Filtering rates of Otsego Lake Zooplankton, summer 1997

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Abstract

It has been well documented that the recently introduced alewife has profoundly impacted Otsego’s zooplankton, particularly the microcrustaceans which historically have been efficient grazers upon the lake’s algae (Harman et al., 1997). During the summer of 1997 the zooplankton community was evaluated for its ability to filter the water column to better understand the effects the alewife is having on the zooplankton community. The filtering rate was used to better understand the amount of algae being consumed. The zooplankton were sampled weekly and examined for average size, filtering rate, number per liter and the composition of the community. The sampling was done at two different sites, one near-shore and one off-shore, to determine what affect alewife movement has on the average size and relative abundance of zooplankton.

INTRODUCTION

Over the past decade Otsego Lake has had many changes occur in the zooplankton community resulting in decreased size of zooplankton and of their populations. This is largely a result of the introduction and subsequent irruption of the alewife, a planktivorous fish. This species was first documented in 1989 (Foster, 1989) and is now considered the dominant fish in the lake (Warner, 1997). The reduction in zooplankton populations has effected the epilimnion because of a decreased rate at which the water is filtered. This reduction in filtration leads to a higher algal standing crop, which results in decreased water clarity and increase rates of oxygen depletion in hypolimnetic waters. Reduction in the numbers and mean size of zooplankters has a great affect on the fish community since most species are planktivorous for at least parts of their lives. Evaluating the filtering rate of zooplankton can help determine the amount of water being filtered which permits insight into the relationships between biological, physical, and chemical characteristics of Otsego Lake.

METHODS

Samples were obtained from two different sites, one near-shore and one off-shore. The near-shore site was located approximately 500 meters from the northern boundary of Rat Cove

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and the off-shore site was located about mid-lake heading west from the same point. At each site a 0.5 meter plankton net was pulled vertically through 12 meters of the water column, concentrating the zooplankton into a 61 micron plankton cup. Samples were diluted to 1 liter and three ml of Lugols iodine solution was added in order to preserve the zooplankton. The sample was then left alone for at least 24 hrs in order to let the organisms settle out. They were then thoroughly shaken and 10 ml were removed with the use of a pipette and diluted with 90 ml of water. These diluted samples were allowed to settle for another 24 hours, then thoroughly shaken and three one ml samples were abstracted and placed into Sedgwick rafter cells. The cells were then placed under a compound microscope with a micrometer in the eye piece where counts and measurements were made for each species found. Pennak (1989) was used for taxa identification.

After the three cells were examined, the average of each taxan length in mm was calculated. The next step was to estimate the number of organisms in the lake. This was accomplished by taking the average of the three Sedgwick rafter cells to obtain the number of organisms per ml; this count was then converted to the number of zooplankton per liter for the near shore and offshore site then multiplied by the number of liters present in the top 12 meters of the water column. The filtering rates of the copepods, cladocerans and rotifers were achieved by using an equation developed by Knoechel and Holtby (1986). This equation involved using their average length to achieve the filtering rates of the zooplankton.

RESULTS AND DISCUSSION

Figures 1 and 2 show the difference in the number of zooplankton between the near-shore and off-shore sites. These data were evaluated to determine if alewives were changing the structure of the zooplankton community. It has been previously observed that alewives have the ability to locally deplete zooplankton (O’Gorman et al., 1991). Therefore, the two sites were observed to see if alewife movements coincided with crustacean zooplankton decreases (see Figure 5). The results show that the difference was negligible, possibly because of the relatively small size of the lake.

As seen in Figures 3 A and B, the majority of the population is made up of rotifers. This has been a continuous trend since the introduction of alewives (France et al., 1993). Alewives are efficient predator which selectively consume larger organisms. This has led to a decline in the number and average size of larger zooplankton. This will also cause a decrease in the efficiency of zooplankton filtering because larger organisms are able to filter a greater size of phytoplankton.

Figure 4 shows chlorophyll \( \alpha \) concentrations compared to the number of zooplankton per liter. The chlorophyll concentrations are indicative of the abundance of phytoplankton found in the water column (King, 1997). The weak negative correlation \( r = -.60 \) between chlorophyll \( \alpha \) concentrations and the zooplankton population may reflect algal grazing by zooplankton.

Figure 5 summarizes the alewife catch per unit effort (CPUE) compared to the density of the crustacean zooplankton. The CPUE was calculated by a trap net which was setup in Rat
Figure 1. Zooplankton densities (per liter); nearshore site.

Figure 2. Zooplankton densities (per liter); offshore site.
Figure 3. Composition of zooplankton community, nearshore (A) and offshore (B) sites.
Figure 4. Total zooplankton densities (#/l) compared to mean photic chlorophyll a concentration (ppb).
Figure 5. Comparison between alewife catch per unit effort and the densities of crustacean zooplankton at the nearshore and offshore sites.
Figures 6 and 7 show the difference between the filtering rate of zooplankton at the near shore and offshore sites. The filtering rate is a measure of the percentage of the top 12 meters of the water column being filtered daily by the zooplankton. This rate was determined by the Knoechel-Holtby equation (1986). These indicate a decrease of filtering rates for the near shore site compared to the offshore site. The majority of the filtering is accomplished by the larger organisms which is vital to decrease the abundance of phytoplankton. The difference in filtering rates between the near shore and offshore sites are due to the difference in the average size of organisms (see Figure 8).

The results of this preliminary study helps increase our understanding of the biological characteristics and its interrelatedness to the chemical and physical characteristics of Otsego Lake. Further evaluations are necessary to evaluate the importance of the filtering rate of zooplankton.

REFERENCES


Figure 6. Percentage of the top 12 meters of the lake filtered daily by rotifers, copepods and cladocerans at the offshore site (after Knoechel and Holbtly, 1986).

Figure 7. Percentage of the top 12 meters of the lake filtered daily by rotifers, copepods and cladocerans at the nearshore site (after Knoechel and Holbtly, 1986).
Figure 8. Mean size of cladocerans at the offshore and nearshore sites, 3 June-22 July.