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Science is a Process

By Ted Gostomski, Network Science Writer

Masks, gloves, disinfectants, social distancing, empty offices, and virtual meetings, schooling, and family get-togethers—this year put us all through a crash-course in how to live during a global public health crisis and how science is integrally connected to our daily lives.

Science is a process. It is not quite a source of answers—though it can provide those—but it is more a guide, a way of thinking and coming to informed and critically evaluated conclusions. Those conclusions are not always set in stone; some will be upended and changed, and we've seen that during the COVID pandemic. But it does not mean scientists ("experts") don't know, don't agree, or are making it up as they go along. It means they are learning as they go along, and they are applying those lessons in the best way possible to help others. It can be confusing, but it is important to stay engaged with the learning instead of casting doubts and eroding trust in the scientific method and the conclusions that come from it.

Using science to inform park management is like that. We collect the data about plant communities, water quality, songbird populations, and even natural and human-caused changes to the landscape. We analyze those data for trends and compare the trends with what others are seeing elsewhere. This is all done in a rigorous way to hold steady any variations that could pull the trend in one direction or another—things like local weather patterns or soil types or the aging birder who doesn't realize they no longer hear the higher-pitched bird songs (a.k.a., observer bias). After all this analyzing, we have a picture of what is likely happening, and we use that picture to help managers take actions to either avert a change or accommodate it, stop a local source of pollution, or simply understand the changes we can do nothing about.

This is not a fast process. There are sometimes do-overs. We have to be careful about framing our findings within the limits of our project's scope, and all this can be frustrating for people who want more certainty. But it's a reliable process, tested over centuries, and responsible for advances in all aspects of our lives.

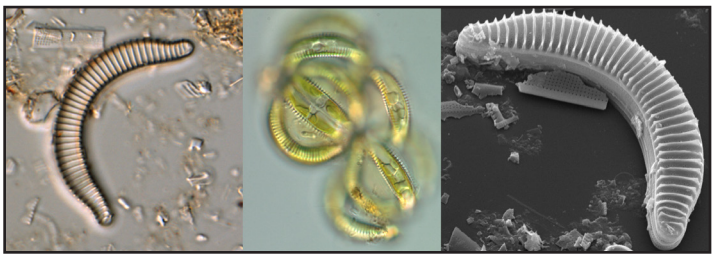
None of this is to say that science is the only way of learning about and understanding the world we live in, but it is the most reliable process for helping to guide park management and for saving people's lives.

This year has also been an exceptional opportunity for citizen scientists to engage in critically thinking about what one hears and reads, to sort fact from opinion, look for evidence, and make choices based on the evidence and the facts.

Stay engaged, have faith in the learning process, and be humble enough to realize we do not have all the answers, and that's OK. We will get through this together.

Former Aquatic Ecologist is Now a Diatom!

It may not carry the same panache as being knighted by the Queen of England or being inducted to the Rock and Roll Hall of Fame, but Joan Elias, the Great Lakes Network's first aquatic ecologist, has been immortalized in the form of a diatom named in her honor: *Semiorbis eliasiae*.



The diatom *Semiorbis eliasiae*. *Left to right*: a light microscope image (light micrograph) of the diatom valve or shell, a light micrograph of a live colony of *Semiorbis eliasiae*, and a scanning electron micrograph of a single cell. Images courtesy Mark Edlund/St. Croix Watershed Research Station.

Diatoms are a type of algae with cell walls made of silica. When they die, portions of the cell walls called *frustules* settle into the bottom sediments and are preserved like tiny bits of glass. Different species of diatoms can be identified by the unique patterns of their frustules. We use them to monitor environmental changes in lakes and rivers because the diatom community composition shifts in response to such changes. Thus, the layers of frustules contained in bottom sediments provide a history of water quality going back hundreds of years.

> "If you turn the diatom just right, it smiles at you like Joan does."
>
> —Mark Edlund

Mark Edlund at the St. Croix Watershed Research Station identified the new diatom, which is one of only three other species in the genus *Semiorbis*. The new species came from a sediment core collected in 2007 from the Outer Island lagoon in the Apostle Islands.

"The genus *Semiorbis* is really uncommon. I've been collecting diatoms since 1987 and have only found it twice. Outer Island is one of those places", says Edlund. Live colonies were also collected from Outer Lagoon in 2015

"We used a many lines of evidence to determine this is a brand new species: comparison to other collections from Canada, Norway, New Jersey, and Florida; differences in the structure of its shells, and sliding landmark shape analysis. So far, the Outer lagoon is the only place Joan's diatom is found. It may be in other places, but just not found yet."

If the Outer lagoon created a unique environment for *Semiorbis eliasiae*, the fate of that environment is in question. A large storm in September 2014 created a breach in the long-shore bar that separated the lagoon from Lake Superior, essentially creating a cove. However, by July 2020, about one-third of the original lagoon had been re-isolated from Lake Superior with a new long-shore bar.

Specimens of *Semiorbis eliasiae* are permanently preserved in diatom collections at the Academy of Natural Sciences in Philadelphia, The Canadian Museum of Nature, and the Science Museum of Minnesota. A journal article announcing the discovery is forthcoming.

Joan Elias. Photo © Mark Edlund

New Reports and Publications

All of these reports can be found on the Great Lakes Network website: www.nps.gov/im/glkn/reports-publications.htm. Those published in peer-reviewed journals can also be found using their DOI (digital object identifier). Great Lakes Network staff are indicated in **bold blue** text.

Casper, G.S., S.M. Nadeau, and **A. Kirschbaum**. 2020. Acoustic amphibian monitoring data summary report for Apostle Islands National Lakeshore: 2018. Natural Resource Data Series NPS/GLKN/NRDS—2020/1269. National Park Service, Fort Collins, Colorado.

Casper, G.S., S.M. Nadeau, and **A. Kirschbaum**. 2020. Acoustic amphibian monitoring, 2018: Grand Portage National Monument. Natural Resource Data Series. NPS/GLKN/NRDS—2020/1289. National Park Service. Fort Collins, Colorado.

Casper, G.S., S.M. Nadeau, and **A. Kirschbaum**. 2020. Acoustic amphibian monitoring, 2018: Indiana Dunes National Park. Natural Resource Data Series. NPS/GLKN/NRDS—2020/1290. National Park Service. Fort Collins, Colorado.

Casper, G.S., S.M. Nadeau, and **A. Kirschbaum**. 2020. Acoustic amphibian monitoring, 2018: Isle Royale National Park. Natural Resource Data Series. NPS/GLKN/NRDS—2020/1291. National Park Service. Fort Collins, Colorado.

Casper, G.S., S.M. Nadeau, and **A. Kirschbaum**. 2020. Acoustic amphibian monitoring, 2018: Mississippi National River and Recreation Area. Natural Resource Data Series. NPS/GLKN/NRDS—2020/1292. National Park Service. Fort Collins, Colorado.

Casper, G.S., S.M. Nadeau, and **A. Kirschbaum**. 2020. Acoustic amphibian monitoring, 2018: Pictured Rocks National Lakeshore. Natural Resource Data Series. NPS/GLKN/NRDS—2020/1293. National Park Service. Fort Collins, Colorado.

Casper, G.S., S.M. Nadeau, and **A. Kirschbaum**. 2020. Acoustic amphibian monitoring, 2018: Sleeping Bear Dunes National Lakeshore. Natural Resource Data Series. NPS/GLKN/NRDS—2020/1294. National Park Service. Fort Collins, Colorado.

Dykstra, C.R., **W.T. Route**, K.A. Williams, M.W. Meyer, and **R.L. Key**. 2019. Trends and patterns of PCB, DDE, and mercury contamination in bald eagle nestlings in the upper Midwest. Journal of Great Lakes Research 45(2): 252–262. Available at: https://doi.org/10.1016/j.jglr.2019.01.010.

Dykstra, C.R., **W.T. Route**, and K.A. Williams. 2020. Trends and patterns of perfluoroalkyl substances in blood samples of bald eagle nestlings in Wisconsin and Minnesota, USA. Environmental Toxicology. DOI: https://doi.org/10.1002/etc.4864.

Edlund, M.B., D.R.L. Burge, N.A. Andresen, **D.D. VanderMeulen**, J.R. Stone, and B. Van de Vijver. The genus *Semiorbis* (Eunotiaceae, Bacillariophyta) in North America. Diatom Research.

2020 Field Season Summary

Amphibians

Those parks that left their recorders out over the winter (GRPO, ISRO, APIS, and some at MISS) didn't have to worry about maintaining their units until early fall. Despite the challenges of COVID-19, the remaining parks (PIRO, SLBE, INDU) were able to deploy their units in early spring. The data from from the 2020 field season is still working its way to the office, but from most indications, it seems like the new SM4 recorders are performing well.

During the field season, we worked with the contractor to complete the 2018 park-specific data summary reports that include some cumulative data as well. These reports are being finalized at the national office and should be available for parks later this fall.

The 2019 field data analysis is nearly completed, and the 2020 field data will be sent to the contractor in early 2021. Thanks to everyone for their efforts in pulling this off during a challenging year. One nice thing about this monitoring is that it only takes one or two visits (deployment and recovery) and the recorder collects an entire field season of data.

Bats

The bat program kicked off the summer with two major accomplishments: In early May, we published the acoustic monitoring protocol and accompanying standard operating procedures. In late May, we finalized the submission of our 2015–2019 data to the North American Bat Monitoring Program (NABat). The data we share with NABat will be incorporated into their continent-wide trend analyses and species status reports. Special thanks to Rebecca Key for facilitating the data transfer.

Despite extra challenges this year related to COVID-19, all bat monitoring sites were successfully surveyed at five parks (GRPO, INDU, ISRO, SACN, and VOYA). An additional two parks (APIS and MISS) did very limited sampling at a few sites of management interest. We appreciate the efforts of all the park staff who made this field season a success. Although some parks were unable to conduct any sampling this year, we are hopeful that everyone will be back at it in 2021.

Voyageurs staff set up a bat detector at the Sand Point Portage site.
NPS PHOTO.

We received 2020 field data from all five parks and completed data entry and quality checks. Next we will be processing the acoustic files in Kaleidoscope Pro to obtain species identifications, and completing manual vetting with the assistance of a contractor. Katy is also finalizing a multi-year data summary report specific to each park, covering all years of surveys through 2019. Park staff are encouraged to reach out to Katy or Al with specific data requests as needed.

Contaminants—Dragonfly Larvae and Fish

Park staff, volunteers, and partners collected dragonfly larvae in all nine network parks in 2020 despite the logistical challenges imposed by the pandemic. In particular, Sadie Young from the Grand Portage Band really stepped up on short notice to collect both dragonfly larvae and small prey fish at GRPO. Network staff also sampled fish from three APIS lagoons, including collection of black bullhead from two sites. The bullheads represent a higher trophic level than has been previously assessed for mercury.

More widely, our partners from the Dragonfly Mercury Project published a foundational manuscript titled "A National-Scale Assessment of Mercury Bioaccumulation in United States National Parks Using Dragonfly Larvae As Biosentinels through a Citizen-Science Framework" (https://pubs.acs.org/doi/10.1021/acs.est.0c01255). In this paper, the authors use data collected from national park units across the country, including those in the Great Lakes Network, to assess mercury contamination in national park surface waters. One key finding in the paper is that although mercury concentrations differ by dragonfly family, they can be standardized, allowing for assessment across all study sites in determining trends over time.

Rick Damstra lifts a minnow trap from the Stockton Island lagoon in the Apostle Islands. The traps also caught black bullheads, who were attracted by the abundant minnow food-source. The bullheads represent a higher trophic level than has been previously assessed for mercury. NPS PHOTO.

Contaminants—Bald Eagles

Bald eagle nest occupancy surveys, which are conducted by park partners every spring, did not occur in 2020 due to the pandemic. However, former network program manager Bill Route, in collaboration with our partners, continues to analyze bald eagle contaminants data collected from 2006 through 2015 and publish the findings.

Most recently, he and others published a paper updating PFAS trends for nestlings sampled at APIS, MISS, and SACN. (*PFAS, or per- and polyfluoroalkyl substances*, are a group of chemicals used to make coatings and products that resist heat, oil, stains, grease, and water.) Full details on the paper are at https://setac.onlinelibrary.wiley.com/doi/10.1002/etc.4864.

Another paper on the status of and trends in PBDE contamination has been accepted for publication in the journal *Environmental Toxicology and Chemistry*. That paper includes the same three Great Lakes Network parks, as well as sites in northern and eastern Wisconsin sampled by the Wisconsin Department of Natural Resources. (*PBDEs, or polybrominated diphenyl ethers*, are a class of compounds that are used as flame retardants.)

Finally, two other papers are in development, one on bald eagle population dynamics and nestling morphological characteristics, and one on lead stabile isotopes found in eagle nestling red blood cells.

Landbirds

We came close to not having a field season, but in the end, bird surveys were completed in seven of the nine network parks. Thank you to the park staff and contractors who complied with all the safety concerns and special protocols put in place to keep them and the rest of us safe and healthy.

We published a report in the NPS Natural Resources Report this fall analyzing songbird data collected from 2014 through 2018. We identified 92 park-specific *species trends*, (8–20 species per park), 10 of which were statistically significant (three declining and seven increasing). *Species richness* ranged from 47 to 101 species per year, with SLBE's annual average of 91 species being the highest among the parks. The *species diversity index* for each park ranged between 0.95 and 0.97 (on a scale of 0 to 1), indicating a high level of diversity in all parks.

Guild analysis revealed significant changes for guilds in four of the parks during the five-year period:

- Increasing upper canopy foragers and urban species at APIS;
- Increasing insectivores, aerial foragers, and woodland species at GRPO;
- Declining insectivores, shrub/low canopy foragers, successional/scrub species, and woodland species at ISRO; and
- Increasing shrub/low canopy foragers, woodland species, and Neotropical migrants at SLBE.

The report has been submitted for publication in the NPS Natural Resource Report series and should be available in early 2021.

Landscape Dynamics

Thanks to the help of Emma Hakanson, a full-time seasonal employee in the network office, we were able to finish validation of ISRO (and Thunder Bay area) polygons this summer, and we are in the process of summarizing disturbances for the period 1995–2017 in a data summary report to be published this winter. We also finished validating disturbance polygons for GRPO for the same time period, and we are halfway through the validation of disturbances at APIS and the larger area outside the park for the period 1995–2018. Reports for those two parks should be available in the summer of 2021.

Vegetation

The vegetation team was not able to work at APIS this summer, as planned, but we will be there in 2021 instead. This pushes all parks back by one year in the rotation.

In lieu of fieldwork, the team made a lot of headway with reporting this summer. We completed most summaries and comparisons from our work at ISRO in 2019, and we will be completing a draft technical report by the end of the calendar year. We also have nearly completed analyses looking at understory change between 2010 and 2019 at ISRO. A draft for park review should be out early in 2021. We will also be looking at woody browse impacts there over the two sampling periods. Additionally, we completed a draft manuscript examining browse at SLBE. This focuses on impacts to woody and herbaceous species.

Water Quality—Diatoms and Midges

We completed some laboratory work in the spring, identifying chironomid midge species, but we could not do any field work on either of these projects due to delayed field seasons and work plan limitations.

In 2021, we will complete diatom sampling at APIS and VOYA (and maybe ISRO), and midge work will continue at ISRO.

Water Quality—Inland Lakes

A delayed field season prevented one sampling round at VOYA and INDU, but otherwise, we successfully completed all water quality work in 2020! We are all very excited about how much work was safely done this year. Besides a couple of events like being chased off Siskiwit Lake (ISRO) by a lightning storm, or road construction at SLBE keeping staff from a sampling event on one lake, 2020 was extremely successful under the circumstances.

Water Quality—Large Rivers

Despite missing two early season samples in April and May during the Wisconsin Safer at Home order early in the COVID-19 pandemic, the rest of the Large River Water Quality sampling at SACN was completed on schedule in 2020. GLKN staff were only allowed to travel 100 miles from our home base in Ashland, which put four of our eleven water quality sites out of reach. While SACN staff usually play a critical role in our water quality work, they were indispensable during this year of restricted travel. Thanks to the commitment of SACN staff, samples were obtained at Osceola, Bayport, Hudson, and Prescott that would have otherwise been missed. In addition to the routine water quality samples, aquatic insects were collected at all eleven sites using Hester-Dendy artificial substrate samplers during July and August. GLKN sampling crews were led by Rick Damstra, and assisted by David VanderMeulen and Thomas Parr. SACN crews were led by Jay Johnson, with help from new aquatic technician Marian Shaffer (welcome Marian!). They were ably assisted by Jason Dowell and St. Croix River Association intern Jeremiah Walters. Finally, we would like to bid happy retirement to our colleague Byron Karns, who will be missed!

Stoneflies captured in a Hester-Dendy invertebrate sampler in the St. Croix River near Norway Point Landing. Stoneflies typically indicate excellent water quality. The insects are rinsed from the samplers (seen in the bottom and top right corners of the photo) onto a filter for processing. NPS PHOTO

Weather and Climate

Weather and climate monitoring hums along as a self-driven program, which was a good thing in this year of COVID-addled travel. Staff made a maintenance visit to Sand Island (APIS) to repair a cable that had been chewed through.

We will be in touch with parks this winter to gather feedback on the usefulness of Climate Analyzer and if it is a tool we want to continue to support. If travel allows, we will do annual station maintenance at PIRO and SLBE in 2021.

Collaborative Projects

We provided a diver and boat operator for several projects, including monitoring the water quality of Lake Superior in nearshore areas adjacent to APIS, and mussel surveys. These collaborative efforts span multiple federal agencies and academic institutions.

Network staff also assisted with common loon surveys at ISRO.

MWR Aquatic Ecologist Brenda Lafrancois drops a Van Dorn water sampler into Lake Superior offshore from Meyers Beach, part of the mainland unit at APIS. Water samples are one of a variety of measures collected for the nearshore monitoring project carried out by Lafrancois in collaboration with the University of Minnesota in Duluth and with assistance from the network. NPS PHOTO

Apostle Islands National Lakeshore
Grand Portage National Monument
Indiana Dunes National Park
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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