An Illuminating Great Lakes Tale: The Alewife and the Opossum Shrimp

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In recent decades, Lake Ontario has become increasingly clear. The grazing of invasive zebra mussels and the reduction of inputs of compounds such as phosphorus have combined to improve its water clarity. Does an increase in light penetration affect how predators in lake food chains find their prey?

Yes, says Dr. Lars Rudstam, Associate Professor in the Department of Natural Resources at Cornell University. Increased predation is one consequence of the "illumination of the food web" associated with the increasing water clarity in the Great Lakes.

In several New York Sea Grant funded projects, Rudstam, along with his colleagues and students at Cornell, the USGS Great Lakes Science Center, and the Canadian Centre for Inland Waters, has been examining the interaction of forage fish and invertebrates in Lake Ontario and predicting trends in their populations.

The main forage fish of economically-important sportfish species such as Chinook salmon and other salmonids in Lake Ontario is the alewife. The relatively high abundance of alewife is the reason for the faster growth of Lake Ontario salmon compared to those in other Great Lakes. Alewife may be switching from a diet consisting primarily of zooplankton to one that also includes the opossum shrimp, Mysis relicta, a small shrimp that feeds on zooplankton. The alewife benefits from this addition to its diet; the opossum shrimp's high content of unsaturated fatty acids is necessary for the alewife's successful overwinter survival.

At night, mysids migrate from the bottom of the lake towards the surface to feed, making them vulnerable to alewife predation. Says Dr. Rudstam, “We have shown that light levels associated with the peak of the mysid layer are usually too low for alewife to use vision to feed on mysids. We therefore hypothesize that much of the predation we see in the field is occurring at the upper edge of the mysid distribution, where it is still light enough for alewife to utilize vision to feed.”

The team further hypothesizes that increased light penetration due to increasing water clarity will cause increased light levels at the mysid layer and therefore higher feeding rates of alewife on mysids. Rudstam’s team has also shown that alewife can feed on mysids in total darkness, although capture success declines in such conditions.

In addition to potential increases in alewife feeding, increased water clarity will limit mysids’ access to their own food—the zooplankton in the warmer, upper layer of water. Mysids may therefore grow more slowly, decreasing birth rates. The combination of decreased birth rates and increased mortality rates should lead to declines in the mysid population. Early indications show this may be occurring. In 2006, the population had decreased to half of the density in 2005 Future work will determine if this is a continuing trend. However, the effect of decreased mysids on the complex alewife-mysis-zooplankton food web--and therefore on alewife production itself-- is difficult to predict.

Much of this work has been recently published in the journal *Limnology and Oceanography* 52(4) under the title "The effects of temperature and predator-prey interactions on the migration behavior and vertical distribution of Mysis relicta.”

Source: Cornell University