

Decline in Lake Michigan Bottom Life

Environmentally Sensitive Organisms Missing in Lake Michigan Samples

Tiny shrimp-like organisms called amphipods that are normally found in bottom mud of the Great Lakes are now absent from southeastern Lake Michigan at depths shallower than 230 feet, according to NOAA's Great Lakes Environmental Research Laboratory (GLERL) in Ann Arbor, Michigan.

Routine monitoring of the abundance of these environmentally sensitive organisms at 40 sites in Lake Michigan's southern basin provides researchers with a reliable measure of the lake's health. While the NOAA scientists have not yet determined the exact cause of the complete disappearance of amphipods, they suspect it is linked to the introduction of zebra mussels in southern Lake Michigan in 1989, severely limiting food available to the amphipods.

Since the amphipod *Diporeia* normally makes up to 70 percent or more of the living biomass in a given area of a healthy lake bottom, its decline in Lake Michigan may spell hard times for a variety of fish species that depend heavily on them for food, according to GLERL biologist Tom Nalepa, who has been sampling Lake Michigan sediments since the early 1980's.

"What we believe is happening is that energy used to support amphipod growth is now being turned into zebra mussel tissue," says Nalepa. Many species of fish readily eat amphipods, but few species can use zebra mussels for food. In addition, amphipods have a much higher food value than zebra mussels. There's concern that the loss of amphipods in the food chain could lead to declines in a number of fish, including perch, alewives, sculpin, bloater, and smelt, with possible secondary effects on trout and salmon predators.

Data collected in the early 1990's indicated that the decline was concentrated in the far southern end of the lake. *Diporeia* is now completely gone from an area around the lake extending from Chicago to Muskegon, MI.

The amphipod
Diporeia spp.



"During the 1980's we could collect up to 20,000 amphipods living on every square meter of lake bottom," Nalepa said. "Now, they're all gone."

To sample the lake bottom, Nalepa uses a device called a "Ponar grab," a steel shovel-like device that is lowered by cable to the lake bottom from the lab's research vessel to retrieve a measured scoop of mud. Once onboard the ship, the sample is then washed through a fine sieve to strain out any animals living in the mud.

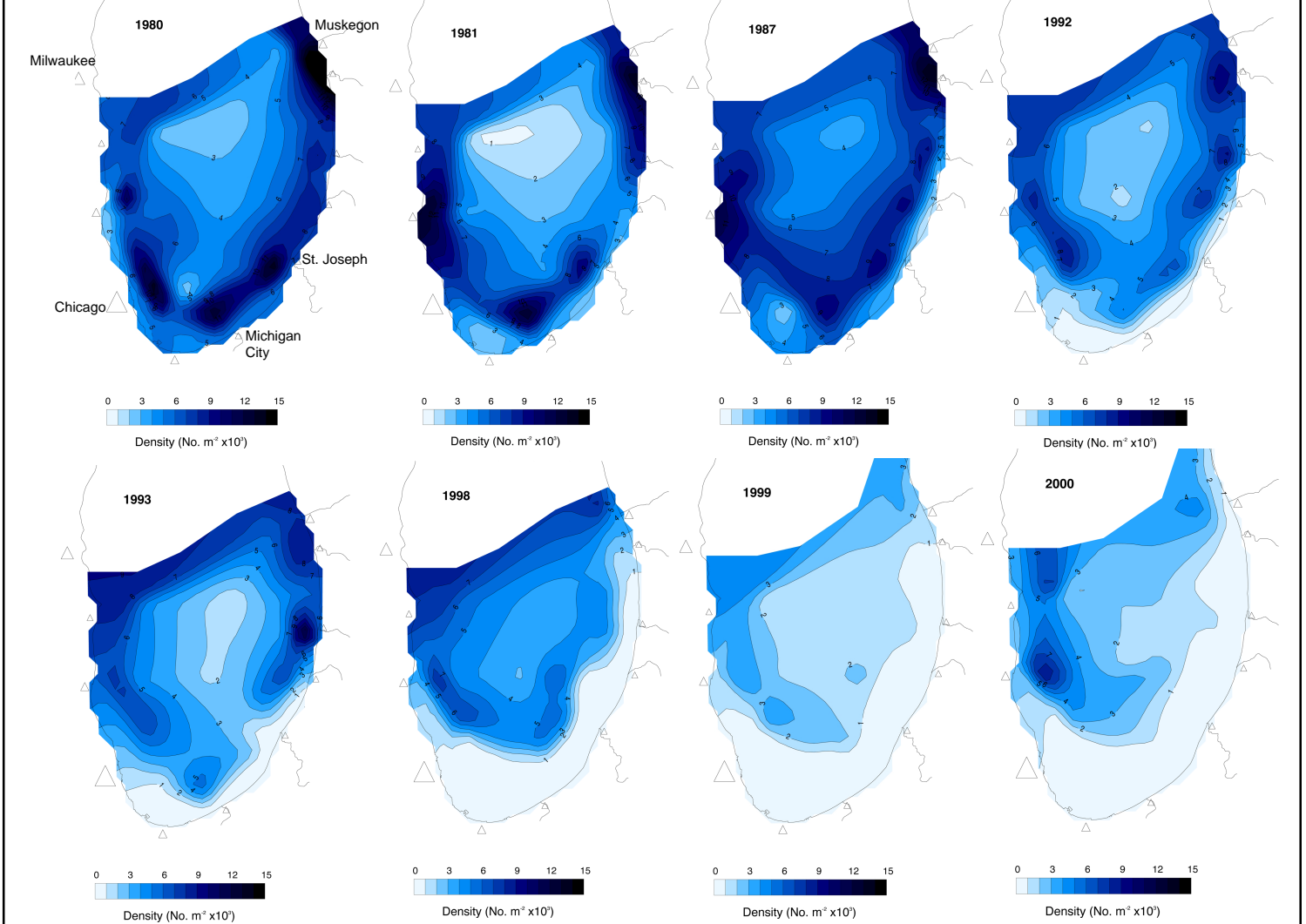
While other organisms are still present in the mud, they are not as readily fed upon by fish as are amphipods. Prior to the zebra mussel's appearance in Lake Michigan, amphipods had relied on a rich crop of microscopic plants called diatoms for growth and survival. Diatoms bloom in lake water in early spring and then eventually settle to the lake bottom. Amphipods then would feed and grow on this plant material. GLERL studies have shown that when amphipods feed on this rich material, their lipid (fat) content goes way up. That stored energy is what fuels their growth and survival through the remaining year. Large concentrations of zebra mussels residing on rocky bottom areas of southern Lake Michigan may be filtering out diatoms and thereby depriving food to amphipods, according to Nalepa. Research is being conducted to examine other reasons for the decline.

A map of amphipod abundance in southern Lake Michigan during the 1980's - 2000 is shown on the next page.

For more information on this subject or other GLERL research programs, please contact: Information Services, NOAA GLERL, 2205 Commonwealth Blvd., Ann Arbor, MI 48105. 734-741-2262.

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Diporeia



Amphipod Facts

- Amphipods are small crustaceans (1/2" or less) with laterally-compressed body forms.
- "Amphi" (of both kinds) and "pod" (foot) refers to the two sets of legs the animals have for swimming (pleopods) and for crawling (pereopods).
- Common names for amphipods: scuds, sideswimmers, beach hoppers, and sand fleas.
- In cold water of the Great Lakes, the dominant amphipod consists of one or more species of the genus *Diporeia*, which are related to species found globally in arctic and temperate ocean waters. These animals are environmentally sensitive, requiring clean, cold, well-oxygenated water for growth and survival. They have inhabited the Great Lakes since the Great Lakes were formed 5,000-10,000 years ago.
- The *Diporeia spp.* life cycle is up to 3 years in colder deeper regions of the Great Lakes and 1 year in warmer, shallower areas. Upon maturity, adults reproduce only once. The female incubates 12-14 eggs in a brood pouch (marsupium) where young are released after hatching.
- *Diporeia* are distributed throughout the colder, deeper waters of the Great Lakes and can be found even in the deepest areas. Highest abundance is generally at a 30-50 m depth.
- *Diporeia* feed on plant material and debris that settles out of the overlying lake water and is deposited on the surface of the lake bottom. The animals have molar-shaped grinding crushing mouthparts to aid in breakdown and digestion of such material. The amphipods burrow and feed primarily in a thin (half-inch) upper layer of lake bottom mud where food and dissolved oxygen are abundant. During the night, the amphipods are known to swim out of the mud into overlying water, but the extent and reasons for this behavior are not well understood, but likely related to reproductive activity.
- *Diporeia* are eaten by a variety of Great Lakes fish providing an important energy source. Oil (lipid) content of the amphipod is high and can reach up to 50% of the animal's overall dry weight. This high fat content also means that the animal readily takes up toxic contaminants and serves as a pathway for concentration of contaminants further up the food chain. With the decline in *Diporeia*, there will likely be changes in the way contaminants are cycled.