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Telling Science Stories

By Ted Gostomski, Network Science Writer

Science, wrote Paul Gruchow, *has become a priesthood. Its meticulously trained practitioners are suitably cloistered* [and] *speak a language, for the most part, that even well-educated persons outside their specialties cannot understand, communicating through journals and the proceedings of societies impenetrable to the general public.*[1]

This is a stinging criticism, but one that, unfortunately, tends to be true. Scientists – beholden to objectivity and the reduction of bias – see any communication veering from the statistically-rich technical report or public presentation as too "touchy-feely." Yet, the National Park Service is charged with not only protecting the resources within the parks, but also helping visitors to make connections with those resources, both intellectually and emotionally. This responsibility applies to biologists as well as rangers and interpreters. We must tell a story that entertains *and* informs. In the Inventory and Monitoring Program, we strive to use scientific monitoring data to tell stories about the parks and how they relate to the larger world. We have the intellectual parts of our stories. Can we find a way to make them emotionally memorable?

Freeman Tilden, the "father of interpretation" in national parks, suggested that those who want to tell a good story should not ask themselves, "what is it I wish to say?", but instead should consider, "what would the audience wish to hear?"[2] Rather than just reciting numbers and pointing to graphs, we need to answer the question, "so what?" So, why is this important? What does it have to do with the larger world and my place in it? In short, why should people care about what we are monitoring?

In his book, *Don't Be Such a Scientist*, Randy Olson, a filmmaker and former professor of marine biology, notes that two main errors can be made in presenting science to the public: the error of accuracy, and the error of boredom. We can mitigate the

(Continued on page 2)

Bill Route talks about contaminants in eagles for an "audio postcard" that aired on NPR-affiliate WBEZ (Chicago). Listen online at http://bit.ly/khoaTH

Telling Stories About Science

(Continued from page 1)

second error by telling a story that motivates, and *then* educates.[3] We have to catch the audience's attention before we start trying to send a message. In an essay for *Escape From the Ivory Tower*, Jim Handman, a producer for a Canadian radio science program agrees. He points out that technical science papers already follow a "narrative arc" that every good story must have: here's the issue, here's what we did, here's what we found, and here's why the things we found are important.[4] The trick is to make your story clear, concise, and conversational, and one way to do that is to turn the technical report on its head. Rather than starting with the background, start with what you are learning from your research and why it's important, then tell how you learned these things and how it compares or contrasts with what the prevailing ideas or thoughts were prior to your work.

Jim Wiener, a partner in the Network's contaminants monitoring program, gives an impromptu talk to visitors at Sleeping Bear Dunes National Lakeshore while members of his field crew process fish and aquatic insects.

Another way to engage people is to first help them connect with the larger place. Sigurd Olson promoted wilderness and the national parks by telling stories about his time canoeing and camping in the Boundary Waters Canoe Area and neighboring Voyageurs National Park, the Namekagon River (part of the St. Croix National Scenic Riverway), and even the Apostle Islands. By exploring his own relationship with these areas, he revealed why the reader should also care about them and simultaneously inspired the same sort of passion for one's own favorite places.

In training at the Grand Canyon last fall, I learned about Significant Emotional Events, or SEEs — milestones or experiences that can change the course of one's life. Interestingly, SEEs are often connected so strongly to places that the person remembers as much about where they were as they do about the life-changing thing that happened. Thinking about the significant events in my life, I realized they are deeply and inextricably linked to places. In fact I consider them significant events *because* of those places. This sort of attachment forms a baseline for comparison, a fabric on to which we pin stories and data. We can view national parks in the same way and use them as jumping-off points for talking about the critical natural resources we are monitoring and what the data reveal. But to be the most successful at this, we need one more thing.

Park interpreters are master storytellers. They bring to their jobs an innate skill for talking with visitors and helping them make emotional and intellectual connections to park resources. To be the best science communicators we can possibly be, we need to build relationships with park interpreters and learn how to see the tangible and intangible values of our work, how to tell the stories our data prescribe, and how to answer the question "so what?".

After six field seasons, some of our programs have enough data to begin telling meaningful stories. Working with park interpreters, we can begin translating science's "secret language" into something more accessible, stories that reinforce the importance of the Great Lakes Network national parks. ●

References

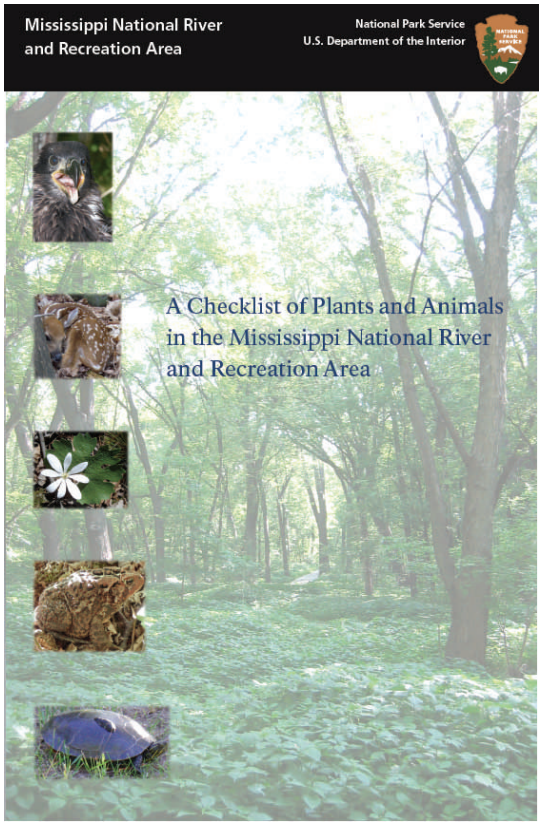
[1]Gruchow, P. 1995. Naming What We Love. Pages 123-130 in *Grassroots, The Universe of Home*. Milkweed Editions, Minneapolis, MN.

[2]Tilden, F. 2007. *Interpreting Our Heritage*, 4th edition. University of North Carolina Press, Chapel Hill.

[3]Olson, R. 2009. *Don't Be Such a Scientist: Talking Substance in an Age of Style*. Island Press, Washington, D.C.

[4]Handman, J. 2010. Tell me a story. Pages 48-49 *in* N. Baron, *Escape From the Ivory Tower: A Guide to Making Your Science Matter*. Island Press, Washington, D.C.

Checklist Booklet Puts Data in Visitors' Hands



Mississippi National River and Recreation Area (MISS) has a new booklet to share with visitors. Simply titled, "A Checklist of Plants and Animals of the Mississippi National River and Recreation Area," the booklet compiles all the plant and animal species lists that were gathered, entered, and certified in NPSpecies (now part of the more extensive IRMA — Integrated Resource Management Applications — database) during the inventory phase of the inventory and monitoring program.

"The NPSpecies database is a powerful tool for natural resource professionals who need an accurate list of all species in their park," says Network Coordinator, Bill Route. "This new checklist is our first attempt to make the information more broadly useful to park staff and to the general public, and we hope to use it as a template for the other Network parks."

The booklet was created by Network science writer, Ted Gostomski, and reviewed by MISS staff. The response was very positive.

"Our staff loves it," says Nancy Duncan, Resource Management Specialist at MISS. "And it helps visitors to see just how much diversity there is in the river corridor."

The booklet lists more than 2,100 species, divided into 10 sections: Mussels (Clams); Fish; Amphibians; Reptiles; Birds; Mammals; Trees, Shrubs, and Vines; Ferns and Fern Allies (Pteridophytes); Grasses, Sedges, and Rushes; and Forbs (Wildflowers). Each section presents the entire certified list for that group along with indicators of its status (Present, Likely Present, Unconfirmed, Historic, and Encroaching) and abundance (Common, Uncommon, Rare, Unknown). Interesting "factoids" are sprinkled throughout the book, offering more insight to the river's natural history, and selected references show users where they can learn more.

Mississippi River staff wasted no time in printing the booklet and putting it into the public's hands. "We handed out copies at the Minnesota State Fair, and it is now available at our Visitor Center. We think this will be a very popular item," says Duncan. ●

Staff Insider

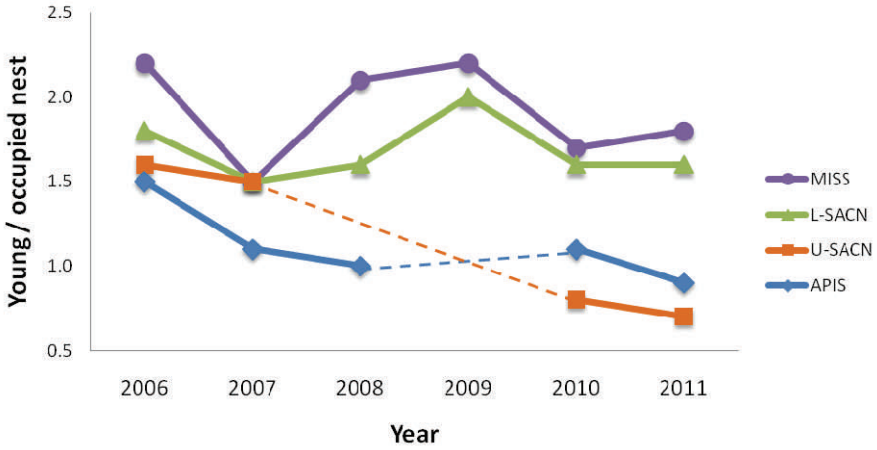
David VanderMeulen, Aquatic Ecologist

David VanderMeulen has an undergraduate degree in Applied Ecology and Environmental Sciences from Michigan Technological University, and a Master's degree in Water Resources Science from the University of Minnesota - Duluth. David began his career as a private consultant, focusing on water quality monitoring, aquatic plant surveys, and lake management planning. He joined the National Park Service in 2005, and began his current position as an aquatic ecologist with the Network in 2007. David is primarily responsible for monitoring water quality at the Mississippi National River and Recreation Area and St. Croix National Scenic Riverway. Other responsibilities include serving on the St. Croix River Water Resources Basin Team and on the St. Croix National Scenic Riverway Dive Team. ●

2011 Field Season Summary

Bioaccumulative Contaminants—Bald Eagles

Sampling of bald eagle nestlings was completed in May and June at APIS, MISS, and SACN. We visited 94 territories in the three parks, and collected plasma and feather samples from 91 nestlings. We sent samples from 54 nestlings for laboratory analysis, and samples from 36 siblings were archived for later use.



The number of young per occupied nest, a measure of a local eagle population's productivity, ranged from 0.7 on the Upper SACN to 1.8 at MISS (graph). Productivity was below the healthy population threshold of 1.0 young per occupied nest at both the Upper SACN (0.7) and at APIS (0.9). A change in personnel on the Wisconsin DNR survey crew (beginning in 2010) may have contributed to these low estimates, but generally these areas are less productive than MISS and the Lower SACN, which remained highly productive.

The results of blood and feather sample analyses will be available later this winter, and a summary report will be prepared soon after. Bill Route collaborated with the University of Michigan's School of Public Health to investigate the effects of mercury on bald eagles. Results indicate mercury alters brain chemistry and that 14-27% of the population may be affected. The paper was published in the journal *Ecotoxicology* in September 2011.

Bioaccumulative Contaminants—Fish, Dragonflies, and Lower Food Web

Adult Fish — 2010

Because 2011 samples are still being analyzed, 2010 data are presented here. Concentrations of total mercury in axial muscle fillets of 440 adult (mostly predatory) fish sampled from VOYA, ISRO, PIRO, SLBE, and INDU, ranged from 0.01 to 1.7 parts per million (ppm) wet weight. Concentrations in 47% of these fish exceeded the Environmental Protection Agency (USEPA) tissue residue criterion (0.30 ppm). Mercury levels were generally highest in northern pike at VOYA and lowest at INDU.

Concentrations of total lead were less than 0.05 ppm in most composite samples of whole fish from the six park units. Concentrations of DDT, DDD, DDE, and PCBs were not detected in most whole-fish samples. Of those that were detectable, concentrations were highest in gizzard shad from Middle Lagoon at INDU (DDE ca. 0.5 ppm, total PCBs ca. 0.45 ppm). Emerging contaminants of concern found in fish of the Great Lakes region included polybrominated diphenyl ethers (PBDEs, used as flame retardants) and perfluorinated compounds (perfluoro sulfonates and perfluoro acids, used in production of fluoropolymers). PBDEs were low to non-detectable in most whole-fish composite samples, with detected concentrations generally below 0.010 ppm. Perfluorinated compounds were found in all samples, with the highest concentrations (ca. 0.10 ppm) in largemouth bass from Middle Lagoon at INDU. Most concentrations were typically below 0.020 ppm.

Successful seine-netting of age-1 perch at Beaver Lake, PIRO. Photo by Sean Bailey.

Larval Dragonflies — 2011

Larval dragonflies were collected from all six park units (the five noted above plus GRPO) in 2011. Members of the clubtail (Gomphidae) and skimmer (Libellulidae)

families were the most common taxa at ISRO, PIRO, SLBE, and VOYA. Larval darners (Aeshnidae), emeralds (Corduliidae), spiketails (Cordulegastridae), and cruisers (Macromiidae) were also collected from those parks, but in lesser numbers. Skimmers, darners, and emeralds were the most common taxa collected at INDU and GRPO. These samples are being processed (species and sex identification, morphological measurements) in preparation for analysis of total- and methyl-mercury.

Analyses of larval dragonflies collected in 2010 are still underway, but initial results for clubtails from PIRO and VOYA reveal mean methylmercury concentrations in larvae from PIRO lakes ranged from 57.3 (Standard Error=4.7) to 113 (SE=2.4) parts per billion (ppb) on a dry-weight basis and were highest in Chapel Lake. At VOYA, methylmercury concentrations in larval clubtails averaged 54.9 (SE=6.3) ppb in Peary Lake and 89.2 (SE=9.8) ppb in Ryan Lake.

Lower Food Web
We sampled filtered and unfiltered water, sediment, seston (suspended particles, mostly algae), and zooplankton from lakes to quantify levels of total mercury and methylmercury in components of the lower food web. At stream (GRPO) and wetland sites (Great Marsh at INDU), we sampled unfiltered and filtered water, sediment, and seston.

Mean concentrations of methylmercury and total mercury in unfiltered water from all sites were 0.28 nanograms/liter (ng/L, or parts per trillion) and 2.2 ng/L, respectively, which are typical of the upper Midwest. Levels were highest in northern streams and lowest in southern lakes. Correlations between methylmercury in water and watershed-related variables (pH, dissolved organic carbon) suggest that wetland- and forest-dominated watersheds have higher methylmercury concentrations at the base of the food web. As expected, mean concentrations of methylmercury increased substantially through the aquatic food web (sediment [all sites] =1.5 nanograms/gram, seston [all sites] =10 ng/g, zooplankton [lake sites only] =99 ng/g), as did the proportion of methylmercury within total mercury. Thus, despite any physical/biological/chemical or other differences between sites, the extent of mercury accumulation between steps in the food web is roughly proportional.

Landbirds

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

Grand Portage National Monument
Thirty-eight points on three transects were surveyed between 1 and 3 July. Though surveys were conducted at the extreme late end of the protocol period, a total of 130 individuals among 60 species were recorded. No notable species were observed.

Indiana Dunes National Lakeshore
All 50 sites were surveyed, and 548 individual birds among 60 different species were counted. This year we finally recorded a Wild Turkey on the survey even though turkeys returned to the park several years ago. Ring-billed Gulls were the most commonly encountered species (84 birds).

Isle Royale National Park
The only new species detected in 2011 was a Black-headed Grosbeak on the Windigo route in open maple forest near Sugar

(Continued on page 8)

PARK Codes

APIS
Apostle Islands National Lakeshore (Wisconsin)

GRPO
Grand Portage National Monument (Minnesota)

INDU
Indiana Dunes National Lakeshore (Indiana)

ISRO
Isle Royale National Park (Michigan)

MISS
Mississippi National River and Recreation Area (Minnesota)

PIRO
Pictured Rocks National Lakeshore (Michigan)

SLBE
Sleeping Bear Dunes National Lakeshore (Michigan)

SACN
St. Croix National Scenic Riverway (Wisconsin/Minnesota)

VOYA
Voyageurs National Park (Minnesota)

Stories From the Field

Network staff venture out to the parks every season for a new round of sampling and data collect
Mississippi River floodplain during high water, the kindness of landowners, or the beauty of 40 kn

Making Connections

The Network's bald eagle/contaminants monitoring crew often must sample nest-trees on private property. In May of 2010 we found ourselves knocking on the door of Phil LeBoutillier, a kindly 90 year-old resident of West Hudson, WI, who offered to drive us to his nest in a 1940s-era Farmall tractor and trailer he was working on. The trail wound down a steep bank of the St. Croix River then crossed a deep ravine that Phil had bridged — perhaps not too long after his tractor was built. As we crossed the bridge we held our breath as rotted planks bent under the tractor's weight. Our climbers, Jim Spickler and Giacomo Renzulo, risk their necks daily while climbing 80 foot nest-trees, but declined the ride back up and over that bridge! The smile on Phil's face is indicative of the many smiles we get when we invite landowners to observe, touch, and experience the birds they've watched grow. It's highly rewarding to see people make lasting connections with wildlife and the environment.

- Bill Route, Network Coordinator/Ecologist

Tree climbers, Jim Spickler (left) and Giacomo Renzulo (right) with Phil LeBoutillier and a pair of eaglets from a nest on Phil's property.

In the Heat of the Summer

Every field trip this summer at Voyageurs was an adventure and something I looked forward to in the morning. The solitude and the way the different lighting hits the ancient rocks that line the waters makes traveling to even the most visited places a new and invigorating exploration.

It was a hot summer with heat indexes over 100 degrees Fahrenheit some days, which is unusual for the icebox of the nation (International Falls, MN). It was not uncommon for us to see wolf pups (photo) and deer swimming from island to island. Lake sturgeon were spotted "porpoising" and jumping into the air near the dam at Kettle Falls. On several occasions a loon came close enough to the boat that we could look it in the eye. On our hikes we collectively saw over two hundred lady slippers. On certain days we didn't need a lunch because the wild blueberries, raspberries, strawberries, and black berries on the trails were plentiful enough to tide us over.

-Jaime LeDuc, Water Quality Technician

Background photo: 40-knot winds pummel Isle Royale just one day after the fish contaminants crew completed their sampling in June. The gale pushed 8- to 9-foot seas across Lake Superior, disrupting ferry service to and from the island. The *Ranger III* stayed in Houghton MI, and the *Voyageur II* from Grand Portage, MN, — the boat the fish crew was scheduled to be on — stayed an extra night on the islan

ion and almost always return with stories to tell. Whether it's the challenges of working in the ot winds (when you're on shore), there's always something worth remembering.

What Should I Put For "Ground Cover"?

The spring of 2011 turned out to be an unusual year on the Mississippi River. More rain than normal led to higher water for a longer time than is typical. Unfortunately, this coincided with our long-planned spring/summer sampling along the river corridor. We started sampling right after Memorial Day and continued through June. We started with the driest, most upland sites - places such as Grey Cloud Dunes State Natural Area - and worked our way down to the floodplains. Unfortunately the high water made sampling and access difficult, even in plots that were not directly in an active floodplain. For the final eight days of sampling, we focused on our plots in the Gores Pool Wildlife Management Area, and unfortunately (again!) the weather did not cooperate. Continued rains during this period led to the river rising even higher during each of the eight days. We continued putting in plots wearing hip boots, realizing at some point that, rather than beach the canoe on the side of the river and bushwhack in, it was easier and more practical to simply canoe through the woods to the plots!

- Suzy Sanders, Plant Ecologist

Botanist Caitlin Clarke makes the best of a soggy situation on a forest vegetation monitoring plot along the Mississippi River.

A Day with the Superintendent

We all know that park superintendents are very busy people who deal with a wide variety of management issues. When St. Croix National Scenic Riverway Superintendent Chris Stein arrived in 2008, he developed a vision for the park that placed special emphasis on "keeping the water clean". But Chris is more than a visionary; he is also action-oriented. He is very involved in working with park partners throughout the St. Croix watershed to protect and improve water quality, and one day this summer, he made time in his busy schedule to assist me in the Network's long-term monitoring of water quality on the St. Croix River. This is a full-day commitment, but Chris was enthusiastic. He asked questions about my work, and he gladly wrote numbers on a data sheet as I read them to him from a probe that collects temperature, dissolved oxygen, and other information.

In spite of the relatively wet summer weather we had been having, the superintendent and I enjoyed a beautiful day on the river, and to top it off, we were treated to some aerial acrobatics by a pair of bald eagles.

- David VanderMeulen, Aquatic Ecologist

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2010 Field Season Summary

(Continued from page 5)

Mountain. Isle Royale is not near the range of this species, but Black-headed Grosbeaks are known to wander throughout eastern North America. It is an accidental wanderer to Michigan. A Pine Grosbeak was heard north of Lake Richie, but it sang up until we began the count period. Then it went silent. We recorded it as "miscellaneous." Common Ravens are exhibiting an increasing trend regionally, but not on Isle Royale. As in past years, there were few detections this season – just four observations across all eight transects. The numbers of both species and individuals were consistent with long-term means, but there is speculation that composition of the bird communities is changing.

Female Black-headed Grosbeak. Photo by Dave Menke/USFWS.

Mississippi National River and Recreation Area
No report submitted.

Pictured Rocks National Lakeshore
This was the first year for landbird monitoring at PIRO. Forty-seven (47) points were established along six transects located across the park. Designing the survey was complicated because of different management practices and habitats between the Shoreline Zone and the Inland Buffer Zone (IBZ). Rapid vegetation assessment was completed at all of the points this year, during which it was discovered that one of the points in the IBZ was within a compartment being logged. State-listed species detected included Common Loon, Trumpeter Swan, and a Merlin. The monitoring effort will receive some additional modifications over the winter, but overall the survey went well, and we are pleased with the results.

Sleeping Bear Dunes National Lakeshore
Point counts were conducted from 17 through 21 June at all 41 points. Seventy-four (74) species were documented among 654 individuals. Though three Black-billed Cuckoos were observed in 2010, when both eastern and forest tent caterpillar cycles were at their peaks, there were none recorded this year. A singing Dickcissel was one noteworthy record. Dickcissels have been observed regularly in the fields south of Empire over the past two summers.

St. Croix National Scenic Riverway
Counts were conducted at 150 points over three survey routes — the lower St. Croix River between Taylors Falls and Stillwater, MN (LOSA; 53 points), the Namekagon River downstream from County K Landing (50 points), and the upper St. Croix River from the Gordon Dam to Riverside Landing (USAC; 47 points). We recorded 97 species among 3,203 individual birds. Over the 16 years of these surveys 144 species have been recorded.

It was a rainy June and several days' surveys were postponed or terminated early and resurveyed at a later date. Highlights included a Brown Creeper on the USAC route and an Acadian Flycatcher on the LOSA route. The Brown Creeper was one of only two sightings in 16 years of the survey, and the Acadian Flycatcher was the first recorded on the survey. Double-crested Cormorants also appeared on the LOSA route for the first time since 2003.

Voyageurs National Park
This was the 16th year of landbird monitoring data collection at VOYA. Unfortunately, Resources Biologist Lee Grim suffered an injury completing the Anderson Bay Loop Trail route and was only able to complete 4 of 7 routes in the park. Despite the setback, we documented 60 different species (compared to 78 in 2010 from a full dataset).

Land Cover/Land Use

Processing and analysis of disturbances has been completed for Voyageurs (VOYA) and Isle Royale (ISRO) national parks, with Apostle Islands National Lakeshore (APIS) currently in progress. We use advanced remote sensing techniques to identify changes (disturbances) in forest cover, both inside and outside each park. Healthy ecosystems rely on natural disturbances like fire, wind, and beaver cuttings to maintain a mosaic of diverse forest types. Unhealthy ecosystems can result from a lack of such disturbance or from too much unnatural disturbance, which can hinder wildlife movements and act as vectors for invasive

species.

Satellite imagery, which is available at no cost, allows us to look at large pieces of the landscape (ca. 180,000 ha) to put park ecosystems in regional context. We use high-speed computer programs to examine several years of satellite imagery with sufficient detail to track small or subtle disturbances such as beaver flooding and forest thinning of as little as 20% of the canopy.

Our ability to monitor such disturbances on a yearly basis provides park managers with trends in forest cover in and directly adjacent to the parks. For example, our data show that the percent of land being logged each year outside of Voyageurs and Isle Royale national parks has declined in recent years, which may reflect reduced demand for timber in the wake of the slowed economy. Being aware of these changes helps managers anticipate impacts to park resources.

Vegetation

Mississippi National River and Recreation Area

Thirty-two plots were established at MISS, divided among upland forests, bottomlands, and floodplains, and on lands owned by twelve MISS partners including 3M, the Minnesota Historical Society, Macalaster College, Ft. Snelling State Park, and in the DNR-managed Gores Pool, downstream from Hastings, Minnesota. Unfortunately, 2011 was a wet year, with rain falling more often and later into the season than is typical. We initiated our sampling in upland plots, reserving the floodplain for the end of our month-long sampling window, but the Mississippi River continued to rise throughout our final two-week sampling period. This prevented us from reaching our target of 40 plots, as many of our planned locations were under more than two feet of water. Nonetheless, establishing plots in floodplains was exciting because those sites were generally ecologically intact – dominated by silver maple, cottonwood, and box elder – and contained few invasive species. Among other things, our data will be analyzed to determine forest structure and regeneration in this habitat. This is especially relevant because many keystone floodplain species are dependent on pulses in water flow in order to successfully regenerate.

Christine Groebner determines soil texture as part of the earthworm and soils assessment.

Despite being the eighth of nine parks visited in the initial vegetation sampling rotation, a number of species were recorded in plots that we had not noted in other parks, including Kentucky coffee tree and Ohio buckeye. We are scheduled to revisit MISS in 2017.

Apostle Islands National Lakeshore

Forty-four plots were established on 15 islands, and four plots were established on the mainland. The islands on which plots were established span a range of both deer abundance and disturbance histories, distances to the mainland, and size. The data can be used to assess changes in deer browse impacts over time, and to contrast browse impacts across islands with different deer histories. Our findings on down woody material may also be used to assess habitat availability for small to mid-size mammals while details on snags can be related to existing knowledge of bird populations.

In addition to sampling trees, herbs, shrubs, and down woody material, we assessed the impacts of exotic earthworms. Soil cores revealed a mean organic horizon depth of 5.7 cm. This is considerably deeper than organic horizons typically observed in other publicly owned forests where earthworms have been established for long periods of time. Nonetheless, earthworms were observed in a few cores and are undoubtedly present on most, if not all, of the Apostle Islands. Earthworm impacts on the understory are not dissimilar to regeneration and establishment problems resulting from deer browse. We are scheduled to revisit APIS in 2017.

(Continued on page 10)

2010 Field Season Summary

(Continued from page 9)

Water Quality—Inland Lakes

We conducted three rounds of sampling on 37 lakes (33 index lakes, and 4 non-index lakes) at APIS, INDU, ISRO, PIRO, SLBE, and VOYA. Nine additional lakes at ISRO and SLBE were sampled once each. Routine sampling of index lakes allows us to track any changes occurring over time, while sampling at additional lakes gives us a better understanding of aquatic resources at the parks.

We experienced more problems with fickle multiprobes in 2011 than in any other field season. We sent equipment back and forth to one another and rearranged field schedules in order to accomplish the monitoring. Many thanks to the Great Lakes Exotic Plant Management Team — Isaiah Messerly, Ryan Colley, and Carmen Chapin — for helping to facilitate these transfers.

Apostle Islands National Lakeshore
Although we always measure the water level of APIS lagoons relative to permanent benchmarks, we have never been able to measure them relative to Lake Superior. This year, on a particularly calm day with little to no wave action in the Lake Superior bays adjacent to the lagoons, we measured the lagoon water levels at Michigan and Outer islands relative to Lake Superior water level. Michigan Island lagoon is at approximately the same level as Lake Superior, while Outer Island lagoon is approximately 22 cm higher than the lake. This interesting fact will help us explain water level behavior in these two lagoons.

Indiana Dunes National Lakeshore
Josh Dickey began the sampling season amidst the disarray associated with an office and lab move. He overcame that hurdle only to be faced with a malfunctioning multiprobe in time for their second round of sampling. But he didn't let that deter him either. Beginning in the second sampling round, dissolved oxygen concentration in Long Lake became extremely low — less than approximately 2.5 parts per million. Such levels are generally considered too low to support aquatic life. Water levels at Long Lake were low, but similar to last year. Removal of one of the water sources to the lake (a retention pond on the eastern edge of the lake) makes water levels of particular interest. We expect Long Lake to become shallower, more filled with aquatic vegetation (even more than it is now), and more of a wetland in future years.

Isle Royale National Park
Rick Damstra and water quality technician Jess Ruuti completed all scheduled monitoring as planned. They sampled eight non-index lakes, completed bathymetric mapping of five lakes, serviced temperature and depth loggers on two streams (part of pilot testing for a wadeable streams monitoring protocol), followed-up on visitor reports of algal blooms in several lakes, and maintained a vertical array of temperature probes on Lake Richie for the second full season. In addition, they provided crucial support to the park by assisting researchers from the University of Maine and the St. Croix Watershed Research Station, and with two Great Lakes Restoration Initiative (GLRI) projects.

Pictured Rocks National Lakeshore
We rely on notes made on the data sheets to get a sense of what the crew experiences, and Lora Loope and Leah Kainulainen are especially good about including comments from the field. Some of their informative comments this year: "Fog so thick we could not see shore." "Chemocline appears to be several [meters] higher...[than] in years past." Lora had more than her share of multiprobe problems, but was able to complete all sampling thanks to loaners from GLKN and VOYA.

Sleeping Bear Dunes National Lakeshore
Chris Otto began the season with a malfunctioning multiprobe, which he sent in for repair and got back just before the second round of sampling. He immediately conducted the first round, and we re-scheduled the second round. His field notes also indicated many days of high winds.

Voyageurs National Park
Jaime LeDuc led the sampling effort at VOYA again this year, measuring the routine parameters and collecting additional water samples for total suspended solids. The results of these additional samples will be used in a collaborative project with the St. Croix Watershed Research Station to model the effects of past and future climate change on GLKN lakes.

This year we deployed a vertical array of temperature loggers in Little Trout Lake. The array will provide important information on the thermal structure of the lake (such as how deep the thermocline extends, when and how often the lake mixes, and timing and rate of spring warming) and will be useful to managers in determining future fish stocking efforts. Data from the probes were downloaded in September and the array was re-set for data collection under the winter ice.

Water Quality—Large Rivers

St. Croix National Scenic Riverway
Data collected by U.S. Geological Survey gauging stations show that water levels and river flow were especially high until September, when they dropped back down to typical long-term levels. Many of the water quality variables we measure are positively correlated with higher flow, so we expect to see increased levels of some variables, such as nutrients and sediment.

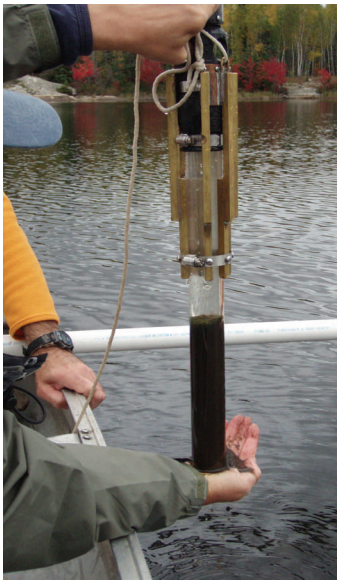
By mid-summer, Lake St. Croix — a natural series of pools in the lower 25 miles of the river — experienced some unusually low dissolved oxygen levels, with concentrations at or below five parts per million. Several factors likely contributed to the this: (1) heavy rainfall and high flows bringing more water from upstream wetland and backwater areas that typically have lower oxygen levels, (2) consumption of oxygen by decomposition of the abundant organic material, and (3) algae being swept downstream by high flows before their production of oxygen (via photosynthesis) could be absorbed by the water. Oxygen levels in the lake increased in the fall as the lake mixed and cooled off.

We collaborated with researchers on (1) an assessment of zooplankton assemblage in Lake St. Croix prior to invasion by non-native Asian carp; (2) testing for DNA of non-native Asian carp in the St. Croix, Mississippi, and Minnesota Rivers; (3) native mussel propagation; (4) quantitative zebra mussel density in Lake St. Croix; and (5) zebra/native mussel competition and predation.

Mississippi National River and Recreation Area
Annual monitoring alternates between MISS and SACN, and 2011 was the off-year for MISS.

Diatoms

Diatoms are collected in bottom sediment cores from inland lakes and lake-like river sites every three to five years at Network parks. Diatoms serve as bioindicators of water quality, as the assemblage of species present reflects conditions in the lake or river. In 2011 we collected samples from 10 lake and lake-like river sites at APIS, MISS, and SACN. Samples from INDU will be collected this fall. Our collaborators at the St. Croix Watershed Research Station will analyze the samples and report on changes that have occurred since the last sampling, which occurred between 2006 and 2008 at the three parks.



A bottom sediment core retrieved from a lake at Voyageurs.

Weather and Climate

The Network is working to identify climate monitoring summaries that are beneficial to the parks without duplicating the numerous products of national and regional climate monitoring efforts. We developed a web page that brings together both real-time and historical weather and climate information from meteorological stations close to the parks. We hope that this climate resource page will be one of the sites that park employees find useful enough to check regularly. Take a look: http://science.nature.nps.gov/im/units/GLKN/monitor/climate/climate_resources.cfm. Click on your park acronym at the top of the page to go directly to the section for your park. ●

National Park Service
Great Lakes Inventory and Monitoring Network
2800 Lakeshore Drive East, Suite D
Ashland, Wisconsin 54806
Phone: (715) 682-0631
http://science.nature.nps.gov/im/units/glkn/

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

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Editor
Ted Gostomski

Network Coordinator
Bill Route

Webmaster
Mark Hart

Thanks to the following contributors
Sean Bailey
Alex Egan
Joan Elias
Ulf Gafvert
Mark Hart
Cindy Heyd
Randy Knutson
Jaime LeDuc
Robin Maercklein
Bill Route
Kris Rolfhus
Suzy Sanders
Mark Sandheinrich
David VanderMeulen
Brandon Seitz
Alice Van Zoeren
Steve Windels