Phone system (estimate ^b)	300.00
Misc. office equipment and supplies	954.26
subtotal	8,979.26
Total estimated expenditures =	82,000.00

^a = A portion of this has been "rolled over" to be spent in FY2001.

^b = These three estimates include ~\$3,000o being rolled over into FY2001.

Fiscal resources

The Great Lakes Network was provided \$65,000 from the servicewide I&M program and \$17,000 from the MWRO in FY 2000 (Table 5). Overall, nearly 80% of this amount was used to coordinate network business, prepare this study plan, and enter park data into servicewide database systems. The remaining 20% was split nearly evenly between travel, including a scoping workshop for invited experts, and equipment and supplies to set up the network office.

The network expects to receive an average of \$280,000 per year for four additional years (FY 2001-2004) to coordinate and conduct biological inventories (Table 6). In most years, > 60% of the network budget will go toward new field inventories (includes a portion of the coordinator's time). About 20% will go toward coordination, facilities, and administrative expenses. The remaining 20% will support the continuing compilation and management of historical and newly acquired data. Data management funds are calculated as follows: 25% of the coordinator's salary, all biological technician salary and travel, all GIS support, vouchering and specimen curation expenses, and 10% of each field investigation budget.

Table 6: FY 2001-2004 Budget plan for the Great Lakes Network. Budget projections based on GLN receiving \$1,181,860 over a five-year period, including \$65,000 in FY 2000.

Item	Estimated Annual Costs			
	FY 2001	FY 2002	FY 2003	FY 2004
<i>Wages and administrative:</i>				
Coordinator, GS-11/6+ w/benefits	70,674	73,064	77,522	79,977
GIS support, regional & park based (estimate)	10,000	10,000	6,000	6,000
Data technicians, park based, GS-5s @1pp/park	13,022	10,770	9,269	9,562
Travel support for GIS/data management team	2,000	2,000	1,200	1,400
Office rental @ \$14.20/sq ft/yr w/COLA + 8% GSA	2,815	3,012	3,111	3,209
Phone & internet service starting @\$25/mo/office	670	670	700	700
Office misc (phone hookup, postage, paper...	1,116	600	600	600
Travel and training ~3% of salaries	3,500	4,000	4,200	4,600
Steering committee, semi-annual meetings	2,100	2,300	2,500	2,700
GSA vehicle @ 350/mo	1,000	2,000	2,000	2,000
Printing costs for annual I&M report	400	500	600	700
APIS administrative (10% of GS-5/7 w/ benefits)	3,854	3,984	4,114	4,245
Subtotal	111,151	112,900	111,815	115,693
<i>Field work:</i>				
Total estimated cost for 9 field studies in appendix A	110,900	94,400	169,900	187,300
Vouchering and curation for field collections	2,500	3,500	5,000	5,500
Challenge / contingency fund (over runs, add-ons)	21,100	15,000	25,100	25,100
Subtotal	134,500	112,900	200,000	217,900
Annual budget	245,651	225,800	311,815	333,593
Grand Total	\$1,116,860			

GOALS AND OBJECTIVES

Servicewide Program

The goals of the NPS servicewide biological inventory program are to:

- 1) provide park managers with comprehensive, scientifically-based information on the status of selected biological resources within parks in a form that increases accessibility and utility for managers, scientists, and educators; and
- 2) lay the groundwork for developing effective monitoring programs that will help managers protect such resources into the future.

To attain these goals, future biological inventories must be designed to meet one or more of three basic objectives (NPS 1999):

- 1) To document through existing, verifiable data and targeted field investigations, the occurrence of at least 90% of the species of vertebrates and vascular plants currently estimated to occur in park units.
- 2) To describe the distribution and relative abundance of species of special concern, such as state and federally protected species and exotics, that occur within park units.
- 3) To provide baseline information needed to develop a monitoring program tailored to specific park or network-wide threats and resource issues.

Great Lakes Network

The primary goal for the GLN over the next four years is to work toward cataloging and completing basic inventories of vascular plants and vertebrates, and address a critical invertebrate need, in the nine park units. Specifically, the Great Lakes Network has the following objectives for the inventory phase of the I&M program:

Objective 1: To the extent possible, fund and facilitate field studies for high priority inventories at each of the network parks. It will not be possible to complete all needed inventories in the nine park units. The GLNO will work from a prioritized list to ensure critical needs are met.

Tasks:

- Maintain a dynamic list of each park's needs for additional biological inventories.
- Ensure this list receives peer-review periodically and that new information is used to re-prioritize each park's needs.
- Combine related needs into multi-park inventory projects, when it is scientifically and fiscally prudent to do so.
- Identify other government agencies, private organizations and institutions that conduct similar field work so data and methods might be shared.
- Identify and solicit collaboration among partner groups to share data collection and costs of conducting inventories.

Objective 2: Ensure a high level of credibility for network-funded projects.

Tasks:

- Select credible scientists or other knowledgeable experts to conduct inventory projects.
- Require all project proposals and/or study plans to be peer reviewed prior to funding.
- Require all final reports to include full documentation, analysis and discussion of project results, and a peer review by at least two subject matter experts.
- To the extent possible, facilitate publication of results in scientific journals or presentation at regional and national professional conferences.

Objective 3: Ensure that historical and newly acquired data and reports are readily accessible to managers, scientists, educators and the public, except for sensitive material regarding rare natural elements.

Tasks:

- Assess the value of old data sets. Valid data will be entered into the Dataset Catalog and other appropriate NPS data management systems, and such data will be made available to investigators for use in current works.
- Develop a policy for dealing with old data that was poorly documented or collected using substandard techniques.
- Routinely update and conduct quality checks on the information entered into NPS databases such as NPSpecies and the GIS Theme Manager, which will be available on the Internet.
- Routinely update and conduct quality checks on the natural resources bibliography (NRBib) of all literature on natural resources associated with network parks, which will be available on the Internet.
- Routinely update the catalog of tabular and GIS data sets (Dataset Catalog) and ensure applicable spatial data is posted to the web-based NPS GIS clearinghouse.
- Publish an annual report series in which abstracts of network-funded projects are presented and results made available.
- Organize an annual Great Lakes Network conference for presenting the results of network-funded projects for park staff, principal investigators, and other interested parties.

Objective 4: Elevate the professional standing and effectiveness of resource management staff in the network parks and the network office.

Tasks:

- Require that NPS staff and contractors be held accountable for network-funded projects by using scientifically rigorous methods, and by fully reporting findings in peer-reviewed reports and literature.
- Request that all Principal Investigators provide the opportunity for co-authorship in reports and scientific literature to NPS staff. Co-authorship should be offered when anyone has contributed substantially to at least three of the five recognized activities in a project: requisition and administration of funds, design and formulation of methodology, collection and tabulation of data, statistical analysis of data, and writing.

CURRENT KNOWLEDGE AND CRITICAL NEEDS

Assessing the Current Information Base

Six biological technicians were hired or existing positions extended in FY 2000 to locate and catalog information from park libraries and files to update the servicewide species information database (NPSpecies) and the natural resources bibliography. Most of these park-based technicians were current or former intermittent employees who had previous

knowledge of park resources. To further help with this effort, GLNO organized a workshop with M. Wotawa, NPS inventory specialist, who familiarized technicians with the use of NPSpecies. Specifically, the following has been accomplished:

Assessing verification through NPSpecies

In terms of effort, the first step of populating NPSpecies with at least one form of documentation is > 90% complete, with the exception of MISS for reasons explained below (Table 7). Beyond this initial step, five network parks have made strides toward entering distribution and abundance data. INDU has much of the distribution and abundance data in other database files, but this information needs to be converted into the NPSpecies database format. The remaining parks will take on this task in the coming years with the aid of network funds.

The GLN parks have a mean per park verification rate > 73% for vascular plants and vertebrate species believed to occur in each park (Table 8). However, this number is probably an underestimate. Tentative plant species lists for VOYA and GRPO, and herpetofauna for VOYA were derived from checklists for large counties. Both parks are on the northern extreme of these large counties that span the mixed hardwood/boreal forest border; consequently, habitats for some expected species probably don't occur within these parks. At ISRO and SLBE birds and herpetofauna show slight over verification (e.g. > 100%) because vagrants and unexpected species have been observed. Due to these circumstances, the validity of the initial expected list should be verified by subject matter experts. Each park utilized local expertise, county and state lists, natural history guides, neighboring parks and personal knowledge to estimate which species are expected. The result of this evaluation is our current "best estimate" of species verification.

Table 7: Status of Cataloging Natural Resource Information in NPSpecies. Estimated proportion of work completed for tasks related to cataloging and documenting all natural resource information in the NPS units in the Great Lakes Network as of September 2000.

Task	Percent completed								
	APIS	GRPO	INDU	ISRO	MISS	PIRO	SACN	SLBE	VOYA
NPSpecies lists all species known to be present with at least 1 form of documentation.	95	90	90	92	80	98	90	97	100
NPSpecies contains all available information on each species including distribution and abundance and citations.	0	0	2	84	20	81	10	90	70
NRBib cites all literature pertinent to natural resources known by the park.	98	95	98	98	45	98	95	68	90
Dataset Catalog contains all available tabular and spatial (GIS) data sets known by the park.	0	0	0	0	0	0	0	0	10

The first step for the network parks, except for MISS, was to enter or verify at least one source of documentation (voucher specimen, published report, or observation from a qualified observer) for those species believed to occur in each park. Additionally, most parks noted species they expected to occur but had no documentation. The NPS inventory specialist and data management staff provided initial databases for these eight parks. These databases were generated from earlier versions of NPFlora and NPFauna, from other literature and from electronic files sent to the NPS I&M office in Fort Collins. However, it was necessary for park technicians to verify data conversions for each species and enter additional information from a backlog of reports, data sets, and files.

Table 8: NPSpecies :Summary for the Great Lakes Network. Status of species verification by taxon group for each park in the Great Lakes Network as of September 2000.

Taxa	Number of species per park								
	VOYA ^c	GRPO ^d	ISRO ^e	APIS	PIRO	SACN	SLBE ^e	MISS ^f	INDU
<i>Number expected^a:</i>									
Vascular plants	1289	700	839	734	884	1418	1430	1113	1426
Herpetofauna	25	15	12	31	25	39	36	37	49
Fish	56	34	61	43	68	98	84	106	82
Birds	233	127	218	275	225	285	239	279	334
Mammals	58	39	16	32	47	51	51	51	48
Total	1661	915	1146	1115	1249	1891	1840	1877	1939
<i>Number verified^b:</i>									
Vascular plants	765	475	748	713	627	740	914	915	1425
Herpetofauna	10	12	12	23	23	39	37	37	48
Fish	53	23	61	34	45	97	74	75	57
Birds	230	110	233	264	167	250	246	246	333
Mammals	42	26	15	25	35	51	44	44	47
Total	1100	646	1069	1059	897	1177	1315	1317	1910
<i>Percent verified</i>									
Vascular plants	59.3	67.9	89.2	97.1	70.9	52.2	63.9	82.2	99.9
Herpetofauna	40.0	80.0	100.0	74.2	92.0	100.0	102.8	102.8	98.0
Fish	94.6	67.6	100.0	79.1	66.2	99.0	88.1	70.8	69.5
Birds	98.7	86.6	106.9	96.0	74.2	87.7	102.9	88.2	99.7
Mammals	72.4	66.7	93.8	78.1	74.5	100.0	86.3	86.3	97.9
Mean percent verified	73	76	99	87	76	88	89	86	92

^a = Species likely to occur based on published literature and/or state, county or other lists.

^b = Species known to occur in the park based on at least one piece of evidence.

^c = Lists for expected plant and herb species are for two large counties and are probably over estimated.

^d = List for expected number of plants includes a large county and is likely an over estimate.

^e = Observations of vagrants and unexpected species yielded >100% verification in some cases.

^f = Recent park; technician hired late in year. Verification is now proceeding (see text).

MISS had no previous NPFlora or NPFauna databases and no literature was provided to Ft. Collins. Additionally, insufficient technician time was allotted to MISS in FY 2000 under a wage sharing agreement between SACN and MISS. To rectify this a second technician was recently hired full time to verify species for MISS; and a portion of FY 2000 funds have been “rolled over” to FY 2001. Species verification is now going smoothly for MISS and they are currently about 80% finished the data mining (Table 7). The NPSpecies database for MISS was populated by converting all species names from SACN’s database, then purging all reference and voucher information, since these neighboring parks share similar large riverine habitats. Species occurring in SACN but obviously missing from MISS (e.g. gray wolves) were also stricken; therefore, MISS is essentially starting with a database of expected species. Discussions with local experts suggest there is a plethora of information available for MISS from studies conducted by the many municipalities, agencies, educational institutions and organizations along this urban/park corridor. Finding and entering this information will be an on-going process for several months.

NRBib

As of April 2000, the Natural Resources Bibliography (NRBib) contained 8,123 literature citations for the nine network parks (Table 9) and is mostly current (Table 7). However, verification and completeness of citations, and thus the utility of NRBib, is in need of much work. The GLN will place NRBib as a high priority in the coming years so that available information can be readily accessed.

Table 9: Status of Citations in the NPS NRBib. Number of citations listed in the National Park Service’s Natural Resources Bibliography for each of the nine parks in the Great Lakes Network as of April 2000.

Park	Number of citations
APIS	334
GRPO	41
INDU	644
ISRO	3034
MISS	656
PIRO	575
SACN	1321
SLBE	294
VOYA	1223
Total	8123

Dataset Catalog and GIS Theme Manager

The NPS Dataset Catalog and the GIS Theme Manager were not used by the GLN because these programs were still under development by the NPS I&M team, and because NPSpecies and NRBib were higher priorities of network parks. They will be a higher priority for network data technicians and park-based technicians beginning in FY 2001.

Table 10: Status of GIS Data Themes. Themes as reported by the nine NPS units in the Great Lakes Network as of September 2000. An 'X' indicates the theme is complete, or in the process of being completed; an '+' indicates themes that have partial coverage, are incomplete or outdated.

GIS Layer	Park								
	APIS	GRPO	INDU	ISRO	MISS	PIRO	SACN	SLBE	VOYA
Boundary	X	X	X	X	X	X	X	X	X
Digital Elevation Model (DEM)	X		X	X	X	X	X	X	+
Hydrology	X	X	X	X	X	X	X	X	+
Hypsography		X	X			X		X	
Vegetation	+		X	+		X	+	X	+
Soils	X			X	X	X	+	X	
Trails	X	X	X	X	X	X	+	X	X
Roads	X	X	X	N/A	X	X	X	X	X
Structures	X	X	X	X			+	X	+
Digitized USGS Maps	X	X	+	X	X	X	+	X	X
Fire	+		X	+			+		+

GIS Themes and Capabilities

Critical GIS data themes are in various stages of completion for the network parks (Table 10). Many of these themes are available as downloadable files on the NPS GIS clearinghouse web site, which has helped coordinate new inventories and promote discussions with potential partners about monitoring. The effort to assemble available information has highlighted the fact that many GIS themes exist, but not all are posted on the web site nor documented in the Dataset Catalog. The network's GIS/data management team will work toward rectifying this deficiency.

VOYA, SACN and INDU have committed GIS staff. Other network parks have either shared resources, Cooperative Agreements with universities or Indian bands, or intermittent staff who provide basic GIS services. The MWR GIS Support Office (Madison, WI) provides GIS products and assistance as time and staff allows. Parks that lack committed GIS staff have taken steps to meet GIS needs, but GIS hardware, software, and support staff are a critical need to many GLN parks. GIS-based vegetation maps are also a high priority for several parks in the network. Funding for vegetation mapping is currently handled by a separate NPS program and will not be addressed here. GIS themes that show the distribution of specific wildlife and plant populations are available in some network parks, but absent in others. Creating new themes and cataloging what exists will be an on-going job in all of the parks. The newly formed GIS/data management team will continue to assess GIS needs and advise the network coordinator on prioritizing projects.

Voucher specimens

Suzanne Gucciardo, GRPO, contacted natural history collections and herbariums in a 14 state area across the Midwest Region, as well as prominent national institutions. A

survey form was sent to 225 institutions to obtain contact information, the size of their collection, and its accessibility (i.e. did they have a web-based database, a resident database, or hardcopy only). A database (available on request) was created from the responses received from 154 institutions. Of particular interest were 44 institutions in the four-state area around the Great Lakes Network.

Twenty-three institutions (15% of respondents) had web-based, searchable databases and 71 (46%) had at least a portion of their collection digitized in some form. However, precise geographic information is often lacking on older specimens, or the collection data is suspect, so that linking specimens to individual parks is difficult (T. Reznicek, curator of vascular plants, U. Michigan, personal communication). Responses frequently suggested that an all-inclusive search for specimens at most museums and herbariums would be a daunting and highly inefficient task. Rather, it was suggested that museum records be searched only when specific species cannot be documented readily by routine field investigations, or if historical occurrence is in question. The cooperativeness of curators varied from “We will be very pleased to cooperate with NPS...” to “Even filling out questionnaires such as the one included with your message is time-consuming and takes away from the primary focus of the jobs of collections managers and curators, which is taking care of the specimens.” It clearly appears that assessing voucher information will be an on-going challenge.

Prioritizing Inventories Needs

The Great Lakes Network identified and prioritized additional inventory needs through the following five-step process:

- 1) Resource staff at each park assessed the status of park inventories and provided a prioritized list of new inventories they believed necessary to meet minimum goals of the servicewide I&M program. They were also asked to evaluate the “level” of information needed, defined by national I&M staff as (NPS 1999):
 - Level 1 = presence/absence data needed only
 - Level 2 = abundance categories desired
 - Level 3 = relative abundance and distribution data needed, and
 - Level 4 = absolute abundance information required.Parks provided their estimated needs via an Microsoft Excel™ spreadsheet designed by GLNO. Park submissions were compiled into a draft list of “proposed” inventories.
- 2) This spreadsheet was e-mailed to the 43 taxon experts invited to attend a two-day workshop in Ashland, WI on April 26 and 27, 2000. These experts were asked to review the proposed inventories within their taxonomic expertise before the workshop. Park priorities were not provided to ensure their critique was unbiased.
- 3) Thirty-one experts attended the workshop (Appendix F) to discuss proposed inventories during 25-minute face-to-face sessions with representative(s) from each park. Park representatives were at liberty to change their estimated needs based on

these discussions, by adding or deleting inventories, or changing the level of need. Following these discussions, each panel of experts voted on the “importance value” of proposed inventories by ranking each as high-, moderate-, or low-importance. Their opinions were based on whether the inventory was critical for making management decisions in the park and/or if the inventory was scientifically significant in a regional context. These expert rankings and their comments on each inventory were captured in an Excel spreadsheet by a scribe assigned to each group.

- 4) After the sessions with park representatives, experts were asked to reflect on and summarize the most pervasive inventory needs across all network parks. These summaries became high priority “inventory themes” for the network.
- 5) Following the workshop, all park projects were grouped within the themes identified in Step 4. Within each theme, projects were sorted by park priority, with expert rankings provided for comparison. The resulting spreadsheet was returned to each park for review and re-prioritization. This iterative process allowed park staff to reconsider their assessed needs with the benefit of taxon expert opinions and importance ranks. The resulting peer-reviewed and theme-based inventory list is the foundation for the network’s four-year program for conducting field inventories.

NEW FIELD INVENTORIES

Overall Strategy

The Great Lakes Network has opted, as have other networks (e.g. Northern Colorado Plateau), to target inventories to fill information gaps or to provide critical information, rather than design a complex multi-taxon inventory blitz (Geissler 1998). The needs of GLN parks for inventories range from near-shore fishes in Lake Superior to terrestrial furbearers and grassland birds. This diverse need for data requires sampling schemes adapted for specific species and habitats. A sampling framework (NPS 1999) applied park wide for multiple taxon would likely yield information on common and widespread species for which documentation already exists. In some cases, for example fishes at INDU, documentation is below the desired 90% (e.g. 69.5%). However, the need for distribution and abundance information on threatened and endangered species outweighs that park’s need to document the remaining 25 fish species. Many of these fish only occasionally enter INDU’s boundary off the shore of Lake Michigan, and there are no critical management concerns for them.

Our strategy is to conduct inventories targeted at species or species assemblages that are undocumented or for species of special management concern. As in the INDU example above, many GLN parks need specific distribution and abundance data, such as rare or invasive exotic plants, and our approach will maximize its acquisition.

The five-step prioritization process presented above resulted in 132 park projects placed into themes for future inventories. Justification, level of information desired, and the

results of discussions between park representatives and experts at the workshop were captured in a spreadsheet (structure shown in Appendix G; complete database available from the GLNO on request). Due to funding constraints and a desire for equity across network parks, the steering committee voted to fund the top two priorities for each park. Subsequently, GLNO facilitated the design, preparation and critical review of nine field investigations that address the top 18 priorities, or the first and second priority of each park. The Great Lakes Network Office is taking a leading role in coordinating and completing these inventories over the next four years (Table 11).

To the extent possible, parks may “buy in” to studies they are not initially involved with. The network will have a challenge/contingency fund (see Table 6) for enticing parks to augment the network budget from park-based funding and/or funding partners. For example, SLBE is not currently slated to receive network funding for a bat inventory, but the park is willing to put base money toward a bat inventory to fund a well respected cooperator (Dr. Allen Kurta, University of Michigan). The network will work toward making this a win-win situation, potentially by helping fund a portion of SLBE’s bat inventory and using Dr. Kurta to conduct and/or train staff for bat inventories in the remaining three parks.

Table 11: Schedule and Costs for FY 2001-2004. Annual plans for new inventories to be completed over the next four years in the Great Lakes Network park units of NPS.

Project title	Parks involved	Project designers	Schedule and annual costs (in \$1,000's)				Totals	Avg/par
			2001	2002	2003	2004		
Application of national lynx detection protocol	VOYA	B. Route J. Schaberl	8.3	8.1			16.4	16.4
Freshwater mussel survey	MISS	M. Davis N. Duncan	35.6				35.6	35.6
Distribution and abundance of grassland birds	SLBE	R. Grundel	35.0				35.0	35.0
Inventory of near-shore fishes	APIS, ISRO, PIRO	M. Hoff	32.0	16.4	29.0	44.2	121.6	40.5
Occurrence and relative abundance of bats	GRPO, APIS, PIRO	B. Route		22.2	18.9		41.1	13.7
Occurrence of nocturnal birds	GRPO	K. Kozie		1.7	2.0	3.1	6.8	6.8
Occurrence and relative abundance of amphibians and reptiles	INDU, SACN, VOYA	M. Knutson B. Richardson		46.0	46.0	46.0	138.0	46.0
Gap analysis for rare and exotic plants	INDU, SACN, MISS, SLBE	N. Pavlovic			64.0	64.0	128.0	32.0
Inventory of aquatic plants	ISRO	B. Route D. Mason			10	30.0	40.0	40.0
Totals			110.9	94.4	169.9	187.3	562.5	29.6

Individual Project Statements

The justification, methods, schedule, budget and specific deliverables for each of the nine projects are detailed in individual project statements (Appendix A). These project statements are stand-alone plans that detail each investigator's responsibility. Each project statement was prepared by professional scientists or other subject matter experts. In many cases, the preparer will be the PI; but for other projects, the study will be put out for bid (Table 12). The network expects to have a well-rounded mix of NPS, USGS, and other partners for investigators. All project statements were reviewed by the target parks and by at least two reviewers with knowledge in the subject area (Appendix B).

Five of the nine projects target the needs of individual parks and four are currently designed as multi-park studies. After further consideration, however, we have determined that multi-park studies within the Great Lakes Network can be inefficient and overly expensive. The herpetological work currently planned will require travel between

Table 12. Principle Investigators and Cooperators. Affiliation of principal investigators (PI) and other partners expected to participate in inventories for the Great Lakes Network over the next four years.

Project	PI affiliation	Other partners
Application of the National lynx detection protocol	NPS (GLNO & VOYA)	USFS will provide protocol, sample kits and DNA analysis
Freshwater mussel survey	Minnesota Department of Natural Resources and NPS (MISS)	
Distribution and abundance of grassland birds	Undetermined	USGS will likely provide consultation
Inventory of nearshore fishes	USGS	
Occurrence and relative abundance of bats	NPS or contractor	University of Michigan as potential partner (see text)
Occurrence of nocturnal birds	Independent contractor, and/or NPS (GRPO) and Indian band staff	Grand Portage Indian Band
Occurrence and relative abundance of amphibians and reptiles	USGS, potentially Milwaukee public museum	
Gap analysis for rare and exotic plants	USGS	Each park's RMS
Inventory of aquatic plants	Undetermined. Private contractor or University likely	

four parks separated by several hundred miles. The cost in time and money for coordination, travel, lodging and per diem outweighs the advantages. Park-specific objectives and logistical problems also differ between these parks. In FY 2001 we will re-examine this study with the intention of reorganizing it into one single-park study and one dual-park study. The original cost estimate has been reduced and is our best estimate for completing the work. Revised cost estimates will be submitted with new project statements in the future.

National NPS guidelines provide that inventories funded by this initiative should be restricted to vertebrates and vascular plants...“...with few exceptions for T&E invertebrates...” (NPS 1999). Freshwater mussels (Unionids) are among the most imperiled animals in North America (Stolzenburg 2000); and in Minnesota, 26 of 49 known species are now listed as extirpated, endangered, threatened or of special concern (Bright 1988; MNDNR unpublished data). MISS is currently lacking even the most basic information on presence/absence of freshwater mussels. Other parks in the network could use better information on freshwater mussels, but are making strides in that

direction. We argue that, due to the high potential for adverse impacts to mussels in the Mississippi River (see project *Problem Statement*), an inventory of mussels is critical for MISS and that this should be an exception to the funding guidelines.

The remaining projects statements are self-explanatory. See Appendix A for full details on each project.

Strategies for attaining 90% verification

The nine full-scale inventories detailed in appendix A will help address 12 cases where taxon are below the desired 90% verification goal (Table 8) (note: this excludes MISS where data mining is on-going and verification is expected to be very high). Of the remaining 12 deficiencies, three are near 90% and we can't reasonably conclude they are truly deficient. We expect that these three will exceed 90% with continued data mining and refined expected lists. Verification for the remaining nine will also increase during this process.

We built in to our program a "challenge/contingency fund" of >\$15,000 per year (Table 6). This money will be limited to cost over-runs for funded projects and for "challenge grants". Challenge grants will require parks to contribute park base, other NPS funds, or partner funds to the cost of a proposed inventory. Proposals for challenge grants can be initiated by the parks or the network coordinator. The network coordinator will be responsible for ensuring these inventories are well designed and critiqued by outside reviewers including the regional I&M coordinator and the servicewide program. Challenge grants will be restricted to inventories and data mining efforts for taxon that are below 90% verification. The following describes some of the potential for challenge grants as well as on-going studies that will help raise the remaining deficiencies:

Vascular plants:

- VOYA and GRPO are currently estimated at 59% and 68% verification of vascular plants respectively. These are conservative estimates based on plant lists from large counties stretching south of both parks. We will examine plant lists from nearby districts of the Superior National Forest which should be more tailored to these parks. We expect an improvement in verification. Additionally, GRPO is currently conducting a floristic inventory with an expected completion date of December 2001. GRPO will likely exceed 90% verification following this effort. VOYA may remain < 90%, but verification will greatly improved with a new expected list. A network challenge grant may be useful for VOYA if aimed at a specific subset of vascular plants.
- PIRO is currently at 71% verification for vascular plants, but they are awaiting the results of work on exotic and rare plants by USGS-BRD. PIRO will also begin an NRPP study aimed at forest biodiversity in 2001. Park staff are the principal investigators and they believe many plants will be verified. We expect PIRO's verification will exceed 90% by FY04 with these efforts.
- All other units below 90% (ISRO, SACN, and SLBE) are getting inventory projects to address their deficiencies.

Herpetofauna:

- GRPO, which is at 80% verification of herpetofauna, is primarily missing a few salamanders. As with vascular plants, GRPO's expected list for herps needs revision. GRPO currently has a herpetologist on staff and a challenge grant may help purchase equipment for a small-scale study to verify the species in question.
- APIS is currently at 74%, however, they just recently completed a study on deformed amphibians and some newly vouchered species are not included in this total. We expect additional data entry, a revised expected list, and possibly, a small inventory of reptiles to bring APIS over 90% verification by FY04.
- VOYA is being addressed through a funded inventory and through the USGS-BRD amphibian research and monitoring initiative.

Fish:

- In response to comments on the draft study plan, PIRO changed priorities from herpetofauna with >90% verification to fish with 66% verification. PIRO will join APIS and ISRO in the nearshore fish inventory (appendix A) and this will increase their verification considerably.
- GRPO believes additional information is available on fish from the Grand Portage Band of Minnesota Chippewa, the state of Minnesota, and US Fish & Wildlife Service who has done work in and around the park. A revised list of expected species is also needed. We believe that continued data mining and a revised expected list will bring GRPO from the current 68% to near the 90% level.
- SLBE is at 88% verification for fish. Continued data mining and revisions to their expected list will likely put them above the 90% level.
- INDU has currently verified about 70% of the fish believed to occur in the park. Many of the 25 species that remain unverified are from deep waters of Lake Michigan and they only occasionally range within INDU's boundaries. Other unverified fish are inhabitants of small ponds and creeks. We believe that continued data mining and revisions to the expected list will raise the verification level for Lake Michigan fish. A network challenge grant may leverage park-based or partner funds to conduct a small-scale inventory of fish in ponds and creeks. INDU should meet or exceed the 90% level by the end of FY04.
- All other deficiencies (APIS and PIRO) are being addressed through funded inventories.

Birds:

- PIRO is currently at 74% verification on birds. Their deficiency is primarily in migrants including shorebirds. PIRO recently hired a permanent fulltime biologist who is proficient in bird identification and has an interest in a small-scale presence/absence assessment of migratory birds. Network staff and a challenge grant may help with this effort. Additionally, PIRO has an NRPP study beginning in FY2001 that focuses on forest biodiversity. PIRO staff are the principal investigators and they hope to verify a number of migrant birds. We expect that PIRO will exceed 90% verification with the above efforts.

- SACN is at 87% verification for birds. The park has an on-going breeding bird survey and they expect verification to reach 90% in time.
- The one other deficiency (GRPO) is being addressed through a funded inventory.

Mammals:

- VOYA has about 72% verification for mammals and is deficient primarily with felids, bats, and small mammals. VOYA currently has a contractor doing monitoring work on small mammals and they expect additional species will be verified in this on-going effort. The lynx survey that is funded for VOYA (appendix A) has a good chance of verifying bobcat. The network may use a challenge grant to leverage park-based funds or partner funds to conduct a small-scale inventory of bats in VOYA as an extension of the multipark bat inventory that is already funded. We hope to have mammals near the 90% level for VOYA by the end of FY04.
- All other deficiencies (GRPO, APIS and PIRO) are being addressed through funded inventories.

Unmet funding needs

Many needs will not be funded through this initiative. Our database of prioritized projects (outlined in Appendix G) can be queried to list, for example, all the next highest priorities in each park, or all additional amphibian projects, or all endangered species needs. If additional monies are made available through this I&M initiative, additional parks could be added to the current projects or new projects could be designed. In particular, an inventory on small mammals, which was ranked as the #3 priority in several parks, is sorely needed. We have prepared draft project statements for small mammals and for shorebird and colonial bird species, the number three priority for two parks. These projects can be quickly subjected to critical review and implemented.

DATA MANAGEMENT

New inventory data in the GLN will be archived at the network office and copies of all data will be provided to the parks where collected. CD's of electronic data sets, GIS products, and reports will be sent to the MWRO and WASO. We currently do not plan to develop an integrated data management system at the network level for inventory information. However, we will move toward a centralized, integrated system during the monitoring phase. At present, we will use the servicewide systems that are already in place to organize data and make information readily available. We will make spatial data more available through the existing NPS GIS clearinghouse and the Theme Manager, tabular data available through the NPS Dataset Catalog, and literature through the NPS Natural Resources Bibliography. The network coordinator, with advice from the GIS/data management team, will facilitate the continual progression of each park toward good data management practices and begin developing an integrated system at the network level. Our approach to handling old and new data is outlined more specifically below.

Old data

Network parks made great strides during FY 2000 in organizing old data sets and reports to update NPSpecies and NRBib (Tables 7,8,9). We will continue to do so by: 1) requiring investigators to provide historical information for NPS data management systems; 2) allocating 25% of the coordinator's time to data management; 3) acquiring the services of a University-based GIS/data management team leader; 4) hiring or augmenting park-based technicians to enter and catalog historical information; 5) augmenting regional and park-based GIS programs to work with the GIS/data management team to populate the GIS Theme Manager and GIS clearinghouse; and 6) hiring fulltime data management and GIS support during the monitoring phase. The network is well on the way to updating NPSpecies and NRBib and we will turn our efforts toward the Dataset Catalog, the GIS clearinghouse, and the GIS Theme Manager in the near future.

This network strongly agrees that there is a plethora of data to be mined from park files (NPS 1999); however, we hesitate to launch into full-scale efforts to modernize and make available such data without first assessing its integrity. We argue that much time can be wasted organizing data that is suspect due to poor collection techniques, inadequate documentation and small sample size (NRC 1992). Such data may be useful for updating species lists, but further use should be evaluated on a case-by-case basis. One network objective (Objective 3) is to develop a checklist for assessing old tabular and spatial data, and then adopting a policy for handling data of dubious quality. Old data will not be discarded; however, we will resist spending time managing data that is of marginal value at best and misleading at worst. Good historical data that is well documented and collected with appropriate methods will be made readily available to investigators and park managers. NRBib, the Dataset Catalog, the web-based versions of NPSpecies, the GIS clearinghouse, and the GIS Theme Manager will normally suffice as a first step toward organizing and presenting the availability of such information. This information, when made readily available, will be assimilated into on-going and future investigations if indeed it is worthy. Thus, we intend that old data will get “modernized” via a natural selection process. The network’s primary role will be to ensure it is readily available.

The GLNO expects to spend much time ensuring that information in NRBib, the GIS clearinghouse, and the Dataset Catalog is well maintained for the network parks. We view these three tools as the primary mechanisms for organizing, cataloging, and making available natural resource information. Additionally, we will assess the utility of the GIS Theme Manager in making old spatial information more available.

New data

Between 19 and 26% of the annual budget will support data management. Funding was inadequate to meet basic needs for field inventories so a data manager was not hired. We will hire a data manager and GIS support staff during the monitoring phase. Meanwhile, the coordinator and a GIS/data management team that includes University, regional, and park-based staff will play a major role in entering data obtained from new inventories. The responsibilities for entering and verifying new data in NPS systems will be split between each PI, the network and the parks (Table 13).

Table 13: Products and Deliverable Results. Responsibilities for products and deliverables that result from proposed inventories of biological resources in Great Lakes Network parks.

Product	Responsibilities ^a		
	Principal investigator	Network ^b	Park ^b
Annual progress report for each park being inventoried.	Submits annually through web-based IAR system.	Verifies completion.	Verifies completion.
Draft report for critical review.	Prepares and submits an electronic copy to the network coordinator.	Reviews for completeness and distributes to parks, MWRO, WASO and other peer reviewers.	Reviews to ensure park objectives have been met.
Final revised report in electronic form.	Submits to network coordinator in MS Word format.	Reviews and distributes to parks, MWRO, and WASO, adds to NRBib.	Reviews and adds to park library.
Electronic copy(ies) of database(s) in MS Excel or Access format.	Gets pre-approval from network coordinator. Submits completed database(s) to network coordinator.	Reviews and distributes to GIS/data management team, parks, MWRO, and WASO. Adds to Dataset Catalog.	Reviews and adds to park's data management system.
Electronic copy(ies) of Arcview compatible GIS data file(s) with meta data.	Gets pre-approval from the network coordinator. Submits completed file(s) to network coordinator.	Reviews and distributes to GIS/data management team, parks, MWRO, and WASO. Adds to Dataset Catalog, Theme Manager and Clearinghouse.	Reviews and adds to park's GIS system if applicable.
Updated species information on web-based NPSpecies database.	Provides consultation to ensure inventory data and other literature is interpreted correctly.	Enters the new inventory information into NPSpecies.	Verifies completion.
Cataloged voucher specimens.	Enters all specimens into the ANCS+ system.	Verifies completion.	Verifies completion.
Up-dated NRBib	Provides citations for work not currently listed in NRBib.	Enters new citations into the NRBib system.	Verifies completion.
Up-dated Dataset Catalog	Enters all data sets into the Dataset Catalog system.	Verifies completion.	Verifies completion.

^a = The Midwest Regional Office is also responsible for program oversight and critical science reviews.

^b = The network is responsible for GIS and tabular data entry and cataloging, though technicians may be park-based.

All investigators are expected to organize data into MS Access databases which are Arc View compatible. Metadata associated with these files will be required and must meet Federal Geographic Data Committee (FDGC) standards. The structure of databases, GIS

products, and their metadata files will be reviewed and pre-approved by the network GIS/data management team before investigators begin collecting data. After inventories are completed, draft submissions of data products (both GIS and tabular) will be critiqued by the GIS/data management team. At a minimum 5% of the digital data will be cross checked against the original data forms. Submissions which fail to meet a minimum standard of 95% accuracy will be rejected. We will require that data get analyzed and summarized in peer-reviewed reports, which will be cataloged in NRBib and/or other NPS systems as appropriate. Originals of all data and reports will be archived at the network office and copies will be provided to each park where the study occurred. CDs of data sets and reports will be given to the MWRO, and the NPS I&M program. The network coordinator and each park's resource manager will be responsible for ensuring compliance.

As we move towards the monitoring phase, we envision making much of our summary data available through a network web site.

VOUCHER SPECIMENS

For documenting species occurrences, voucher specimens represent the most concrete evidence available. However, a great deal of work is required to determine what vouchers already exist for species in each park. Some parks have their own well maintained collections (INDU) or know where many specimens are located (APIS, SACN). Additionally, specimen collections from neighboring lands held by state agencies, other federal agencies, and universities often serve to document species presence. The network, via a MWR effort, made initial contact with additional institutions likely to have vouchers for many species in GLN parks (see "voucher specimens" under "Assessing the current information base"). We will continue to locate large collections to reduce the need for new voucher specimens.

In our view, future contacts with most museums and herbariums across the nation should be done at the regional or national level. Curators at these institutions are often overworked and will have little time or money to conduct specimen searches for each of the 32 NPS networks. One search, initiated from the national I&M office regarding all NPS units, might result in a list of all known specimens within a certain geographic range of each park. The networks could then facilitate the linkage of useful specimens to parks.

What will be collected in current efforts

We will emphasize obtaining vouchers for presently uncollected species. The collection of live specimens will be at the discretion of each park, but in no circumstance will state or federally listed vertebrate taxa be collected live. Minimum collection of listed plant species will be made only after a search of collections reveals no voucher specimens exist.

Vouchers may be a complete specimen (e.g. a preserved vole), an identifiable part (e.g. a skull or tissue for MtDNA fingerprinting), a photograph (e.g. an endangered plant), a

sound recording (e.g. bird songs), a well-made plaster cast (e.g. the track of an elusive carnivore), or in some cases even sign (e.g. a nest or shell fragments from an endangered bird). A small portion of the network budget is allocated for curation of voucher specimens for new studies and the investigators are expected to provide additional resources (Table 6).

The following are suggested guidelines for each taxon for specimen collections in the Great Lakes Network parks.

Birds – Live bird specimens will normally not be collected as part of this inventory effort. There may be compelling reasons for collection in some circumstances, and exotic birds may be readily taken. Birds found dead and in identifiable condition will be collected. To the degree possible, we will ask field investigators to acquire voucher photographs, sound recordings, or other identifiable parts or sign (e.g. feathers, egg shells etc.).

Mammals - Where possible, mammals will be documented through means other than collecting new live specimens. For protected species, it is not appropriate; and for other species, it is not feasible to take complete voucher specimens (e.g. black bear or moose). On the other hand, it is desirable to have a complete collection of the small mammal assemblage for each park (i.e. microtines). Dead animals will be salvaged whenever possible and kept frozen on site until processing is possible.

Amphibians and reptiles - At a minimum, presence of reptile and amphibian species at each park should be documented using high-quality photography to produce close-up color slides. Animals found dead and in identifiable condition should be salvaged as voucher specimens. Depending on park needs, live animals may also be collected and preserved as voucher specimens. This may be important for unexpected species (e.g. range extensions) or for documenting deformities (e.g. frogs). The resource management specialist at each park must be consulted before live animals are collected.

Fish – Depending on park needs, live fish will be collected and preserved as voucher specimens. This is important for unverified species and for documenting the distribution of exotics (e.g. ruffe, *Gymnocephalus cernuus*). The resource management specialist at each park must be consulted before live animals are collected.

Vascular plants - Voucher specimens will be collected for all new vascular plant species encountered during surveys. At least one specimen of each species collected will be deposited in each park that has a herbarium. Duplicate specimens and specimens for parks that lack a herbarium will be deposited in an acceptable collection.

Where will specimens be placed

All specimens will be placed in a reputable collection agreeable to the park(s) where vouchers were collected. All voucher data will be cataloged in ANCS+ and NPSpecies databases. All collections will follow policies of collections management outlined in Chapter 5 of the NPS Natural Resource Management Guidelines (NPS 1991).

Some GLN parks are moving toward partnerships with specific institutions with an interest in individual parks and/or taxa. For example, the Olga Lakala Herbarium (University of Minnesota-Duluth) holds many plant specimens from VOYA and GRPO. This institution's location makes partnering with these parks highly desirable. The network office will help facilitate similar partnerships for future specimens.

QUALITY CONTROL

The GLN I&M program will be reviewed annually for quality assurance/quality control (QA/QC) during each fall steering committee meeting. The GLN steering committee consists of one representative from each network park, plus regional and servicewide I&M staff (Appendix D). This should provide good representation of concerns or problems from all levels. The regional I&M coordinator will be asked to conduct the review. At a minimum, the annual reviews will include:

- 1) Use of fiscal resources
- 2) Review of program objectives
- 3) Integrity (statistical quality and representativeness) of the data being collected
- 4) Tabular and GIS data management procedures
- 5) Quality of final products and the peer-review process
- 6) Applicability of results for conferences, journals and other professional communication channels

Individual project statements, which have been peer-reviewed, were written with the first step of QA/QC in mind (Irwin 1999). Prior to the start of each field season, the network coordinator will organize at least one conference call between investigators and park resource management specialists. Additional conference calls and/or face-to-face meetings will be arranged as necessary. The following points will be discussed as a minimum:

- 1) Objectives – is there still agreement on the previously stated objectives?
- 2) Methods – are the methods understood by all parties and are they adequate to meet the objectives?
- 3) Scheduling – are the dates for field work in each park set and are they agreeable to all parties?
- 4) Products and deliverables – does the investigator understand the products being requested and will they be delivered as stated? Were adequate progress reports submitted in a timely manner for studies continuing from previous years?
- 5) General concerns – are there logistical, communication, coordination or other concerns that need to be addressed?

Handling live wildlife

A potential negative side effect for any wildlife research project is injuring or stressing captured animals. Investigators should minimize stress by releasing animals as quickly as possible after capture. Rarely is there reason to mark animals as part of the initial inventory work, but marking may be critical to the success of future monitoring projects.

All procedures for handling animals will be reviewed and approved by an animal care and use committee of biologists from the network parks and the Midwest Regional Office.

Environmental compliance

Each park where a study is being conducted will be responsible for seeing that environmental compliance is completed. Parks can use their own compliance form or a network form will be provided. Copies of all compliance documentation will be provided to the network coordinator who will ensure compliance is completed before field work begins.

Wilderness issues

Several parks have designated Wilderness, Wilderness Study Areas, or proposed Wilderness. Wilderness values must be considered in all NPS operations including inventory and monitoring. The MWRO's Wilderness coordinator is on the GLN steering committee and will advise the network as needed.

CONCLUDING REMARKS

The Great Lakes Network took a park-based approach toward populating NPSpecies and will continue to be park-based where possible. While the network office will take a leading role in organizing and coordinating inventories, each park will be involved in field logistics, coordination and some level of data collection. The network office and the parks will be jointly responsible for review and acceptance of products. Additionally, we will continue to provide network funds to augment park-based technicians to enter both old and new information into approved NPS natural resource databases. GIS and data management needs for the current inventory effort will be met by having a network GIS/data management team consisting of a University-based team leader along with park, network, and regionally-based team members. This team will create proactive checklists of core elements that must be included in all GIS and database products. They will also review and approve of GIS and data management products before and after they are populated with field data. We will require investigators to provide new products that are compatible with NPS systems and we will strategically "purchase" additional products from regional, University, and park-based programs. Both data management and GIS capabilities of the network office will grow when monitoring money becomes available.

The nine GLN parks work together with a true spirit of cooperation and the number of parks is small enough that decisions can be reached through consensus. As a result, the steering committee, with a voting member from each park, will continue to be the primary decision making body. The network coordinator serves to organize the group, facilitate meetings, help focus attention on critical needs, ensure expert design, conduct, and review of studies, and coordinates the entry of data into servicewide databases.

Preparations for monitoring

At the GLN steering committee meeting on 30 and 31 August, 2000 we began preparing for the monitoring phase. We heard from two members of the GLN Inventory and

Monitoring Advisory Group regarding the potential direction of our monitoring program. Additionally, Dennis May, the USFS's project leader for forest health monitoring (FHM), provided information on how FHM may augment our monitoring needs. The value of collecting data related to a central theme was also discussed. Further exploration of our options will include input from regional I&M staff and other scientists at the spring steering committee meeting which is set to occur in April 2001. An analytical approach to group decision making (e.g. Schmoldt and Peterson 1999) will be used to objectively examine our monitoring goals and objectives.

As an additional preparatory step toward monitoring, we began listing the frequency, annual cost, and history of monitoring programs currently being conducted in each of the network parks. We expect future funds will be used to support new or enhanced monitoring, rather than supporting programs that are already funded through other sources. Through these steps and similar efforts, the Great Lakes Network will be well prepared for the monitoring phase of this initiative by the close of FY 2002 if not earlier.

LITERATURE CITED

(Note: Additional citations appear in project statements.)

- Blouch, R.I. 1984. Chapter 20: Northern Great Lakes States and Ontario forests. Pages 391-410 in L.K. Halls ed. White-tailed deer ecology and management. Wildlife Management Institute. Stackpole Books, Harrisburg, PA. 870 pp.
- Bright, R.C. 1988. Chapter 9. Mollusks. Pages 397-406 in B. Coffin and L. Pfannmuller eds. Minnesota's endangered flora and fauna. The University of Minnesota Press, Minneapolis, MN. 473 pp.
- Callison, C.H. 1967. America's Natural Resources. Natural Resources Council of America. The Ronald Press Co., New York, NY. 220 pp.
- Carson, R. 1962. Silent Spring. Houghton Mifflin Co., New York, NY. 368 pp.
- Colborn, T., D. Dumanoski, and J. Peterson Meyers. Our Stolen Future. Penguin Books Inc., New York, NY. 305 pp.
- Gerrard, J., and G.R. Bortolotti. 1988. The Bald Eagle: Haunts and Habits of a Wilderness Monarch. Smithsonian Institution Press, Washington, DC. 177pp.
- Geissler, P. 2000. National park inventories: Statistical methods. Available at www.mp1-pwrc.usgs.gov/fgim/cmodel.htm. 9/15/98 revision.
- Irwin, R. 1999. QA/QC guidance for NPS projects with modest funding levels: How to develop a detailed study plan which includes a quality assurance project plan. National Park Service. Draft memo dated August 19, 1999.
- Kallemeyn, L.W., and G.F. Cole. 1990. Alternatives for reducing the impacts of regulated lake levels on the aquatic ecosystem of Voyageurs National Park, Minnesota. US National Park Service. Voyageurs National Park, International Falls, MN. 99 pp.
- Karns, P.D. 1967. *Pneumoststrongylus tenuis* in deer in Minnesota and implications for moose. J. Wildl. Manage. 31(2):299-303.
- LaBounty, J.F. 1986. Lakes. Pages 237-254 in A.Y. Cooperrider, R.J. Boyd, and H.R. Stuart eds. Inventory and monitoring of wildlife habitat. U.S. Dept. of Inter., Bureau of Land Management. Service Center, Denver, CO. 858 pp.
- McNab, W.H., and P.E. Avers. 1994. Ecological subregions of the United States: section descriptions. Administrative pub. WO-WSA-5. U.S. Dept. of Agriculture, Forest Service, Washington, DC. 267 pp.

- Omart, R.D., and B.W. Anderson. 1986. Riparian habitats. Pages 169-200 in A.Y. Cooperrider, R.J. Boyd, and H.R. Stuart eds. Inventory and monitoring of wildlife habitat. U.S. Dept. of Inter., Bureau of Land Management. Service Center, Denver, CO. 858 pp.
- National Park Service [NPS]. 1988. National Park Service Management Policies. U.S. Dept. of Interior, National Park Service, Washington, DC.
- _____. 1991. NPS-77: Natural Resource Management Guidelines. U.S. Dept. of Interior, National Park Service, Washington, DC.
- _____. 1999. Guidelines for Biological Inventories. Inventory and Monitoring Program, National Park Service. www1.nature.nps.gov/sfancy, 9/28/99.
- National Research Council [NRC]. 1992. Science and the National Parks. National Academy Press, Washington, DC. 122 pp.
- Nute, G.L. 1931 (reprinted 1987). The Voyageur. Minnesota Historical Society, St. Paul, MN. 289 pp.
- Ray, A.J. 1987. The fur trade in North America: an overview from a historical geographical perspective. Pages 21-30 in M. Novak, J.A. Baker, M.E. Obbard, and B. Malloch eds. Wild furbearer management and conservation in North America. Ontario Ministry of Natural Resources. Ontario Trappers Association, Ontario, CAN. 1150 pp.
- Schmolt, D.L. and D.L. Peterson. 1999. Analytical group decision making in natural resources: Methodology and application. *Forest Science* 46(1):62-75.
- Schorger, A.W. 1970. The otter in early Wisconsin. *Wisconsin Academy of Science, Arts and Letters*. 58:129-146.
- Smith, J.W. 1996. Wildlife use of the Missouri and Mississippi River basins—an ecological overview. Pages 91-111 in D.L. Galat and A.G. Frazier eds. Overview of river-floodplain ecology in the upper Mississippi River basin. Vol. 3, Science for floodplain management into the 21st century. J.A. Kelmelis ed. U.S. Gov. Printing Office, Washington, DC. 147 pp.
- Snyder, F.L., M.B. Hilgendorf, and D.W. Garton. 1994. Zebra mussels in North America: the invasion and its implications. Ohio Sea Grant publication OHSU-FS-045. Ohio State University, Columbus, OH. 4 pp.
- Stolzenburg, W. 2000. America the bountiful. *The Nature Conservancy* 50(3):10-15.
- Theiling, C.H. 1996. An ecological overview of the upper Mississippi River system: Implications for post-flood recovery and ecosystem management. Pages 3-28 in

- D.L. Galat and A.G. Frazier eds. Overview of river-floodplain ecology in the upper Mississippi River basin. Vol. 3 Science for floodplain management into the 21st century. J.A. Kelmelis ed. US Gov. Printing Office, Washington, DC. 147 pp
- Thompson, D.Q., R.L. Stuckey, and E.B. Thompson. 1987. Spread, impact and control of purple loosestrife (*Lythrum salicaria*) in North American wetlands., Fish & Wildlife Service Research Report No. 2. US-DOI, Washington, DC. 55 pp.
- U.S. Fish & Wildlife Service [USFWS]. 1987. Migratory nongame birds of management concern in the United States—the 1987 list. Office of Migratory Bird Management. USFWS, Washington, DC. 27 pp.
- Weller, M.W. 1986. Marshes. Pages 201-224 in A.Y. Cooperrider, R.J. Boyd, and H.R. Stuart eds. Inventory and monitoring of wildlife habitat. U.S. Dept. of Inter., Bureau of Land Management. Service Center, Denver, CO. 858 pp.
- Wells, R.W. 1978. Daylight in the Swamp. NorthWord Press, Inc., Minocqua, WI. 241 pp.