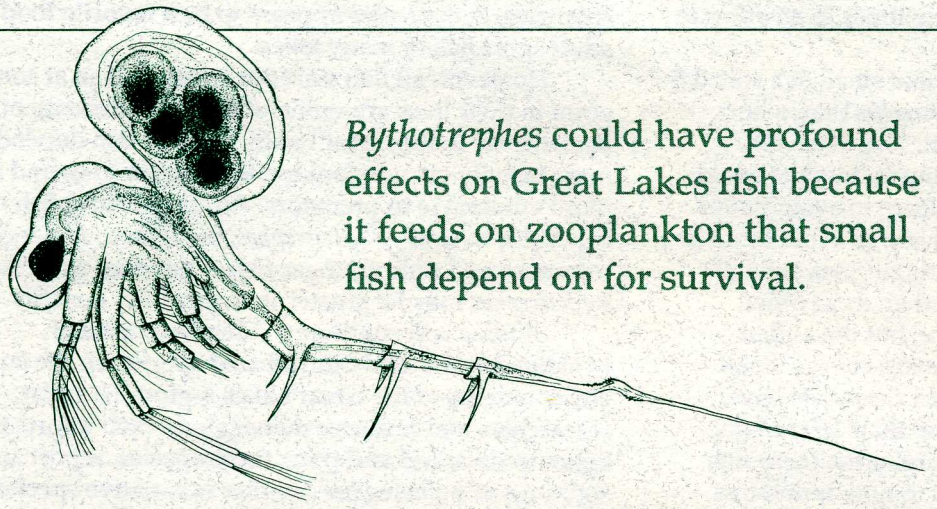
Effects of Spiny Tailed *Bythotrephes* on Great Lakes Fish

A fact sheet produced by Michigan Sea Grant for the Great Lakes Sea Grant Network



Bythotrephes could have profound effects on Great Lakes fish because it feeds on zooplankton that small fish depend on for survival.

The Great Lakes and their fish populations vary from warm, shallow Lake Erie with its walleye and perch community, to cold, clear Lake Superior and its abundance of lake herring and lake trout. But while the Great Lakes support a wide variety of native fish species, their food webs contain many introduced and invading species.

Non-native species often have a negative impact on native Great Lakes fishes. The sea lamprey, aided by overfishing in the early 1900s, severely depressed lake trout populations, and they have never rebounded. In fact, natural reproduction of lake trout now occurs only in Lake Superior. The Atlantic alewife changed forage fish communities — perhaps permanently. Many Lake Michigan fish species, collectively called cisco, are now extinct because they could not compete with alewife for food and habitat.

While the sea lamprey and alewife caused obvious and dramatic changes to fish communities, another invader—the spiny-tailed *Bythotrephes* (bith-o-TREH-feez)—has subtle effects on Great Lakes fish that may be just as damaging.

The spiny tailed *Bythotrephes* is a crustacean that invaded North America in the 1980s and is now established in all the Great Lakes. Originally limited to lakes in Eastern and Western Europe and China, the animal was apparently transported in ship ballast water across the North Atlantic. Recently, *Bythotrephes* has invaded large inland lakes in Canada and Minnesota and may spread beyond the Great Lakes region.

Unique Features Aid Survival

Bythotrephes is a small shrimp-like animal that grows to an average of 10 millimeters (0.4 inch) in length and feeds on other small aquatic animals. It has powerful limbs for swimming and grasping food items, and a large pigmented eye for seeing light and images in the water. It can often detect prey by sensing their movement through the water. When *Bythotrephes* captures a food item, it inserts its mouthparts into its victim and, much like a vampire bat, sucks out all the fluids.

Bythotrephes is classified in a group known as zooplankton — small aquatic animals that inhabit open water. Zooplankton form an important link in lake food webs because they graze on small plants or animals and are food for young fish. A carnivorous zooplankton such as *Bythotrephes* could have profound effects on Great Lakes fish because it feeds on zooplankton that small fish depend on for survival.

Although *Bythotrephes* itself is tasty to fish, it is protected from small fish predators by an unusually long tail spine. *Bythotrephes'* tail spine is rigid, can have up to four pairs of protruding barbs, and contributes up to 80 percent of the animal's length. For example, its body is only about 2 millimeters (0.08 inch) long, but its tail spine can be 8 millimeters (0.3 inch) long. The barbs are not present at birth but appear in pairs as the animal periodically sheds its outer skeleton. Decades ago, Russian biologists hypothesized that the tail spine stabilizes *Bythotrephes* while swimming. However, while the spine certainly affects how the animal swims, researchers have discovered that the spine also protects *Bythotrephes* from small fish.

Defensive Spine Deters Small Fish

Fish usually manipulate food in their mouths before they swallow it and so are frustrated by awkwardly shaped food. Researchers watched Great Lakes fish feeding on *Bythotrephes* in the laboratory and found that small fish have great difficulty ingesting the spiny zooplankton.

The **Great Lakes Sea Grant Network** is a cooperative program of the Illinois-Indiana, Michigan, Minnesota, Ohio, New York, and Wisconsin Sea Grant programs that supports greater knowledge and stewardship of the Great Lakes and ocean resources. Through its advisory agents, researchers, educators, and communicators, the Great Lakes Sea Grant Network supplies the region with usable solutions to pressing problems and provides the basic information needed to better manage the Great Lakes for both present and future generations. Sea Grant is part of the National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce.

Many fish such as young alewives, yellow perch and lake trout can easily capture *Bythotrephes* but have difficulty when trying to swallow it. These small fish flare their gills and throat, jerk their head and body, and reject and recapture the animal many times in an effort to swallow it.

Laboratory experiments show that small fish spend 8 to 10 percent more time eating *Bythotrephes* than other prey, and eventually learn to avoid it. This behavior, seeing and recognizing a food item but learning to avoid it, is quite common in nature. Birds learn to avoid butterflies that feed on toxic plants; frogs learn to avoid bumblebees; and octopuses learn to avoid stinging sea animals.

Bythotrephes has more protein than most other zooplankton because of its large size, but the added nutrients may not make up for the extra energy small fish expend trying to eat *Bythotrephes*. Scientists have found that in nature only fish greater than 100 millimeters (4 inches) feed on *Bythotrephes* and often these fish eat very few *Bythotrephes* compared to how numerous they are.

Large Fish Prey on *Bythotrephes*

Fish shift their habitats and food preferences as they grow — often feeding on zooplankton when they are young and eating other fish when they are older. Food that is difficult for a young or small fish to swallow may not be difficult for a larger fish to swallow. This may be why scientists find large numbers of *Bythotrephes* in the stomachs of adult fish in the Great Lakes. In other countries, *Bythotrephes* appears to be a favorite food for adult sport fish in many lakes.

However, all fish start out small, and so at some point in their lives are vulnerable to the presence of *Bythotrephes* in the Great Lakes. Smaller fish depend more heavily on zooplankton than larger ones and are more vulnerable to predators. Although older fish might benefit from eating *Bythotrephes*, the losses in energy, resources and time younger fish experience as a result of *Bythotrephes* may be greater than any later benefits.

Studies will continue to identify effects of *Bythotrephes* and other introduced species on the aquatic environments of the Great Lakes region. To assist researchers and resource managers in their efforts to better understand and track these species, report any sightings of *Bythotrephes* or other non-native species to your Department of Natural Resources, Ministry of Environment, or the Sea Grant Program in your state.

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Additional Publications

Journal Articles

Zooplankton (Bythotrephes cederstroemi) *Spine Induces Aversion in Small Fish Predators*, by D. Rae Barnhisel. MICHU-SG-92-303. Free.

Causes and Consequences of Cladoceran Dynamics in Lake Michigan: Implications of Species Invasion by Bythotrephes, by John T. Lehman. MICHU-SG-92-302. Free.

Fact Sheet

Spiny Tailed Bythotrephes: Its Life History and Effects on the Great Lakes, by Carla E. Caceres and John T. Lehman. MICHU-SG-90-700. Free.

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