



Seventh Annual
**WESTERN GREAT LAKES
RESEARCH CONFERENCE**

April 1-2, 2009



**Great Lakes Visitor Center
Ashland, Wisconsin**



**7th Annual
Western Great Lakes Research Conference**
April 1-2, 2009



The Western Great Lakes Research Conference provides a forum for information and idea sharing between researchers and managers of national parks and other public lands throughout the Western Great Lakes area.

This conference provides a forum for resource managers, their cooperators, and other interested parties to exchange information about natural and cultural resource research and management activities at parks and other protected areas in the western great lakes region.

Conference steering committee members include: **Stella Collier**, Great Lakes–Northern Forest Cooperative Ecosystem Studies Unit, University of Minnesota; **Joy Marburger**, National Park Service–Great Lakes Research and Education Center, Indiana Dunes National Lakeshore; **Bill Route**, National Park Service–Great Lakes Inventory & Monitoring Network; **Wendy Smith**, National Park Service–Great Lakes Research and Education Center, Indiana Dunes National Lakeshore; **Jerrilyn Thompson**, National Park Service–Great Lakes-Northern Forest Cooperative Ecosystem Studies Unit; and **Julie Van Stappen**, National Park Service–Apostle Islands National Lakeshore.

CONFERENCE SPONSORS

NPS Apostle Islands National Lakeshore

NPS Great Lakes Inventory & Monitoring Network

NPS Great Lakes Research and Education Center

Great Lakes-Northern Forest Cooperative Ecosystem Studies Unit

University of Minnesota (CESU Host)



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**7th Annual
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CONFERENCE SCHEDULE – DAY 1

Wednesday, April 1, 2009

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11:30-1:00	REGISTRATION	
1:00 – 1:20	WELCOME SPEAKERS	
1:20 – 1:40	Three Decades Of Monitoring Colonial Waterbirds On National Park Service Lands In The U.S. Great Lakes: Trends And Unique Aspects Linda R. Wires* and Francesca J. Cuthbert, University of Minnesota– Department of Fisheries, Wildlife and Conservation Biology	48
1:40 – 2:00	Breeding Bird Monitoring at Isle Royale National Park, Michigan: 1996-2008 Alexander Egan, NPS–Isle Royale National Park	27
2:00 – 2:20	Avian Migration on Minnesota's North Shore Heidi Seeland*, Anna Peterson, and Gerald Niemi, University Of Minnesota Duluth-Natural Resources Research Institute	44
2:20 – 2:40	Great Lakes Piping Plover Recovery: National Park Service Contributions Francesca J. Cuthbert* and Erin A. Roche, University of Minnesota– Department of Fisheries, Wildlife and Conservation Biology	24
2:40 – 3:00	Apparent Nest Abandonment As Evidence For Breeding Season Mortality In Great Lakes Piping Plovers Erin A. Roche*, Francesca J. Cuthbert and Todd W. Arnold, University of Minnesota–Department of Fisheries, Wildlife and Conservation Biology	42
3:00 – 3:20	BREAK AND POSTER VIEWING	
3:20 – 3:40	Monitoring the Ecological Effects of Lake Level Management on Voyageurs National Park Using Beavers (<i>Castor canadensis</i>) Steve Windels, NPS–Voyageurs National Park	47
3:40 – 4:00	Effects of 2000 rule curve on the Reproductive Success of the Common Loon (<i>Gavia immer</i>) in Voyageurs National Park James Paruk*, Northland College; Aleya Nelson and David Evers, Biodiversity Research Institute; Lori Siegel, Siegel Environmental Dynamics; Jen Fox and Steve Windels, NPS–Voyageurs National Park; and Cory Cournard MacNulty, Voyageur’s National Park Association	40



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CONFERENCE SCHEDULE – DAY 1

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4:00 – 4:20	Wetland response to water level regulations at Voyageurs National Park James Meeker*, Northland College; and Alan Harris, Northern BioScience	37
4:20 – 4:40	Effects of Predator Scent on Use of Foraging Trails by Beavers Bill Severud* and John Bruggink, Northern Michigan University–Biology Department; Jerry Belant, Mississippi State University–Dept. of Wildlife and Fisheries; and Steve Windels, NPS–Voyageurs National Park	45
4:40 – 5:00	Utilizing the Incident Command System Principles and Processes to Respond to Invasive Species Bill Bolen, USEPA Great Lakes National Program Office	20
5:00 PM	END FOR THE DAY	

**Please join us for a social gathering at the
Deepwater Grill and Brew Pub in downtown Ashland!**



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CONFERENCE SCHEDULE – DAY 2

Thursday, April 2, 2009

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8:00-8:05 AM	WELCOME BACK	
8:05 – 8:25	Connecting Research, Education, and Outreach through Research Internships Joy E. Marburger, NPS–Great Lakes Research and Education Center, Indiana Dunes National Lakeshore	36
8:25 – 8:45	Historic Preservation and Environmental Conservation John H. Broihahn, Wisconsin Historical Society	21
8:45 – 9:05	Butternut Conservation: A Case of Successful Engagement of Public Agencies and Private Landowners M.E. Ostry* and M. Moore, USDA Forest Service, Northern Research Station; and M.E. Mielke, USDA Forest Service, Northeastern Area State and Private Forestry	39
9:05 – 9:25	A Great Lakes Beach Analysis Tool Utilizing Geographic Information Systems (GIS) Rick Jodoin*, Lori Fuller and Sheridan Haack, U.S. Geological Survey, Michigan Water Science Center	32
9:25 – 9:45	The use of Technology to survey, map and evaluate Great Lakes Shipwrecks. Mark Gleason, Discovery World, Milwaukee, WI	29
9:45 – 10:00	BREAK AND POSTER VIEWING	
10:00 – 10:20	Implementation of a long-term vegetation monitoring program at Voyageurs National Park Suzanne Sanders* and Jessica Grochowski, NPS–Great Lakes Inventory & Monitoring Network	43
10:20 – 10:40	Herp Inventory and Monitoring in the Western Great Lakes Gary S. Casper*, Great Lakes Ecological Services; and Stephen J. Hecnar, Lakehead University–Dept. Biology	22



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10:40 – 11:00	Monitoring and Management Recommendations for Prevention and Early Detection of Asian Earthworms and Reducing the Spread of European Earthworms in Working Forests of the Western Great Lakes Region. Cindy Hale*, The Natural Resources Research Institute; Andy Holdsworth, MN-DNR Policy, Research & Planning Services; Jim Barott, U.S. Forest Service–Chippewa National Forest; and Rebecca Knowles, Leech Lake Band of Ojibwe–Dept. of Resource Management	31
11:00 – 11:20	Odonata of Coastal Fens and Poor Fens Adjacent to Lake Superior in Wisconsin Robert B. DuBois*, Julie M. Pleski, William A. Smith and Eric J. Epstein, Department of Natural Resources, Bureau of Endangered Resources	25
11:20 – 11:40	Chronic toxicity of diphenhydramine hydrochloride and erythromycin thiocyanate to <i>Daphnia magna</i> J.R. Meinertz, T.M. Schreier and J.A. Bernardy, U.S. Geological Survey, Upper Midwest Environmental Sciences Center; and J. Franz, Winona State University	38
11:40-1:40 PM	LUNCH AND POSTER VIEWING	
1:40 – 2:00	Early Detection Monitoring Approaches For Exotic Aquatic Species In Great Lakes Harbors And Embayments Anett S. Trebitz *, John R. Kelly, Joel C. Hoffman, Greg S. Peterson and Corlis W. West, U.S. Environmental Protection Agency, Mid-Continent Ecology Division	46
2:00 – 2:20	Zooplankton assemblages at Voyageurs National Park: establishing a pre-<i>Bythotrephes</i> baseline for interior lakes Ryan Maki*, NPS–Voyageurs National Park; Brenda Moraska Lafrancois, NPS, St. Croix Watershed Research Station; Joan Elias, NPS–Great Lakes Inventory and Monitoring Network; Marte Thabes Kitson and Donn Branstrator, University of Minnesota, Duluth	35
2:20 – 2:40	Invasion status and ecological effects of an exotic zooplankter (spiny water flea, <i>Bythotrephes longimanus</i>) in Great Lakes National Parks W. Charles Kerfoot*, Foad Yousef and Emily Ninmann, Department of Biological Sciences and Lake Superior Ecosystem Research Center, Michigan Technological University	33



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3:00 – 3:20	Brook Trout Population Evaluation in Otter Creek Brett Fessell, Grand Traverse Band of Ottawa and Chippewa Indians	28
3:20 – 3:40	BREAK AND POSTER VIEWING	
3:40 – 4:00	Developing microsatellite markers to understand the genetic diversity of wild rice in Lake Superior coastal habitats Anthony Kern, Northland College	34
4:00 – 4:20	A diatom-based model for environmental monitoring of lakes in the Western Great Lakes National Parks Joy M. Ramstack*, Mark B. Edlund and Daniel R. Engstrom, St. Croix Watershed Research Station, Science Museum of Minnesota; and Joan Elias, NPS–Great Lakes Inventory and Monitoring Network	41
4:20 – 4:40	Interactive Effects Of Hydromanagement, Land Use and Climate On Water Quality Of Border Lakes In Voyageurs National Park And Vicinity Mark Edlund* and Joy Ramstack, St. Croix Watershed Research Station, Science Museum of Minnesota; Claire Serieyssel, University of Minnesota; and Larry Kallemeyn, USGS, CERC-International Falls Biological Station	26
4:40 – 5:00	Hydrologic Impacts of Projected Future Climate Change in the Lake Michigan Region Keith Cherkauer* and Vimal Mishra, Purdue University; and Tushar Sinha, Arizona State University-School of Life Sciences	23
5:00 PM	CLOSING	



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POSTER PRESENTATION ABSTRACTS

(Alphabetized by lead author)



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Poster Abstract

Water Quality Monitoring in Voyageurs National Park

Joan Elias, National Park Service—Great Lakes Inventory and Monitoring Network, 2800 Lake Shore Drive East, Ashland, WI 54806 (joan_elias@nps.gov)

The Great Lakes Inventory and Monitoring Network (GLKN) is one of 32 National Park Service monitoring networks throughout the United States, which together include over 270 national park units. The GLKN consists of 9 park units, including Voyageurs National Park (VOYA). The inland lake resources of GLKN parks are astounding, numbering in the thousands. VOYA, alone, contains nearly 300 lakes >1 ha.

GLKN began monitoring water quality in Voyageurs National Park (VOYA) interior lakes in 2006. Monitoring consists of sampling 8 index lakes 3 times annually during the open water season, and 14 additional lakes on a longer rotation, as funding permits. We selected the index lakes to span gradients of lake type (based on classification by MDNR), geographical location within each park, visitor use, lake basin morphometry, and watershed size. Parameters measured include a core suite (profiles of temperature, pH, conductivity, and dissolved oxygen), water clarity, water level, chlorophyll-a, dissolved organic carbon, alkalinity, major anions and cations, and nutrients.

Results of 3 years of monitoring show that the index lakes of VOYA are dilute and poorly buffered. Mean pH values range from a low of 6.4 (Shoepack Lake) to 7.7 (Little Trout Lake). Most lakes are mesotrophic, with relatively low nutrient and chlorophyll levels. Nevertheless, several lakes exceed EPA reference criteria for the ecoregion. Lake water levels generally decline 10 – 30 cm within each summer, but average levels have risen 2006-2008.

Summary results of the first 3 years of monitoring are compared with results of previous projects. The challenges of implementing a long-term monitoring program are discussed.



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Poster Abstract

Oak Wilt on Federal Lands: What Can You Do? (Part 1: Intro and 1st case study)

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Oak wilt, caused by *Ceratocystis fagacearum*, is a fungal disease that causes rapid death of oaks in the red oak subgroup by clogging the vascular system of the host tree. The disease also affects white oaks; however pathogen distribution and development may be limited in the host tree, resulting in lower impact. Although the origin of *C. fagacearum* is still unknown, most pathologists believe that it is not native to the North Central region. Oak wilt is widely distributed throughout much of the region, yet there is considerable area with a significant red oak resource that does not have oak wilt disease.

Opportunities for management are closely tied to activities that interrupt the spread of the oak wilt pathogen. Overland spread, which establishes new oak wilt centers, occurs when sap-feeding beetles carry spores from fungal mats on infected trees to wounds on healthy trees in the spring. Overland spread is prevented by avoiding wounding and destroying potential spore producing trees. Once an oak wilt center is established, tree-to-tree spread occurs through connected root systems. Root graft spread causes an expansion of the pocket of disease, and can be prevented by disrupting the root graft connections. The following case studies on federal lands represent the various options for oak wilt control.

Fairy Falls is a unique 40 acre parcel along a small tributary to the St. Croix River near Stillwater, Minnesota. This parcel, managed by the National Park Service as part of the St. Croix National Scenic Riverway, contains sensitive geological features and rare plants, plus a myriad of invasive species.

Oak wilt was identified on the site in 2007, and appeared to be limited in occurrence. NPS responded by establishing a vibratory plow line around the known oak wilt infection center, killing all oaks within the treatment line, and removing and chipping all potential spore producing trees (PSPTs). The adjacent neighbor invested in similar response. In 2008, surveys identified additional oak wilt pockets on both the NPS and adjacent landowner's properties. In February 2009, horse logging was used to minimize site disturbance while removing the PSPTs. Additional surveys and possibly additional vibratory plow work will be implemented in 2009. The U.S. Forest Service has provided technical and partial financial assistance for implementation of this project.

(See the following abstract for two additional case studies.)



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Poster Abstract

Oak Wilt on Federal Lands: What Can You Do? (Part 2: 2nd and 3rd case studies, and summary)

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In the summer of 2001, oak wilt was discovered in a timber sale unit on the Chequamegon-Nicolet National Forest near Waubesa Lake, Wisconsin. A selective harvest during the susceptible period for oak wilt infection had allowed the oak wilt pathogen to infect the cut stumps and wounds, resulting in widespread distribution of disease throughout a high value oak stand. Because the site was of glacial till origin and contained many boulders, use of a vibratory plow to sever root grafts would have been difficult and ineffective. A novel treatment was used in which the infected trees and a buffer of non-symptomatic trees around these infected trees were cut for timber, and then the stumps were pulled from the ground with an excavator. This ruptured the root graft connections between infected and healthy trees. The treatments exposed much mineral soil and resulted in stumps and boulders littering the landscape, creating many microsites similar to naturally created tip-up mounds. During the spring following treatments, white pine seedlings were planted under the remaining oak and associated overstory. By summer, forbs and shrubs had effectively concealed the stumps and boulders, and greatly softened the visual impacts of the treatments. By the second summer following treatment, a carpet of aspen and birch seedlings, along with some red oak and maple seedlings had germinated. More oak wilt was found in the area in 2002, requiring additional treatment of about 7,700 trees in fall of 2004. Subsequent follow-up treatments have been much smaller in scale, and the appearance of new diseased trees has been greatly reduced. In this situation, the value of timber products removed has offset the cost of treatment.

In August 2007, oak wilt disease was discovered at Sand Lake Campground on the Huron-Manistee National Forest. Sand Lake Campground is a highly developed and popular campground in Michigan's Lower Peninsula. Approximately 70 trees across 20 acres within the 70 acre campground had become infected following pruning operations conducted during the susceptible period for oak wilt. During the dormant period of 2008, infected trees, as well as approximately 50 additional trees, were identified for removal to reduce the potential for local spread of oak wilt. Stumps of infected trees were ground out in order to mechanically disrupt the transmission of the fungus to adjacent healthy trees and to improve aesthetics of individual camp sites. Material from infected and adjacent trees was removed and destroyed. The 2008 growing season showed the treatment to be an unqualified success. Approximately 5 additional trees were confirmed with oak wilt by late summer. These trees and susceptible oaks within approximately 50 feet of infected trees were removed and chipped, and a vibratory plow line was installed to sever root grafts. The site will be monitored and retreated annually to ensure that oak wilt does not become a major cause of mortality in the campground. Costs were covered by U.S. Forest Health Protection (FHP) suppression funding.

If you have oak wilt on a federal site which you are managing, you can consult with U. S. Forest Health Protection pathologists to help you plan a response. Consider the value or importance of the oak resource at risk, and the likelihood of successful treatment. Treatment generally involves steps to prevent both overland spread and root-to-root spread of the disease. The cost of treatment may be partially offset by federal FHP suppression funding; in other situations, cost of treatment must be borne by the local land management unit.



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Poster Abstract

**A Summary of the Indiana Dunes National Lakeshore Vegetation Mapping Project,
USGS-NPS Vegetation Mapping Program**

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The USGS-NPS Vegetation Mapping Program (VMP) is a cooperative effort by the U.S. Geological Survey (USGS) and National Park Service (NPS) to classify, describe, and map vegetation of national parks to provide baseline vegetation information to the NPS Inventory and Monitoring Program. The USGS Upper Midwest Environmental Sciences Center, NatureServe, and NPS Indiana Dunes National Lakeshore (INDU), have completed the classification and mapping of plant communities of INDU and immediate surroundings.

Photointerpreters and ecologists collaborated to describe National Vegetation Classification (NVC) System vegetation types and determine how best to map them. The team collected vegetation sampling plots and accuracy assessment (AA) sites, validating 35 NVC associations plus other NVC alliance and formation types not described at the association level.

Sixty-six map classes were derived to map vegetation and land cover, with 55 representing NVC vegetation types and 11 depicting general land cover. Features were interpreted from 1:12,000-scale fall-dated color infrared aerial photographs using zoom stereoscopes. The interpreted data were spatially referenced, making the spatial database layers usable in a GIS software program.

The vegetation map layer provides over 4,000 polygons of detailed attribute data covering 13,258 ha. Of the area mapped, 3,549 polygons (87.7%) represent NVC vegetation types, encompassing 8,421 ha (63.5%) of the total map extent. Forest types dominate the vegetative landscape (NVC types), populating 52% of the NVC polygons and covering 62.5% of the NVC area, largely dominated by the Black Oak Forest association.

A thematic AA study was conducted of map classes representing NVC types. Results present an overall accuracy of 78.2% (Kappa index of 76.9%) based on data from 469 AA site data. Most individual map class themes exceed the VMP standard of 80% with a 90% confidence interval.

The mapping project delivers many geospatial and vegetation data products in hardcopy and digital formats. These products consist of an in-depth project report discussing methods and results, which include descriptions and a dichotomous key to vegetation types, map classification and map class descriptions, and a contingency table showing AA results. They also include representative ground photos of vegetation types; database of vegetation plots and AA sites; field data sheets; aerial photograph prints and images; hardcopy maps; and a geodatabase of vegetation types (map layer), fieldwork locations (vegetation plots and AA sites), aerial photo indexes, and a project boundary.



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Poster Abstract

Range expansion and movement of round goby in the St. Louis River Estuary

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The round goby (*Apollina melanostomus*) is a benthic fish, native to the Ponto-Caspian Region of Eurasia. In the last 15 years this species has become naturalized in the Laurentian Great Lakes with dramatic impacts on local ecology. Round gobies were first discovered in the Duluth-Superior Harbor, Lake Superior, in 1995. As populations inhabiting the most ideal habitat of the Duluth-Superior Harbor increase, range expansion into less desirable locations is expected. In another study through the Mensinger lab, Bergstrom et al. established the distribution and range of the round goby throughout the Duluth-Superior Harbor and portions of the lower St. Louis River from 1998 to 2004. To collect this data Bergstrom et al. utilized a semi-balloon bottom trawl. Bergstrom et al reported, by 2004, round gobies had expanded throughout the Harbor and upstream to river kilometer 13, but remained absent in western Lake Superior. The round gobies affinity for rocky substrate precludes the use of trawling in much of its preferred habitat. This study utilizes standard 16" minnow traps to continue monitoring upriver migration of round gobies and evaluate the effectiveness of this sampling method. Using this method round gobies have been identified to river kilometer 36; indicating either additional upstream introductions or a greater rate of expansion than previously thought.



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Poster Abstract

Monitoring Invasive Exotic Plants in the Great Lakes Network using Multi-Criteria Risk Models

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Multi-criteria risk models were developed to assist with the monitoring and management of ten target invasive exotic plants within the Great Lakes Network of the National Park Service (NPS). The goal of the predictive models was to guide annual monitoring of exotics as part of the Vital Signs program to detect ecosystem change. The models utilize Geographic Information System data to assess the risk of invasion across a Park at three phases of invasion: introduction, establishment, and spread. A unique risk model was tailored to the biological and environmental preferences of each species, as well as the plant's potential modes of dispersal. The final models and a user manual were made available to the NPS for use. The user manual guides not only installing and running the models, but also customizing models by adjusting risks, parameter weights, and the addition of new parameters. This allows for the incorporation of new and updated GIS data over time. The user manual also aids the user in customizing the models not only to fit a specific Park, but to more accurately predict risk in a single habitat type or area of interest.



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Poster Abstract

Preserving National Park Resources on America's Freshwater Coast: The National Park Service Strategy for the Great Lakes

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Phyllis M. Ellin, National Park Service, c/o U.S. EPA - Great Lakes National Program Office, 77 W. Jackson Blvd. (G-17J), Chicago, IL 60604 (Phyllis_Ellin@nps.gov)

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As freshwater seas, the Great Lakes have not always been considered part of the 'ocean' community, but they share many features with their salt water marine counterparts (e.g., large size, coastal processes, cultural and economic importance, maritime history, and traditions, etc.). Recognizing these similarities, the *U.S. Ocean Action Plan*, completed in 2004 in response to Executive Order 13366, specifically included the Great Lakes in its guidance for strengthening and coordinating U.S. ocean policy. The NPS, in response to this *U.S. Ocean Action Plan*, launched an initiative intended to focus attention on ocean and Great Lakes park marine resources. The 2006 *NPS Ocean Park Stewardship Action Plan* calls for an increased understanding of marine ecosystems and human interactions, restoration of impacted natural and cultural resources, and new measures to enhance park resource management efforts. Fostering partnerships, strengthening the capacity of the NPS to explore and protect marine resources, and engaging the public in park stewardship are fundamental to the Action Plan. Promoting stewardship of Great Lakes national park resources is not new. A comprehensive strategy is needed that looks to the future, integrates all programs (including natural and cultural resources, resource and visitor protection, interpretation and education, facility management, planning, and partnerships), calls for a focused effort of collaboration within and between parks, facilitates partnerships, and addresses the complex issue of global climate change. Regionally focused conservation strategies are increasing. The attention focused on the Great Lakes through the Great Lakes Regional Collaboration established through Executive Order 13340, and the intergovernmental strategy document it produced in 2005 have prompted related questions about how the priorities of the various agencies active in the Great Lakes, including the NPS, complement these efforts. This Strategy provides the Midwest Region with the vision to become a leading partner in the conservation and restoration of marine resources and maritime heritage that define our Great Lake parks. The Strategy identifies ways to sustain and enhance these activities and to incorporate them into the larger framework of the U.S. Ocean Action Plan and the NPS Ocean Park Stewardship Plan. Specific goals and action items for the four topical areas identified in the *NPS Ocean Park Stewardship Action Plan* will be addressed in the Midwest Region Great Lakes Strategy:

Establish a seamless network of Great Lakes parks, sanctuaries, refuges, and reserves

Discover, map, and protect Great Lakes national parks

Engage the public, communities, and visitors in Great Lakes national park stewardship

Increase technical capacity for Great Lakes national park exploration and stewardship

Some of the specific actions identified in the Midwest Region Great Lakes Strategy can be implemented and achieved within months, while others are more complex and will involve longer timeframes to fully implement. The strategy will be periodically reviewed and revised as action items are completed and as additional tasks are identified. The strategy can be downloaded at the NPS Nature and Science website:

<http://www.nature.nps.gov/water/marine.cfm>



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Poster Abstract

Invasive Plant Control Prioritization and Update: Indiana Dunes National Lakeshore

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Indiana Dunes National Lakeshore is listed as the sixth most diverse unit out of all 391 units of the National Park System in the nation with 1,494 recorded species of plants, but of those, 304 (20%) are non-native (NPSpecies). In order to preserve this rich species diversity, invasive plant control in combination with a number of restoration projects is an integral part of the Resource Management Division of Indiana Dunes National Lakeshore. In this extremely fragmented park consisting of over 10,000 federal acres and limited personnel resources, it is imperative that we determine our priorities to maximize our restoration and control efforts.

Of the 300 + non-native plants at the national lakeshore, twenty have been identified as high priority targets for control, as they pose the most serious threats to the park. In addition to these select twenty species, the park is also focused on early detection and rapid response. During field season 2008, the park located and treated five species for the first time: *Euphorbia cyparissias* (Cypress spurge), *Gypsophila paniculata* (Baby's breath), *Cynoglossum officinale* (Houndstongue), *Artemisia vulgaris* (Mugwort), and *Humulus japonicus* (Japanese hops).

Since a majority of the park has been invaded by at least one species, prioritizing the areas to be treated is a crucial step in effectively controlling invasive plants. Places with special features, such as those with unique habitats or with endangered species, as well as areas that are minimally impacted have been identified as priority work areas. When resources are available, invasive plant populations within these areas are mapped using GPS units to increase the parks knowledge base. After treatment, all plants are mapped and data are collected using GPS/GIS to monitor the success of treatment and to aid in retreatment as necessary. How these priorities have been determined, what they are, and the progress that has been made at Indiana Dunes National Lakeshore will be presented.



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Poster Abstract

Deer Management at Apostle Islands NL - Efforts to Protect Rare Plant Communities

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Deer Management at Apostle Islands NL - Efforts to Protect Rare Plant Communities
Deer management within the park is complex. The park's 21 islands have a diverse deer history. A few islands were not historically impacted by browsing and contain rare forest communities dominated by Canada yew (*Taxus Canadensis*), a species nearly extirpated on the mainland. Hunting is allowed within the park's enabling legislation and deer management is closely coordinated with both the State and local tribes. A Wildlife Management Plan and EA for Harvestable Species was recently completed. Consistent with the plan, the park has begun to implement aggressive culling activity to reduce the numbers of deer on islands that are being heavily impacted by overbrowsing. Various techniques are being used including: State hunting (hunting is allowed within APIS); NPS cullers; volunteer cullers; and the use of clover traps. This paper will discuss the park's approach to this difficult and complex natural resource issue as well as lessons learned.



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Poster Abstract

Integrating Research, Monitoring, and Education in the Great Lakes Network

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Participants representing five national parks in the Great Lakes Network met for a week in December of 2008 to brainstorm ways to integrate research and monitoring efforts with education and interpretation at their respective parks and in the network as a whole. Workshop participants included resource managers, researchers, interpreters, classroom teachers, and staff members from both the Great Lakes Inventory and Monitoring Network and the Great Lakes Research and Education Center. Outcomes from this meeting will be shared.



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ORAL PRESENTATION ABSTRACTS

(Alphabetized by lead author)



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Oral Abstract

**Rapid Response to Invasive Species utilizing Incident Command System
Concepts and Principles**

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Effective response to Invasive Species has been hindered by the lack of coordination between affected agencies and organizations primarily due to the constraints posed by jurisdictional authorities. This situation is further aggravated by the inexperience of the responding authorities to seamlessly integrate their respective research, monitoring, and response assets into an organized structure that can surmount jurisdictional impediments and create an ability to control and eliminate the threats posed by invasive species. While effective response to fires, emergencies, and other disasters has been demonstrated by the Emergency Response community, researchers and scientists have had little exposure to the system by which multi-jurisdictional and multi-disciplinary organizations conduct these operations. The current federally mandated and thoroughly vetted system used for over 30 years that has proved successful is known as the Incident Command System.

This presentation will introduce the audience to the basic framework of the Incident Command System and provide further detail on the functional roles of the command and general staff positions inherent to this structure. A particular emphasis will be placed on the operational, planning, logistics, and administrative support functions that can provide scientists and researchers the capability to detect, assess, and provide management recommendations for response to Invasive Species. As part of the planning process, the audience will be presented with the "Planning P" a system by which they can effectively organize their activities and derive response actions to control and/or eliminate the threat posed by Invasive Species to the Great Lakes ecosystem. To conclude the presentation, the audience will be presented with the lessons learned from the first two Rapid Response exercises conducted in the basin and future recommendations will be solicited for further rollout of this emergent program.



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Oral Abstract

Historic Preservation and Environmental Conservation

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The goal of Historic Preservation is the preservation of historic places through actual site protection or through documentation. Historic Preservation in the United States traces its origins to the 18th century. These early efforts were championed by individuals and private organizations and focused on the protection and preservation of American revolutionary sites, the sites associated with the men involved in the revolution, and to a lesser degree the preservation of monumental Native American earthworks. While private individuals and private organizations still play a critical role, much of the historic preservation activities since the 1960s have been mandated or encouraged by Federal and State legislation. Five historic preservation programs administered by the Wisconsin Historical Society preserve historic places and by doing so help protect the environment. The Rehabilitation Income Tax Credit Program encourages the re-use of historic structures which supports the use of a wide range of existing infrastructure. This program reduces materials hauled to land fills and these projects use smaller amounts of new building material. The National Register of Historic Places encourages the preservation of historic structures, historic landscapes, cultural sites, and archaeological sites. The Archaeological Property Tax Exemption Program and the property tax exemption available for Native American burial mounds and other cemeteries rewards landowners for protecting important archaeological and cultural places. Since these sites tend to be adjacent to wetlands, lakeshores, stream and river confluences, and river valley bluff tops, their preservation helps protect environmentally sensitive areas. Recent efforts at some Native American mound groups have focused on the restoration of these unique cultural landscapes. Wisconsin's Maritime heritage initiative helps protect the Great Lakes by merging water, land, and the built environment into an integrated landscape and by encouraging "green" heritage tourism.



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Oral Abstract

Herp Inventory and Monitoring in the Western Great Lakes

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Thorough inventories and effective monitoring programs are of fundamental importance in determining the status of species and tracking changes in abundance and distribution, especially as regards ongoing rapid climate change. We completed herp inventories for the Lake Superior Basin, and for four western Great Lakes parks: Apostle Islands, Isle Royale, Pictured Rocks, and Sleeping Bear Dunes. These projects included historical reviews followed by targeted field work to develop species lists and identify information gaps. We also tested several monitoring methods for herps in the Lake Superior Basin and the Milwaukee River Basin, and make recommendations for improving inventory and monitoring programs through occupancy modeling and use of detection probabilities for determining minimum sampling effort.

Herp inventories included historical reviews collecting and summarizing all available specimen, literature, and observational data, followed by targeted field surveys. Annotated species lists were developed for each area with status comments, along with detailed databases of all known records. The Apostle Islands harbors 6 salamanders, 11 anurans, 2 turtles, and 4 snakes, with species lists developed for each island. Isle Royale harbors 3 salamanders, 6-7 anurans, 1 turtle, and 2 snakes. Pictured Rocks harbors 5-6 salamanders, 5-7 anurans, 3 turtles, and 4-5 snakes. Sleeping Bear Dunes harbors 5-7 salamanders, 9-11 anurans, 4-7 turtles, 10-12 snakes, and 1 lizard. The Lake Superior Basin harbors 7 salamanders (plus unisexual *Ambystoma*), 12 anurans, 6 turtles, 10 snakes, and 2 lizards.

Herp monitoring was investigated by performing intensive surveys and developing detection probabilities (DPs) for various methods and species, then calculating the minimum number of samples required for 95% confidence in detecting species if present. We obtained useful DPs for at least one method for 24 species for the Lake Superior and Milwaukee River basins. DPs varied widely among species, methods, and sites. Several species (e.g. spring peepers, green frogs, newts) were highly detectable with similar DPs among regions, making them valuable for use as regional large-scale indicators. Other species, especially snakes and turtles, had more variable DPs, generally decreasing with higher latitudes. Although lower DPs make monitoring challenging for these species, range contraction or expansion will be readily noticeable only near range peripheries. For programs with sampling effort below the 95% confidence level, we recommend utilizing proportion-of-area-occupied modeling to correct for false negatives when modeling occupancy trends. This methodology allows for use of data from existing monitoring programs for large scale analyses (i.e. calling frog surveys). We identify overlaps in methods for detecting species and make recommendations for achieving best return on effort for monitoring programs. For inventories we provide recommendations for minimum sampling effort for high confidence in detection.



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Oral Abstract

Hydrologic Impacts of Projected Future Climate Change in the Lake Michigan Region

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The Great Lakes are an important source of fresh water, recreation resource and transportation corridor for the Midwestern United States and Canada. The timing and quantity of fresh water inputs and how those may change under projections of future climate change are important for understanding how conditions, including river flows, and lake levels, within the region may be affected. Water quality and the density and diversity of in-stream habitats are responsive to changes in the distribution of daily streamflow, something not typically included in studies of climate change impacts. Projections of precipitation and air temperature changes in the four states surrounding Lake Michigan from the IPCC AR4 were downscaled and bias-corrected before being used to drive a large-scale hydrology model and produce maps of surface runoff and baseflow. These were then routed along drainage networks for regional rivers, and hydrologic metrics describing aspects of the distribution of daily flows important for hydrology and in-stream ecology were computed. The impact of regional climate change projections on early- (2010-2039) and mid-century (2040-2069) streamflow was highly variable; however, by the late-century period (2070-2099) annual streamflow was found to have increased in all rivers.

Seasonally, winter and spring flows increased significantly by the late-century period, but summer flows become more variable with a decrease in low-flows and an increase in peak-flows. The number of days with flows above the annual mean-flow (TQmean) decreased in summer, but flashiness (R-B Index) increased.



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Oral Abstract

Great Lakes Piping Plover Recovery: National Park Service Contributions

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The Great Lakes population of Piping Plovers was listed as federally endangered under the US Endangered Species Act in 1986. Historically, Piping Plovers nested along shoreline throughout the Great Lakes (population estimates range from 300-800 pairs) but declined to 11-14 pairs, all within the state of Michigan by the mid-1980s. This decline is largely attributed to habitat loss and degradation due to recreational and residential development. Other factors include human disturbance and scientific collecting prior to listing. Important breeding habitat for this species exists on National Park Service land in Michigan (Sleeping Bear Dunes National Lakeshore, SLBE) and Wisconsin (Apostle Islands National Lakeshore, APIS). The purpose of this presentation is to: 1) provide a population perspective of plover population trends since listing and 2) identify contributions of National Park Service land to recovery of the Great Lakes population of Piping Plovers.

To document breeding activity or presence of non-breeding plovers, we surveyed all Michigan shoreline. Wisconsin surveys were completed by personnel from the USFWS Green Bay Field Office, Bad River Tribe, The Nature Conservancy, Apostle Islands National Lakeshore, and Wisconsin Department of Natural Resources (WI-DNR). Each pair of nesting plovers discovered was monitored until adults left the area. We captured and banded adults and chicks according to procedures stipulated by our USFWS permit.

As of 2008, the known breeding population was 63 pairs distributed in Michigan, Wisconsin and Canada. Since the banding program was initiated, individuals from both NPS sites have consistently shown strong fidelity to breeding locations but movement among sites (WI, MI) by first time breeders and adults also occurs. NPS lands provide habitat for a significant percent of the Great Lakes population. For example, in 2008, almost 50% of pairs nested at SLBE and APIS. Sleeping Bear is notable at a population level for number of chicks fledged (40% in 2008) and number and diversity of sites with breeding habitat. Although APIS fledged fewer chicks (5% in 2008) than SLBE, it is an extremely important recolonization site that links MI and WI.



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Oral Abstract

Odonata of Coastal Fens and Poor Fens Adjacent to Lake Superior in Wisconsin

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We sampled adults and exuviae of Odonata in eleven coastal fens and poor fens near Lake Superior in Douglas, Bayfield, and Ashland counties in Wisconsin to determine species that were breeding in these areas, and gain knowledge about their relative abundances, flight periods, and nymphal habitats. The flora in these fens was characterized by mats of *Sphagnum* mosses, a variety of ericaceous shrubs, and a number of sedges, among which *Carex lasiocarpa* Ehrhart (slender sedge) was most dominant. We averaged seven visits per site from early June through September, 2004, to cover the flight periods of most species of Odonata at this latitude. Fifty species of Odonata were identified at the sites, 33 of which exhibited evidence of breeding. Species commonly breeding in the fens included *Lestes disjunctus* Selys (northern spreadwing), *Coenagrion resolutum* (Hagen in Selys) (taiga bluet), *Enallagma hageni* (Walsh) (Hagen's bluet), *Nehalennia irene* (Hagen) (sedge sprite), *Aeshna canadensis* Walker (Canada darner), *Williamsonia fletcheri* Williamson (ebony boghaunter), *Leucorrhinia frigida* Hagen (frosted whiteface), *L. glacialis* Hagen (crimson-ringed whiteface), *L. hudsonica* (Selys) (Hudsonian whiteface), *Libellula quadrimaculata* Linnaeus (four-spotted skimmer), *Sympetrum obtrusum* (Hagen) (white-faced meadowhawk), and *S. vicinum* (Hagen) (autumn meadowhawk). Eight uncommon species were found to breed in at least one of the fens, including *Lestes eurinus* Say (amber-winged spreadwing), *Aeshna sitchensis* Hagen (zigzag darner), *A. tuberculifera* Walker (black-tipped darner), *A. verticalis* Hagen (green-striped darner), *Somatochlora incurvata* Walker (incurvate emerald), *W. fletcheri*, *Nannothemis bella* (Uhler) (elfin skimmer), and *Sympetrum danae* (Sulzer) (black meadowhawk). *A. sitchensis*, found at an insular fen on Stockton Island, was a first state record for Wisconsin. *W. fletcheri* and *S. danae* were found to be more common in these habitats than previously thought, causing their rarity status with the Natural Heritage Inventory of the Wisconsin Department of Natural Resources to be relaxed, and they will no longer be actively tracked. Emergence and flight periods of Odonata in coastal peatlands began at least a week later than in similar inland peatlands in these counties.



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Oral Abstract

Interactive Effects Of Hydromanagement, Land Use and Climate On Water Quality Of Border Lakes In Voyageurs National Park And Vicinity

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In the past century, the border lakes in and near Voyageurs National Park have been subject to multiple anthropogenic and natural stressors. Stressors have included logging, damming, hydromanagement, population growth, beaver activity, and climate change, which can be broadly categorized into three groups: land use, hydromanagement, and climate. In order to determine how these stressors have impacted the lakes, we developed a before-after control-impact paleolimnological study. Lakes included in the study were the dammed lakes of Namakan, Rainy, and Kabetogama, which are all in the Voyageurs National Park region, and undammed Lac La Croix, which is upgradient in protected wilderness lands. One sediment core was retrieved from each lake and analyzed for ²¹⁰Pb inventory, loss-on-ignition, and diatoms. Multiple statistical analyses (species richness and turnover, cluster analysis, multivariate ordination, diatom-inferred water quality, and variance partitioning) were used to provide a more comprehensive picture of how diatom communities in the lakes were affected uniquely and interactively by the different stressors. Among the various stressors, land use generally explained the greatest amount of variance in diatom communities. Nevertheless, it is important to note that the interactive effects among land use, climate, and hydromanagement were also highly significant. Although hydromanagement is a primary resource concern in this region, multiple stressors and their interactions were identified as drivers of change in the diatom community and therefore must be considered in the management of the border lakes. An annotated bibliography and data compilation has been assembled to document the history of landuse, climate, and resource utilization in the region.



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Oral Abstract

Breeding Bird Monitoring at Isle Royale National Park, Michigan: 1996-2008

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The National Park Service's Inventory and Monitoring program has been essential to identifying species and tracking populations within park units. Standardized, unlimited distance point counts were conducted annually on established trails at Isle Royale National Park from 1996 to 2008. Eight routes, with a total of 130 points, spanned the island. Since 1996, survey objectives have been: 1) to determine the size and composition of the Neotropical (long-distance) migrant, continental (short-distance) migrant, and resident passerine communities and other species detectable by point count protocols; 2) to annually monitor these communities and make general comparisons between years; and 3) to compare the status of these communities with other regional populations. Species used in data analyses were those appropriately sampled by point count methods in forested terrain.

An average of 1,424 individuals representing 57 species was detected annually. Eighty-five species from twenty-five families were identified during the 13-year period. In order to track changes in abundance over time, linear regression analyses were reported for most species that were detected. Significant increases were found for ten species: pileated woodpecker, golden-crowned kinglet, brown creeper, song sparrow, hairy woodpecker, hermit thrush, Wilson's snipe, yellow-bellied flycatcher, alder flycatcher, and red-breasted nuthatch. Significant declines were found for eight species: Cape May warbler, evening grosbeak, least flycatcher, rose-breasted grosbeak, chipping sparrow, Tennessee warbler, common raven, and Canada warbler. Isle Royale trends were compared to regional analyses by state, regional forest ecosystem, and regional national forests. Results were generally consistent with other studies. Findings from annual park reports, including diversity measurements for each route and comparison of species richness detected on point counts with a recent, five-year breeding bird atlas are discussed. These results demonstrate that the Isle Royale bird survey is a useful tool that park managers can utilize for identifying species of concern on the island, while both the public and regional land managers can benefit from the general information revealed on this widely valued group of vertebrates.



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Oral Abstract

Brook Trout Population Evaluation in Otter Creek

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Brook trout are native to the upper Great Lakes including Lake Michigan and many of its tributaries. Historically, anadromous brook trout commonly referred to as “coasters” were relatively abundant in nearshore waters of northern Lakes Michigan and Huron in addition to Lake Superior (Becker 1983), and it has been suggested that some brook trout populations may still exhibit these migratory behaviors. These populations may not only provide valuable recreational and subsistence fishing opportunities, they likely promote genetic diversity and vigor to Great Lakes adfluvial brook trout populations. Though well documented and studied in Lake Superior, little is understood regarding populations of adfluvial brook trout potentially existing in Lake Michigan. Based on fishery surveys, Otter Creek (a short tributary to Lake Michigan) is known to have large brook trout residing with unobstructed access Lake Michigan; though it is not known whether this population possesses a migratory element. As an element to a watershed based restoration initiative funded through the EPA Targeted Watershed Grants Program, the Grand Traverse Band is investigating the brook trout population in Otter Creek to document its size, health, habits and potential for enhancement. Radio telemetry and PIT technologies are being utilized to evaluate anadromy by tracking movements of individual fish. Additionally, we look to compare Otter Creek brook trout genetics against known genotypes of adjacent populations to evaluate differences and/or similarities; with a principle interest in restoring or enhancing populations of brook trout local to the Grand Traverse Region. Finally, through comprehensive habitat evaluations of the stream and its tributaries we will be recommending and implementing Best Management Practices for restoring brook trout habitat to a condition resembling pre-logging era to the greatest extent possible. These studies began in the fall of 2007 and will continue through of 2011.



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Oral Abstract

The use of Technology to survey, map and evaluate Great Lakes Shipwrecks.

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Some National Park units as well as other agencies have significant cultural resources represented by shipwrecks within their boundaries. These wrecks are rarely visited by the non-diving public or evaluated by staff on a yearly basis by the agencies responsible for them. Often staff diving visit only the wrecks that are used by the public and rarely visit deep wrecks or ones that are in water over 200 feet. Recent improvements in underwater technology in the areas of Remotely Operated Vehicles and Side Scan Sonar result in a cheaper and more practical method to evaluate wrecks that are on the bottom of our Great Lakes. This presentation will review an effort by Discovery World staff demonstrating the use of ROVs and Side scan to undertake annual evaluations of shipwrecks in a cost effective manner.

The Great Lakes have thousands of shipwrecks representing the rich maritime heritage as well as providing a significant tourism resource of this region. Many of these wrecks, in particular the ones in deep water, are in a condition similar to the day that sank. These wrecks are unlike the shipwrecks that are found in our oceans. Of significance, the lack of wood eating organisms and the cold fresh water of the Great Lake preserve the wooden ships of past centuries. These same ships would disappear in a few decades in salt water or at the very least greatly reduce in appearance. Recently water borne exotics have started to have an effect that should be evaluated on an ongoing basis. While the ships have survived for decades in our waters the impacts of exotics such as the zebra and other mussels have dramatically change the appearance of our wrecks by covering the surface areas. The impacts of exotics, scuba divers and in the case of shallow wrecks the weather all can have an impact that should be evaluated annually by the agencies that are responsible for these important resources.

In the past, time consuming and expensive research efforts were need to map and study each shipwreck. Usually research or evaluations has been conducted by scuba divers who have limited time on each wreck due to water conditions and depth. In today's limited budgets underwater research efforts are often too expensive to undertake yearly. Today evaluations and mapping can utilize the new small ROVs in combination with Side Scan Sonar can provide an inexpensive alternative. This improved technology can provide an alternative to the expensive research methods of using divers. An additional benefit is that this technology's results can easily be shared with the visiting public on the web and even can be incorporated into a live broadcast using footage from the ROV.



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Oral Abstract

Biogeographic patterns of fish communities of inland lakes of Isle Royale, Voyageurs and Sleeping Bear Dunes National Park Units

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The roles of historical biogeography, local habitat factors, and human impacts were assessed to evaluate their influence in structuring present fish communities of inland lakes of Isle Royale (ISRO), Voyageurs (VOYA) and Sleeping Bear Dunes (SLBE) National Park Units. Regional and local faunas for each Park Unit were identified from literature and agency records; all areas drew upon a common upper Mississippi basin source pool.

Multivariate analyses of lake species composition and habitat attributes suggested that SLBE had warmer summer temperatures, a longer growing season, and more warm water species than ISRO or VOYA. Fish communities and habitats of ISRO and VOYA were more similar in species composition, climatic conditions, and lake geophysical attributes, but VOYA lakes had a longer growing season, greater range of temperatures and included more warm water and introduced species. ISRO lakes were cooler on average and harbored more cold water species. Our results support previous work that has demonstrated the interplay of regional and local factors to structure local communities within the same region. For ISRO, VOYA and SLBE Park Units, our results will aid assessing the status of fishery resources and developing long-term monitoring, conservation and management programs.



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Oral Abstract

Monitoring and Management Recommendations for Prevention and Early Detection of Asian Earthworms and Reducing the Spread of European Earthworms in Working Forests of the Western Great Lakes Region.

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European earthworms invasion into previously earthworm-free hardwood forests in the northern US and Canada are followed by a cascade of changes affecting soil structure, chemistry, regeneration and native plant and animal communities. The recent appearance of Asian earthworms (*Amyntas*), with even more dramatic impacts, further leads to concerns about the potential loss of native forest species and the sustainability of northern hardwood forests. The scale of these invasions suggests that a substantial portion of northern forests could be impacted by European earthworms within the next few decades. Nevertheless, findings also suggest that local control of invasions into currently earthworm-free or minimally impacted may be possible. A growing body of research into the patterns, mechanisms, and impacts of earthworm invasion can inform potential responses to target efforts in ecosystem and soil types that are most threatened. Earthworm spread continues via human activities such as dumping fishing bait, transporting compost or soil from earthworm-infested areas, or all-terrain vehicles (ATVs) and logging equipment that can transport earthworm cocoons on tires and underbodies. No mechanisms to remove earthworms or to reverse their impacts exist, therefore, prevention of future introductions is key to the protection of northern forests and the resources they provide. Actions to limit the ecological impact of earthworms could affect a variety of stakeholders including natural resource managers, timber harvesters, anglers, recreational visitors, and residents. Using a combination of literature review, vector risk assessment, expert opinion, and focus groups with a wide range of potential stakeholders, we discuss a set of recommended actions to minimize the continued spread of earthworms in the working forest landscape.



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Oral Abstract

A Great Lakes Beach Analysis Tool Utilizing Geographic Information Systems (GIS)

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An Ocean Research Priorities Plan (ORPP) was developed to address the recommendations of the U.S. Commission on Ocean Policy (established by Congress in 2000). The ORPP defines research priorities for understanding critical ocean processes and interactions and applying that understanding toward stewardship and responsible use of the oceans and the Great Lakes. As part of the ORPP, the U.S. Geological Survey has developed a Great Lakes beach analysis tool utilizing geographic information systems (GIS) with the intent of 1) improving communication and sharing of available monitoring and scientific information; 2) developing analysis tools that can relate beach conditions to Great Lakes physical settings and conditions; and 3) identifying physical and biological processes that influence beach health. To date, various spatial and tabular information has been compiled into a GIS-based internet mapping application. This will enable users to view Great Lakes beach monitoring data, examine the physical setting (such as land cover, topography, and geology) and link to real-time monitoring stations for wind velocity and direction, wave height, and rainfall.

This presentation will demonstrate some aspects of the Great Lakes beach GIS and seek input in relation to other coastal applications. Although the tool is currently oriented toward addressing beach health, the underlying coastal GIS application may have additional uses for coastal resource management.



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Oral Abstract

Invasion status and ecological effects of an exotic zooplankter (spiny water flea, *Bythotrephes longimanus*) in Great Lakes National Parks

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The spiny water flea (*Bythotrephes longimanus*) is an invasive, predaceous zooplankter that has significantly influenced Great Lakes food webs and has begun to invade inland waters of the Great Lakes states and Canada. The first year of the 3-year project emphasized exploratory surveys, to determine which parks and lakes had been invaded and to identify possible dispersal vectors. Sediment samples were taken from 51 lakes and sieved for evidence of spines and resting eggs (established egg bank). Preliminary evidence suggests that the unusual thick-shelled resting egg, which is capable of passing through fish guts intact and in viable condition, has a relatively short longevity (>10 years) in lake sediments.

We found that *Bythotrephes* is actively spreading within a latitudinal band that stretches from Minnesota to Ontario. The species had invaded one near-boundary lake at Sleeping Bear National Lakeshore (Big Platte Lake). Downstream connection via the Platte River led to incidental occurrence of spines (no egg bank) in Loon Lake. We confirmed the presence of *Bythotrephes* in two interior lakes at Pictured Rocks National Lakeshore (Beaver Lake, Grand Sable Lake) and in at least three large lakes of Voyageurs National Park (Namakan, Kabatagoma, Rainy Lake). Lack of invasions at Isle Royale National Park contrasted with rapid spread on the nearby Keweenaw Peninsula (Portage, Lac LaBelle, Fanny Hoe, Medora, Gratiot, Roland, Gerald, Gogebic Lakes). Although the two areas had comparable geology, lake density, and fauna (e.g. ducks, shorebirds, fish-eating raptors; beaver; other potential natural dispersers), they differed dramatically in power boat access, visitation, and protective measures. The contrast between Isle Royale and the Keweenaw Peninsula underscores human-aided dispersal of *Bythotrephes* via active launch ramp activity, i.e. fishing boats, live wells, and bait buckets. Visitation frequency, power boat access, and preventative measures appear to be important variables influencing recent inland geographic dispersal of *Bythotrephes* from coastal regions of the Great Lakes.



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Oral Abstract

Developing microsatellite markers to understand the genetic diversity of wild rice in Lake Superior coastal habitats

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American wild rice (*Zizania palustris* L.) is a native aquatic annual grass found in shallow-water lakes, rivers, and coastal regions in the Lake Superior and Lake Michigan basins. The plant has suffered dramatic declines across much of its historic range due to human activities, particularly in Great Lakes coastal habitats, where it has been extirpated from many areas. Because of its considerable ecological and cultural significance, considerable interest exists in restoring the plant to suitable habitats.

There is growing consensus among the restoration community that considering the genetic consequences of reintroduction and augmentation programs is important to maximize the likelihood of successful restoration. Unfortunately, appropriate molecular tools to address such questions are not available for most species, including wild rice. To remedy this, my lab has spent the last two years developing a suite of microsatellite (SSR) markers for use in wild rice genetic diversity studies.

Although SSR markers are widely considered the most informative and robust markers for such work, they are hampered by considerable development time and technical challenges. Using previously-identified SSR sequences from Asian cultivated rice (*Oryza sativa*) and the threatened species *Zizania texana*, we have cloned, sequenced, and re-designed primers for 44 syntenic loci in American wild rice, and are now utilizing these markers for wild rice genetic diversity studies in Lake Superior coastal habitats.

In this report, I will describe preliminary results and give a project overview of studies being done in the future NERR site in the St. Louis River estuary near Duluth, MN, where wild rice populations have suffered dramatic population reductions and associated bottlenecks. A comparison of genetic diversity will be made between these populations and much-larger populations in the Kakagon Slough complex near Ashland, WI.



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Oral Abstract

Zooplankton assemblages at Voyageurs National Park: establishing a pre-*Bythotrephes* baseline for interior lakes

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The invasive spiny water flea (*Bythotrephes longimanus*) was first detected in the North American Great Lakes in the 1980s, and has since begun to invade inland waters of Quebec, Ontario, and the northern United States, including upper Michigan and northern Minnesota. Although *Bythotrephes* had invaded most of the large lakes at Voyageurs National Park (VOYA) by 2007, it has not been detected in VOYA's hydrologically isolated interior lakes. Since previous research has linked human use of lakes with *Bythotrephes* invasions, VOYA Management has taken steps to protect these lakes from invasion by implementing new regulations and Best Management Practices. In advance of any future invasions of the interior lakes, we aimed to 1) document native zooplankton communities, 2) characterize their relationship to environmental features, and 3) identify zooplankton taxa and lakes that may be particularly vulnerable. We collected pooled vertical zooplankton tows from 25 interior lakes during July 2007, and from a subset of 12 lakes in May-June and September 2007. Here we present zooplankton results from 22 of the lakes sampled during our mid-summer survey, supplemented by water quality data collected by the Great Lakes Network in 2006 and 2007.

Over 40 zooplankton taxa were identified from these lakes, representing all major zooplankton groups and substantially expanding the zooplankton species list for VOYA. Dominant gradients in the environmental data included lake size and depth, nutrients, chlorophyll-*a*, transparency, alkalinity, and shoreline development. Preliminary ordination analyses (redundancy analysis) showed that these physical and chemical variables, along with sulfate and ammonium, explained a significant amount of the variation in the zooplankton species-environment relationship ($p=0.005$), with subgroups of taxa associated with different lake types. Top-down factors, not yet considered, may also play an important role. Deep, clear lakes have been shown to be most suitable for *Bythotrephes* elsewhere; our analysis of physical and chemical water quality data suggests that several such lakes exist at VOYA (e.g., Cruiser, Little Trout, Mukooda, and O'Leary), and may be particularly vulnerable to *Bythotrephes* establishment and ecological effects in the future.



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Oral Abstract

Connecting Research, Education, and Outreach through Research Internships

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In winter of 2006, the Great Lakes Research and Education Center, located at Indiana Dunes National Lakeshore, initiated an internship program to support research and monitoring programs in Great Lakes national parks. The primary objectives were to provide students with hands-on opportunities to assist with and/or develop research projects and to assist cultural and resource managers in implementing those projects. The process involved (1) obtaining project needs and timelines from participating park managers; (2) developing a public announcement; (3) interviewing prospective candidates and university mentors; (4) implementing the projects; (5) developing internship products for distribution; and (6) facilitating discussions among participating parks and interns to improve the program. Overall, the program was deemed successful from both the managers' and students' perspectives. Interns produced oral and poster presentations, research reports, and master's degree theses during the program. Information resulting from the internships was presented at conferences, workshops, and incorporated into NPS websites and other park programs. To date nine of 10 parks have participated in the program.



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Oral Abstract

Wetland response to water level regulations at Voyageurs National Park

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To increase our understanding of VNP wetland vegetative response to the 2000 rule curve changes, we relied on two approaches: 1) an assessment of comparative sampling, that is comparing eleven sampled sites on Namakan to ten each at both Rainy and Lac La Croix (a non-regulated control lake), all sampled since the new rule curve was established; and 2) an assessment of repeat sampling of two sites in each basin over time using data gathered in 1987. We present here a summary of each of these two analyses for both the shoreline and the combined aquatic habitats (1.25 m and 2.0 m depths).

Shoreline Comparative Analyses. Multivariate analysis showed that shoreline communities of Lac la Croix, Namakan Reservoir, and Rainy Lake differ from each other. In general, there were enough taxa unique to particular basins to suggest that either past or present water level management does differentially influence the shoreline communities. Grouping taxa into life form guilds also suggests differences in shoreline vegetation among basins, suggesting that the effects of the long term reservoir-type management, even though modified in 2000, still exists in the Namakan shoreline vegetation.

Shoreline Repeat Analyses. Each basin also showed substantial increases (at least a doubling) in the total cover at shoreline elevations over the 15-16 year period from 1987 to 2002-3, and most of these changes can be attributed to increases in woody cover.

Aquatics Comparative Analyses. Based on multivariate analyses Lac la Croix differed significantly from the other two basins. A major part of these differences are attributed to a greater proportion of tall submergent vegetation found at Namakan and Rainy when compared with Lac La Croix. In addition, Lac la Croix has generally greater vegetation structural diversity compared to the other basins, that is, relative cover is more evenly distributed among the life forms. In addition, several floating leaf taxa have presumably been eliminated from Namakan due to extreme reservoir-type management for the 85 years since the creation of the dam.

Aquatics Repeat Analyses. Even though the comparative analyses suggest there are still differences among the basins' aquatic vegetation, there is strong evidence with the repeat sampling to suggest that the aquatics also appear to have changed considerably within basins since 1987. However, Namakan continues to have less emergent and floating leaf cover than the other basins and has significantly fewer overall species than Lac la Croix, suggesting that although this basin may have responded to changes in the rule curve, it still lacks some of the structure of the non-regulated basin.

Explanations for the vegetative differences and changes we present could be due, in part, to factors other than that of water level controls. Regional productivity may be increasing due to influences acting at larger scales, such as climate change or atmospheric deposition. We are not yet capable at this time to evaluate these alternative hypotheses, but since we have increased the number of sites, these should provide a more complete picture the next time they are sampled.



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Oral Abstract

Chronic toxicity of diphenhydramine hydrochloride and erythromycin thiocyanate to *Daphnia magna*

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Pharmaceuticals and personal care products (PPCP) are a group of compounds that include prescription and over-the-counter drugs, detergent by-products, fragrances, and cosmetics. These compounds are continually introduced into aquatic environments largely through wastewater treatment plants. There is not a clear understanding of the affects that these compounds have on aquatic organisms including aquatic invertebrates. Aquatic invertebrates are most likely continually exposed to low levels of PPCP through adsorption across their gill surfaces or ingestion of contaminated organic material.

As part of a parent project to determine the presence and effects of PPCP in the St. Croix National Scenic Riverway, we exposed *Daphnia magna* to 2 pharmaceutical compounds that are present or most likely present in the Riverway. The test chemicals were diphenhydramine hydrochloride (Benadryl™, an over-the-counter antihistamine, sedative, and hypnotic) and erythromycin thiocyanate (a commonly used macrolide antibiotic). There were 8 treatment groups consisting of 7 test chambers per group. The treatment groups included a control group (0.0 µg/L), diphenhydramine hydrochloride (DH) groups with nominal concentrations of 0.12 (the nominal environmental concentration), 71, and 850 µg/L, erythromycin thiocyanate (ET) groups with nominal concentrations of 0.45 (the nominal environmental concentration), 250, and 3000 µg/L, and a DH:ET group with nominal concentrations of 84 µg/L DH and 320 µg/L ET. *D. magna* were exposed continuously for 21 days in a flow through test system. The study was initiated when one <24 h old *D. magna* was distributed to each chamber. *D. magna* were offered a food designed for aquatic invertebrates each day. Samples of water from each treatment group were acquired each day throughout the trial. Chemical concentrations were determined within 4 days of sampling. Survival of first generation *D. magna* and young production were monitored daily. The probabilities of death, times to death, times to first brood, numbers of broods, total numbers of young, and length of *D. magna* surviving to the end of the trial were compared among treatment groups.

Relative to the control treatment group, continuous exposure of *D. magna* to DH concentrations > the nominal environmental concentration of 0.120 µg/L, ET concentrations > 555 times the nominal environmental concentration of 0.45 µg/L, and a mixture of DH and ET significantly increased the time to death and time to first brood and decreased the number of broods and total number of young produced.



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Oral Abstract

Butternut Conservation: A Case of Successful Engagement of Public Agencies and Private Landowners

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Butternut (*Juglans cinerea*) is native to the northeastern quarter of the United States and southern Canada; extending from New Brunswick south to Georgia and west to Arkansas and Minnesota. Butternut trees are highly valued for their nuts and wood, and used by wildlife for food and habitat. Butternut often is found growing in riparian areas and contributes to forest diversity across its range. The fungus *Sirococcus clavigignenti-juglandacearum*, thought to be an exotic pathogen, causes multiple stem and branch cankers that kill butternut over a period of years. Since its first discovery in the late 1960's, the disease has drastically reduced populations of butternut throughout its range to the extent that in many States butternut is listed as a species of special concern and is listed as endangered in Canada. In addition to loss of trees to the disease, butternut is not a long-lived tree, is not able to compete well with other hardwoods in mature stands and is not reproducing over much of its range. The species is further threatened by Japanese walnut (*Juglans ailantifolia*) which hybridizes with butternut. The hybrid could eventually displace butternut because it is more disease resistant and vigorous than butternut. The threat of hybridization appears to be worse in the South and near towns, farm sites and roads. It can be difficult to separate hybrids from butternut based on morphology alone. However, differences in DNA can be used to distinguish between these two species and their hybrids. In the late 1980's people increasingly began to note canker-free butternut growing among diseased and dying butternut. Since 1990, with the assistance from various public land management agencies and private landowners in locating potentially disease resistant butternut, scientists with the Northern Research Station and their research partners have clonally propagated these trees via grafting. Several field archive plantings have been established to conserve these trees for further testing. Many of these original source trees remain disease-free even though the butternut canker has severely affected and killed many of their neighboring trees. Results from artificial inoculations of some of the grafted trees in the field have provided evidence of differential responses to the pathogen among selected trees with some trees being able to resist infection or restrict canker elongation after infection. Trees with putative canker resistance will be candidates for future field evaluations and breeding with the long-term objective of producing seed orchards of canker-resistant, regionally adapted butternuts for reintroduction to eastern landscapes. This research effort has only been possible with the assistance of cooperators in land management agencies and the hundreds of interested, highly dedicated private landowners who provided locations of potential candidate butternut trees, allowed collections of scion wood for grafting and long-term monitoring of their trees, and the landowners who have offered land and assistance for establishing archive plantings.



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Oral Abstract

Effects of 2000 rule curve on the Reproductive Success of the Common Loon (*Gavia immer*) in Voyageurs National Park

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Historically, loons in Voyageurs National Park (VNP) have had low reproductive success. In January 2000, VNP adopted a new water level management strategy (rule curve), in part, to reduce the negative biological effects associated with the previous management program. New rule curve changes were principally focused on Namakan Reservoir where the annual water level fluctuation was reduced from 3m to 2m and the timing of the peak water level was changed from ~30 June to ~30 May. The main objective of this three-year study (2004-2006) was to investigate how changes in the new rule curve affected loon nesting and productivity. Field teams monitored a total of 129 loon territories. Territories were surveyed by motorboat on a 3-5 day schedule to record reproductive behavior. Under the new rule curve, fewer loon nests were flooded and productivity increased. Approximately 35% fewer nests were flooded and productivity increased 35%. Both 2004 and 2006 had higher than average historical productivity rates. Also, 36 chicks were observed in 2006, the highest total ever recorded for this basin. On Rainy, the new rule curve was not expected to impact loon nesting or productivity. Interestingly, compared to decadal productivity averages on Rainy for the 1980's and 1990's (0.44 and 0.47 fledged/pair) our average loon productivity for the 3 years was low (0.24 fledged/pair). Predation rates on loon nests increased on both basins. Various abiotic parameters measured for all loon nests on both basins did not accurately predict loon nesting outcomes (flooding, stranding, or success/failure). This suggests biotic parameters, such as human disturbance, predation, loon density, or other factors, may be impacting loon nest outcomes. We offer two management recommendations: 1) consider developing a study plan to further investigate causes of loon nest failure and low productivity that includes both abiotic and biotic interactions, and 2) consider using active management techniques such as area closures or artificial platforms to improve loon productivity in Voyageurs National Park.



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Oral Abstract

A diatom-based model for environmental monitoring of lakes in the Western Great Lakes National Parks

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The Great Lakes Inventory and Monitoring Network (GLKN) is using a novel approach for lake monitoring that couples paleolimnological analysis of sediment cores with modern sediment and water quality sampling in the network parks (Voyageurs, Isle Royale, Apostle Islands, Sleeping Bear, Pictured Rocks, Indiana Dunes, St. Croix, Mississippi). Index lakes have been identified within each GLKN park for water quality and biomonitoring. Each lake is sampled for water quality 3-4 times per year. Second, a single surface sediment sample is collected from index lakes during fall sampling; this sample integrates spatial/temporal variability of diatom production. Third, long cores (~200 years) have been taken from 1-3 lakes in most parks. Biogeochemistry, radioisotopes, and diatoms in the cores are analyzed to recreate the historical record of change in park lakes. With field year 2008 finished, the calibration model that links diatom communities with ecological gradients in the parks has been completed. We apply this model to diatom assemblages in sediment cores for quantitative reconstructions of historical water quality parameters. The calibration model is also applied to the index lake surface sediment samples to examine recent ecological trajectories in the lakes and to determine potential environmental stressors. In addition to the calibration model, historical and recent environmental trajectories based on sediment cores from lakes on Isle Royale and the Apostle Islands will be highlighted.



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Oral Abstract

Apparent Nest Abandonment As Evidence For Breeding Season Mortality In Great Lakes Piping Plovers

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Abandonment was the most common source of nesting failure for Great Lakes Piping Plovers (*Charadrius melodus*) breeding along the shorelines of Lake Michigan and Superior during 1993-2007. Observations suggested that most abandonments involved disappearance of attendant adults rather than desertion. If abandonment represents adult mortality, it clearly has greater implications for population dynamics than simple nest failure. The purpose of our study was to integrate nest-monitoring histories with mark-resighting analyses to determine if nest abandonment was indicative of adult mortality or desertion. Nesting plovers had extremely high within-year resighting probabilities (10-day mean $p = 0.908$, SE = 0.025), and cumulative probabilities of being detected approached 1 for plovers that were present on the breeding grounds for ≥ 20 days post-abandonment, suggesting that desertion would be readily identified unless plovers left the monitoring areas immediately after abandoning their nests. None of the 31 plovers that had been labeled as disappeared via nest monitoring were ever observed again, and an among-year mark-resighting analysis suggested they were all dead. In recent years mortality associated with nest abandonment has averaged 8% and constitutes approximately a third of total annual mortality. Disappearances occurred primarily from 16 May to 19 June, involved plovers that were older than average, and were most frequently attributed to predation by Merlins (*Falco columbarius*). Early season nest abandonment in Piping Plovers is most often due to adult mortality, and management of this critically endangered species should recognize this and take action to protect breeding plovers from further mortality.

Key words: *Charadrius melodus*, endangered species, nest abandonment, Piping Plover, program MARK, survival.



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Oral Abstract

Implementation of a long-term vegetation monitoring program at Voyageurs National Park

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We initiated a long-term vegetation monitoring program at Voyageurs National Park (VOYA) in summer 2008. The goals of this monitoring program are to detect forest change and to draw inferences about forest health so that management recommendations can be provided to Network parks. Data collected included tree species and diameter at breast height (DBH) for all individuals >2.6 cm DBH, sapling density, and coarse woody material.

Thirty-eight plots were established at VOYA in 2008 spanning four habitats. Most overstory species were exhibiting healthy regeneration and recruitment into the canopy, however there were some exceptions. In dry mesic, nutrient poor habitat, jack pine density was at a maximum in the 22.5 to 30 cm DBH size classes and decreased in successively smaller size classes. Seedling density was low at 250/ha. Red pine tree density was low in all size classes in both dry mesic nutrient poor sites and in habitat classified as dry mesic to mesic, nutrient poor to medium. There were no red pine seedlings in our sampling plots in either habitat. In wet mesic to wet, poor to medium nutrient habitat, eastern white cedar was not found with DBH smaller than 15 cm, despite the fact that cedar basal area was 8.47 m²/ha. No cedar seedlings were found in plots. Coarse woody material (CWM) varied greatly between habitats, with a mean volume of 45 m³/ha in dry mesic habitat, but over 70 m³/ha in other habitats. Similarly, mean CWM density was 459 pieces/ha for dry mesic habitat, but greater than 700 pieces/ha in all other habitats.

In a tree species exhibiting healthy reproduction, the density will be greatest at smaller size classes and decline as the size class increases, forming a reverse-J shape curve when graphed. Lower tree density among smaller size classes compared with larger size classes suggests impaired regeneration. This can be either a natural, healthy, successional process, or an indication of an impaired ecosystem. In the case of jack pine and red pine in dry mesic sites, fire suppression is the most likely cause of this. Currently, the park natural resource staff intentionally burn about 400 hectares annually, although this is only approximately 10% of the area affected by the historic burn regime. In addition, this burning is typically conducted during the spring when the duff layer and larger fuels do not burn. This leads to excessive accumulation of fuel loads and a greater threat of large and intense fires in the future. Reduced white cedar regeneration is likely due to high deer browse pressure. Current recommendations for sustainable reproduction of cedar are to reduce deer populations to < 4 deer/km² and to establish exclosures at a limited number of white cedar populations. We will resample at Voyageurs in 2014 and again, every six years thereafter.



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Oral Abstract

Avian Migration on Minnesota's North Shore

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Interest in the development of wind power on the North Shore of Lake Superior has led to concerns over conflicts between wind power development and birds migrating through the region.

Potential conflicts include the creation of barriers to migratory movements, habitat loss and fragmentation due to development and the associated infrastructure, and direct mortality resulting from collisions with wind turbines. On average, approximately 94,000 raptors and 150,000 non-raptors are counted each fall at Hawk Ridge, Duluth, Minnesota located at the western tip of Lake Superior. Although these numbers indicate that the North Shore is an important migratory corridor, migratory bird concentrations along the North Shore beyond Hawk Ridge are unknown. To address this issue, migratory bird surveys were conducted along the North Shore between Knife River and Grand Portage, Minnesota from mid-August to mid-November 2008. A total of approximately 4,288 raptors (14 species including Bald and Golden Eagles and Peregrine Falcons) and 16,483 non-raptors (approximately 46 species including Herons, Gulls, Waterfowl, and Songbirds) were observed.

Preliminary results suggest migratory birds concentrate along the North Shore of Lake Superior as far north as Grand Portage and heavily utilize topographic ridgelines.



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Oral Abstract

Effects of Predator Scent on Use of Foraging Trails by Beavers

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American beavers (*Castor canadensis*) may increase their use of aquatic food over terrestrial food in response to perceived predation risk, and this may affect their relative fitness. We used a combination of Reconyx infrared cameras and Trailmaster infrared monitors to examine the effects of predator scent on foraging trail use in Seney National Wildlife Refuge in Michigan's Upper Peninsula. Sixteen lodges with active foraging trails were selected. At each lodge, 1 trail was treated with wolf urine, while 1 was an untreated control. Camera images yielded indices of age class of beavers using the trails, and the number of crossings by beavers. Trailmasters recorded the number of crossings at each trail. Our results will elucidate whether beavers avoid areas with indirect evidence of predation risk.



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Oral Abstract

Early Detection Monitoring Approaches for Exotic Aquatic Species in Great Lakes Harbors and Embayments

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Aquatic invasive species pose a significant ecological and economic threat in the Great Lakes basin. Early detection of invaders is desirable so as to allow for a timely management response, raising the question of how to accomplish this detection in a consistent, cost-effective manner. To that end, we have been conducting intensive sampling of benthic macroinvertebrates and fish in the Duluth-Superior harbor/St. Louis River estuary on Lake Superior. This water body is subject to heavy propagule pressure from international shipping and other introduction vectors, and our sampling detected a variety of both “old” and “new” invaders (e.g., common carp, rainbow smelt, tubenose goby, zebra mussel, New Zealand mud snail, quagga mussel). Our deliberately oversampled data set provides the basis with which to evaluate sampling strategies (gear types, spatio-temporal distribution, use of ancillary environmental predictors, etc.). Analyses confirm that early detection of invaders is inherently an inefficient process, with increasing amounts of effort required to detect the next new or rare species. Detection probability depends not only on species abundance, but also on spatial distribution and vulnerability to sampling gear. Species acquisition curves, species ordinations, and species composition metrics differed substantially among the types of sampling gear used, and the gears catching the largest numbers of individuals were not necessarily the ones that most rapidly detected invasive species. Since the identity, introduction vector, and habitat preference of the next exotic species cannot be known, monitoring should cover a diversity of locations and habitats. While all habitat types should receive some level of sampling effort, our analyses suggest that the most efficient strategies bias benthic invertebrate sampling towards shallow vegetated habitats and away from deep and bare habitats; and bias fish sampling towards fyke and electrofish samples and away from trawl samples. *This abstract does not necessarily reflect EPA policy.*



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Oral Abstract

Monitoring the Ecological Effects of Lake Level Management on Voyageurs National Park Using Beavers (*Castor canadensis*)

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Water levels and flow regimes of the international waters of Rainy Lake and the Namakan Reservoir on the Minnesota-Ontario border have been controlled by several private dams since the early 1900s. Voyageurs National Park, MN contains more than 27% of these water bodies. In response to documented ecosystem degradation, the International Joint Commission (IJC) issued the 2000 Rule Curves to mimic a more natural water cycle, particularly in reducing the winter drawdown in the Namakan Reservoir. Beavers (*Castor canadensis*) were selected as part of a suite of best bet indicators for assessing the ecological effects of the new hydrologic regimes. Several aspects of beaver ecology have been studied from 2004 to the present in the park to compare with similar data collected in 1984-1986 during the previous water level management regime (i.e., the 1979 Rule Curves). Beavers appear to have deeper and more stable access to water during the winter drawdown at present than during the 1979 Rule Curves. Consequently, beavers spent more time inside their lodges versus outside of the lodge during the winter than before the changes in 2000. Other aspects of beaver ecology related to water level management, including body condition, reproduction and survival, and availability of aquatic forages will be discussed.



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Oral Abstract

Three Decades of Monitoring Colonial Waterbirds on National Park Service Lands in the U.S. Great Lakes: Trends and Unique Aspects

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Colonial waterbirds are a significant biological resource in the Great Lakes ecosystem. Information on their distribution, abundance and population trends is essential for implementing effective conservation and management strategies, and for studying ecosystem change. Therefore, to estimate population sizes and distributions, the U.S. Fish and Wildlife Service and Canadian Wildlife Service began coordinated, decadal Great Lakes-wide surveys of breeding colonial waterbirds in the mid-1970s. To date, three comprehensive surveys have been conducted in the U.S. portion of Great Lakes waters, and the 4th is nearing completion. These efforts have documented 17 colonial species breeding at > 825 sites. Most colony sizes were estimated through nest counts conducted on the ground, from boats, or from aerial photographs. Some important products from these efforts include: an extensive database that has been used by natural resource agencies, NGOs, academic institutions, and individuals to study diverse topics (e.g., population sizes, distribution and large scale trends; rare and abundant species; conservation planning); identification of sites with high conservation value to colonial waterbirds breeding in the U.S. Great Lakes; and documentation of significant population changes and recent colonizations by particular species. A variety of lands were used by nesting colonial waterbirds, including those in state, federal and private ownership. Of the more than 800 sites used, 113 (~14%) were in Great Lakes National Park Service units. These included sites in Lake Superior at Isle Royale National Park and the Apostle Islands National Lakeshore, and in Lake Michigan at Sleeping Bear National Lakeshore. Species found at these sites included Double-crested Cormorants, Great Blue Herons, Herring and Ring-billed Gulls, and Caspian Terns. In this paper we will present detailed information on distribution, population size and trends for these species in each of these NPS units based on data obtained through four decadal Great Lakes census efforts. We will also characterize the uniqueness of each of these areas for colonial waterbirds relative to the rest of their range in the U.S. Great Lakes.



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Congratulations to the 2008 awardees for the NPS Midwest Region Director's Awards for Natural Resources!

Each year the Director of the National Park Service recognizes outstanding achievements in understanding, protecting, and managing park natural resources. In 2008, four of the six the Regional Awards went to resource professionals in the Great Lakes area! Please extend your congratulations to these award recipients:

Steve Windels, Voyageurs NP — Natural Resource Management
Jay Glase, Great Lakes Fisheries Biologist — Professional Excellence in Natural Resources
Brenda Moraska Lafrancois, Great Lakes Aquatic Ecologist — Natural Resource Research
Bob Krumenaker, Apostle Islands NL — Superintendent of the Year

Steve Windels - Natural Resource Management Steve Windels has made outstanding contributions to natural resource management. His exemplary performance in 2008 in support of management goals in Voyageurs National Park and the Midwest Region demonstrate his extraordinary skills, dedication, competence, and enthusiasm. As Terrestrial Ecologist, Steve is responsible for the study, inventory, monitoring, restoration and management of a broad range of natural resources. Among his accomplishments, he completed a study to "Investigate Impacts of Artificial Lake Levels Management on Voyageurs National Park—Beavers." Windels initiated a study of double-crested cormorant foraging ecology on Kabetogama and Rainy lakes. He coordinated a multi-agency sturgeon tagging effort on the Namakan Reservoir and completed a Detailed Implementation Plan for the Namakan Sturgeon Project. Steve implemented a snow-tracking survey to estimate abundance and distribution of wolves in Voyageurs National Park. Steve also successfully secured funding to investigate the impacts of climate change and other factors on moose. Other accomplishments include air quality, Canada lynx, loon, eagle and osprey populations monitoring. He serves as Threatened and Endangered Species coordinator for the park. As Research Coordinator, he provided peer review for manuscripts submitted to scientific journals.

Jay Glase - Professional Excellence in Natural Resources As the Midwest Region Fishery Biologist, Jay works with parks primarily serving the Great Lakes Inventory & Monitoring Network. Annually his contributions involve research investigations and management projects at NPS units extending geographically from Indiana Dunes National Lakeshore on southern Lake Michigan to Voyageurs National Park in northern Minnesota at the Canadian border. In 2008, Jay advanced the science of resource management significantly in several areas. Most notably, Jay has been instrumental in efforts aimed at preventing a non-native fish virus, Viral Hemorrhagic Septicemia (VHSv), from infecting the fisheries of Lake Superior. This effort has led to increased collaboration and cooperation not only between parks on the Great Lakes, but with other agencies and organizations around the lakes, as they work together on ballast water regulations, bait use, and fisheries management. In addition to the contributions Jay has made to understanding VHSv, he has initiated many fishery projects in many different habitats ranging from creeks, small rivers, large floodplain rivers, wetlands, rock pools, small, medium, and large lakes (including the Great Lakes).



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Brenda Moraska Lafrancois - Natural Resource Research As the MWR Regional Aquatic Ecologist, Dr. Brenda Moraska Lafrancois provides professional assistance on emerging aquatic resource issues in the Great Lakes Region. The collaborative research and analysis of scientific information has filled a need in NPS units extending geographically from Indiana Dunes National Lakeshore on southern Lake Michigan to Voyageurs National Park in northern Minnesota at the Canadian border. Her scientific contributions have addressed issues such as nutrient input into the Saint Croix River, mercury transport in inland lakes, and VHS virus spread in fish populations. Her most outstanding contribution involves innovative research into Type E botulism within Dreissenid mussel beds resulting in the mortality of thousands of birds and fish. Brenda has contributed significantly to increase the knowledge base and overall understanding of aquatic resources in Great Lakes Network parks. Her work has allowed park managers, the Inventory and Monitoring program, and other researchers to gain an insight into aquatic systems and identify resource protection actions needed in Great Lakes parks. The Great Lakes Network and the Midwest Region have benefited greatly from her communication of scientific information for resource management decisions.

Bob Krumenaker - Superintendent of the Year Superintendent Bob Krumenaker has become an articulate and highly visible spokesperson on the issue of global climate change in the NPS – speaking to numerous audiences on the local, regional, national, and even international levels. Starting in 2002, he initiated a wilderness study in the park, and guided it to a final proposal that had such an extraordinarily high level of public support that Congress and the President followed up with wilderness designation within a few short months. He has skillfully managed the park's approach to neighboring Ojibwe bands and their recent assertion of treaty rights within the Apostle Islands National Lakeshore – blending the protection of the park's resources while maintaining healthy relationships with critical park neighbors. He helped institute a formal rule change for snowmobile and ATV use that limits their use in the park. Under his tenure, the park has managed to foster public support and acceptance for additional natural resource projects – including ones that have been controversial or unsuccessful in other parks, such as deer reduction or wilderness designation. Bob is exceptionally well-versed in the nuances and subtleties of NPS policy, and always arrives at a solution to a problem that first and foremost is good for the park's resources. He consistently makes a point of listening to those with alternative viewpoints. By incorporating their concerns into the solutions, he has often created allies where the NPS often has adversaries.



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