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2018 Field Season Summary

Al Kirschbaum places a amphibian recorder near a wetland in the Apostle Islands.

Jaime LeDuc collects a water sample at Voyageurs.

Vegetation monitoring team camp at Sleeping Bear Dunes.

Collecting larval dragonflies for contaminants monitoring at Pictured Rocks.

Clockwise from top: Water quality monitoring on Lake Desor (Isle Royale), Middle Lagoon (Indiana Dunes), and the Namekagon River (St. Croix Riverway).

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Amphibians

Thanks to the parks for their continued support in doing the field work and sending the data our way for archival and future analysis. We had another successful year, with only a handful of equipment problems.

Speaking of equipment, we've been experimenting with the newest Wildlife Acoustic recorders — the SM4 — to see if we can address a problem some parks have of not being able to deploy the recorders in time to catch the early-season species (*see Figure 1*). The new SM4s can be deployed over the winter and start recording the following spring (1 April). We tested these units at Apostle Islands and Isle Royale, putting a fresh set of SD cards and batteries in the units last fall, and they worked this field season with no issues. Thus, we think some parks could reduce the number of visits to one per year, just to swap out the batteries, SD cards, and temperature logger. For those parks who do not want to leave recorders out over the winter, these new units will still provide more reliable data with less involvement by park staff. We are in process of purchasing 50 new SM4 recorders that should be available to deploy for the 2019 field season.

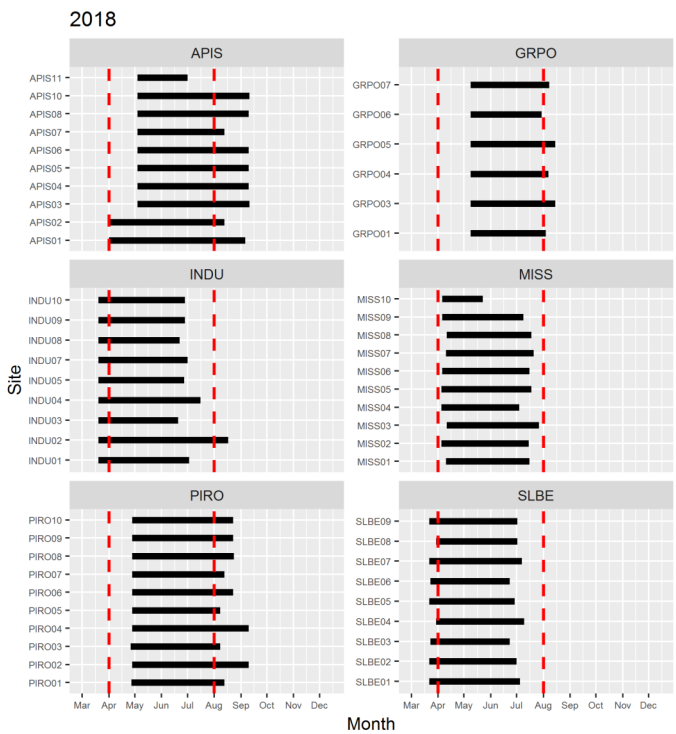

Figure 1. Length of amphibian recorder deployment for each site and park in 2018. The red dotted lines indicate the bounds of the field season we would like to capture each year (1 April through 1 August).

Last winter Gary Casper of Great Lakes Ecological Services analyzed and summarized results of the 2017 field season. The summary report was sent to park contacts via email at the end of August. There were no significant findings from 2017, just a fairly smooth operation. This tends to happen with long-term monitoring datasets. Sometimes no news is good news. We are still trying to find ways to better detect some tricky species such as the Northern Leopard Frog and Mink Frog. We did take steps to increase our likelihood of detecting Mink Frog this past season by adding additional samples in the early morning.

Gary has finished a new egg mass and larval key for amphibians. This will be a good resource for park staff interested in identifying salamander egg masses or tadpoles while deploying the song meters in the spring. This is a free publication available to all parks, so please let Ted know if you would like copies of this key.

Bats

This was the fourth year of bat acoustic monitoring for VOYA, APIS, ISRO, SLBE, and PIRO; and the third year for GRPO, MISS, SACN, and INDU. Many of our parks are located in or adjacent to counties where White Nose Syndrome (WNS) has been confirmed, though it has not been specifically documented within park boundaries yet.

Field staff completed sampling at 241 unique locations across the nine parks this season. Our detectors recorded more than 422,000 audio files, which will be filtered to exclude recordings of insects, birds, and other non-bat noise prior to analysis.

Acronym Decoder

APIS Apostle Islands National Lakeshore (Wisconsin)

GLKN Great Lakes Inventory and Monitoring Network

Species identifications for 2018 are not yet available because data are still being reviewed and analyzed. The good news is we do have preliminary results from the first few years. For 2015–2017, looking at combined data from all parks, the five most commonly recorded species each year were the Big Brown Bat, Eastern Red Bat, Hoary Bat, Silver-haired Bat, and Little Brown Bat. This is measured as the average number of call files per deployment night (*see Figure 2*). We saw a large drop in Little Brown Bat activity from 2016 to 2017, while the other four species remained steady or had a smaller increase or decrease. The Little Brown Bat is a hibernating species that is highly susceptible to WNS, so this observed decline is cause for concern.

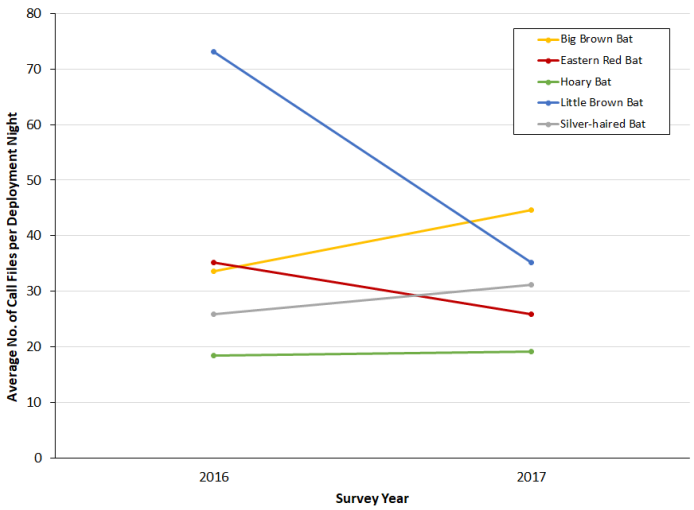

Figure 2. Average number of bat call files recorded per deployment night in 2016 vs. 2017 for five bat species at eight Great Lakes Network parks. PIRO's 2016 data analysis is pending, and different analytical methods were used in 2015, so those data are excluded.

Contaminants

Larval Dragonflies and Fish

Mercury is the most pervasive contaminant in the upper Midwest, so we have focused most of our contaminants monitoring on it, using both dragonfly larvae and fish. Since 2015, through our involvement with the Dragonfly Monitoring Project (DMP), a nation-wide NPS effort to monitor mercury in larval dragonflies, we began annual collections and analysis of larval dragonflies from sites in all nine parks. Notably, in 2018 we published our protocol for monitoring mercury in larval dragonflies and fish, which was necessary in order to officially include the work as one of our network vital signs.

Through a combination of park staff, volunteers, and partners we were able to facilitate collection of dragonfly larvae from four sites per park in 2018. This was the first year where park staff chose an additional site of high interest for monitoring, beyond the same three from previous years. Fish, which are sampled from parks every five years, were also collected from four sites at both PIRO and SLBE. That work was made possible by field assistance from park and Midwest Region staff (at PIRO), and the Michigan Department of Natural Resources and the Grand Traverse Band of Ottawa and Chippewa Indians (at SLBE). In 2019 our plan is to work with park staff and partners to collect fish from MISS and SACN, and larval dragonflies from all nine network parks.

Bald Eagles

Though contaminants sampling was discontinued, we continue to track and report on eagle nest occupancy. State and county partners conducted aerial surveys for active bald eagle nests at APIS, MISS, and SACN in 2018.

The number of active bald eagle territories has steadily increased at APIS and MISS since 2006 (*see Figure 3*). The

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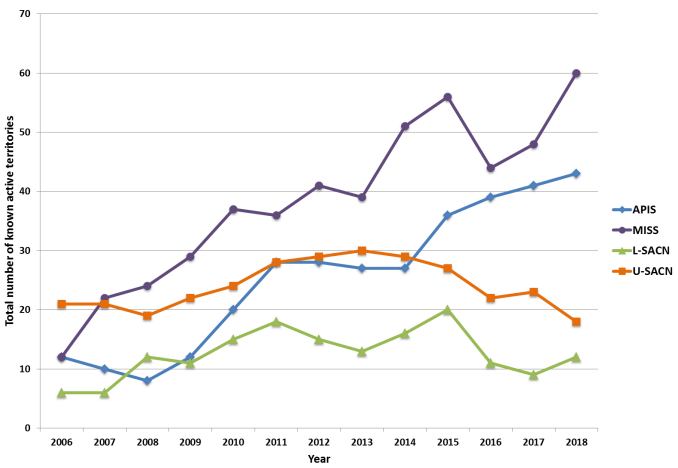

Figure 3. Number of active bald eagle territories at Apostle Islands (APIS), the St. Croix Riverway above St. Croix Falls (U-SACN) and below St. Croix Falls (L-SACN), and the Mississippi River (MISS). Data are from surveys conducted by the network, the Wisconsin DNR, and the Three Rivers Park District, Minneapolis. All 2017 and 2018 data are provisional.

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increase has been most dramatic at Mississippi River, with approximately 60 active territories in 2018 — a 5-fold increase since 2006. Apostle Islands has also seen steady growth, and since 2016 has more active territories than St. Croix, which declined in recent years. We do not know how many active territories each park can sustain, but the gradual decline in nests along the St. Croix and Namekagon Rivers suggests they may be reaching a threshold due to limited food and/or nest sites. Bald eagle populations crashed in the 1950s and '60s due to DDT and PCBs, but they have steadily increased since then due to the chemicals being banned in the U.S., the passage of the Clean Water Act, and through conservation efforts.

In late September 2018, after an extensive data checking process, we reached a key milestone by uploading to IRMA (the NPS's Integrated Resource Management Applications website) nearly all of the bald eagle data collected from 2006 to present, making it available to parks and the public. We are also still analyzing and reporting on the data. In 2018 we published articles on lead contamination and on the potential biological effects associated with exposure to a number of contaminants in the journals *Ecotoxicology* and *Environmental Pollution*, respectively. We also submitted an article to the *Journal of Great Lakes Research* in which we update our 2010 publication on trends in mercury, PCBs, and DDE. APIS eaglets had the highest concentrations of DDE, but the contamination levels declined in nearly all study areas since 2006 (*see Figure 4*).

PCBs were last analyzed in 2011, and our analysis of trends over time focused on samples collected from Lake Superior because we were able to include data first collected in 1995 by a separate but similar monitoring effort. From 1995 through 2011, we found a 3.6% per year decline of PCBs in eagles along the south shore, but not at APIS.

Also drawing on an expanded data set from a prior study, we found that for our Lake Superior study areas mercury contamination in eagles declined at 1.6% per year from 1991 through 2015; however, from 2006–2015 mercury did not decline at APIS, nor did it decline at the upper St. Croix and Namekagon rivers (U-SACN). Moreover, we found evidence for an increase at the lower St. Croix (L-SACN) and Mississippi River (MISS) study areas. Mean concentrations of mercury, PCBs, and DDE at all sites were below levels associated with significant impairment of reproduction, and average reproductive rates were >1.4 young per nest. However, increasing concentrations of mercury in some areas, combined with relatively high concentrations at some nests, suggest that continued monitoring of mercury should be a management priority.

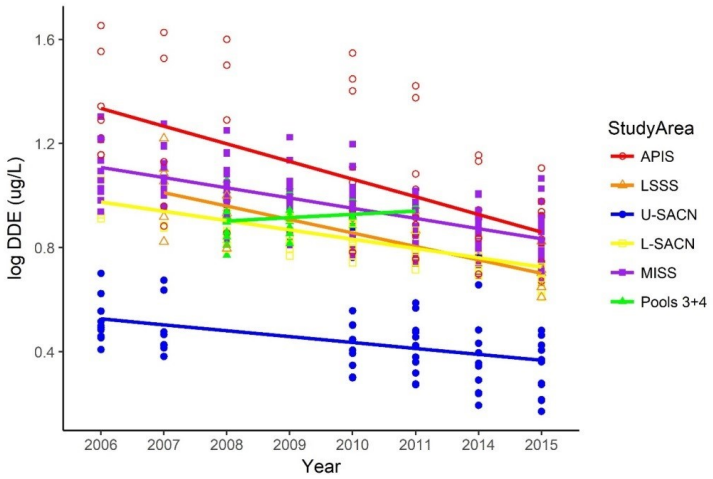

Figure 4. DDE concentrations (µg/L wet weight) in plasma of nestling bald eagles from six study areas in Wisconsin/Minnesota, 2006–2015. APIS = Apostle Islands, LSSS = the south shore of Lake Superior in Wisconsin, U-SACN = upper Saint Croix National Scenic River, L-SACN = lower Saint Croix National Scenic River, MISS = Mississippi National River and Recreation Area, and Pools 3+4 = pools 3 and 4 of the Mississippi River. Lines indicate the estimated trends from the mixed effects model, which included study area and year as fixed effects and territory as a random effect.

In 2019, watch for an update to our assessment of trends in PBDEs (flame retardants) and PFCs including PFOS (the surfactants used to make fabric protectants and non-stick surfaces), publication of our eagle monitoring protocol, and a Natural Resources Data Summary report showcasing a proof-of-concept project where we subjected 15 composite samples of archived nestling blood to a new laboratory procedure that evaluated the presence of over 2,000 non-target chemicals.

Water—Contaminants of Emerging Concern

Monthly surface water samples were collected from four main-stem sites on the Namekagon and St. Croix Rivers and two sites on Lake St. Croix at SACN (June–August), and from nine sites in four Lake Superior tributaries at PIRO (May and August). The samples were analyzed for over 200

different pesticides, pharmaceuticals, and personal care products collectively known as contaminants of emerging concern, or CECs. The work is part of a NPS/USEPA monitoring program designed to assess the presence of CECs in national park surface waters.

We published a Natural Resources Data Summary report in October, summarizing CEC monitoring at GRPO, INDU, PIRO, SLBE, and VOYA in 2016 and 2017. Unsurprisingly, INDU — which is in an urban industrialized setting but is also bordered by agriculture — had the highest number of CECs detected compared to sites in the other, more remote parks, many of which are within designated wilderness areas.

Landbirds

The biggest news in the landbird program has to do with data management. Volunteers and student interns have worked since last fall to enter data from past years into the Midwest Avian Data Center database, only to learn that new rules prohibit us from using "third party" databases as the primary repository of government data. Thus, our Assistant Data Manager, Rebecca Key, set to work with staff in Fort Collins to build a new online database just for the Great Lakes Network. Park staff were given access to the database this summer and Rebecca conducted a series of webinars to show them how it works. Since then, parks have entered 2018 survey data on their own — something we have been waiting to do for a long time! We owe a huge debt of thanks to Rebecca and staff in Fort Collins for constructing the database, working out the bugs, and helping people start using it.

We will conduct quality checks on the data this fall and winter to certify datasets that can be posted to IRMA and to the Midwest Avian Data Center database, making our rich bird monitoring dataset widely available to scientists and the public.

Aside from data management, field work was carried out without any problems again this year. A few highlights:

Apostle Islands National Lakeshore

Surveys were hampered by a cranky Lake Superior and a shortage available birders. Devils Island was rendered completely inaccessible when a storm destroyed the island's one dock in the fall of 2017. Wind and waves during the month of June made the two shoreline landings unsafe. However, of the surveys that were done, notable species included seven Scarlet Tanagers (four on Oak Island and three on Raspberry) and an Indigo Bunting.

St. Croix National Scenic Riverway

High, fast water and beautiful weather were hallmarks of monitoring on the upper Namekagon River and the midsection of the St. Croix River. That is until the flood happened in mid-June. Surveys were delayed for a week until the St. Croix receded, boat launches and some campsites re-emerged, and canoes could safely travel the river.

Lark Sparrow.
©Wikimedia Commons/Andrew C.

The most notable species wasn't even heard or seen during the surveys. A Lark Sparrow was heard *and* seen on a roadside power line during a bike-ride shuttle from canoe to vehicle on the very first day. Though this open country bird is not uncommon in the area where it was seen (near Grantsburg, WI), the area is the northern edge of its range in the Great Lakes region.

Isle Royale National Park

Unusual records this year included Red Crossbills recorded on two transects, including a flock of 9 on Passage Island; a Sora; three Purple Finches, which are generally uncommon but showed up on different routes; and two Sedge Wrens, which are thought to be somewhat common but occupy a habitat that is not well-represented on the survey routes.

Vegetation

The vegetation monitoring team spent their summer at SLBE in 2018, resampling all 50 permanent forest monitoring plots.

Probably the most notable stressor we saw there is deer browse. While we collect data on the frequency of

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quadrats with browsed woody species, this is difficult to interpret because, in many plots, there is very little woody material still available in the browse zone. Often, what remains is beech, a species that is generally avoided by deer.

Overbrowsing by deer, along with changes to the soil caused by non-native earthworms, reduces the richness and abundance of the ground cover and what tree saplings are present. NPS PHOTO

Another way to quantify deer impacts is to examine the abundance of preferred herbaceous species. We identified the preferred browse species at SLBE (generally the lily-like species), determined the frequency of quadrats in which they occur (with 30 quadrats/plot), then calculated the mean frequency per plot. While we have not yet performed tests for change, it appears there is little change between 2009 and 2018 (*see Figure 5*). This may be due to the fact that browse pressure was already high in 2009.

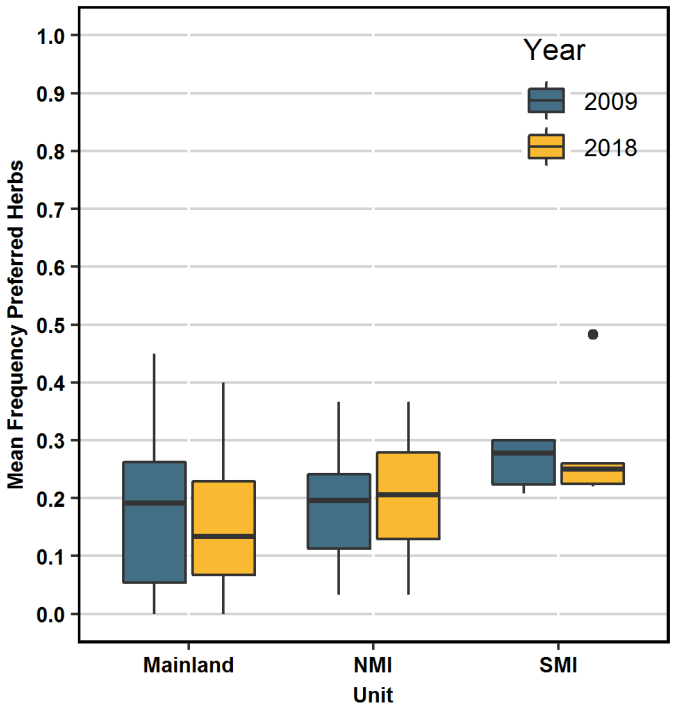

Figure 5. The average frequency of preferred herbaceous species at SLBE in 2009 and 2018, shown by unit. SMI = South Manitou Island, NMI = North Manitou Island.

Other main threats to forest health at SLBE include beech bark disease, invasive plant species, and non-native earthworms. As part of our monitoring we classify each plot by the degree of these impacts, from earthworm-free to heavily invaded (*see Figure 6*).

A full interpretation of all data will be presented in the technical report, scheduled for completion in 2019. We are scheduled to resample at SLBE in 2027.

Water Quality—Diatoms and Midges

The assemblage of diatom and midge species present in a lake or river reflects the environmental conditions in that water body. Under most water chemistry conditions, the silica-based cell walls of diatoms are preserved in lake sediment when the diatoms die. Once collected, those cell walls are used to identify the diatom species present. For diatoms in 2018 we focused mainly on data analysis and reporting instead of fieldwork. The only fieldwork completed was collection, by St. Croix Watershed Research Station staff, of two long sediment cores from

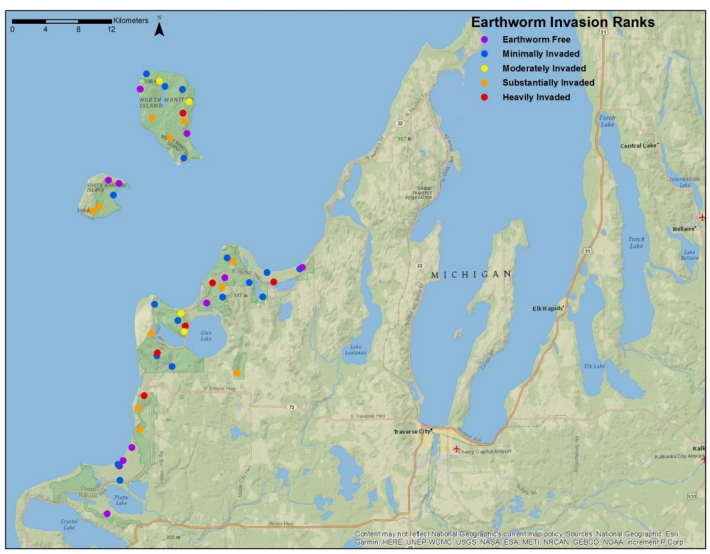

Figure 6. Earthworm invasion rankings for 49 of the 50 plots at Sleeping Bear Dunes. Earthworm impacts were not assessed at one plot, near the Heritage Trail and D.H. Day Campground.

Sargent Lake and Lake Richie at ISRO, which will be dated and analyzed for diatoms going back 150+ years before present.

From May to August, midge samples were collected monthly from Siskiwit, Harvey and George lakes at Isle Royale. This is the second of three years for sampling inland lake midges. Goals are to conduct an inventory of the community, establish a reference condition for each lake type, and assess diversity and differences between lake types based on chemical and physical conditions of each lake.

Preliminary data from 2017 revealed 203 species. Siskiwit Lake, the largest and most oligotrophic of the inland lakes had the highest diversity with 117 species, Harvey had 105 species, and George had 60 species. Only 7% of species were shared across all three lakes and 68% occurred in only one lake, showing that a very different community occupies each lake. If communities remain distinct, we should be able to create a basic model of midge occupancy based on lake type.

The most intriguing finding was of the species Baeoctenus bicolor in Siskiwit Lake. Late-instar larvae of this genus live inside mussels and either feed parasitically on the gills of the mussel host or graze filtered material on the gills. While B. bicolor is currently thought to be host-specific to Anodonta mussels, ISRO only has two known inland lake mussel genera: Lampsilis and Pyganodon. It appears that either B. bicolor larvae are not necessarily host specific, Siskiwit Lake has a population of undetected Anodonta, or the larvae are free-living in the absence of their preferred host.

Initial findings from 2018 show the same general communities of genera. A summary report for 2018 will be provided in early 2019. Project results will be presented at a conference and published in an aquatic ecology journal in 2020-2021.

Water Quality—Inland Lakes

As in previous years, we conducted three rounds of sampling on 31 lakes and maintained vertical arrays of temperature loggers (temperature arrays) that collect data year-round from lakes at Isle Royale (Lake Richie), Pictured Rocks (Beaver and Grand Sable Lakes), Sleeping Bear Dunes (Manitou and Bass Lakes), and Voyageurs (Little Trout, Mukooda, and Shoepack Lakes). Data from these arrays are providing important information on lake thermal structure as it relates to weather and climate, suitability for fish habitat, and resuspension of lake sediments in the summer that could lead to increased nutrient levels and algal blooms.

Apostle Islands National Lakeshore

GLKN staff provided logistical support (diver and boat operators) for several projects, including 1) monitoring the water quality of Lake Superior in nearshore waters adjacent to Meyers Beach, 2) sampling park beaches and nearshore areas for microplastics, 3) surveying park waters for native and non-native mussels, and 4) a nearshore bathymetric mapping effort. These collaborative efforts span multiple federal agencies and academic institutions.

Indiana Dunes National Lakeshore

Josh Dickey and his assistant Shalesa Johnson conducted all three rounds of sampling at Middle Lagoon in 2018.

Isle Royale National Park

Alex Egan and Isle Royale biological technicians Jennifer Gendelman and Fred Hoeft completed all three rounds of sampling, serviced the Lake Richie temperature array, cleaned dissolved oxygen loggers in several lakes for a USFWS project on cisco, collected sediment samples from traps suspended in the water column, assisted with common loon surveys, and collected chironomid midges from three survey lakes. Alex and interns Eli Bieri and Michael McCullough completed two bird survey routes. Alex was also lucky enough to help Lara Bender with the final trip at ISRO of the Echo, the vessel used for bathymetric survey project.

Pictured Rocks National Lakeshore

Leah Kainulainen and her assistant Alice Ahlfield completed all scheduled monitoring at six inland lakes. In July and September, they serviced temperature arrays at Grand Sable and Beaver Lakes. With some extra assistance from park superintendent Dave Horne, Leah, Alice, and Dan Monhollon continued wadeable streams monitoring

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on the Miners River and two sites on the Mosquito River. Algae samples were collected from Legion Lake for former park aquatic ecologist Lora Loope, who is investigating a recent shift in algal communities, which is mentioned in a recently published water quality brief for the park.

Sleeping Bear Dunes National Lakeshore

Chris Otto and Lori Knudson, with assistance from Alicia Schwieterman, Kathleen Gordon, and Sean Hollowell, completed all scheduled routine monitoring at six index lakes. Lori and her crew also serviced temperature arrays at Lake Manitou and Bass Lake (Leelanau County) in the summer and fall.

Voyageurs National Park

Jaime LeDuc completed all sampling at the nine index lakes, with assistance from park staff and volunteers Chandra Wiley, James Smith, Blaine Helleloid, Bowden Godfrey, and Lindsay Brandt. The water quality crew also serviced temperature arrays on Little Trout, Mukooda, and Shoepack Lakes; completed loon surveys on the nine index lakes; collected water samples from Ek, Brown, Peary, Ryan, and Shoepack Lakes, as part of an ongoing collaboration between GLKN, Voyageurs, and the USGS to monitor mercury in surface water at the park; and collected larval dragonfly samples from Shoepack, Brown, Peary, and Ryan Lakes for the Dragonfly Mercury Project. Some of their most memorable moments were hearing a howling wolf pack at Cruiser Lake, observing a loon nest in Ek Lake, seeing tundra swans in Peary Lake, and snacking on wild blueberries, strawberries, and raspberries on several of the trails.

Water Quality—Large Rivers

Winter's grip held on late in Spring 2018, resulting in delayed sampling at three Namekagon River sites and at the CCC Bridge on the upper St. Croix River. April monitoring at the remaining six sites was cancelled due to unsafe ice conditions. After the delayed spring start, all other sampling was completed on schedule. Rick Damstra was ably assisted by GLKN lakes aquatic ecologist Alex Egan and St. Croix Riverway biological technicians Samantha House, Mike Rhoades, Ben Hines, Chloe Ross, and Emily Greger.

We again collaborated with Metropolitan Council Environmental Services by collecting phytoplankton samples for them during routine monitoring at three sites in Lake St. Croix. We also assisted SACN with a

River ecologist Rick Damstra collects water from the Namekagon River at Phipps Landing in April 2018. There was still over two feet of snow on the access road. NPS/A. EGAN

macroinvertebrate (aquatic insect) monitoring effort at two sites. We also collected water samples from six sites monthly in June, July, and August, which were analyzed for over 200 CECs (*see* Water—Contaminants of Emerging Concern *on page 6*).

It was a summer of extreme rain events throughout the St. Croix watershed. In June, heavy rains led to flooding on the Tamarack River and failure of the Radigan Dam. In July more heavy rain led to flooding on the Snake River that caused the river flow to peak at nearly 20 times higher than the long-term median flow, as measured by the USGS gauge at Pine City, MN. In September another extreme rainstorm caused the breach of a retention pond at an abandoned gravel pit in Scandia, MN, leading to tons of sand filling a creek that feeds into the St. Croix River. These rain events occurred in between our sampling events, and water levels had returned to normal by the time we returned. Through our monitoring we continue to track water quality impacts of events like these on St. Croix and Namekagon Rivers. ●

New Reports and Publications

Bartz, K.K., K.M. Junghans, and **D.D. VanderMeulen**. 2018. Protocol for monitoring mercury in resident lake fish – Version 1.0: Southwest Alaska Inventory and Monitoring Network. Natural Resource Report NPS/SWAN/NRR—2018/1734. National Park Service. Fort Collins, Colorado.

Bruggeman, J.E., **W.T. Route**, P.T. Redig, and **R.L. Key**. 2018. Patterns and trends in lead (Pb) concentrations in bald eagle (Haliaeetus leucocephalus) nestlings from the western Great Lakes region. Ecotoxicology 27(5): 605–618. Available at: DOI 10.1007/s10646-018-1933-5.

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Elliott, S.M., **W.T. Route**, L.A. DeCicco, **D.D. VanderMeulen**, S.R. Corsi, and B.R. Blackwell. 2018. Contaminants in bald eagles of the upper Midwestern U.S.: A framework for prioritizing future research based on in-vitro bioassays. Environmental Pollution. Available at: https://doi.org/10.1016/j.envpol.2018.10.093.

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VanderMeulen, D.D., **B. Route**, J. Wiener, R. Haro, K. Rolfhus, M. Sandheinrich, S.J. Nelson, A. Klemmer, C. Eagles-Smith, and J. Willacker. 2018. Protocol for monitoring mercury in dragonfly larvae and fish (version 1.0): Great Lakes Inventory and Monitoring Network. Natural Resource Report NPS/GLKN/NRR—2018/1726. National Park Service, Fort Collins, Colorado.

Sand completely filled in Middle Creek (foreground) near Scandia, MN, and created a new delta in the St. Croix River (background) after an intense rainstorm caused a retention pond berm to fail at an abandoned gravel pit. This incident is under investigation. ©Greg Seitz/St. Croix 360

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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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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