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2003

Great Lakes Network Technical Report
GLKN/2003/07

Suggested citation: Route, B. 2003. Results of scoping workshops to identify monitoring issues for national park units in the Great Lakes Network. National Park Service, Great Lakes Inventory and Monitoring Network, Ashland, WI. 54806. Great Lakes Network Technical Report: GLKN/2003/07. 16p.

Results of Scoping Workshops to Identify Monitoring Issues for National Park Units in the Great Lakes Network

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Abstract: The National Park Service's Great Lakes Inventory and Monitoring Network held scoping workshops at each of the nine member park units to identify current efforts, new issues, and priority themes for long-term ecological monitoring. One hundred-fifty individuals, primarily park staff, participated in the workshops. Participants identified 214 ongoing monitoring efforts at the nine parks and listed 216 issues to consider for future monitoring. New issues can be grouped into 17 categories, including water quality, visitor use, land use change, exotic plants and animals, mammal populations, bird populations, invertebrate communities, and others. An attempt to prioritize new issues into programmatic themes resulted in similar groupings. The top three themes are water quality/ aquatic integrity, land use and landscape change, and exotic plants and animals.

Introduction

The National Park Service (NPS) is instituting a program to inventory and monitor natural resources at approximately 270 park units across the Nation. The program is being implemented by forming 32 "Networks" of parks that share common management concerns and geography. The Great Lakes Inventory and Monitoring Network (hereafter, referred to as GLKN or the Network) is composed of nine national park units in four states surrounding the western Great Lakes (Table 1). Six of the nine are situated on one of the Great Lakes, two are on major river systems, and one is associated with a mosaic of large and small inland waters along the Canada / United States border. Thus, fresh water is a prominent natural resource shared by these nine units. Nonetheless, because of the many land-based facilities and management concerns, terrestrial resource issues are equally important.

The Network received startup funding to plan its long-term ecological monitoring program in fiscal year 2002. The goal of the NPS program is to identify and monitor "Vital Signs" of park ecosystem health. Vital Signs are a select group of attributes that are particularly rich in information critical to understanding and managing NPS areas.

Vital Signs for the Great Lakes Network will be generated by combining ideas from these park-based scoping sessions with knowledge of subject matter experts. The Network will hold two focus workshops in winter 2003-04 to engage subject matter experts. Workshop attendees will use conceptual models that describe ecosystem function, system drivers, stressors, and linkages to further elucidate potential Vital Signs. A final list of Vital Signs will be determined through ranking criteria applied by Network staff and natural resource professionals from each park.

This report provides the results of scoping workshops held at parks within the Great Lakes Network. The purpose of the workshops was to list and prioritize ongoing and potential future monitoring efforts at each park. In particular, it was our desire to get the on-the-ground perspective of those having first-hand knowledge of park resources and management issues. Thus, the intended audience was park employees and close partners (a partner is defined as any state, federal, tribal, university, local government, or non-

governmental organization (NGO) who actively participates in monitoring, research, and management of natural resources in and directly adjacent to the network parks).

Table 1. ALPHA code, size, and primary water association of nine parks in the Great Lakes Network.

Park	ALPHA	Acres	Associated water body
Grand Portage National Monument	GRPO	710	Lake Superior
Indiana Dunes National Lakeshore	INDU	1,500	Lake Michigan
Mississippi National River and Recreation Area	MISS	53,776	Mississippi River
Apostle Islands National Lakeshore	APIS	69,372	Lake Superior
Sleeping Bear Dunes National Lakeshore	SLBE	71,199	Lake Michigan
Pictured Rocks National Lakeshore	PIRO	71,397	Lake Superior
St. Croix National Scenic Riverway	SACN	92,735	St. Croix River
Voyageurs National Park	VOYA	218,054	Inland lakes
Isle Royale National Park	ISRO	571,790	Lake Superior
Total		1,150,330	

Methods

In advance of each workshop, an Excel spreadsheet template was sent to each park's representative to the Network (park rep). The park reps were asked to complete the spreadsheet with the following information for all known monitoring efforts: project name, primary variables being monitored, monitoring interval, start year, responsible agency, approximate costs, and whether a written report was available. Spreadsheets were combined into one database of all known monitoring activities in and adjacent to the nine parks in the Network.

Prior to the workshops, park reps were provided with a scoping primer and a tentative agenda. Park reps advertised the workshop to park staff and partners they chose to invite. They also organized the meeting place and facilities. Workshops were scheduled so that two neighboring parks could be visited within a day of each other to reduced travel time and associated costs. The author and regional I&M staff traveled to each park and facilitated the scoping workshops.

Scoping workshops were organized into three separate sessions:

1) Information sharing – This was a two-way dialog to provide information and answer questions about the I&M program, the purpose of the workshop, and to review the current monitoring activities at the park.

2) Brainstorming – During this session the attendees discussed potential future monitoring efforts. To capture the broad spectrum of thoughts, participants were allowed to list whatever came to mind for monitoring. We considered all potential physical, chemical, and biological resources, including processes (e.g., nutrient flow). Participants were provided about two hours to brainstorm ideas. The result was a list of both current and proposed future monitoring efforts that could be

sorted and queried. All information was eventually transferred to an MS Access database.

3) Prioritization – Key staff and partners then prioritized current and future monitoring activities at the park. The intended audience for this session was the natural resource professionals and front-line management staff. At PIRO, where scoping workshops began, we attempted to apply ranking criteria to each monitoring issue. We found it difficult to apply the criteria, however, because objectives were not fully defined for the new issues, and the issues included both broad and specific concerns. Thereafter, each participant listed his or her top five "monitoring themes" that would provide data on resources they believed critical to their park. We defined "monitoring theme" as a group of related issues or indicators that might be monitored under the umbrella of one program. For example, water quality might be listed as a critical monitoring theme under which several indicators could be monitored (e.g., aquatic macroinvertebrates, water chemistry, water levels, and flow).

Results and Discussion

Participation and information sharing

The first scoping workshop was held at PIRO on January 8, 2002, and the last was held at APIS on May 13, 2002. Between 10 and 27 individuals participated in each workshop and most (60% overall) were natural resource professionals (Table 2). In all cases the park superintendent attended the workshop. Workshops were primarily attended by NPS employees although staff from eight partner groups also participated.

Table 2. Attendance and agency representation at nine scoping workshops aimed at identifying issues and themes for ecological monitoring at national park units in the Great Lakes Network.

	Total	Agency representation[1]				
Park	attending	NPS	USGS	FWS	DNR	Other
INDU	18	16	3	0	0	0
SLBE	27	25	1	0	1	0
SACN	15	15	0	0	0	0
MISS	20	11	0	2	1	6
APIS	17	11	2	3	0	1
GRPO	15	9	0	1	0	5
PIRO	10	9	1	0	0	0
VOYA	18	15	2	0	0	0
ISRO	10	10	0	0	0	0
	150	**121**	**9**	**6**	**2**	**12**

1= NPS= National Park Service; USGS= US Geological Survey Biological Resource Division; FWS= US Fish & Wildlife Service; DNR= State Department of Natural Resources; Other= includes Tribal (GRPO), Environmental Institute (APIS), and City, County, and private organizations (MISS).

The discussion on monitoring activities being conducted by the park and its partners resulted in the identification of several new programs. This was particularly valuable at MISS where 20 previously unidentified monitoring activities were provided by attending partners. MISS is the only park in the Network that does not currently have any monitoring conducted by staff, thus partner involvement at the meeting was invaluable. In total, we identified 214 on-going monitoring programs in the nine parks, ranging from seven at GRPO to 32 at both INDU and VOYA (Appendix A). We captured information on the primary variables being monitored, when possible, and frequency of data collection, start year, and contact information.

Brainstorming

Participants listed from 19 to 36 new monitoring issues for each park for a total of 216 (Appendix B). Many issues were redundant among parks and they can be grouped coarsely into 17 different categories (Table 3). Water quality monitoring greatly out-numbered other categories, followed by visitor use, exotic plants and animals, land use change, mammal populations, bird populations, and invertebrate communities, to name a few. Categorization of these issues is somewhat subjective because some could fit within more than one category (e.g., fish community monitoring is also an indicator of water quality).

Table 3. Monitoring issues by category showing the frequency that workshop participants mentioned issues within each category.

Type of monitoring	Frequency	Percent
Water quality	40	19
Visitor use	23	11
Exotic plants & animals	21	10
Land use change	16	7
Mammal populations	16	7
Bird populations	14	6
Invertebrate communities	10	5
Air quality	8	4
Climate/weather	8	4
Geophysical changes	8	4
Herpetofauna	8	4
Vegetation changes	7	3
Fish communities	5	2
Large-scale events	5	2
Wetlands	4	2
Processes (nutrient cycles)	3	1
Other	20	9
Total	**216**	**100**

Prioritization

Following the brainstorming sessions, natural resource staff and park managers grouped issues into monitoring themes and ranked their relative importance to the park. These themes were pooled across the nine parks and sorted by votes to provide a coarse ranking of prioritization for the Network (Table 4).

This ranking provides insight into park staff's perceptions of issues that need to be monitored. Again, water-related issues were listed most often. Similarly, exotic species and land use change were pervasive. However, this coarse ranking may not be a true representation of importance to park or Network-wide monitoring. Certain themes are inherently broader and thus listed more frequently because of the variety of issues contained within. For example, water quality includes issues ranging from human health to wildlife habitat. On the other hand, some themes may have been under ranked. For example, relatively few participants mentioned climate or weather, yet accurate data on weather patterns and long-term climate change are fundamental to the assessment of trends for many natural resources.

Difficulties with lumping and splitting are inherent when a diverse group of individuals list and prioritize issues. Regardless, water quality, exotic species, and land use change are obvious themes across the Network that require further consideration. It was important in this first effort to allow participants to brainstorm in a fairly unconstrained manner. This resulted in a more exhaustive list and helped ensure that potentially important issues were not overlooked. The thematic ranking in Table 4 should be viewed as a first cut by park and Network staff to identify critical program areas.

Future considerations

We expect to take the following steps to finalize a list of Vital Signs:

- October 7-9, 2003 – We will hold Technical Committee and Board meetings to discuss and adopt criteria and methods for ranking vital signs. Network staff will come to the meetings with recommended criteria and methods drawn from the experience of other networks and agencies. Network staff will also recommend a draft list (< 50) of "best bet" Vital signs that are based on park scoping, conceptual models, and the SOLEC indicators.
- October 27, 2003 – The Network's Science Advisory Group will meet to review and recommend strategies for ensuring good science products. The group will review and make recommendations on the criteria and methods for ranking Vital Signs.
- November through March, 2004 – We will hold two focus meetings with subject matter experts. One meeting will focus on air and water indicators and one will focus on terrestrial and wetland indicators. The two groups will use the conceptual models to discuss the relative merits of various indicators, taking into account measurability, sensitivity, and ecological significance.

Table 4. Potential monitoring themes identified by participants at nine scoping workshops at national park units in the Great Lakes Network. Rank scores and averages (Avg.) are based on votes by participants (see note 2).

	Proportion of participants ranking as a top five need [2,3]										
Monitoring theme[1]	**VOYA**	**GRPO**	**ISRO**	**APIS**	**PIRO**	**SLBE**	**INDU**	**SACN**	**MISS**	**Avg**	**No. parks**
Water quality including an index to aquatic integrity.	1.00	1.00	1.00	0.60	0.75	0.83	0.70	0.88	0.42	0.80	9
Landscape change, including land use and habitat fragmentation.	0.57	0.67	0.00	1.00	1.00	0.83	0.20	0.75	0.67	0.63	8
Exotic species, both aquatic and terrestrial.	0.71	0.67	1.00	0.40	0.75	0.50	0.70	0.38	0.50	0.62	9
Threatened, endangered and rare species of animals and plants.	0.14	0.67	0.67	0.80	0.50	0.67	0.90	0.25	0.58	0.58	9
Forest health (FHM) and habitat quality.	0.57	0.67	0.50	0.60	0.50	0.83	0.30	0.50	0.25	0.52	9
Human activities in the park including camping, trail use, facilities etc..	0.29	0.67	0.17	0.20	0.25	0.00	0.20	0.25	0.42	0.27	8
Weather / climate change.	0.14	0.00	0.17	0.40	0.25	0.00	0.10	0.00	0.00	0.12	5
Geologic processes - sandscapes, beach erosion.	0.00	0.00	0.00	0.40	0.00	0.50	0.00	0.00	0.17	0.12	3
Air quality / pollution.	0.14	0.00	0.17	0.20	0.00	0.00	0.30	0.00	0.00	0.09	4
Harvested species, fish, game, plants.	0.29	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.09	2
Ecosystem processes including nitrogen cycling and disease.	0.00	0.00	0.67	0.00	0.00	0.00	0.10	0.00	0.00	0.09	2
Aquatic high diversity areas including wetlands and river sloughs.	0.14	0.00	0.00	0.20	0.00	0.17	0.00	0.13	0.00	0.07	4

1 = Monitoring theme defined as a group of related issues or indicators that might be monitored under the umbrella of one program (i.e. water quality / aquatic integrity could include macroinvertebrates, water chemistry, lake levels, and stream flow).
2 = Participation in prioritization-setting: VOYA=7 GRPO=3, ISRO=6, APIS=5, PIRO=4, SLBE=6, INDU=10, SACN=9, MISS=12, Total= 62.
3 = Park alpha codes: VOYA= Voyageurs National Park, GRPO= Grand Portage National Monument, ISRO= Isle Royale National Park, APIS= Apostle Islands National Lakeshore, PIRO= Pictured Rocks National Lakeshore, SLBE= Sleeping Bear Dunes National Lakeshore, INDU= Indiana Dunes National Lakeshore, SACN= St. Croix National Scenic Riverway, MISS= Mississippi National River and Recreation Area.

Appendix A. Summary of current monitoring efforts by the National Park Service and its partners in the Great Lakes Inventory and Monitoring Network. Numbers reflect the total known projects in that category.

	PARKS									
Ecosystem Component	APIS	GRPO	INDU	ISRO	MISS	PIRO	SACN	SLBE	VOYA	TOTAL
Air Resources										
Meteorology			1	1				1		3
Air quality	1		1	1				1	1	5
Ozone			1	1						2
Mercury or other pollutants			1					1		2
Acid Rain			1	1						2
Fire Weather			1					1		2
Water Quality										
Physical: temp., cond., pH, clarity	1	1	1		3	1	1	1	2	11
Nearshore bacterialogical			1					1		2
Riparian - Riverwatch			1		1					2
River flow/River stage/Lake levels					2		2	1	1	6
Sedimentation					1			1		2
Geology and Landscape Processes										
Bluff erosion	1							1		2
Sandscape/Beach erosion	1		1			1	1			4
Fire/Habitat processes			3	2					1	6
Hydrology								2		2
Land use monitoring					3			1		4
Plants										
Selected plant communities	2	1	2		1	1		1	1	9
Exotic Plants	2		2	1	1	2	2	4	1	15
Sensitive, rare and threatened plants	2		3	1		1	1	3		15
Plant health & disease			1	1		2			2	6
Invertebrates										
Aquatic invertebrate communities					2				1	3
Sensitive, rare and threatened inverts			1				1	1		3
Gypsy moth	1		1	1		1		1		5
Zebra mussel						1	1	1	1	4
Other exotic invertebrates				1						1
Fisheries										
Salmonids – coaster brook trout, etc.		1		1		1				3
Nearshore Fisheries		1	1						1	3
Sportfish harvest									4	4
Fish Ecosystem					3		1		3	7
Exotic Fish						1				1
Reptiles & Amphibians										
Anuran call survey	1		1	1	1	1	1	1		7
Other herp community				1			2			3
Amphibian deformities				1						1
Birds										
Breeding bird survey	1	1	1	1	1	1	1		1	8
Migratory bird survey	1									1
Winter bird survey							1			1
Colonial waterbirds	1		1	1			1	1	2	7
Game birds	2	1								3
Bald eagle	1			1		1	1	1	2	7
Piping plover	1		1			1		1		4
Other avian T & E species							1	1		2
Special concern avian species			5	1				2	2	10
Mammals										
Ungulates	1	1	2		1			1	2	8
Beaver	1			1			1		2	5
Black bear	1					3			1	5
Timber wolf				1						1
Other mammal							2		1	3
Human uses										
Human impacts				1			3	1	1	6
Total	22	7	35	22	20	19	24	32	33	214

Appendix B. Issues and concerns captured at brainstorming sessions during workshops at nine national park units in the Great Lakes Network. Issues are organized by park and theme. The text is lightly edited to ensure original thoughts are retained.

Park	Theme	Park-proposed project/issue	Stated reason for monitoring
APIS	Air	Air quality	Entry point of nutrients and toxins.
APIS	Bird	Expand migratory bird work	Determine how significant different islands are for migratory birds.
APIS	Bird	Owls	Sensitive species.
APIS	Bird	Raptors	Sensitive species.
APIS	Climate	Climate	Provides context (past, present, and future) for many natural resource issues.
APIS	Climate	Global Climate Change	How does this relate to species presence/absence over time?
APIS	Climate	Phenology of environmental and biological parameters	To monitor trends in season length related to climate.
APIS	Events	Fire history	To develop natural disturbance regime and track landscape change in and adjacent to parks.
APIS	Exotics	Boat Hulls	Vector of invasive species.
APIS	Exotics	Earthworms	Monitor effects of these exotics on nutrient cycling, depletion of hummus, and plant community structure.
APIS	Exotics	Nuisance species	Effects of highly invasive species on the aquatic and terrestrial communities.
APIS	Exotics	Species diversity	Ecological integrity. Assess invasives effects on native species.
APIS	Fish	Fish communities	Community level monitoring shows linkages and changes in the ecosystem.
APIS	Geophysical	Bluff erosion (expansion/refine)	Lose of terrestrial habitat and implications to park facilities.
APIS	Geophysical	Landscape change	Understand landscape evolution/succession. Beaver ponds are an example.
APIS	Herptiles	Amphibians and Reptiles	National significance of declining herptiles, sensitivity, IBG
APIS	Inverts	Fresh water mussels	To assess effects of zebra mussels and other exotics on native mussels.
APIS	Inverts	Insects	Important prey bases, native/invasive issues, human use and pests.
APIS	Inverts	Lepidoptera	Rare and sensitive species, add to biological diversity.
APIS	Land use	Dark Skies	As an indicator of trends in human use and populations.
APIS	Land use	Land use change	Evaluate land use and disturbance in and outside of park to understand the significance to park resources and provide context.
APIS	Mammal	Mesocarnivors	Harvested species. Mink and otter are bioaccumulators and indicators of aquatic health.
APIS	Mammal	Small mammals	IBG, primary prey base for several species, role in forest change, nutrient recyclers.
APIS	Other	IBG	Gradient analysis- integrate the monitoring information that we already have, determine robustness, consider buffers.
APIS	Process	Fungus (underground parts)	Important nutrient recyclers.
APIS	Process	Nutrient cycling	Compare to mainland, compare forest types and landscape types.
APIS	Visitors	Ethnobotany	To monitor harvest by local tribes.

Appendix B. continued.

APIS	Visitors	Forest encroachment on historic clearings	Preservation of cultural landscapes.
APIS	Visitors	Soundscapes	Potential effects on wildlife and humans.
APIS	Visitors	Viewscapes	Human use and values of the park.
APIS	Visitors	Visitor use	Day use impacts. Compile trends in social behavior, use as reference for designing educational systems and better management.
APIS	Water	Contaminant concentrations in fish	Human and wildlife health concerns.
APIS	Water	Expand water quality monitoring	Public health on Meyers beach requires statistically valid samples.
APIS	Water	Lake levels	Implication to sandscapes, erosion, cultural resources, and facilities.
APIS	Water	Zooplankton and Benthos	Cost effective because analysis can be done locally for zooplankton.
APIS	Wetlands	Wetlands	Tension zones where species composition is most sensitive to change.
GRPO	Air	Air quality	Band is considering a station. MN had a station at Hovland for acid rain. Mercury and dioxin are concerns from Thunder Bay. GRPO may be a year-round site that is up air stream from ISRO. Haze cam is being operated by the band (mwhazecam.com)
GRPO	Bird	Cormorants	Indicators of Lake health. Islands off Pigeon Bay are full of cormorants.
GRPO	Bird	Geese	Management concern over lawn area that is used by geese.
GRPO	Bird	Swallows	Nesting on buildings so they have been removed. Human health issue.
GRPO	Events	Large scale perturbations	Impacts of insect infestations, blow downs, fire etc.
GRPO	Exotics	Invasive species	Purple loosestrife in a few places. Visitor introductions. Need to monitor current management. Gypsy moth being monitored by MN Dept of Ag. GM is a hot spot for Gypsy moth. Earthworms, grasses…
GRPO	Exotics	Noxious weeds	Regulated by state, sow and Canada thistle
GRPO	Herptiles	Amphibians	Good indicators of wetland health.
GRPO	Inverts	Insects	Potential human and wildlife health problems with transmission of disease.
GRPO	Land use	Land use	MNDNR flies every 3 years and provides photos. Need consistent use of air photos to look at change over time. More data mining needs to be done and create GIS layers.
GRPO	Mammal	Beaver	Portage history is built in part on the fur harvest industry. Beaver pond at upper end of the portage should be monitored. Redo survey done by Smith in mid 80s.
GRPO	Mammal	Lynx	Federally-listed as threatened.
GRPO	Management	Small mammals	Human health concerns. Management of open areas has changed and may have caused local increase.
GRPO	Other	Habitat typing	Monitor the change in habitats (forest and aquatic).
GRPO	Visitors	Campgrounds (2 sites)	Impacts of visitors, fire wood collection, pit toilet, erosion.
GRPO	Visitors	Canoe landing	Cultural resources, wild rice beds, soil compaction, stream bank erosion..
GRPO	Visitors	Plants used traditionally	Effects of management activities, harvest by band members and/or illegal harvest. Sweet grass distribution and abundance.
GRPO	Visitors	Rendezvous	High density of visitors at one time causing vegetation change, soil compaction, fire pits…

Appendix B. continued

GRPO	Visitors	Trail use and condition	Erosion, compaction, wetlands… Are management actions, or lack of, meeting expectations?
GRPO	Visitors	Visitation to spiritual sites	Is the Monument adding to visitation, should they monitor the use?
GRPO	Water	Beach monitoring of water quality	Swimming at public beach near the park. Bay is greener than in the past. Monthly coliform monitoring is needed.
GRPO	Water	Water quality	Use organisms and physical components (water levels) to monitor. Macro inverts, chemical bioaccumulation in organisms
GRPO	Wetlands	Wetlands	Expand on monitoring being done by the band. Have indicators (inverts, plants) which will be correlated with chemical data.
INDU	Air	Air quality	INDU is on the low end of the clean air continuum for the Network.
INDU	Air	Atmospheric deposition	Vehicle exhaust; should we be augmenting what the state monitors?
INDU	Exotics	Agricultural insects	Local agricultural practices bring in exotic species or natural species in greater numbers.
INDU	Exotics	Aquatic invasives	Assessment of inland ponds. DNR does Great Lake.
INDU	Exotics	Cladophora	Impact offshore waters and nearshore. Kills natural flora and fauna. Being studied as a potential indicator of change in the Great Lakes (SLBE PhD student).
INDU	Exotics	Forest pests and disease	Gypsy moth, Asian long-horned beetle etc.
INDU	Exotics	Pets	Feral animals and the impact on other wildlife.
INDU	Exotics	Terrestrial invasives	Assessing management activities which may cause influx of species.
INDU	Exotics	zebra mussels	Well established in the park.
INDU	Geophysical	Geomorphology	Lake shore becoming shallower. Possible result of beach nourishment. Beach sediment (texture) is changing.
INDU	Inverts	Insects	As vectors of disease (mosquitoes, ticks) also natural populations may be indicators of ecosystem health. Important for visitors and staff. Partnerships can help.
INDU	Inverts	Pollinators	Bees and butterflies are important pollinators and add to biological diversity.
INDU	Land use	Corridors	Map corridors important for wildlife and plants - both invasives and natural species.
INDU	Land use	Land use change	Fragmentation and how it affects various species and ecosystem. Species being separated from other habitat.
INDU	Mammal	Air deer survey	Extremely high numbers of deer in some areas of the park influence vegetation.
INDU	Management	Restoration	Assess restoration efforts for a number of activities (wetlands, old home sites, parries
INDU	Other	Animals of special concern	Herptiles, other rare birds and mammals that are declining or that indicate change in habitat quality.
INDU	Plant	Nonvascular plants	As indicators of air quality and for nutrient cycling.
INDU	Plant	Vegetation management	Monitoring linked to vegetation management goals. To identify management needs.
INDU	Water	Geohydrology	Stream dynamics and how it affects ecology of the area (movements of sediments, pollutants, nutrients). USGS monitoring the larger streams. Data available.
INDU	Water	Ground / drinking water	Merge programs done by RM and Maintenance. Staff. Human health issue.
INDU	Water	Pathogens and bacteria	As indicators of water quality for swimming (human contact).
INDU	Water	Visitor health at beaches	Being funded by EPA. Measuring E. coli (distribution). Looking at 13 beaches in the nation.
ISRO	Bird	Bird migration patterns	ISRO may be important as a migrational stop over.

Appendix B. continued.

ISRO	Climate	Climate	Impacts on wildlife populations, plant populations. Measure winter severity index.
ISRO	Climate	Climate change	Eoctone boundaries are great for detecting change (ISRO) is on boundary.
ISRO	Events	Fire	Fire as an agent of change.
ISRO	Exotics	Earthworms	Soil change, exotic species.
ISRO	Exotics	Exotics	Both plants and animals.
ISRO	Fish	Herring populations	Have observed a decline in YOY herring. Mike Hoff (USGS) has done some work.
ISRO	Inverts	Insects	Changes in populations will affect birds, may indicate aquatic integrity.
ISRO	Land use	Night skies	Impacts of local park and external (GM) cities on night skies. Class I air space.
ISRO	Mammal	Small mammals	Important prey base and of high interest in investigations of island biogeography.
ISRO	Mammal	Wolves	High visibility species and have dramatic impacts on moose and vegetation complex.
ISRO	Other	Change	For example wetlands are vulnerable to changes.
ISRO	Other	Disease	Human health, wildlife populations.
ISRO	Plant	Forest succession	Has implications for habitat for a variety of species.
ISRO	Process	Ecosystem	Function of ecosystem processes (nitrogen cycles… drivers of the ecosystem.
ISRO	Visitors	Human impacts	Fishing pressure and the impact on lake (inland and Superior) systems. Currently no effort to monitor fishing pressure. Is in the GMP as one of 3 significant statements.
ISRO	Visitors	Impacts	Impacts on ambient sound levels, also visual impacts. Index to "naturalness".
ISRO	Visitors	Naturalness	Index to "naturalness" and how it changes with increasing human use in and adjacent to the parks.
ISRO	Visitors	Park management	How park management brings in staff and visitor impacts (internal and external impacts).
ISRO	Visitors	Subsistence use	Certain plant species are harvested. Two tribes have interest in subsistence but little use currently.
ISRO	Visitors	Visitor experience	No wake zones are in the GMP.
ISRO	Water	Aquatic systems integrity	Lake Superior fisheries community dependence Input to state DNR on harvest management.
ISRO	Water	Aquatic systems integrity	Inland lake fish communities, fisheries management, harvest management
ISRO	Water	Contaminants	Mercury deposition, other toxics (PCBs…), human use of fish (6 lakes currently need advisory)
ISRO	Water	Lake levels	Shoreline erosion, docks, boating, recreation and park staff, effect on rare plants and other biota (chorus frogs) that depend on distance to water.
ISRO	Water	Mussels/sponges	Freshwater mussels and sponges as indicators of aquatic environment.
ISRO	Water	Water quality	Pollutants from boaters, visitors, (direct linkage GMP)
ISRO	Water	Water temp	Have observed changes.
ISRO	Water	Wave action	Wave height affects animal and plant populations.
MISS	Bird	Migratory waterfowl	Pool 2 - enhancement going to be done so this would show before and after; consistent with F& W Service on refuge
MISS	Exotics	Exotic species mussel i.e., zebra mussel	Distributions, extent of reproduction and other data needed. Tributaries and boat traffic should be tracked.
MISS	Fish	Unique fish communities	To monitor non-game species more closely.
MISS	Geophysical	Erosion	Stability and geomorphology of the river and islands.

Appendix B. continued

MISS	Herptiles	snakes	Semi-aquatic; terrestrial species are more important in this region
MISS	Herptiles	turtle nesting sites	along the river; shoreline armored and/or heavy use by humans
MISS	Herptiles	turtles	Wabasha area Pool 4 and 5 there is some information going on (back to ~ 1989); also mud puppies
MISS	Inverts	Native mussels	Last big river refuges for some species in Midwest; have baseline data but need full monitoring.
MISS	Land use	Land cover	Track percent impervious surfaces to assess runoff and habitat changes over time.
MISS	Land use	Wildlife corridors	Availability of terrestrial vertebrate movement corridors from uplands across highways and railroads to get to the river.
MISS	Management	Restoration	Oak regeneration; Ramsey county parks and other areas; loss of the resource due to deer browse.
MISS	Other	All taxa inventory	Similar to MN County Biological Survey. To help initiate long-term monitoring.
MISS	Plant	Rare plants	For example, bluff communities - several rare plant species exist there.
MISS	Process	processes	For example, mercury changes (to methyl mercury) via detritus.
MISS	Visitors	Recreation use	Impacts to the resource from increase in various types of recreational use (e.g., eroding banks from boat wakes).
MISS	Water	aquatic vegetation	Pool 2 consistent with LTRM (like in Pool 4)
MISS	Water	commercial navigation	barge, etc. information from Corp to develop monitoring plan e.g., how many fish are ground up; fleeting areas changes due to increased residential use, etc. (moving into more sensitive areas of the river)
MISS	Water	water quality	hormone disrupters, Prozac, caffeine, etc.
PIRO	Air	Air quality	Contaminants. Either an air quality station or biological monitoring
PIRO	Bird	Raptors	Indicator of habitat quality, human use.
PIRO	Climate	Weather patterns	Need to know long-term weather patterns for numerous natural resource concerns (weather severity index, lake levels, ice on/off… May be able to link with Firepro data collection.
PIRO	Events	Events	Documentation of drastic events (insect invasions, wind blow down, fire, bluff erosion)
PIRO	Events	Events	Network staff and park staff use consistent method of observing and entering observational data on major ecological events. Must be GIS based.
PIRO	Geophysical	Soils	Level 2 NRCS soils mapping.
PIRO	Inverts	Lepidoptera	Ecological indicator, community level analysis…
PIRO	Land use	Land use	Inventory and potential monitoring of land use and special habitats (wetlands others). Air photos would best address the needs of the park. May show beach changes, use of the IBZ.
PIRO	Mammal	Beaver	Keystone species, habitat change.
PIRO	Other	Change	Organisms that indicate change (algae, inverts (i.e., sponges, mussels…) perhaps an IBI
PIRO	Other	Harvested species	Monitor harvest levels and populations of wildlife to work with state DNR on seasons and bag limits; also Native American use (plants and wildlife).
PIRO	Other	Harvested species	Fish harvest levels and potential effects on the communities.
PIRO	Other	Human health	Need to track indicators of trends in contaminants in the environment such as bald eagles, otters, mussels, turtles, lichens…

Appendix B. continued

PIRO	Other	Prey species	Prey base for predators. Includes mostly mammals and some birds (grouse).
PIRO	Other	Wildlife health	Deformities, disease etc.
PIRO	Visitors	Human dimensions	Understanding of how humans affect the resources through behaviors and perceptions (tourism is growing in the area).
PIRO	Visitors	Naturalness	Index to "Naturalness" or environmental / wilderness integrity.
PIRO	Visitors	Park management	For example, use of wood preservatives and the affects on the environment.
PIRO	Visitors	Use areas	Monitor the effects of humans at micro sites (camp sites, picnic areas, parking areas, roads). Compare with FHM plots.
PIRO	Water	Acid rain, nitrates, DOC (chemical)	Periodically revisit Bob Stottlemier's sites to monitor acid rain/snow and output in streams.
PIRO	Water	Odonata	Dragonflies as ecological indicators of aquatic health, habitat quality.
PIRO	Wetlands	Wetlands	May be several indicators related to the quality of wetlands and other special habitats.
SACN	Air	Air quality	Class II airshed - no station in park; need regional data; haze; largest point source (Allen S King power plant) on river.
SACN	Air	Lichens	Bio-indicator of pollutants; baseline study done in 1989-1990.
SACN	Bird	Raptors	Red Shouldered Hawk listed by MN and WI as species of concern; St Croix is important regional habitat for hawks.
SACN	Climate	Weather monitoring	Acquire current data and fill in gaps; fire control; climate variability and change; local patterns.
SACN	Exotics	Invasive aquatic animals	Periodic monitoring of rusty crayfish
SACN	Exotics	Invasive aquatic plant monitoring	Incomplete inventory; Augment current monitoring; No established protocol
SACN	Fish	Community-based fisheries monitoring	Need more inclusive monitoring than state game species monitoring
SACN	Geophysical	River geomorphology	Channel stability; bank erosion; sandbar migration; shifting habitats;
SACN	Herptiles	Turtles	Nesting sites; Some State T&E (Blanding's and Wood);
SACN	Inverts	Butterflies	Rare species; Indicators of habitat health; Pollinating species in decline; charismatic microfauna
SACN	Land use	Landscape monitoring	Easements; Land use changes; Effects within entire watershed; Viewsheds; Multiple partnerships; Habitat fragmentation; River crossings (pipelines, bridges, power lines)
SACN	Mammal	Bats	Mosquito control; potential sensitive species; could be some important roosting areas.
SACN	Mammal	Small mammals	One baseline study of prey base and as disease vectors; Floodplain mammals of special interest (how survive floods?).
SACN	Other	Monitoring of aquatic critical habitat	Supports a diverse community of freshwater mussels and fish; WI is designating critical habitats - contact Randy Hoffman; Critical areas identified in recovery plans - "Mandates";
SACN	Plant	Forest Health and Change Monitoring	Gypsy Moth and other stressors; Forest Service has some plots in Riverway.
SACN	Plant	Vegetation Community Monitoring	Community structure (habitat) for rare plants and animals.
SACN	Water	Large woody debris	Affects flow; habitat for fish, invertebrates & turtles.

Appendix B. continued

SACN	Water	Long-term monitoring of mussels	Key component and indicator of aquatic ecosystem; Poor recruitment; Sediment may be a linkage;
SACN	Water	Monitoring of dragonflies	New species identified in St. Croix which may be regionally endemic; Indicator of aquatic health; Easy to monitor
SACN	Water	Riverine Backwaters	High biological diversity areas; pristine;
SACN	Water	Water quality	Expand upriver to include less impacted rivers; Develop baseline to determine level of impairment downstream; Freshwater mussels depend on water quality - entire ecosystem health; Includes all physical, chemical, and biological parameters
SLBE	Bird	Raptors (woodland species)	Monitor use by falconers. Potential partnership with Michigan DNR.
SLBE	Bird	Songbirds	Indicator of change.
SLBE	Exotics	Pitcher's thistle	Augment current monitoring
SLBE	Geophysical	Geophysical monitoring	River mouths, shoreline, dredging activities, up river depth, river bottom, boat launch sites. Artificial and natural
SLBE	Herptiles	Salamanders	As an addition to Frog and Toad Survey.
SLBE	Land use	Land use change	Fragmentation, development in/out of park (watershed), wildlife corridors,
SLBE	Mammal	Beaver	Keystone species, habitat change.
SLBE	Mammal	Rare mammals	Indiana bat (not documented yet), cougar (recent indications), pine marten, shrew (MI DNR).
SLBE	Management	Cultural Landscapes	Assess and monitor management activities on cultural landscapes (exotics, native wildlife).
SLBE	Management	Habitat	Old fields changing to forest or not. Assess current management activities.
SLBE	Other	Data Mining	For example, data from partners on exotics coming in this direction.
SLBE	Other	Lake Michigan Ecology	High public interest. Monitor: aquatic vegetation, exotics, cladophora, alewives, beach fires.
SLBE	Other	South vs. North Manitou	Species diversity (songbirds, orchids, other species sensitive to change)
SLBE	Plant	Beach Bark disease	Kills the trees. SLBE has lots of beach. Epicenter not far away. Non-native??
SLBE	Plant	F H M	Monitor all species, valuable as integrated system
SLBE	Water	Aquatic Inverts	Overall stream monitoring
SLBE	Water	Freshwater mussels	Monitoring as aquatic integrity (MI. Natural Features Inventory has protocol?)
SLBE	Water	Inland Lake Monitoring	Baseline Monitoring, aquatic vegetation, photo monitoring, measure exotics increase
SLBE	Water	Rapid Bio-Assessment	
SLBE	Water	River Monitoring	Crystal River, Platte River Baseline data
SLBE	Wetlands	Wetlands	Monitoring, assessment and integrity
VOYA	Air	Lichens	Bioindicator of air quality. Class I airshed.
VOYA	Bird	Vultures, cormorants, pelicans	Populations seem to be increasing.
VOYA	Bird	Water birds	Trends. [Potential indicators of aquatic health.]
VOYA	Climate	Climate change	Ice out/in data may be of value as indicator of changes in climate.
VOYA	Events	Blow down	Ecological effects, fire potential.
VOYA	Exotics	Aquatic invasives	Released bait. Not allowed but not enforced.
VOYA	Exotics	Terrestrial exotics	All plants and animals (earthworms).

Appendix B. continued

VOYA	Fish	Fish community structure	Species other than the harvested species as an indicator of the aquatic ecosystem.
VOYA	Geophysical	Soils	Moisture, N availability, how it drives the vegetation.
VOYA	Herptiles	Herptiles	May be indicators of several human impacts. Harvested under state regs.
VOYA	Land use	Baseline human impacts	Sites, sounds, etc. from human use in and around the park.
VOYA	Land use	Land use	Land use in and around the park.
VOYA	Mammal	Predators	Top of the food chain, indicator of ecosystem health.
VOYA	Mammal	Ungulates	Prey base for predators and major drivers of vegetation.
VOYA	Visitors	Houseboats visitor counts	Human use of the park.
VOYA	Water	Algal blooms	Species composition, time of year. Human health potential.
VOYA	Water	Aquatic inverts	Interior lakes vs. large lakes. Mayflies etc.
VOYA	Water	Dragonflies	Deformities
VOYA	Water	Mustelids	River otters and mink are good indicators of the aquatic ecosystem.
VOYA	Water	Native mussels and clams	Indicator of water quality, exotics
VOYA	Water	Ponds and creeks	Quality of the water in inland ponds and creek systems. Biotic health.
VOYA	Water	Water quality	Hydrocarbons, E. coli, resorts around Lake Kabetogama, dumping by house boats (gray water)
VOYA	Water	Wetlands	Water levels issue. Important for lots of species. Bogs are also critical.