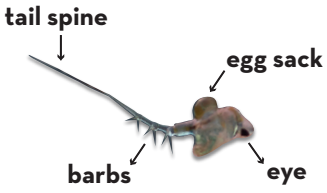
Minnesota Aquatic Invasive Species Research Center

STOP THE SPREAD of Spiny water fleas



.5”
roughly the size of a grain of rice

Overview

Spiny water fleas (*Bythotrephes longimanus*) are a species of tiny, freshwater zooplankton native to northern Europe and Asia. Despite their common name, they are actually small crustaceans, not insects. They are voracious predators of other zooplankton species and have very few natural enemies in Minnesota lakes. These factors, coupled with their capacity for rapid reproduction and high risk of spread, make them a serious threat to Minnesota lakes.

Appearance

Individual spiny water fleas are semi-transparent in body and just barely visible to the human eye. They are typically seen when clusters of them form a gelatinous glob on fishing equipment like downrigger cables and fishing line. Spiny water fleas have a large head, black eye, and a long, barbed spine that is twice the length of its body. Including the spine, their maximum overall length is typically around a half inch. The barbed spine makes it unique visually and is also a defining feature in terms of its invasiveness and impact. While they may seem small to us, spiny water fleas are massive compared to the native zooplankton species they compete with for prey or consume directly.

Where it grows and lives

They are a type of zooplankton, so they reside in the water column. Daily movements (diel migrations) from deeper to shallower parts of a water body help this species evade potential predators (of which there are few) and hunt other zooplankton species. Eggs over winter in bottom substrates.

Lifecycle

Spiny water fleas reach sexual maturity as early as one week old. They also reproduce both sexually and asexually and adapt their reproductive strategy according to environmental conditions. These factors, coupled with high reproductive output allow populations to expand rapidly (in some locations, exponentially) in variable conditions and diverse freshwater systems. Asexual reproduction typically occurs through the spring and summer months. During this period, females can produce up to ten offspring every two weeks without mating. These offspring hatch as free-swimming clones, but can be of either sex. When conditions become unfavorable (reduced food availability or cooling water temperatures) males and females reproduce sexually and produce eggs that settle in lake sediments, where

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they overwinter in a dormant state. Called resting eggs, they are viable for up to 17 months in lake sediment, but typically hatch the following spring. In favorable water bodies, spiny water fleas can exhibit exponential growth and density in the water column can be as high as 100 individuals per cubic meter, dominating the zooplankton biomass of a lake.

Native or non-native lookalikes

Spiny water fleas are totally unique among native Minnesota zooplankton due to their size and long tail spine. The closest related native species are the Daphnia family (of which there are multiple species in Minnesota), which are highly significant components of aquatic food webs. Spiny water fleas decimate Daphnia populations by consuming them directly and outcompeting them for other prey. Another invasive zooplankton in the Great Lakes called fish hook water flea (*Cergopagis pengoi*) bears some resemblance to spiny water fleas, but can be visually distinguished by its kinked tail spine. Fish hook water fleas have not yet been found in inland Minnesota lakes.

Above—Spiny water flea.
Right—Fish hook water flea.

Origin and spread

Native to Eastern Europe (Baltic Region) and Scandinavia, spiny water fleas were first found in Lake Ontario in 1982 and then in all five Great Lakes by the late 1980s. They were likely introduced into the Great Lakes from contaminated ballast material of ocean-going cargo ships, either as free-swimming individuals in ballast water or dormant eggs in mud. The first inland Minnesota detection was at Island Lake Reservoir north of Duluth in 1990. Today, they are found in many of Minnesota's largest and most recreationally important lakes, including Mille Lacs, Lake of the Woods, Lake Vermilion, Gunflint Lake, Rainy Lake, and Lake Kabetogama. The Minnesota DNR currently lists 66 waterbodies in the state as infested with spiny water fleas. Recreational watercraft and fishing gear are the primary means of spread into inland lakes.

The threat to Minnesota waters

Ecological impacts

Spiny water fleas can potentially cause severe impacts to food webs, fisheries, and water quality. Their size, barbed spine, and voracious feeding requirements distinguish them from native zooplankton. Spiny water fleas are not only more successful at hunting and have a wider range of things they can eat (because they are bigger and faster) than their competitors, but they can also eat their competitors, such as Daphnia. A study at Voyageurs National Park found that native zooplankton declined by 50% in the presence of spiny water fleas. Multiple other studies have documented significant declines in zooplankton species richness, biomass, and density directly related to spiny water flea infestations. Zooplankton (a term which encompasses multiple species, both herbivorous and carnivorous) are near the base of aquatic food webs and are important prey for many aquatic animals.

Spiny water fleas have fewer predators than native zooplankton because young native fish cannot consume their sharp, barbed spine. So not only are spiny water fleas consuming the prey that native fish like walleye evolved to eat as they grow, but the spiny water fleas are inedible to small fish. This makes them a food web dead end. Their consumption of mass amounts of herbivorous zooplankton (aka algae grazers) can also lead to increased algal blooms and reduced water clarity.

Economic impacts

Since spiny water fleas reduce or eliminate the food source (directly or indirectly in an aquatic food web) of many important game fish, their presence can harm local economies that rely on recreational fishing and associated tourism. $2.4 billion is spent on fishing every year in Minnesota and thousands of people are employed in fishing related tourism jobs. Walleye fishing is a significant (if not dominant) component of that total spending. MAISRC research has shown that spiny water fleas impact walleye growth and survival.

Research

MAISRC research on spiny water fleas has focused on impacts, invasion history, and vectors of spread.

Invasion history research

MAISRC paleolimnology (a lake sediment study of fossilized spiny water flea parts) results indicate that spiny water fleas were present in Mille Lacs and Lake Kabetogama for decades before they were first detected in the water column using plankton tows. The first water column detection was in 2009 in Mille Lacs, and in 2007 in Kabetogama. All three cores searched from both lakes provided evidence that spiny water fleas were present in both lakes during the 1970s, possibly as early as the 1930s, calling into question our current understanding of their invasion history.

> Takeaway: Spiny water fleas are cryptic invaders that can have a long history of low abundance during which they are not detectable using standard plankton survey methods and effort levels. Many more lakes could be infested than we think. Better survey methods are needed and sediment studies could be a valuable component of this.

Pathways of spread research

Researchers have demonstrated that recreational boaters and anglers are the main sources of inland spread, so this study looked at specific items of equipment that collect the most spiny water fleas in order to inform and focus prevention efforts.

Field researchers deployed a variety of commonly used fishing equipment (surface trolled angling lines, anchors, trolled downriggers, simulated live wells and bait buckets) in two known infested water bodies. While deploying the fishing gear, another research boat worked in parallel towing plankton nets, so that baseline levels of spiny water fleas could be measured against what was collecting on the fishing gear. The team found that trolled lines (surface or downrigger) collected the most spiny water fleas.

Accumulation rates also varied by time of day. Because of diel migrations (daily patterns where the spiny water fleas move from deep water to surface waters at twilight), more accumulated in the evening.

> Takeaway: All gear should be cleaned at all times, but focusing a thorough decontamination effort on fishing line and downrigger cables will remove most spiny water fleas. Anglers may see water fleas bunching up at the smallest eyelet at the end of the rod. Livewells and bait buckets should be drained and sponged dry. These efforts will remove the vast majority of spiny water fleas. This is especially critical for twilight fishing.

Spiny water flea and zebra mussel impacts to walleye: large lakes study

This project combined a food web study with statistical analysis of a 35-year MNDNR dataset from annual shoreline seining of juvenile walleye and yellow perch at 9 lakes (the "Large Lakes": Lake of the Woods, Rainy, Kabetogama, Vermilion, Red, Cass, Mille Lacs, Leech, and Winnibigoshish). Researchers examined differences in walleye and yellow perch size and growth across lakes with zebra mussels, spiny water fleas, or both. Uninvaded lakes were included in the study as well. The researchers found that walleye in their first year of life grew more slowly in the presence of spiny water fleas and were 12-14% smaller at the end of their first summer. The long timeseries allowed them to compare the growth of young walleye in a lake before and after invasion by spiny water fleas (and zebra mussels). Yellow perch growth was not affected, contrary to other studies. In these lakes, it appears that young perch are able to

shift their foraging strategy to adapt to the food web changes wrought by the invaders for the time being.

> Takeaway: This study has major implications for a culturally and economically important Minnesota fishery. Slower growth during the first year is associated with higher mortality due to increased predation, lower energy reserves to help them survive through the winter, and delayed access to a wider range of prey. These concepts apply to walleye and earlier studies have shown that size at the end of their first growing season is a reliable predictor of long-term survival.

How you can help

Prevention

Spiny water fleas are highly susceptible to desiccation. So clean, drain, and DRY is of utmost importance with this species. In dry, summertime conditions, eggs and adults will perish if left dry for ~6 hours. Clumps of spiny water fleas can amass on fishing gear (pole eyelets and downriggers, in particular) or stay alive in residual water and bait buckets. It is imperative that all gear is thoroughly cleaned and dried before entering another waterbody. Drying equipment for 24 hours is the best way to ensure that you're not transporting viable spiny water fleas or their eggs. An important caveat to this is that humid or cool, wet conditions could leave equipment wet or damp for longer than a day, potentially allowing spiny water flea adults or eggs to survive longer out of the water.

Other vectors include mud left on anchors, boots, or docks that could harbor the resting eggs and residual water in boats, engines, bilges, or live wells. Baitfish are another potential vector. Some minnows commonly used for bait may eat spiny water flea resting eggs. These are not digested and can stay viable in the bait fish feces. If baitfish are seined and used on a different lake, they could introduce spiny water fleas at the lake where they are used.

Management

No control methods currently exist or are in development for this species. Right now prevention is our only tool to fight spiny water flea.

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