



Water Quality Monitoring at Isle Royale, 2007–2017

Water is a critical resource that Isle Royale has in abundance. Aside from Lake Superior, there are approximately 44 lakes on Isle Royale, some of which are small, unnamed, pond-like waterbodies. Many of the lakes are popular destinations for park visitors and staff, whether as a source of drinking water, or for swimming, paddling, or fishing.

Nine of Isle Royale's lakes are visited once a month every June, July, and August as part of a long-term water quality monitoring program. This monitoring, conducted by scientists from the NPS Great Lakes Inventory and Monitoring Network with assistance from park staff and partners, tracks measurements of water chemistry such as temperature, pH, and dissolved oxygen; water clarity; nutrient levels (phosphorous and nitrogen influence plant growth and oxygen availability); and water level. These measures help us to understand the current status of inland lake water quality and to detect trends over time.

Beyond our long-term monitoring, we also assist with research and monitoring projects in the park, such as diatom and aquatic macroinvertebrate communities, sediment and lake productivity, and contaminants in fish and dragonflies. It's all tied together, so along with our partners we hope to shed light on the basic conditions and ecology of a crucial resource—water.

What We're Finding

Nitrogen and phosphorus are the two most influential nutrients for regulating the growth of phytoplankton and aquatic plants. Nutrient inputs during summer months can lead to excessive algal growth and high nutrient levels. This is called eutrophication, which can lead to other problems such as the growth of cyanobacteria (*see sidebar at right*).

In 2017 nutrient levels in the lakes were generally below the long-term averages (2007–2016). Overall, there seems to be a decreasing trend in nutrients since we began our water quality monitoring. When we look at individual lakes, it's typical for Siskiwit Lake, which is deep and cold, to have the lowest nutrient concentrations (*see graph*). However, Lake George, which is much smaller and very shallow, also has low nutrient levels. Lakes Richie and Ahmik have higher nutrient levels, but are still mesotrophic; the other five lakes fall somewhere in between.

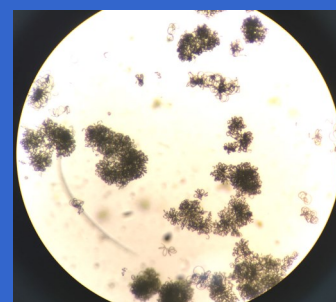
All of these lakes are in a designated wilderness area, so they should be minimally disturbed. Using diatom remains in lake sediments we are able to look back in time to get a



Sargent Lake, Isle Royale National Park. NPS PHOTO

Algae of Dubious Reputation

Algae blooms were noticed at both Chickenbone and Richie Lakes in August of 2017. Some algae species are known to produce toxins that can cause serious health problems in animals and people. Our partners from the St. Croix Watershed Research Station identified the algae as the cyanobacterium *Dolichospermum*, which is known to sometimes produce toxins. Park staff were made aware of this and subsequently posted trail signs advising visitors to collect water *before* hiking to the lakes. We actively track if lakes are experiencing algae blooms and provide warnings to park resource staff.



Dolichospermum. The offending cyanobacteria. NPS PHOTO

sense of what nutrient levels—in our case phosphorous—levels were prior to Euro-American settlement. Although results are derived from a model, we see evidence that nutrients in lakes today are similar to those more than a century ago.

Chironomidae: The Flies Don't Lie

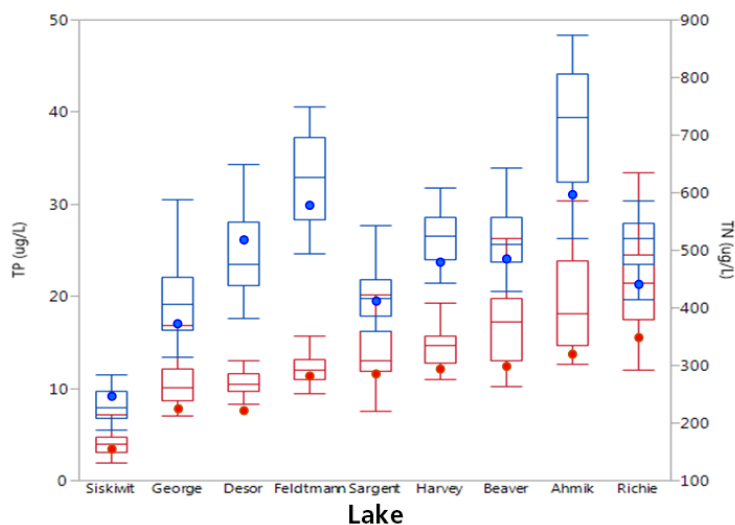
Chironomid midges are typically aquatic flies that occur in almost any body of freshwater. As larvae they are a key part of the food web, consumed by fish and other invertebrates. As aerial adults they feed animals like birds, spiders and dragonflies, and by moving away from water can transport nutrients from aquatic systems to surrounding habitats. Larvae of some species may have particular habitat requirements, such as cold, low-nutrient lakes, slow-flowing rivers, or ponds rich in nutrients. Some can tolerate almost any condition they encounter, including highly polluted waters. As a result, like we do with diatoms, we can also infer water quality conditions based on a water body's community of midges.

In 2017 we detected *Ablabesmyia mallochi* (midges rarely get common names) in numerous lakes, but that doesn't tell us much because that species inhabits a broad array of aquatic habitats worldwide. However, we also found interesting species that inhabit sunken wood (*Xylotopus par*), build case-like homes like caddisflies (*Stempellinella fimbriata*), and inhabit and parasitically feed upon the gills of mussels (*Baeoctenus bicolor*).

What are the midges at Isle Royale telling us? In general the diversity is high, which is what we expect in minimally disturbed lakes. Importantly, we are finding numerous species that have never been documented in North America, having previously been known only from Europe or Asia. We are also finding species that primarily live in arctic habitats, so they're potentially left-overs from when the last glacier retreated.

Lake Level Change

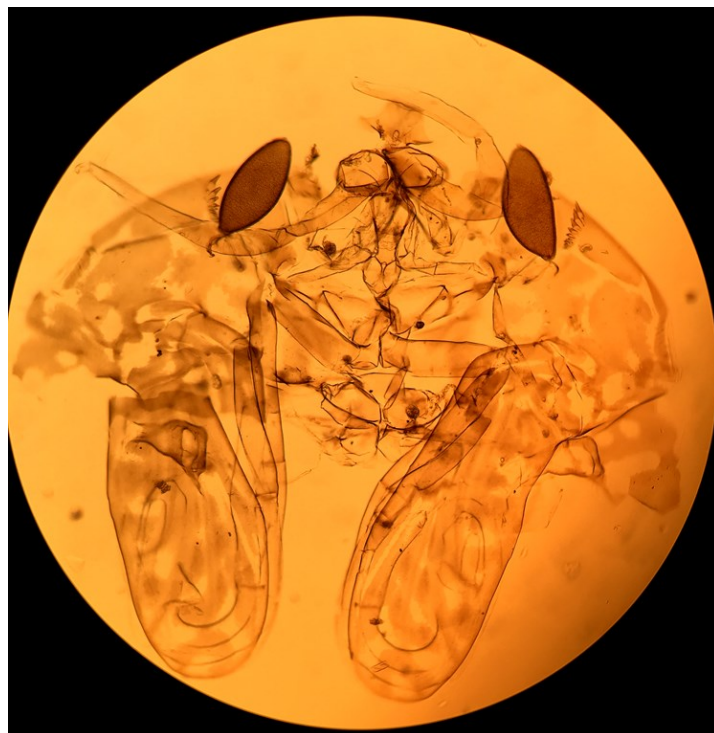
Lake level is probably the feature most frequently noticed by park staff and visitors. At a glance—relative to the first measurement collected more than a decade ago—water levels at most of the lakes where we work are higher (see [graphs on facing page](#)). “Risers” are typically higher by 7 inches to just over 1 foot (0.2–0.4 meters), except for [Sargent](#) which is up by 2.6 ft (0.8 m). Only two lakes—[Harvey](#) and [Beaver](#)—have slightly lower water levels. Water level typically drops by 7–11 inches (0.2–0.3 m) over the course of a summer in any given year, but in some years it hardly changes at all. This fluctuation probably reflects the amount of rainfall from month to month. An abrupt change in lake level is often due to beaver activity. For example, the steep drop for [Lake Richie](#) in 2017 may have been due to a beaver dam failure at the outlet to Chippewa Harbor.



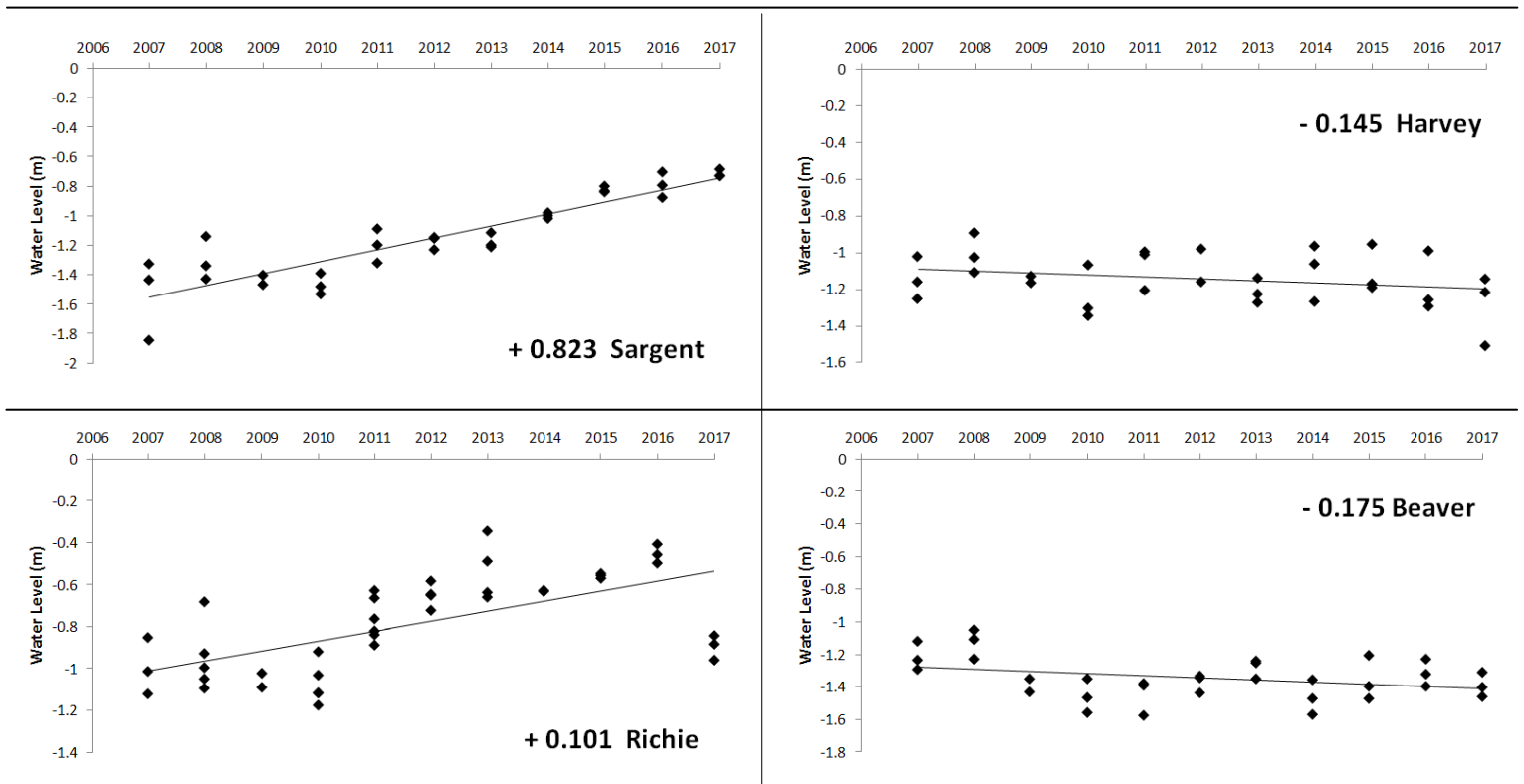
Amounts of total phosphorous (TP, shown in red) and total nitrogen (TN, shown in blue), in micrograms per liter (µg/L), for nine lakes on Isle Royale, 2007–2017. See below for explanation of box-and-whisker plots.

The “box-and-whisker” plot packs a lot of information into a small but simple shape.

maximum value
2017 approx. average value
10-year average
minimum value



Under the microscope. The cephalothorax (head and chest) from a discarded skin of *Ablabesmyia mallochi*. At the top are the dark respiratory organs, which look like footballs and is where the pupa obtains oxygen from water. Below are the wing pad covers. Notice the general mottling pattern; these patterns, ranging from transparent to spotted to mottled, are used to help distinguish one *Ablabesmyia* species from another. During the pupal stage a larva rearranges its body into adult form, then it floats to the surface and leaves the pupal case behind to be collected by curious scientists.



Water level changes on four of nine Isle Royale Lakes monitored annually by the Great Lakes Network. Values are shown in meters and represent the difference in the average levels from 2007 and 2017. Lines show the general trend from 2007 through 2017, and individual dots represent monthly measurements from May through August. *Clockwise from top left:* The largest increase among the nine lakes occurred at Sargent Lake. Decreases in water level only occurred at Beaver Lake and Lake Harvey. A sudden drop in water level at Lake Richie in 2017 is probably related to the blow-out of a beaver dam where the lake flows out toward Chippewa Harbor.

Protected But Not Immune

Although remote and protected, Isle Royale is not immune to declining water quality. By monitoring chemistry, nutrients, and ecology, and even reconstructing likely conditions of the past, we can determine the natural state and fluctuations of Isle Royale lakes. During our regular visits we can also detect important changes that impact visitors, such as algae blooms or lake level. Long-term monitoring gives the park sound knowledge to determine when and how to respond if changes occur both in real-time and in the future. ●



Two in a canoe. Isle Royale biotech Anna Johnson and GLKN aquatic ecologist Alex Egan collecting data on Lake Desor. NPS PHOTO



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www.nps.gov/im/glkn/index.htm

 www.facebook.com/npsglkn

Portions of this monitoring program are
done in collaboration with the following:

