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GREAT LAKES INVENTORY AND MONITORING NETWORK

The Challenge and Benefits of Long-term Monitoring

By Ted Gostomski, Network Science Writer

What information can you glean from this picture? You might be able to identify the trees; you can probably tell what the weather was like the day the photo was taken. Maybe you can infer what sort of habitat this is. But can you say anything about what influences this place? What events led to it looking like this? What goes on alongside this area that could affect it in the future? What does this place sound like? Are there birds singing? What does the air smell like?

Learning about a place—its history, what it's composed of now, and what it might look like in the future—is the purpose of long-term monitoring. By definition, it is not a short-term project. It takes a while to begin seeing results, but that delay is no reason to shrink from the thought of doing it. Nor is it a reason to give up after a couple of years because it seems to not contribute to your goals right now. "Monitoring to document rates and patterns of change is essential for planning," writes F. Stuart Chapin III and his colleagues in *Beyond Naturalness*, yet we are sometimes unable to maintain a long-term monitoring program because of staffing or funding issues. However, long-term monitoring should be regarded as an investment in the future.

Suppose one day you realize there are no birds singing. You might wonder, "has it always been this way?" You might look around to try and determine what the cause for this silence might be. You could probably make some educated guesses but what could you say for sure? Now suppose you notice no birds are singing, BUT you have long-term songbird monitoring data you can look back on to see what you did hear in the past. You can compare this information with what you're seeing and hearing (or not seeing and hearing) now and that will lead you to ask more questions: when did this change come about? What happened at that time that may have caused the change? Is this the only place the change has happened?

Here's another scenario. Imagine you are walking along a trail and you come across a stand of trees that are out of place. Maybe it's a species of tree you have not seen in the park. You may wonder why you haven't noticed them before (they're already 8 feet tall!). Then you may wonder if they are growing anywhere else in the park. Even if you could fly over the park and find every grove of this new species, how long have they been here? And what set of conditions made it possible for them to take root?

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Long-term Monitoring

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Here again, imagine now that you have long-term monitoring data to look back on—plant monitoring data, aerial photography, and satellite imagery going back 30 years. Now what can you learn? You might find data showing a subtle shift in the ground cover plants, suggesting changes in soil moisture and nutrients. You might see in the aerial photos and satellite imagery that the locations of these new groves match with areas that experienced some grand disturbance 10 years ago, maybe a fire or a wind storm. Now you have some solid evidence you can use (if you choose to) to either implement a management intervention or to leave the trees to grow and perhaps proliferate. And if they do proliferate, future monitoring and continued acquisition of aerial and satellite imagery will give you some tools to predict where you might find the trees next.

Just like with the bird example, the understanding of the landscape and the changes on it were enhanced by a long-term data set. Information gathered during one visit on one day, or even multiple visits in a year are still only a "snapshot in time." A snapshot by itself can lead a manager down a different line of thinking than would the longer view—a collection of snapshots taken from the same place over a period of time. This is a view that is only possible by collecting standardized monitoring data over a long period of time.

The National Park Service Inventory and Monitoring Program was established to "improve park management through greater reliance on scientific knowledge." In the short-term, how much management is truly influenced by our monitoring data? Probably not much. But over time, these data accumulate into a body of knowledge that is difficult to refute and impossible to sculpt out of disparate pieces of shorter-term or less-standardized monitoring efforts. The benefit of long-term monitoring is long-term memory. We may not be able to base our management decisions on the information we gather right now, but we can in the future. And in monitoring and management, the future is everything. ●

Has the species composition or distribution of lichens changed or remained the same between 1992 (top, left) and 2011 (right)? How will a forest change after a wind storm? These are questions that can be answered through long-term monitoring.

Recommended Reading

Cole, D.N., and L. Yung, editors. *Beyond Naturalness: Rethinking Park and Wilderness Stewardship in an Era of Rapid Change.* Island Press, Washington, D.C.

Staff Insider—*Special Farewell Edition*

Joan Elias, Aquatic Ecologist

This was the last field season for aquatic ecologist Joan Elias. Joan is retiring from the National Park Service in December after 10 years with the Great Lakes Network. She was the second person hired by Network Coordinator Bill Route, and she has been a steady presence and mentor for others in the Network office and in the parks. Network staff continue to deny the reality of Joan leaving, but when that day comes, we, along with park staff and many partners and colleagues, will wish her well.

Take me to Cruiser Lake, Charles. Joan with Charles Eckman on a lake at Voyageurs.

In this special edition of the "Staff Insider," we asked Joan to reflect on her time with the Network and to share her vision for its future.

You didn't join the Network as an aquatic ecologist, right?

No, I was hired in 2002 as the Inventory Specialist, which was a two-year term position with the possibility of an extension for another two years. I managed a *zillion* inventory projects (*zillion*=49) that were done in the parks—aquatic vegetation at Isle Royale, rare and exotic plants at Indiana Dunes and Sleeping Bear Dunes, and others. I also managed the "data mining" effort, which is when we were gathering the data sets, publications, and species lists that existed but were not readily available. All that information was entered into the three separate databases that now make up IRMA.

Did you get to help with the field work, or just administer the contracts?

I got to help with the aquatic vegetation work at Isle Royale, bat and small mammal inventories at APIS, and a fish inventory at SLBE.

Did you have any idea you could be the aquatic ecologist some day?

No. I thought I would do the term position and that would be it. The need for an aquatic ecologist didn't come about until we began to develop the long-term monitoring plan and identify the vital signs we would be monitoring. I was hired as the aquatic ecologist in 2004.

So now you have been here for 10 years, helped build a number of very successful monitoring programs including both the inland lakes and large rivers water quality, diatoms, and the almost-completed wadeable streams. Which is to say nothing about your role in co-authoring the Network's initial long-term monitoring plan or your coordination of a number of Great Lakes Restoration Initiative projects. What about the formation of the Network do you remember most, good or bad?

I remember how agonizingly long it took to approve the monitoring plan. It had to be written in phases, and each phase had to be approved separately by a string of people all the way up to the Washington office. All the phases had to be approved before the plan as a whole could be finalized and published.

I also remember the process of writing the water quality monitoring protocols. The [NPS] Water Resources Division had very stringent requirements for how to write the protocol. They had to be stringent because, as we were told, the data had to be solid enough to be used in a court of law. In this Network, we don't really monitor anything that's potentially contentious and could result in the water quality data being called into court, but that was the national mandate. So to meet that mandate, we were given a document on how to write a protocol that was hundreds of pages long. I just saw it in my computer files the

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Staff Insider: Joan Elias

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other day—"Part B lite" (QA/QC Review Checklist for Aquatic Vital Sign Monitoring Protocols and SOPS) was the condensed version of the full "how-to-write-a-protocol" document; Part B lite was 172 pages long! Following the WRD guidelines was a lot of work, but I think it resulted in a very solid protocol, both scientifically as well as legally.

Has the Network's focus or work changed since the first formative years?

I did think we would have more of a wildlife focus than we do now. There were (and still are) a lot people in our Network with a wildlife background, so I thought we would have a monitoring program related to mammals.

Besides that, the program really has developed into what we envisioned from the start, which I think is a good thing.

What are you most proud of?

Keeping all the balls in the air. I'm proud that we have three very good aquatic monitoring programs, and I'm happy to see our data are now becoming sought after. I've started receiving requests from universities and other agencies to use our data, and it's good to know that we've collected information that is seen as useful.

I'm also proud that I have seen every one of our river sampling sites, and that I have visited all but two of our index lakes (I never made it to Cruiser Lake at Voyageurs or Lake Desor on Isle Royale).

What's your hope for the Network's future?

I hope the amphibian program really does well. Besides complementing the monitoring we already do, I think the program could provide information the parks will really be interested in, and it's another program (like the eagle and fish contaminants monitoring) well-suited to public interest.

What will you miss most about your time with the NPS?

The work we do and the people we work with. I really enjoy my job, and part of that is because we have such a great team in the Network office and such great people to work with among the managers in the parks and our external partners. It's also stimulating work. I was able to develop a program from the beginning—writing the protocol, conducting field work, ensuring quality control, managing and analyzing the data, and writing reports. I could also collaborate with partners on important spin-off projects, like modelling to predict which lakes are more susceptible to effects of climate change, analyzing trends in mercury in VOYA lakes, and determining algal toxin concentrations in lakes.

What's the first thing you will do on the first day of your retirement?

I'll have a cup of coffee, sit by the window with the bird feeder in front of it, and read the newspaper online. Once the sun comes up, I'll probably go for a ski. ●

2012 Field Season Summary

Bioaccumulative Contaminants—Fish, Dragonflies, and Lower Food Web

This 5-year intensive study, funded by the Great Lakes Restoration Initiative and conducted by Network cooperators at the University of Wisconsin–La Crosse, completed its third and final year of sampling in 2012.

Lower food web components sampled in 2012 include water, sediment, seston (suspended particles, mostly algae), zooplankton, and larval dragonflies. Samples were obtained from 17 lakes at ISRO, PIRO, SLBE, and VOYA; two streams at GRPO; and one lagoon and two wetland sites at INDU. Total mercury and methylmercury in unfiltered water from all sites averaged 3.2 and 0.30 ng/L (nanograms per liter, or parts per trillion), respectively, with methylmercury averaging about 9% of the total mercury present in water. These values are typical of lakes and streams in the northern Great Lakes region where environmental conditions and processes promote methylmercury production and its bioaccumulation to high concentrations in aquatic food webs.

Park Codes and Acronyms

APIS
Apostle Islands National Lakeshore (Wisconsin)

GLKN
Great Lakes Inventory and Monitoring Network

We also collected 459 adult fish (mostly predatory) from the six parks in 2012. We are still in the process of analyzing these samples, so fish data presented here are from 2011 (for mercury) and 2010 (for other contaminants).

Mercury concentrations in axial muscle of 402 adult fish collected in 2011 ranged from 20 to 2,400 ng/g wet weight. Concentrations in 55% of these fish exceeded the U.S. Environmental Protection Agency fish tissue criterion of 300 ng/g wet weight, which was developed to protect the health of persons who eat noncommercial fish. Mercury levels were generally highest in northern pike from VOYA, but concentrations were also high in northern pike, large yellow perch, largemouth bass, and smallmouth bass from some of the lakes sampled at PIRO, ISRO, and SLBE. Mercury levels were generally low in fish from INDU.

DDT and PCB were not detected or had low concentrations in most of the whole adult fish sampled in 2010. Initial analyses indicate that concentrations of these "legacy contaminants" varied among park units. At INDU, DDT and DDD (a break-down product of DDT) were not detected in fish from Middle Lagoon, and concentrations of DDE (another break-down product of DDT) were less than 250 ng/g wet weight. PCBs were not detected in most whole-fish samples from INDU, GRPO, PIRO, and SLBE, but among the samples with detectable levels, concentrations of total PCBs were highest in largemouth bass from Middle Lagoon at INDU (about 200 ng/g wet weight).

Whole-fish were also analyzed for contaminants of "emerging concern"—polybrominated diphenyl ethers (PDBEs, used as flame retardants) and perfluorinated compounds (used in production of fluoropolymers). The PBDEs were low-to-non-detectable in most whole-fish samples from INDU, PIRO, and SLBE, with detected concentrations generally less than 10 ng/g wet weight. Perfluorinated compounds were detected in samples from all six park units and were less than 20 ng/g in most samples. However, concentrations of about 130 ng/g wet weight were found in largemouth bass from Middle Lagoon (INDU).

Methylmercury biomagnified in each park's aquatic food web, with increasing concentrations at each step up the food chain. Data from Beaver Lake (PIRO) provide a good example of this (see table). Methylmercury levels increased with trophic position, with a large increase (more than 100,000-fold) in concentration between water and seston (algae), and 5- to 10-fold increases in concentrations in trophic steps between algae and zooplankton, zooplankton and small fish (perch), and small prey fish and large predatory fish (northern pike and walleye). In Beaver Lake, methylmercury biomagnified to concentrations in predatory game fish that exceeded those in lake water by a factor of more than 10 million. This demonstrates why small amounts of mercury entering the parks in atmospheric deposition can lead to potentially harmful methylmercury exposures in predatory fish, fish-eating wildlife, and humans who frequently consume wild-caught fish.

Biomagnification of methylmercury (MeHg) in the Beaver Lake food web, Pictured Rocks National Lakeshore, Michigan. Average concentrations for all but the water sample are shown in nanograms per gram (ng/g, or parts per billion) dry-weight.

Food web component	*Applicable sample*	*MeHg (ng/g)*	*Bioaccumulation factor (concentration ratio to water)*
Predatory fish	walleye (axial muscle)	1,800	54,500,000
	northern pike (axial muscle)	1,600	48,500,000
Prey fish	small yellow perch (whole-fish)	175	5,300,000
Zooplankton	zooplankton (>154 micrometers)	25	758,000
Algae	seston	4.8	145,000
Water	water (unfiltered)	0.000033	1

Landbirds

Apostle Islands National Lakeshore
Landbird surveys were not conducted at APIS this season.

Grand Portage National Monument
The breeding bird survey was conducted from 27 June through 1 July. The survey was interrupted on 28 June by unacceptably windy conditions, but the weather was fair for the rest of the survey. There were 52 species observed, which is seven fewer

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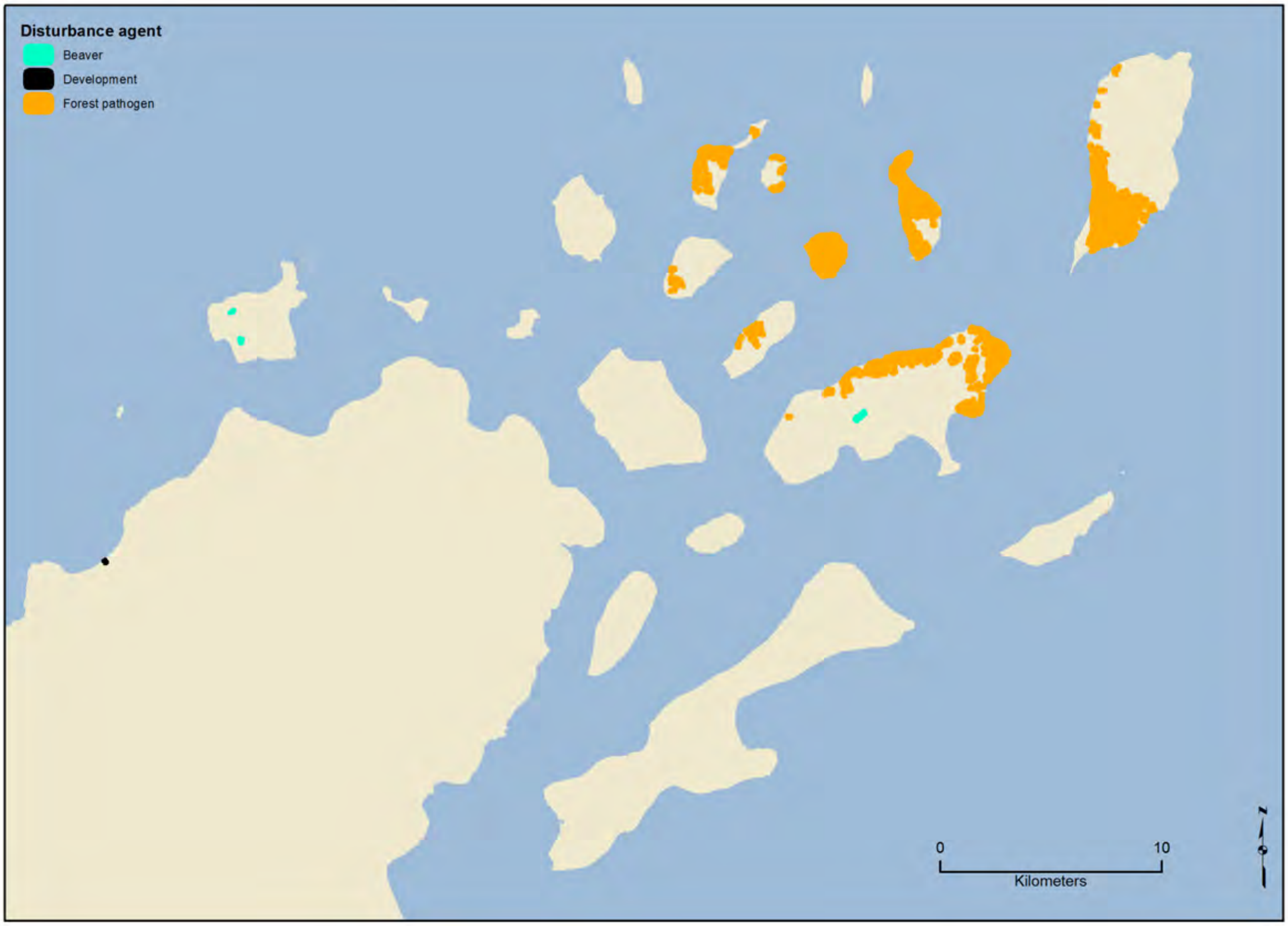
Mapping Landscape Disturbance

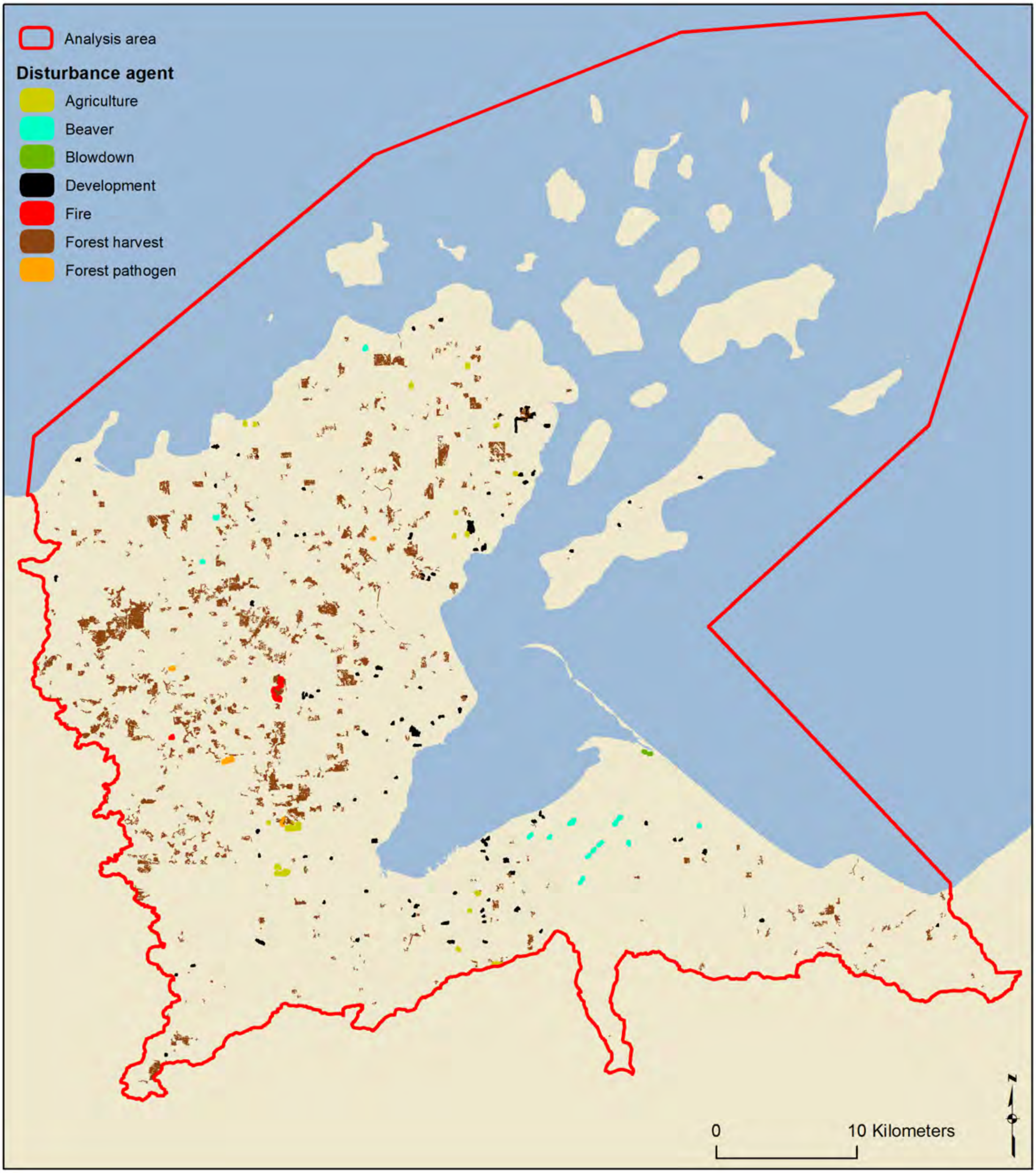
Network staff analyzed satellite and aerial imagery taken between 2004 and 2009 to identify and measure disturbances on the landscape within Apostle Islands National Lakeshore and in adjacent portions of Bayfield, Ashland, and Iron counties. Over the long-term, this information helps managers to identify trends in landscape dynamics and changing land use. Following a six-year rotation through the nine Network parks, we will reanalyze disturbance at Apostle Islands in 2018.



Disturbance inside the park was caused by **beavers**, **development** of the Meyers Beach day-use area near the mainland sea caves, and tree defoliation caused by a **forest pathogen** outbreak of the saddled prominent caterpillar (*Heterocampa guttivitta*; pictured at right). The outbreak only occurred in 2006, but it affected 7.45% of the park and nine islands. Air photos from subsequent years show no evidence of mass die-off among the affected areas. In total, 7.48% of park land was disturbed during the six-year analysis period.

NPS / Jim Nepstad

Download the full report or a one-page resource brief from the Network website
http://science.nature.nps.gov/im/units/GLKN/monitor/landuse/landuse.cfm



Outside the park, disturbance mostly took the form of **forest harvest**, which occurred in each year of the analysis period and peaked in 2007. Nearly 1% of the land outside the park experienced some level of harvest. **Development** was a minor but consistent disturbance, occurring in each of the analysis years. There was also some **beaver** activity outside the park, affecting <0.1% of the land. Fires occurred in 2007 and 2008, and some land was converted to agricultural use. In total, 3.94% of the study area outside the park was affected by some form of disturbance.

2012 Field Season Summary

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than the average number observed since 2006 (59).

Indiana Dunes National Lakeshore
Surveys were conducted at all 50 points, but no summary report was submitted.

Isle Royale National Park
Highlights included very average numbers overall, and an Orange-crowned Warbler finally showed up during a point count. Two Orange-crowns were heard on previous birding mornings, but never during a count itself. This is not really an unusual bird to find here during breeding season, but we are a bit south of the normal range. It was heard on the Greenstone Ridge a few miles west of Chickenbone Lake in mixed forest with lots of gaps.

Mississippi National River and Recreation Area
No report submitted.

Pictured Rocks National Lakeshore
This was the second year of conducting the breeding bird survey at PIRO. Counts were completed at 49 points across the park in early June due to extraordinarily good weather. Seventy species and 786 individuals were counted this year, including 19 new species. Notable occurrences for the year include a Connecticut Warbler, Cape May Warbler, and multiple Red Crossbills.

Sleeping Bear Dunes National Lakeshore
Counts were conducted at all 41 survey points between 10 and 15 June. There were 671 individual birds identified, representing 85 species. Some firsts for the survey were Trumpeter Swan, Northern Mockingbird, Northern Parula, and Osprey. The highest number of individuals of a species was 51 Red-eyed Vireos, followed closely by 49 Red-winged Blackbirds and 35 Mourning Doves.

Alice Van Zoeren looks for a Field Sparrow singing nearby during landbird surveys at Sleeping Bear Dunes.

St. Croix National Scenic Riverway
In addition to the two routes planned for the year, a new route was set up on the St. Croix River from the Raspberry Landing (just downstream from Highway 70) to Nevers Dam. Tentative points were established based on the half-mile marks for the river. Alternate sides of the river were surveyed (from a canoe), generally within a few meters of the shore.

Voyageurs National Park
All 80 points were surveyed in 2012, but no summary report was submitted.

Land Cover/Land Use

Our analysis of disturbances at Apostle Islands was completed, and the report has been published (see center of this newsletter for highlights). We are now summarizing data for MISS and SACN. These two parks protect river corridors embedded within very large watersheds, so we are conducting this work on representative sub-watersheds totaling approximately 300,000 hectares for SACN and 200,000 ha for MISS. These are the first parks we have worked on that have substantial adjacent urban and agricultural land uses, and we are having success in identifying changes within these landscapes thus far.

Development is the predominant change agent around MISS, while there is a broad mix of forest harvest and rural residential development around SACN. Monitoring changes within the watersheds of these parks will provide context for changes observed in stream flow dynamics and water quality that may affect resources within the parks.

We field tested a trail monitoring program at GRPO in early October. This is primarily a condition assessment, with the goal being to inform management of problem areas along the trail (such as wet spots or rotten footboards on boardwalks), and to help direct maintenance efforts.

The Network funded an air photo project at SLBE. The flight occurred in April, but warm temperatures early in the season caused trees to leaf-out prior to the flight. Thus, we did not quite capture leaf-off conditions, but the imagery is high resolution (0.15 m, or 6 in.), and of very good quality.

Vegetation

Having now sampled all the Network parks, we returned to Indiana Dunes to re-sample the 20 plots established in 2007. We also established and sampled 30 additional plots, raising our total to 50 permanent monitoring plots at INDU. These plots were distributed between multiple forest types, with many in black oak savanna, black oak-sassafras woodland, and rich mesic hardwoods. We also had a small number of plots in oak-hickory stands, including one each in the Pinhook Bog and Hobart Prairie tracts.

Chris Groebner consults a field guide while working on a ground cover quadrat at Miller Woods.

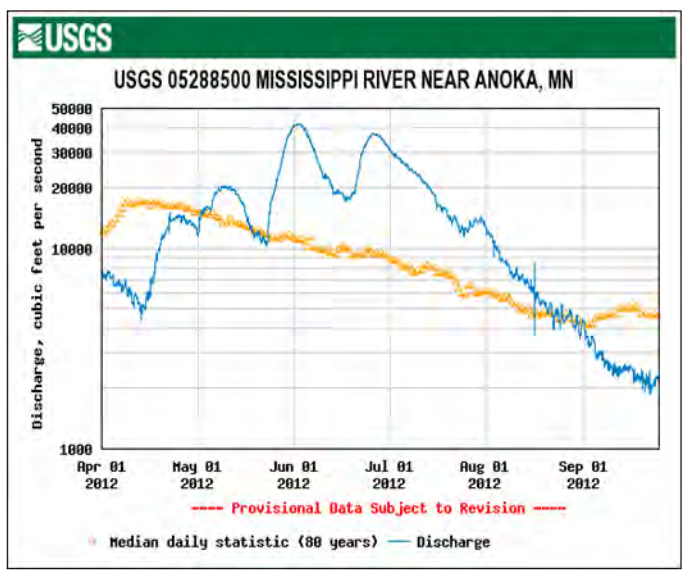
Not surprisingly, forest quality varied between sites. Many of the black oak savanna and woodland sites had few invasive species, while many of the oak-hickory stands appear to be in the early stages of multiflora rose (*Rosa multiflora*) invasions, and several of the mesic hardwood stands are threatened by Oriental bittersweet (*Celastrus orbiculatus*), a non-native vine. Many of these sites also supported a large number of green ash, making the presence of Oriental bittersweet all the more problematic. While green ash is still present in large numbers, many large trees have died. Coarse woody material is high in these stands as a result, but many of the dead ash remain standing, further providing a foothold for bittersweet expansion.

We noted a number of exciting understory species in our plots, including four State Watch List species, eight rare species, two State Threatened plants—Carey's smartweed (*Persicaria careyi*) and Bebb sedge (*Carex bebbii*)—and one State Endangered plant, the highbush cranberry (*Viburnum opulus* var. *americanum*).

Water Quality—Large Rivers

David VanderMeulen completed eight rounds of sampling at MISS and three rounds of supplemental monitoring at SACN. Monitoring assistance was provided by park staff and volunteers, and researchers and interns from park partners.

Many of the water quality parameters we measure are strongly correlated with river flow, and this season was noteworthy in that respect. River flow was below average in late winter due to very little snowpack; it increased during the very wet spring and early summer, then fell again with the onset of what has been described as a "flash drought" beginning in mid-summer and continuing into the fall (see graph). The higher flows in the spring and early summer resulted in muddier-than-usual, sediment-laden water on the Mississippi, but the lack of rain since mid-summer brought about very low flow and relatively clear water conditions. The clearer water likely was beneficial to many aquatic plants and animals, but the low water levels created hazardous conditions for boat navigation.



Discharge on the Mississippi River near Anoka, MN, as recorded by a U.S. Geological Survey gauging station.

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2012 Field Season Summary

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Water Quality—Inland Lakes

We conducted three rounds of sampling on 37 lakes at APIS, INDU, ISRO, PIRO, SLBE, and VOYA. Vertical arrays of temperature loggers collected data year-round from one lake each at ISRO, PIRO, and VOYA. Data from these arrays are providing important information on fish habitat and thermal structure of the lakes as related to weather and climate. We began a collaborative project with USGS to sample 16 lakes and four Lake Michigan beach sites for cyanobacterial toxins (see the ISRO, PIRO, and SLBE sections for more details).

Apostle Islands National Lakeshore
The June sampling occurred shortly after a major flood event in Duluth/Superior. As a result, Lake Superior water was extremely turbid—so much so that it interfered with the boat's sonar, and the surface was streaked with long lines of floating detritus. The plume of sediment and debris could be seen on satellite imagery throughout the summer as it spread between the islands and out towards the middle of the lake. In August, an unprecedented bloom of cyanobacteria (blue-green algae) occurred along the beaches of the park's mainland unit, probably sparked by the pulse of nutrients flushed into the lake during storm run-off and by unusually warm temperatures. Park staff collected a sample of the algal bloom, which we sent to the Wisconsin State Lab of Hygiene for species identification. GLKN staff also collected two samples and sent them to a U.S. Geological Survey lab to analyze for algal toxins. At least two species of cyanobacteria were present, but no toxins were detected.

Indiana Dunes National Lakeshore
Josh Dickey, with assistance from other park staff, conducted all three rounds of sampling. Beginning in early July, dissolved oxygen concentration in Long Lake fell to less than 1.0 part per million, which is generally considered too low to support aquatic life. Water levels at Long Lake were extremely low, exceeding the already low 2011 levels. Since monitoring began in 2006, water levels have reached part-way up the USGS well post (see photo); now it has receded to a point far past the well. As Long Lake continues its trajectory from lake to wetland, we will consider removing it from the inland lakes protocol.

The waterline at Long Lake (INDU) continues to recede as the lake becomes more of a wetland.

Isle Royale National Park
Rick Damstra completed all three rounds of monitoring, with assistance from water quality technician, Jess Ruuti, and park staff. In addition to the routine monitoring, they collected water samples from four index lakes and two non-index lakes for analysis of algal toxins; results to-date have been below detection limits. Lake Richie had a relatively minor bloom of cyanobacteria in August. Rick and Jess serviced temperature and depth loggers on two streams, conducted flow measurements on Washington Creek to contribute to USGS discharge calculations, and maintained a vertical array of temperature probes on Lake Richie for the third full season.

Pictured Rocks National Lakeshore
Lora Loope and Leah Kainulainen completed all scheduled monitoring. They also collected water samples from three index lakes and one non-index lake (Trappers Lake) for analysis of algal toxins. Even though an algal bloom was not obvious, the late July sample collected at Trappers Lake tested positive for Microcystin, a hepatotoxin that is capable of causing chronic liver ailments. The park posted signs to warn visitors. Lora and Leah also sampled Little Beaver Lake (a non-index lake) and began bathymetric mapping of index lakes (with assistance from Jess Ruuti). The vertical array of temperature probes on

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2012 Field Season Summary

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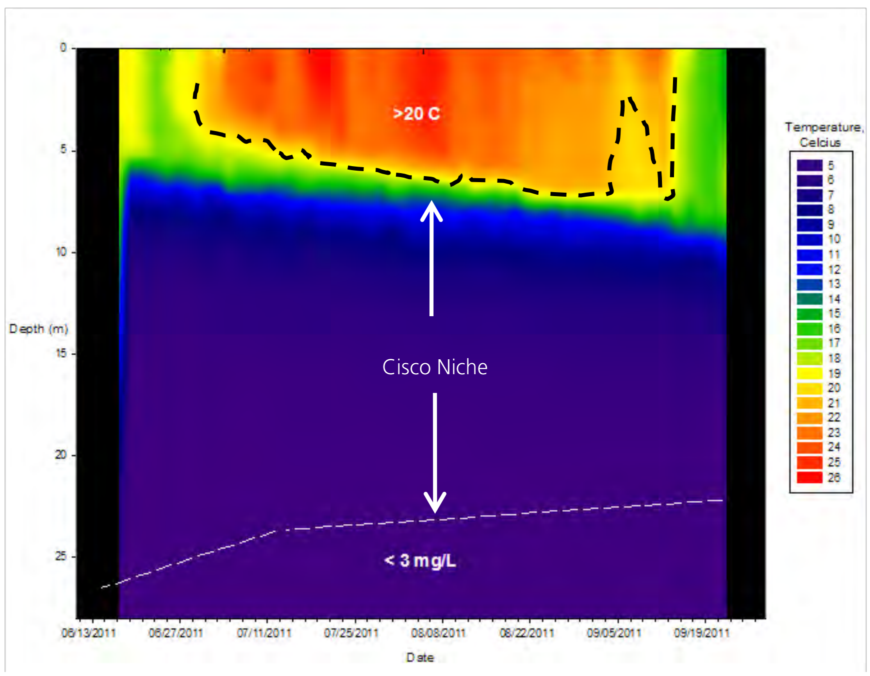
Grand Sable Lake was reset in May for summer conditions. USGS planned to discontinue the staff gauge in Grand Sable Lake this year, so we entered into an interagency agreement to continue the gauge one more year—enough time for Lora and Leah to install a permanent benchmark and continue water level measurements relative to both the gauge and benchmark to allow a continuous record of water level data.

Sleeping Bear Dunes National Lakeshore

Chris Otto, with the assistance of park staff, completed all three sampling rounds, despite uncooperative weather. We limited the routine monitoring to six lakes (fewer than in past years)—the same lakes selected to be part of the algal toxins project. Water samples were also collected from four Lake Michigan beach sites for analysis of algal toxins. To date, results of toxin analyses have been below detection limits. During the second round of sampling (late July), several lakes had unusually warm temperatures (over 25°C, 77 °F) extending deep into the water column. On 24 July, Bass Lake (North) had a temperature of approximately 28 °C (82°F) extending through the top 5 m (16.4 ft). Warm temperatures in the upper portions of the lakes combined with low oxygen levels in the deeper portions of the lakes leave little good fish habitat. One SLBE lake (School) and several other lakes in the area experienced fish die-offs during the summer.

Voyageurs National Park

Jaime LeDuc completed all sampling, with assistance from interns Eric Olson and Sarah Ferguson. The vertical array of temperature loggers in Little Trout Lake was reset in May for summer conditions. The array data from 2010 showed that ample cold water fish habitat was available (<20 °C and >3mg/L dissolved oxygen; see figure). Data from 2011 will begin to give us an idea of whether that habitat is consistently available.



Temperatures in Little Trout Lake as recorded throughout 2010 by a vertical array of temperature loggers. The area between the black and white dashed lines is optimal habitat for cold water fishes such as cisco.

Diatoms

Bottom sediment cores are collected from inland lakes and areas of sediment deposition in river sites at Network parks every three to five years for analysis of diatom species composition. In 2012 cores were collected from 10 lakes at ISRO. Our collaborators at the St. Croix Watershed Research Station will analyze the samples and report on changes that have occurred in the index lakes since the last sampling in 2008.

Weather and Climate

A weather station was installed on North Manitou Island (SLBE) this summer, but is not yet operational due to an unidentified electrical problem. Staff will re-visit the island next spring to locate and fix the problem.

We entered into a cooperative agreement with Mike Tercek of the Sonoran Institute to analyze six years of data for each of three parks—INDU, APIS, and VOYA. He will work with each park and the Network to select NOAA weather stations, quality check the data, create summary products (charts and graphs), and provide a Resource Brief for each park. ●

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Improving park management through greater reliance on scientific knowledge

Apostle Islands National Lakeshore
Grand Portage National Monument
Indiana Dunes National Lakeshore
Isle Royale National Park
Mississippi National River and Recreation Area
Pictured Rocks National Lakeshore
Sleeping Bear Dunes National Lakeshore
St. Croix National Scenic Riverway
Voyageurs National Park

The Current is published twice a year for Great Lakes Network park staff, our partners, and others interested in resource management at Great Lakes region national parks.

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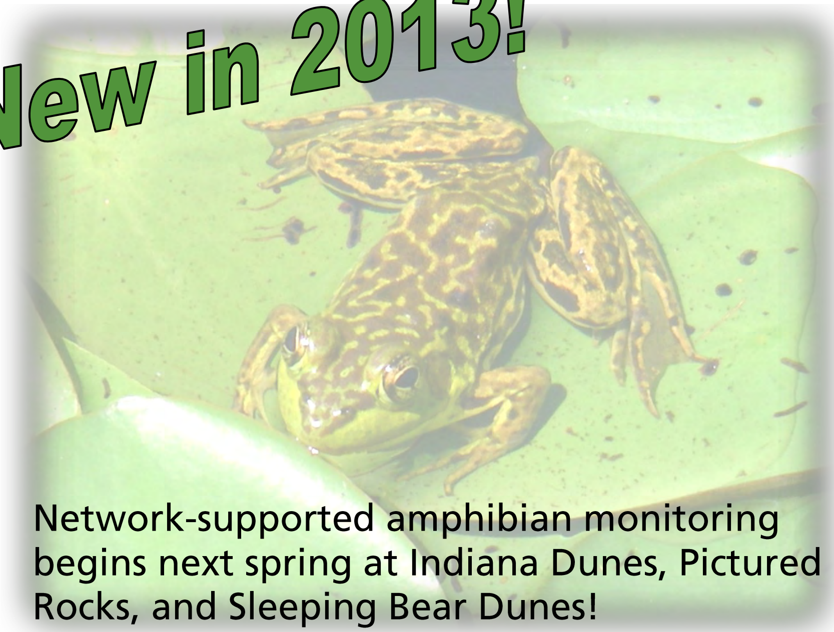
New in 2013!



Network-supported amphibian monitoring begins next spring at Indiana Dunes, Pictured Rocks, and Sleeping Bear Dunes!