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Inventory and Monitoring Division

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We're Feeling the Earth Move Under Our Feet

By Ted Gostomski, Network Science Writer

There is a major change coming to the Great Lakes Network office in 2018. Network program manager Bill Route and GIS specialist Ulf Gafvert are retiring, Ulf in February and Bill in March. They are not the first to retire—Joan Elias did that in 2012—but they were the first Great Lakes Network employees, and their departure creates a major shift in the structure of our office team. At the same time, the I&M program itself is shifting, maturing with age. Thus, there are changes on the horizon that, like these retirements, herald a new chapter for inventory and monitoring in the National Park Service.

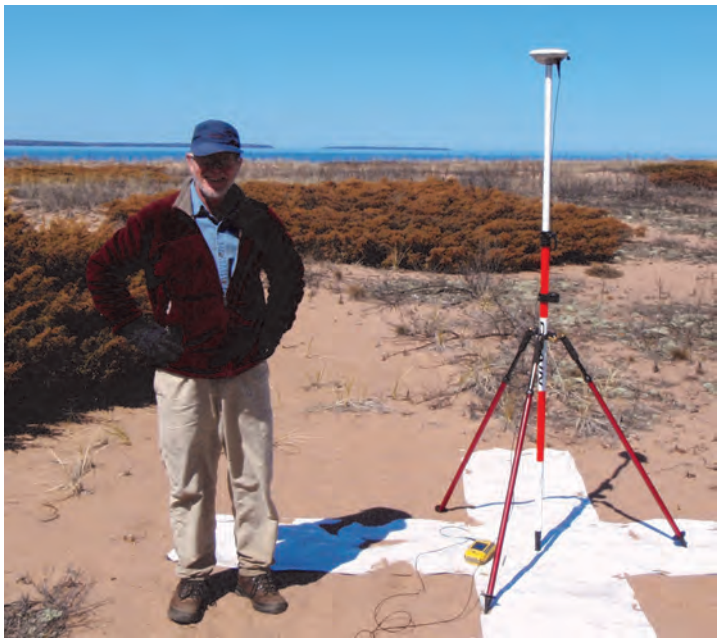
Creation of the Great Lakes Inventory and Monitoring Network began in 1999. Bill Route was hired on a contract basis to lead the first gathering of park resource managers through a process to identify inventory needs for the nine parks. He was hired as the network program manager a year later and proceeded to make a series of brilliant hiring decisions beginning in 2002 when he plucked Ulf Gafvert from the U.S. Soil Conservation Service (now Natural Resource Conservation Service) to be the network's first data manager.

Portions of the interview have been edited for clarity and length.

How has this job compared with your previous ones?

Ulf: I spent half my career as a soil scientist, close to 15 years, then 15 years here. It was largely fieldwork, which was fantastic, especially in my youth. It was also a lot of learning first-hand about the natural world—landscape, land form, and function—which was fantastic to build an understanding. But then, when I got this job, I was able to take those kinds of datasets and use them and do analysis with them. I really miss the fieldwork. But it's been a fantastic career in that respect.

Bill: My transition was similar but maybe less abrupt than Ulf's. I started as field biologist at Voyageurs, then Wrangell-St. Elias in Alaska, then Carlsbad Caverns [New Mexico]. Field work at Wrangell-St. Elias means flying in the back seat of an airplane for much of the time, but Voyageurs was very much "field." You were out on the water, in the woods doing things. I was there for six years, then another five years at Wrangell-St. Elias, then went to Carlsbad Caverns where I was the park's first Chief of Surface Resources (there was a cave specialist as well). We monitored everything above ground, but bats used both the surface and the cave. So I did a lot of bat monitoring at Carlsbad, as well as mountain lions and a few other things, but it was much more management, much more administration. So that was a good transition to this job, which was even more administrative. Although I've had my fun doing the bald eagle work.



Ulf Gafvert sets up a target in advance of aerial photos being taken over the Apostle Islands. NPS PHOTO

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Feeling the Earth Move

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Was field work part of your job description, or did you have to advocate for that?

Bill: Probably less than half of the 32 network program managers are also doing field work. But, it didn't take any real advocating for it. None of my supervisors have had any problem with me doing it.

Ulf: And it's important. I think that's a really good thing for a coordinator [to have both field and office work].

Bill: I do too. It has its downsides. You get to doing that level of field work and it becomes difficult to do both well. I've struggled with that. And it ends up that other program managers have to take up some additional administrative work.

Ulf: Which is also a really good mix. It gives each of us a sense of ownership. All of us have some autonomy or decision-making responsibility regarding budget.

Has your perspective on our work (focus, reach, context) changed since the beginning?

Ulf: The program has evolved so much in terms of starting out with all different ideas on the table. What are we going to monitor? As that changed to where there are solid monitoring programs going on, it has matured. Instead of a broad array of innovative ways of doing things, we have winnowed down to what works, and now the national program is trying to standardize things more. Maybe for better or worse, but it has to come to that because there were a lot of things that weren't working. They were great ideas, and it's good to try different things, but it's time to focus.

Bill: For me, the big vision has never changed. What I think has been so instrumental in making this successful was the idea of networks having boards of directors and technical committees that are integrally involved. Because that connection with the parks has been critical in making our work relevant to what they need. I've always been very cognizant of that and never wanted to have them feel like they had to rein us in. But what we did, the program we developed, is what they wanted.

Ulf: It goes to the core of this being a science-based, long-term monitoring program. That was also part of [former I&M Program Chief] Steve Fancy's vision from the start,

Bill Route points the way to an eagle nest on the Mississippi River. ©ELI NICHOLS

and it's been really successful. It has changed the National Park Service enormously in terms of having good, sound science. And it's brought in so many new people.

Bill: Over 350 new scientists [to the NPS] from a variety of places.

Was there a conscious effort to be sure we were not re-creating the [now defunct U.S. Geological Survey] National Biological Survey?

Bill: Oh yeah. I think Steve Fancy, for political reasons, needed to distinguish us from USGS. We were not to be the scientists who were going to be doing cause-and-effect research. We were supposed to develop long-term monitoring strategies that would incorporate or invite spin-off research by others.

Are you happy with what you have accomplished here?

Ulf: I feel really good about what I've done. It's been really great to go from creating data—from mapping soils and landforms—to using that data to explain and show other people what our understanding and knowledge of landscape processes is. But I still feel hopelessly inadequate in having answered that or provided that to the public. It's difficult to express that deeper understanding of how the natural world works through GIS.

Bill: I think Ulf has provided a lot. I remember when he was pushing for us to use this new stuff, LiDAR [Light Detection and Ranging—a remote sensing method that

uses light in the form of a pulsed laser to measure variable distances to the Earth.]. The first set of data we acquired was a gift because someone in Alaska failed to spend some money and Ulf jumped on it. That resulted in $850,000 of LiDAR being acquired from the Army Corps for ISRO, APIS, and the islands at SLBE*. And since then we have that data for nearly all the parks. It's an add-on to the monitoring.

Ulf: For me, it's also like inventories. We are an inventory and monitoring program, and those spatial inventories—veg map, soil map, geology map, imagery, and elevation data—are really useful baseline data sets that will help us understand things about the parks and the context the parks are in.

Bill: I will leave without having completed several things, and that's primarily because I struggled with trying to do the field work and be the program manager. But also because we're not going to continue the bald eagle program. There's no one to pick it up and carry it forward, so I feel I have to finish everything that hasn't been published or reported on.

Do you have a favorite or proudest moment?

Bill: What I'm most proud of is the group of people working together here who seem very invested. Everyone is pulling in the same direction, which has resulted in a lot of really good work being done. Somehow it seems to have worked. I'm proud of what everybody has done. I always worried that we would be seen as favoring Apostle Islands, because they are right here. But I remember walking down the halls a few times and tapping people on the shoulder and asking what they are working on, and this person was working on something for SLBE, and this one was working on something for INDU. And I was really thrilled to see that we had a group of people who were invested in doing a collaborative effort to monitor things for nine parks.

Ulf: I can't think of one. I've had the freedom to get involved in a lot of diverse kinds of projects.

What do you see as future opportunities or challenges for the network?

Bill: This program, as Ulf said, has matured. And now, we are being given the time to publish our work in scientific journals. That's something I've never been given the time to do. And that, to me, is an area in which the [NPS] has been lacking—getting information to other scientists to show the good stuff that happens in national parks. Also, we have eight different programs that are really well developed and collecting good data. Finding a way to integrate those things is the future. We could use LiDAR data to look at forest structure of bird monitoring sites, for example. I think there's data that can be used to each other's advantage, but we haven't forced it or thought it through entirely. We're starting to; there's been some integration, but it could be done more.

Ulf: Using that LiDAR data for monitoring landscapes, forest structure, those sort of things. Al [Kirschbaum, GLKN remote sensing specialist] has done an incredible amount of on-the-job training and he's taken it to a pretty high degree. If you talk to other people in the NPS, almost no one is doing the kind of work Al is doing to pull out forest structure information.

Challenges?

Ulf: A good collaborative atmosphere in this office. It's not just dependent on who the coordinator is, but that position does kind of point us in a certain direction. Maintaining that sense of investment and ownership and the momentum and collaborative energy is key to keeping this program as strong as it is.

Bill: I think the challenge will continue to be making sure that we are relevant to what parks need. We've matured, but we should not be afraid to change if necessary. You don't continue to collect data just because you've been collecting data. I've always thought there should be one piece of the program that is flexible enough to address whatever the latest hot button issue is. But what issue at what park?

Ulf: I think the GIS program—Al, Rebecca, and myself—has been able to address a lot of those specific park needs for spatial analysis, to answer GIS questions they have. That's been a real plus. It's not monitoring at all, but it's helping parks with immediate needs they have.

Bill: That was shown in our last board and committee meeting. We went into the meeting saying we were going to hire a wildlife biologist to replace Ulf's position, but we came out of the meeting resolved to refill a GIS Specialist because the parks felt that need. They are getting that kind of product out of the GIS program. And our charge is to listen and to try to work with that. ●

* See the Acronym Decoder that starts on page 4.

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Amphibians

This was the fifth year of amphibian monitoring at network parks, and we made it through with only a handful of equipment problems. Bears seem to find the fluffy covers on the microphones tasty, especially at Pictured Rocks, and one song meter at Indiana Dunes was submerged after the tree to which it was mounted collapsed into the wetland. A chainsaw was needed to rescue the unit, but it is apparently still serviceable (*see photo below*).

Data analysis is underway, and we anticipate a synthesis report being published in early spring of 2018. In addition, Gary Casper, the contractor doing the analysis and reporting, is writing a new guide for identifying amphibian egg masses and larvae. This will help us to identify salamander egg masses and tadpoles while deploying the song meters in the spring.

Mark Hart collected water samples from several amphibian monitoring sites at APIS, INDU, and SLBE for eDNA analysis, as well as DNA samples from known species to build the marker sequence for identification. We are interested in seeing how the eDNA samples match up with the sound recordings collected at the same locations. If there is good correlation between them, we may simply collect water samples two or three times a year rather than setting up song meters. Even better, eDNA from water samples would also allow us to monitor non-calling amphibians such as salamanders.

NPS PHOTO

Bats

Katy Goodwin joined us this spring as the new coordinator of our bat monitoring program. She is concurrently enrolled as a graduate student at North Dakota State University, where she is studying bat population-level responses to white-nose syndrome and testing different methods of acoustic analysis.

The bat monitoring program expanded to include a total of ten parks this year. New and noteworthy was the addition of one sampling site at Quincy Mine near Hancock, Michigan—part of Keweenaw National Historical Park. Quincy Mine is known to be a bat hibernation site, but there is little information about whether bats use the area during the summer. After collecting more than 7,000 audio files over approximately one month this summer, we should soon know the answer.

Our main objectives are to collect baseline data on bat populations in the region and document trends over time as the devastating fungal disease White-Nose Syndrome (WNS) moves westward. Eight of the ten parks are located in or adjacent to counties where WNS had been confirmed as of early June 2017 (the latest map can be found here www.whitenosesyndrome.org/resources/map), so this disease is a real threat to our bat populations.

There are currently 242 sites being monitored with acoustic recorders between 1 June and 15 August. For all parks, final results regarding species identifications and year-to-year comparisons will be available once all that data (1.9 terabytes) is reviewed and analyzed.

Outside of fieldwork, we teamed up with the Great Lakes Research and Education Center to produce bat-related outreach materials for social media and the web. We will also be contributing information about our bat monitoring program for a "case study" as part of an upcoming NPS webinar on acoustic data management.

Like some of our other monitoring programs, this project could not be carried out without the skillful planning and many days of hard work by staff at each park, as well as contributions from many network office personnel. A huge thank you to all involved!

Biological technician Samantha House records the location information for a bat recorder along the Mississippi River. NPS PHOTO

Contaminants

Larval Dragonflies and Fish

From 2008 through 2012 our collaborators from the University of Wisconsin-La Crosse collected thousands of larval dragonfly and fish samples from six network parks and analyzed them for a number of organic contaminants, including mercury. Mercury is the most pervasive contaminant in the upper Midwest, so we are now focusing our contaminants monitoring on mercury alone.

As monitoring by UW-La Crosse was wrapping up in 2012, we became involved in the Dragonfly Monitoring Project (DMP), a nation-wide NPS effort to monitor mercury in larval dragonflies. We slowly added a few network parks to the DMP each year until, in 2015, we began fully funding collection and analysis of larval dragonflies from sites in all nine parks. That national effort remains in place and is expected to continue for at least the next few years. One offshoot from that effort is a project to monitor mercury in fish from remote parks in the eastern U.S. To that end, we collected fish from lakes at INDU, ISRO, SACN, and VOYA in 2015 and 2016; analysis is still pending.

Our protocol to monitor mercury in larval dragonflies and fish will be implemented in 2018. For larval dragonflies, the monitoring and analysis work will take place through the DMP, with the following exceptions: (1) we will ask field crews to try to collect 20 larval dragonflies per site vs. the 15 needed for the DMP; (2) each park will be able to pick a fourth site for monitoring that, unlike the three static DMP sites, can change from one year to the next; and (3) unlike the DMP, which only focuses on larval dragonflies, fish will be sampled from parks every five years—for the most part from the same sites where dragonflies are collected—and analyzed for mercury.

In 2017, in anticipation of implementing our protocol, fish were collected by crews at ISRO and VOYA. In 2018 our plan is to work with park staff and partners to sample fish from PIRO and SLBE, and larval dragonflies from all nine network parks. This work is only possible through the hard work and dedication of park staff and partners.

Bald Eagles

State and county partners conducted aerial surveys for active bald eagle nests at APIS, SACN, and MISS in 2017, but data are only available for MISS at this time (Wisconsin DNR has not yet released their data). The number of active bald eagle territories has steadily increased since 2006 (*Figure 1*). The increase has been most dramatic at MISS with 48 active territories in 2017, even though that is slightly lower than the high of 56 reached in 2015. APIS has also seen steady growth, with 38 active territories in 2016. It's been 37 years since the first productive bald eagle nest was found in the Apostles (1983) following the crash that occurred in the 1950s and '60s due to DDT and PCBs. We don't 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.

We did not sample nestlings for contaminants in 2017. We are busy quality checking data and reporting on results. To that end, three projects are in progress: A publication on lead contamination has been accepted for publication in the journal *Ecotoxicology*. That should be available in 2018. We are also updating our 2010 publication on

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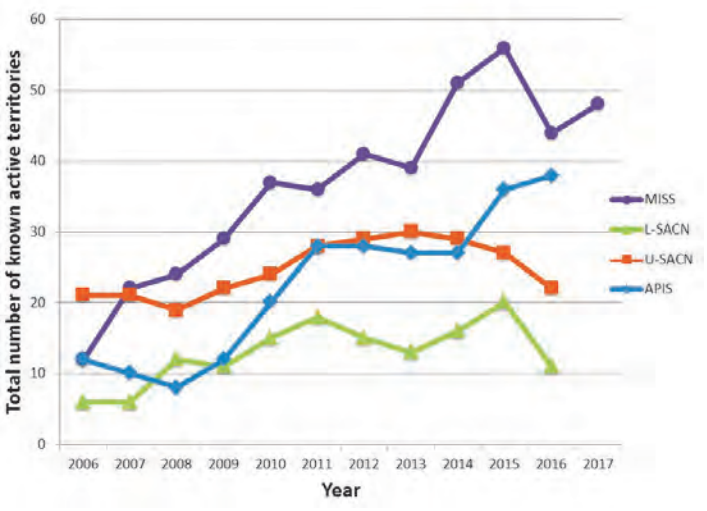


Figure 1. Number of active bald eagle territories at Apostle Islands National Lakeshore (APIS), the upper St. Croix National Scenic Riverway (above St. Croix Falls; U-SACN), lower St. Croix National Scenic Riverway (below St. Croix Falls; L-SACN), and the Mississippi National River and Recreation Area (MISS). Data are from surveys conducted by the network, the Wisconsin DNR, and the Three Rivers Park District, Minneapolis.

mercury, PCBs, and DDE to add eight years of data that should provide a full accounting of trends through 2015, our last year of sampling.

We are working with the USGS and the Wisconsin State Laboratory of Hygiene to evaluate a large number of chemicals found in eagles at APIS, MISS, and SACN. With funding from the Great Lakes Restoration Initiative, we expanded our contaminants monitoring in 2010 to include pharmaceuticals and personal care products, and we now have four years of data for this expanded list of chemicals. In addition, with funding from our national I&M program, we subjected 15 samples of archived nestling blood to a new laboratory procedure that will evaluate the presence of over 2,000 non-target chemicals.

With this expanded information we are using a U.S. Environmental Protection Agency database called ToxCast that contains research on thousands of chemicals to screen for those that may cause biological harm. A novel tool called ToxEval then allows us to use the ToxCast data to compare the actual concentrations we have found in bald eagle nestlings in our parks against data from thousands of controlled studies on laboratory animals. The controlled studies include assessments of chemical effects on such things as metabolism and function in cells, proteins, DNA, enzymes, and many other biological endpoints. This ToxEval tool calculates an "Exposure Activity Ratio," or EAR, that sums up the number and extent to which a chemical exceeds known biological thresholds. This can then be used to screen for chemicals of greatest potential concern. We can also show the results geographically to assess areas where these chemicals may have the greatest potential impact (*Figure 2*).

Each dot in figure 2 is the centroid of an eagle territory, and the EAR scores are the average score for that territory over eight years of monitoring. The larger the dot and warmer the color the larger the EAR score. Higher EAR scores mean greater potential for one or more chemicals to occur at levels that might affect biological systems.

The results are preliminary, and our knowledge of actual

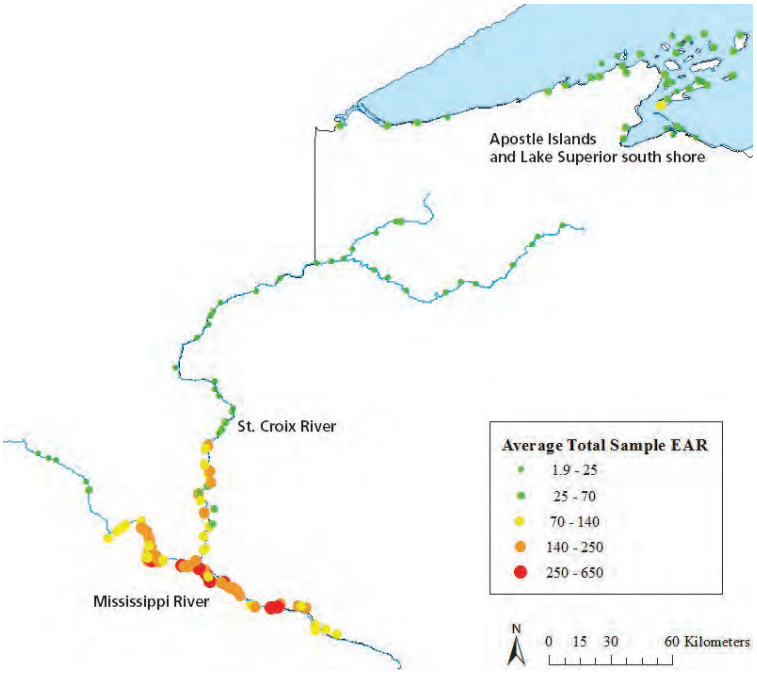


Figure 2. Average sum of the Exposure Activity Ratio (EAR) of 97 chemicals detected in at least one sample of bald eagle nestling plasma in and near the Apostle Islands National Lakeshore, the Mississippi National River and Recreation Area, and the St. Croix National Scenic Riverway. These are preliminary results and subject to change.

effects on eagles rather than laboratory animals is incomplete, but the analysis will contribute to our understanding of how numerous chemicals in the environment may result in sub-lethal effects that are otherwise difficult to assess in natural systems.

Landbirds

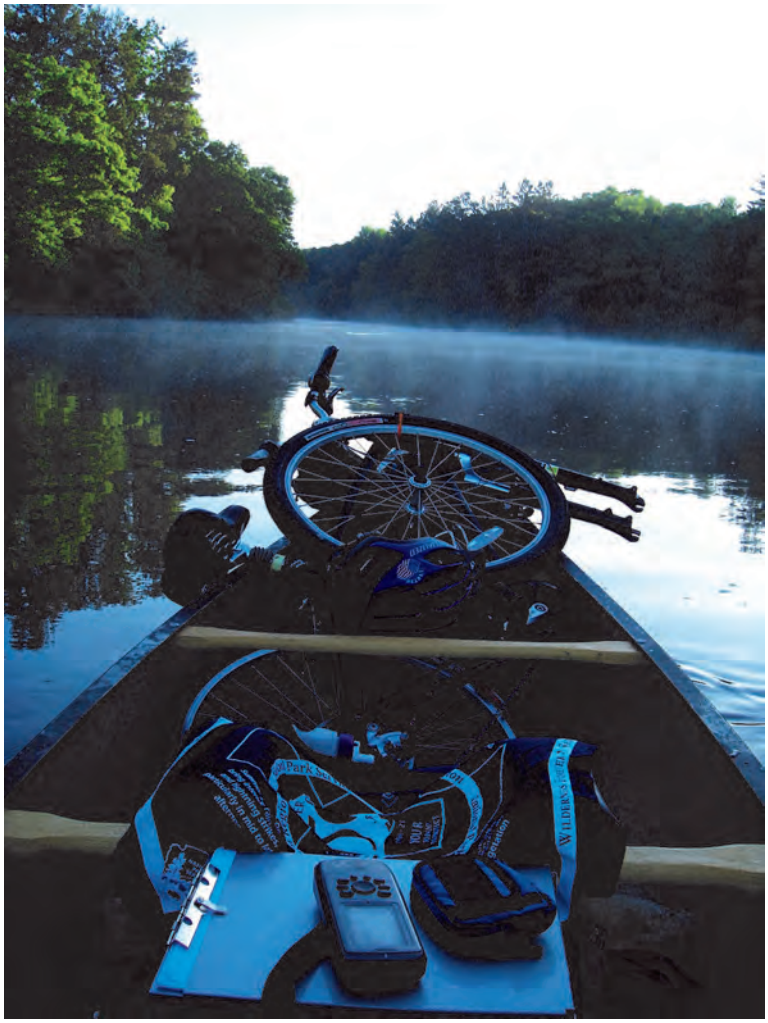
Volunteers and student interns have worked since last winter entering 10-minute songbird data from 2010 to 2016 into an online database hosted by the Midwest Avian Data Center (MWADC), and doing some quality assurance checking. The database developers are working to incorporate data collected at shorter intervals (3-, 5-, and 6-minutes) and to do a bulk upload of data collected prior to 2010. In the meantime, network data manager Mark Hart has been working with Inventory and Monitoring Division staff in Fort Collins to develop an SQL ("sequel server") database for the landbird program. That database, too, will be online, but it will be the primary repository of our data, which will be shared with the MWADC database only after it has been checked and certified. This is being done to meet security requirements for government data.

A few highlights from this year's monitoring:

Pictured Rocks National Lakeshore

This was the seventh year of songbird surveys at Pictured Rocks, and that is a dataset worthy of some statistical analyses. We will do those analyses over the winter to see what trends may be forming. In the meantime, a cursory analysis of data for 2011–2016 revealed a total of 82 species recorded across the six years, with the most common being the Red-eyed Vireo, Ovenbird, American Robin, Black-throated Green Warbler, and Cedar Waxwing.

Thirty-four (34) of the species recorded over the six-year period were long-distance (Neotropical) migrants, 31 were short-distance migrants (wintering in the southern United States), and 17 species were permanent residents in the PIRO area. There were 16 species represented by 10 or more individuals in all years. Among those, five exhibit potential trends in their annual abundances: the American Redstart and Nashville Warbler are potentially increasing, while the American Robin, Hermit Thrush, and Rose-breasted Grosbeak appear to be declining.



Bird surveys on the St. Croix and Namekagon Rivers involved some tricky logistics …. and, unfortunately, a locksmith. NPS PHOTO

St. Croix National Scenic Riverway

High, fast water and beautiful weather were hallmarks of this year's surveys on the St. Croix and Namekagon Rivers, which were conducted by network staff with considerable assistance from SACN bio tech Deanna Leigh, volunteer Clayton Russell, and a locksmith. On the lower river, Deanna proved to be a very capable birder in her own right, and she provided some much-needed local knowledge of landings and backwaters. On the upper reaches, a complex plan of driving, camping, paddling, and

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bicycling was employed the first week. Clayton was a steady and much-needed paddling partner for the tricky stretches of the upper St. Croix in the final week. He also saved the day with his smart phone when the keys were locked in the truck. Logistics aside, the birding highlights included multi-species swallow flocks along the lower St. Croix bluffs, abundant Prothonotary Warblers in the lowlands, and Yellow-billed Cuckoos at multiple points on the lower Namekagon.

Sleeping Bear Dunes National Lakeshore

Kathy Kaczynski and Alison Horton recorded 91 species among 1,130 individual singers this year. This compares to 89 species (1,037 individuals) in 2016 and 94 species (1,185 individuals) in 2015. Red-eyed Vireos have been plentiful in each of the last three years (totals of 73, 75, and 72), and they were the most abundant passerine this year (excluding starlings).

New species for the lakeshore surveys were a Marsh Wren and a Henslow's Sparrow (which became a big attraction for birders). Another highlight was the second Northern Parula recorded during any of the SLBE surveys. The cooler weather this spring (with many days of north winds) may have slowed down the migration so that some birds were in the area later than usual.

Isle Royale National Park

Volunteers and park staff who do surveys on the island seem to agree that they heard more Cape May Warblers this year than in the past, possibly Magnolia and Nashville warblers, too, but their increases were not as dramatic.

Vegetation crew member Dylan Alsbach measures the diameter of a beech tree at Pictured Rocks. The small white spots on the trunk are signs of infection by beech bark disease. NPS PHOTO

Land Cover/Land Use

The land cover team took a year off from analyzing data to focus on completing a trail monitoring protocol and to develop and give presentations at regional meetings.

We have been exploring forest structure and hydrologic products we could develop from the LiDAR data that has been collected at all network parks. We will send this data out over the winter and would like to discuss the potential uses of these products with managers and determine if we can derive other useful items from this very detailed dataset.

Vegetation

The vegetation monitoring team spent this summer in the forests at Pictured Rocks, resampling all 59 permanent forest monitoring plots.

The most notable feature of PIRO forests is the presence of beech bark disease. This disease had reached the east side of the park when we initially sampled there in 2009. This summer, the disease was found to have spread throughout the entire park, with many large trees now dead and down in the eastern half. Our work over these two sampling events (and when we add the third in 2026) will be

invaluable documentation of the disease dynamics.

One highlight of this season was locating Goldie's woodfern (*Dryopteris goldiana*), a state-listed rare plant. We found it in one plot in 2009, and it was there again this year.

Water Quality—Diatoms

The assemblage of diatom 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.

Every three to five years we collect surface sediment samples (about the top 2 cm) from areas of sediment deposition in lakes and rivers. This year, surface sediment cores were collected from Middle Lagoon at INDU and from five areas of sediment deposition in the Namekagon and St. Croix Rivers at SACN. The surface sediment cores were sent to our cooperators at the St. Croix Watershed Research Station to be analyzed this winter.

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 ISRO (Lake Richie), PIRO (Beaver and Grand Sable Lakes), SLBE (Lake Manitou and Bass Lake), and VOYA (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) to an ongoing GLRI-funded project to monitor the water quality of Lake Superior in nearshore waters adjacent to Meyers Beach and Sand Island, as well as a park-funded effort to survey park waters for native and non-native mussels. These collaborative efforts span multiple federal agencies and academic institutions.

Indiana Dunes National Lakeshore

Josh Dickey conducted all three rounds of sampling at Middle Lagoon in 2017, with assistance from other park staff. Josh also teamed up with GLKN data manager Mark Hart to collect a surface sediment sample. As he has done in November for the past three years, Josh collected surface water samples from 19 stream, river, and ditch sites, to be analyzed for surface water contaminants.

Isle Royale National Park

After a four year absence, the newly minted *Dr.* Alex Egan returned to Isle Royale as our new inland lake aquatic ecologist. Though new to our program, this marked Alex's

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Aquatic ecologist Alex Egan is "framed" by equipment that is used to continuously monitor water temperatures from the surface to the bottom at Lake Richie on Isle Royale. NPS PHOTO

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16th season on the island. He, along with ISRO biological technician Cortez Rohr and other park staff, completed all three rounds of sampling. Alex and Cortez also serviced the Lake Richie temperature array, completed two bird survey routes, assisted with common loon surveys, and collected chironomid midges from survey lakes. Midges are a diverse family of aquatic flies. Samples collected from the lakes will be compared with water chemistry and diatoms, all of which will combine to give a holistic perspective on lake conditions and health. Cortez and others also collected fish from Lake Richie, Sargent, and Harvey Lakes that will be analyzed for mercury.

Pictured Rocks National Lakeshore

Leah Kainulainen and her assistant Megan Muzzell completed all scheduled monitoring at six inland lakes. In July and September, they serviced temperature arrays at Grand Sable and Beaver Lakes. Leah continued wadeable streams monitoring on the Miners River through continued deployment of a multiprobe and collection of macroinvertebrates. In early 2017 Leah traveled to Ashland for training in the use of a proprietary database by Aquarius Informatics that we use to manage and archive some of our water quality data.

Sleeping Bear Dunes National Lakeshore

Chris Otto and his assistant Lisa DeGuire completed all scheduled routine monitoring at six index lakes. Chris and Lisa also serviced temperature arrays at Lake Manitou and Bass Lake (Leelanau County) in the spring and the fall.

Voyageurs National Park

Jaime LeDuc completed all sampling at the nine index lakes, with assistance from park biological technician Chandra Wiley and other park staff and volunteers. In the fall Jaime serviced temperature arrays on Little Trout, Mukooda, and Shoepack Lakes. Jaime and crew also collected additional water samples at six inland lake and four large lake sites throughout the summer that will be analyzed for contaminants. Jaime assisted with loon surveys on the nine index lakes, and she collected water samples from five inland lakes to be assessed for mercury levels, as part of an ongoing collaboration between GLKN, VOYA, and the USGS to conduct long-term monitoring of mercury in surface water at the park.

Water Quality—Large Rivers

This was a year of transitions for GLKN staff working at SACN. Long-time biological technician Michelle Prosser left the NPS for a job with U.S. Army Corps of Engineers. In her absence, Rick Damstra was ably assisted by SACN bio techs Deanna Leigh and Matthew Weiss. They completed sampling on schedule and collected diatom samples from the Trego and St. Croix Falls flowages and two sites on Lake St. Croix. We also began a new collaboration with Metropolitan Council Environmental Services by collecting phytoplankton samples for them during routine monitoring at three sites in Lake St. Croix. Rick also assisted SACN with a macroinvertebrate monitoring effort at four sites along the riverway.

Water Quality—Surface Water Contaminants

This summer park staff and partners collected surface water samples at GPRO, INDU, and VOYA as part of a NPS/USEPA Emerging Contaminants Program designed to screen for the presence of pesticides, pharmaceuticals, and personal care products, collectively known as contaminants of emerging concern (CECs). This program differs from the network's contaminants monitoring in that we are collecting water samples rather than fish or dragonfly larvae. It also targets a slightly more refined set of chemicals. In 2018, we hope to monitor CECs in streams at PIRO (we've already assessed inland lakes) and at SACN to follow up on previous monitoring by the USGS. We will also round out our initial screening for CECS in surface waters across all nine network parks.

Weather and Climate

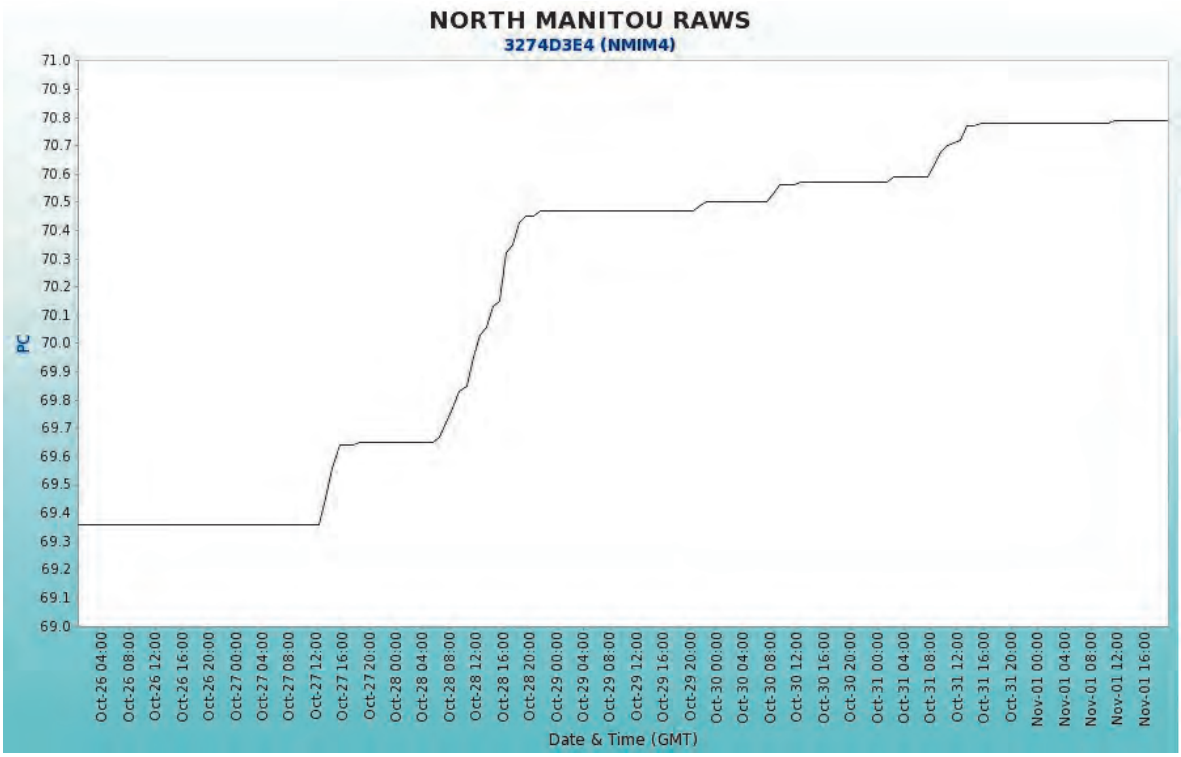
The Climate Analyzer (CA) web portal continues to be our means of synthesizing and distributing climate data appropriate to each park. CA is primarily a tool for looking at historical weather data, but there are also Dashboards for getting the latest station readings. To date, there are CA Dashboards for APIS, PIRO, and VOYA. We will certainly work with any additional park that wants a Dashboard for current conditions.

New Reports and Publications

Edlund, M.B., J.E. Almendinger, X. Fang, J.M.R. Hobbs, **D.D. VanderMeulen**, **R.L. Key**, and D.R. Engstrom. 2017. Effects of climate change on lake thermal structure and biotic response in northern wilderness lakes. Water 9: 678. Available at doi:10.3390/w9090678.

Gostomski, T., and C. Heyd. 2017. Summary of landbird monitoring data for Pictured Rocks National Lakeshore: 2011–2016. Natural Resource Data Series NPS/GLKN/NRDS—2017/1083. National Park Service, Fort Collins, Colorado.

Sanders, S., and **J. Kirschbaum**. 2017. Short-term change in forest metrics at Grand Portage National Monument, Minnesota. Canadian Field-Naturalist 131(2): 151–163. Available at https://doi.org/10.22621/cfn.v131i2.1986.



Precipitation collected (in inches) as recorded by the RAWS weather station on North Manitou Island (SLBE) from 26 October to 1 November 2017. From NOAA's Hydrometeorological Automated Data System (HADS).

We are maintaining RAWS (Remote Access Weather Station) stations in three parks to augment other weather data sources. Unfortunately, there is no great portal for viewing current hourly RAWS data, but the NOAA NexHads2 portals may offer the next best thing. These portals provide graphs of variables such as wind speed, temperature, precipitation, and humidity over a six-to-seven-day period. One of the unique features of the RAWS stations is the snow depth sensor, so the precipitation data can be useful year-round.

You can see examples of the NexHads data for Sand Island (APIS), Munising (PIRO), and North Manitou Island (SLBE). The only way to see these data for a site near you is to select it from a state-wide list on the NexHads2 website. To make it easier, we will provide a list of relevant links for each of the parks in a forthcoming resource brief. ●

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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http://science.nature.nps.gov/im/units/glkn

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