

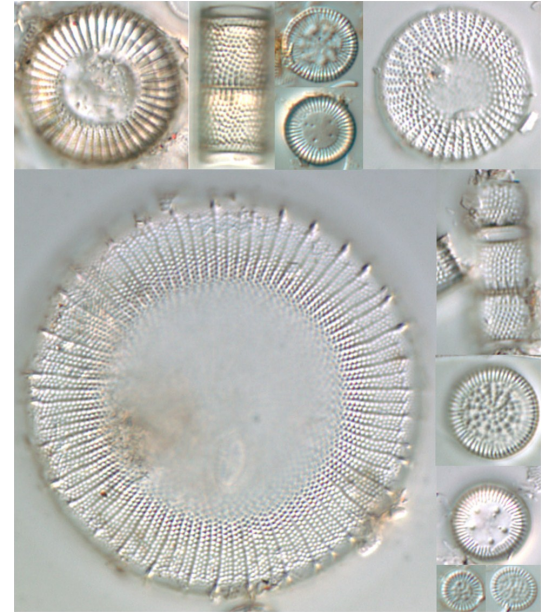


Monitoring North Manitou Island

The National Park Service Great Lakes Inventory and Monitoring Network and resource managers at Sleeping Bear Dunes are conducting long-term monitoring of natural resources on North Manitou Island to “keep a finger on the pulse” of the environment there. Regular visits are being made to Lake Manitou and to various sites around the island to collect information about water, contaminants, amphibians, plants, and climate.

What We Are Monitoring

- **Water Quality**— We collect measurements of water quality in Lake Manitou each month during the open-water season, tracking water level, water clarity, the amount of nutrients, and a variety of water chemistry variables including how much oxygen is available for fish and other life within the lake. In 2013, researchers will install probes in the lake that will record water temperature at regular intervals from the surface of the lake down to the bottom.
- **Diatoms**— We are looking back in time by collecting sediment cores from the bottom of Lake Manitou and looking in those cores for the glass-like remains of a group of algae called diatoms. These remains, called frustules, are like empty clamshells and can be used to identify what diatom species were present at different points in time. Different groups of diatoms require different lake conditions to survive, so based on what frustules are present in or absent from the sediment cores, we can piece together a story of what the lake was like and how it was affected by the land around it.
- **Contaminants**— We are sampling and analyzing larval dragonflies, small prey fish, and larger predatory fish from Lake Manitou to monitor the build-up of contaminants, such as methylmercury (MeHg), in the lake’s food web. MeHg is a toxic form of mercury that accumulates in aquatic organisms, increasing greatly in concentration as it moves up the food chain from water to algae to small invertebrates to prey fish and predatory fish.
- **Amphibians**— These animals are sensitive to changes in the environment, and they generally need good conditions on both land and water to survive. In the past, researchers conducted day and night amphibian surveys on the island using nets and hand-held microphones. New acoustic monitoring technology allows us to monitor amphibians through the use of remote recording devices placed on the island and elsewhere in the park.
- **The Forest**— In 2009, Network biologists set up 50 plots across Sleeping Bear Dunes National Lakeshore to describe and measure the plant communities found at each of them. Twelve plots were set up on North Manitou Island. Measurements at these plots include the kinds and number of trees, shrubs, and groundcover plants, and the amount of down wood. The amount of browsing by deer was also estimated by looking for tell-tale bite marks on the woody stems of shrubs and small trees.
- **Climate**— Being a large body of water, Lake Michigan moderates the temperature for everything around it. Thus, North Manitou Island experiences a climate that is noticeably different than the mainland. Climate is recognized as a key influence on natural systems, and so is an important factor to monitor when trying to understand changes in the island ecosystem. In 2013 a remote automated weather station (RAWS) was installed near the ranger station on the east side of the island.



Diatom frustules magnified 875 to 1,250 times. Photo by M. Edlund.



An automated recorder conducts electronic surveys of frog and toad calls at regular, pre-set times.

What We Are Finding

Water Quality— Since water quality monitoring began in 2008, the amount of water in Lake Manitou has declined, creating more shoreline around the lake. We do not yet know why this is happening, but we are investigating possible effects of beaver dams on the small streams that feed the lake, and ways the lake may be responding to changes in weather and climate. The temperature probes will be left in the lake year-round, giving us information not just on thermal conditions in the lake, but also on things such as how long the lake is covered in ice.

Diatoms— Scientists have dated layers of the sediment cores back to 1757—nearly 250 years! They identified three distinct groups of diatoms, indicating at least three significant environmental changes. Lake Manitou showed initial changes in diatom communities due to increased sedimentation rates during the late 1880s, consistent with landscape and lake responses to initial Euro-American settlement and land clearance. Additional biological changes occurred between 1968 and 1992 and may be related to climate warming.

Contaminants— Average concentrations of MeHg in three species of burrowing dragonfly larvae sampled from Lake Manitou during 2008 and 2010 varied from 21 to 44 parts per billion (ppb); these MeHg levels were similar to those in burrowing dragonflies from two other lakes at Sleeping Bear Dunes but higher than those in dragonflies from a fourth lake at the park. Mercury concentrations averaged 369 ppb in fillets of smallmouth bass (predatory fish). Half (51%) of the smallmouth bass sampled from Lake Manitou during 2008 and 2010–2012 exceeded the fish-tissue criterion for MeHg established by the U.S. Environmental Protection Agency, and one-fourth (25%) had concentrations equaling or exceeding a threshold level (500 ppb) that is known to cause diminished health and reproductive capacity in fish.

Amphibians—Past surveys have documented seven species of amphibians on North Manitou Island. Starting in 2013 automated recorders will be placed at ten sites in the national lakeshore, with one of the sites located on the shore of Lake Manitou. Long-term monitoring will allow us to track changes in what sites are occupied by calling amphibians across the park.

The Forest— Sampling plots were categorized by the amount of soil moisture and nutrients. Nine of the twelve plots on North Manitou were classified as mesic (medium moisture content) and medium-to-very rich nutrient levels. Mesic forests on North Manitou differed considerably from those on the mainland, largely because there were ten times fewer deer on the island (2–3 deer/square mile on the island compared to 22 deer/sq. mile in the Leelanau County portion of the park and 29 deer/sq. mile in the Benzie County portion). As a result, there was a considerable herbaceous layer present and greater tree regeneration on North Manitou. Nonetheless, like the mainland, we observed very little Canada yew on North Manitou. This is largely due to historical deer pressure on the island, coupled with the fact that Canada yew is a very slow growing species. We are hopeful that, over the next several decades, we will begin to observe a recovery of this species.

Though very low levels of beech scale (*Cryptococcus fagisuga*) were noted, Sleeping Bear Dunes is within the advancing front of this disease, so it will become a problem over the next 20 years. Beech bark disease is caused by the non-native beech scale insect and a particular fungus. The scale insect feeds on tree sap. Later-stage nymphs and adults secrete a white, wool-like wax on the outside of the bark. As a result of the holes created by the feeding insects, the tree is open to infection, which is invaded by the fungi. It is the infection and subsequent fungal invasion that kills the tree.

Climate—The weather station on North Manitou has not been up and running long enough for us to accurately characterize the island's climate. But as we gather and analyze data in the future, we expect to see that the island has warmer winters, cooler summers, and less precipitation than the mainland. The data will also be another “piece of the puzzle” to use as we analyze how climate variation impacts the other things we monitor on the island.



The dusky clubtail dragonfly, *Gomphus spicatus*, is one of six species of burrowing dragonflies found in Lake Manitou. Photo by R. Haro.



Sign of trouble. Beech bark disease begins with an infestation of beech scale insects. The presence of the insects is confirmed when they produce a wool-like wax on the outside bark.