



Water Quality Monitoring at Voyageurs, 2006–2018

Just as water is the most basic element of life, it is also the most common characteristic of national parks in the Great Lakes Network. You can see it, you can touch it, and almost everyone comes into contact with it during a visit to Voyageurs National Park. Because it is so important, we monitor many aspects of water quality in park lakes including water chemistry and contaminants.

Lake Levels

Water level is perhaps one of the first things people notice when visiting a lake. In particular, people are often interested in how lake levels affect beach usability, access to docks, and water depth for boating and fishing. Water level is also important to lake ecology because it influences water chemistry and the habitat available for plants and animals in the shallower zones.

In general, during the open water season, water levels are higher after snowmelt and then drop throughout the summer. While a great deal of rising and falling occurs year after year, lake levels usually do not change much on a long-term scale (e.g., 10-years) unless something dramatic happens. Something dramatic did happen on Shoepack Lake.

Water levels for three of the park's lakes have increased steadily since 2006 (*see graphs on next page*). Ryan Lake rose by almost 6 inches (15 cm), Ek Lake is up by a little more than 1 foot (37 cm), and Shoepack Lake has gained more than 3 feet (1 m). All three of these lakes have active beaver lodges, so dams are probably a key factor in water level increases. A beaver dam on Shoepack Lake blew out in 2001, causing the lake to lose 47% of its surface area. In terms of volume, the increase for Shoepack since that blowout equates to a gain of more than 138 million gallons of water! And our measurements suggest the recovery is still occurring.

Water level in two lakes has declined since 2006. Locator Lake lost more than 1 foot (47 cm) and Peary Lake dropped by nearly a foot (27 cm), though both had a lot of variability within and between years. These numbers equate to over 28 million gallons gone from Locator and almost 14 million from Peary. Neither lake has recent beaver activity.

Three lakes other lakes — Brown, Cruiser, and Little Trout — had broadly arcing patterns over the past 13 years. They started at low levels, generally gained in the middle of the time-period, and then dropped again in recent years to about the same level as they were in 2006. Typically, the strong annual variability in these lakes is caused by a large drop in water level during the summer months.

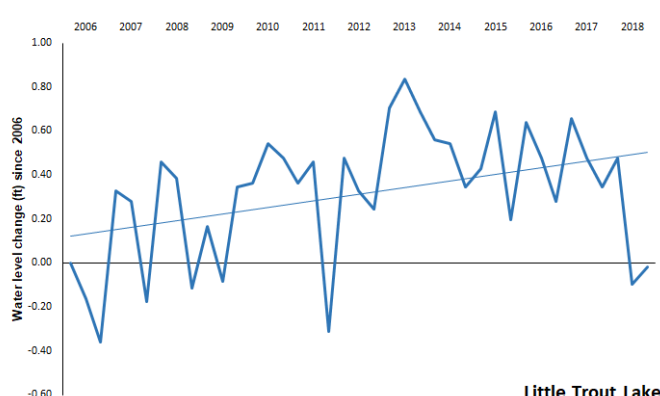
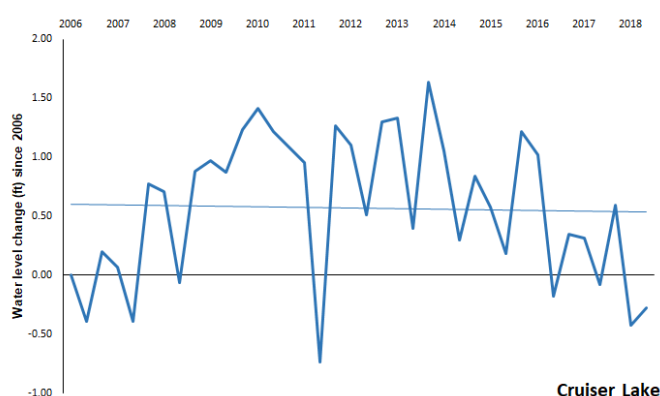
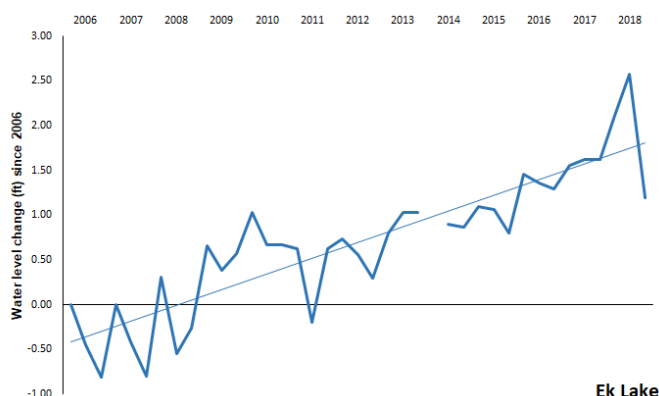
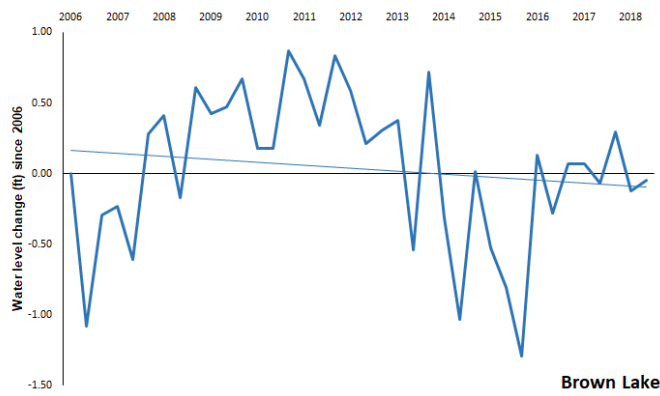
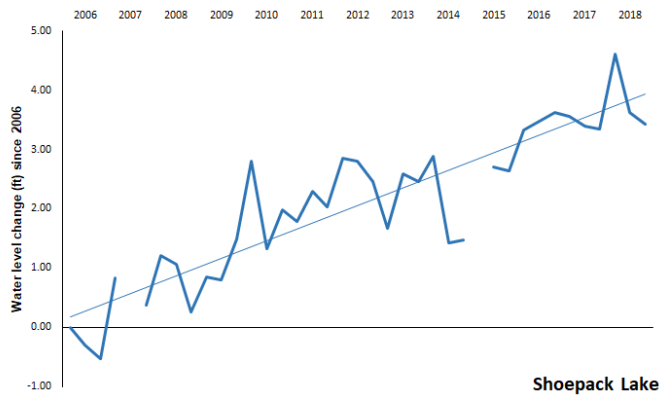
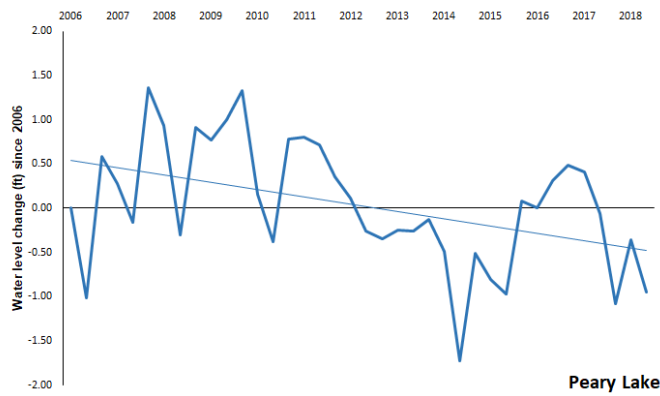
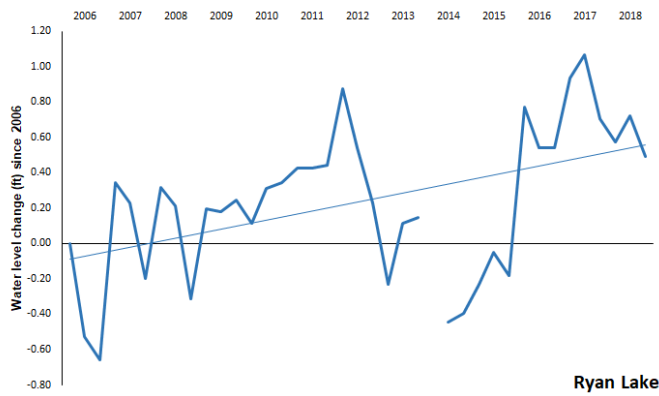
All of the lakes we monitor at Voyageurs have limited connection to ground water. They are fed primarily by rain and runoff, so the size of each lake and the amount of land draining into it influence the water level. These lakes are also relatively close to one another, making their differing water level trends all the more interesting.

Aquatic Invasive Species

Water makes up approximately 40% of the total area in Voyageurs National Park. It is home to many iconic creatures like moose, loon, beaver, lake trout, and muskellunge. Unfortunately, the park's waters are



Biologists measure the water level on Cruiser Lake using a shoreline benchmark, an eye level, and a stadia rod. NPS PHOTO



Water level changes (in feet) on eight of the nine lakes monitored at Voyageurs, as measured from a permanent benchmark 2–3 times per year. Changes are shown in relation to the starting measurement (zero, indicated by *black horizontal line*) taken in early summer 2006. *Blue lines* are the slopes, which are average annual rates of change across the 13-year time period.

threatened by aquatic invasive species (AIS). The park’s large lakes have already been invaded by purple loosestrife, exotic and hybrid cattails, reed canary grass, common reed, rainbow smelt, and rusty crayfish. Another invader — the

spiny water flea (SWF) — was detected in Rainy Lake and the Namakan Reservoir in fall 2006. SWF is a zooplankton native to Eurasia that is impossible to eradicate once it moves into a lake. It eats native zooplankton, without

replacing that important base of the food web because its long, spiny tail makes it much less palatable to small fish.



The spiny water flea is about 12 mm (about ½ an inch) long. PHOTO NOAA-GREAT LAKES ENVIRONMENTAL RESEARCH LABORATORY/J. LIEBIG



Spiny water fleas tangled on a fishing line from Rainy Lake. PHOTO © ERIC OLSON

In 2007, prior to the open water season, three key regulations and management practices were put in place to prevent the movement of SWF and other AIS to the park’s interior lakes. First, anglers are required to use only artificial bait on smaller interior lakes. Second, no privately-owned watercraft are allowed on interior lakes. Instead the park provides canoes and row boats for rent. Finally, no float plane landings are allowed on interior lakes. For any equipment or fishing gear that will contact lake water, anglers are to bring a separate set for interior lake use. Prior to use on interior lakes, this gear should be thoroughly dried for at least five days or washed with hot water (>140°F) for at least one minute. Another important practice is to remove aquatic plants and animals from clothing and fishing gear before moving to new locations.

A survey of 22 of the park’s small interior lakes in 2007 found no SWF. All 26 interior lakes were visited in 2016, and one SWF was found in Lucille Lake, but none were there the following year, suggesting it had not yet become established there. SWF has not been detected in any of the other interior lakes, despite being prevalent in the surrounding large lakes. This is good news and shows that the park’s regulations and management practices have been effective at preventing movement and establishment of AIS for over a decade.

Contaminants

Within the pristine landscape of a remote park like Voyageurs there can be unseen chemicals from local or



Dredge work. NPS staff collect lake-bottom sediments from Quarterline Lake. The sediment is taken back to the lab where it is examined for spiny water flea tail spines and resting eggs. NPS/J. LeDuc

distant sources. Some, such as mercury, have been studied extensively. In 2017, through a unique collaboration between the National Park Service and the U.S. Environmental Protection Agency, water samples were collected from Locator, Shoepack, Ek, Cruiser, Ryan, Little Trout, Kabetogama lakes, and Rainy River, and tested for over 200 *contaminants of emerging concern* (CECs) such as pharmaceuticals, personal care products, and pesticides.

Only seven CECs were detected. (For perspective, 52 different CECs were found in the Mississippi National River and Recreation Area in the Twin Cities of St. Paul and Minneapolis.) The most prevalent CECs at Voyageurs were the agricultural herbicide atrazine (found in 89% of samples) and the insect repellant DEET (55%). These two chemicals are ubiquitous in national parks across the western Great Lakes region. Three other herbicides, caffeine, and the preservative methylparaben were detected less frequently.

Most of these chemicals are probably arriving via atmospheric transport and deposition (on wind, rain, snow, and dust). DEET and caffeine are from local sources, namely people in and around the park waters. Fortunately, concentrations of the chemicals were extremely low, ranging from 10 to 207 parts per trillion (1 ppt = one drop of chemical in one trillion gallons of water) — far below levels known to affect human health. So when it comes to protecting aquatic life such as fish and invertebrates, the risk appears minimal.

Having this baseline information on CECs in park lakes expands our picture of the health of this water world. Continued monitoring will help to protect this place and everyone who calls it home. ●



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Annual water quality monitoring is accomplished at Voyageurs National Park because of the dedication of the following people:

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