Preliminary Spatial Study of Zooplankton Community Composition of the Lower St. Croix River System

Vinai Vang[1], Aaron DeRusha[2], & Toben LaFrancois[3]

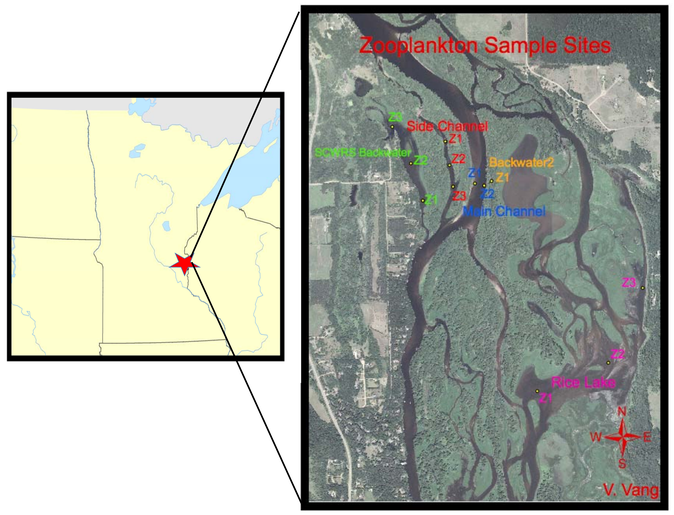
1. Geography & Environmental Studies Student, Gustavus Adolphus College, 2010 STARS Intern at SCWRS
2. Watershed Management Student, University of Wisconsin-Stevens Point, 2010 STARS Intern at SCWRS
3. St. Croix Watershed Research Station 16910 152nd Street North Marine on St. Croix, MN 55047

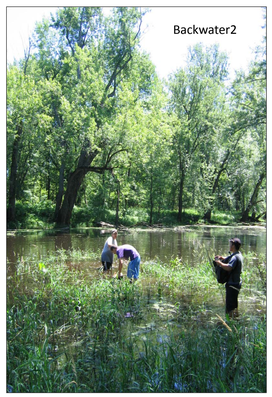
Project Overview

Zooplankton are biologically important in lentic systems but understudied component in lotic systems. Zooplankton provide an important function of the food web as they consume algae and are preys for other aquatic animals. This project was conducted as a part of my 2010 internship in the Science Training and Research Skills (STARS) program at the St. Croix Water Research Station (SCWRS), funded by the National Park Service (NPS). This preliminary study of zooplankton community composition and density in mid-summer (July, 2010) compared Cladocerans, Copepods, and Rotifers from different sub-habitats of the Lower St. Croix River. Rotifers are expected to be the dominant zooplankton (Williams, 1966). This was found to be true in some but not all of the sub-habitats of the St. Croix River. Reasons for why some sub-habitats are dominated by cladocerans are being addressed in future components of this study. Lotic areas of the lower St. Croix have lower numbers of zooplankton and are usually rotifer dominant. Lentic areas have increase numbers of zooplankton and are dominated by cladocerans with the exception of the SCWRS backwater. Basic water quality and surface flow was also taken for analysis of chlorophyll-a and other nutrients to relate water quality to zooplankton community composition. A comparison of standard horizontal (54 um) and vertical (30 um) tow methods was used as well as net size difference. The horizontal tows appear more effective in capturing cladocerans but underrepresented the rotifers due to its bigger mesh size. Vertical tows captured more rotifers and seem to be more biologically representative in the backwaters.

Methods

Sites were chosen to represent different major habitat types (backwater, side channel, main channel, and Rice Lake (a river lake) just upstream from Lake St. Croix. All site were located near the SCWRS for convenient long-term monitoring and easy access. During the sampling, we discovered a bog or stagnant water and one zooplankton sample was collected along with water chemistry reading for comparison. Coordinates for each site were recorded with a GPS and flow estimates were taken by placing a neutrally buoyant flask in the water and recording the time it took to travel two meters. Substrate types were estimated by what was collected in the nets and by observation. Water quality samples were taken with a YSI handheld sonde one meter under the surface in the most integrated area of the habitat. Water quality samples were collected at the most integrated area of each site and analyzed in the lab for chlorophyll-a and other nutrients.





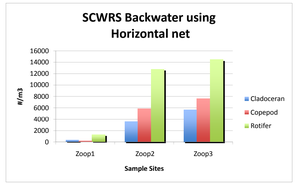


Figure 1. The variability of zooplankton captured in 3 different sites along the backwater of the St. Croix River using a horizontal net. Smaller amount of zooplankton were captured at Zoop1. Zoop2 and Zoop3 captured about the same amount of zooplankton. This show how variable densities can be within one area.

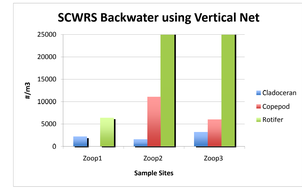


Figure 2. The same site as in figure 1 was sampled using a vertical net. The results are similar except Zoop2 (360,436) and Zoop3 (397,395) obtain far more captured in the net. This shows that there is a difference between the two methods that we used.

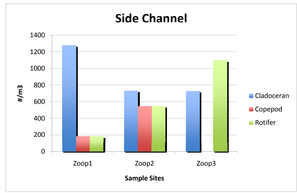


Figure 3. This shows how different community composition is within an area.

Rotifers from SCWRS backwater

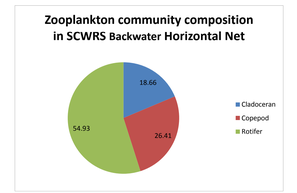


Figure 5. A horizontal tow show the backwater is dominated by rotifers but with substantial cladocerans and copepods.

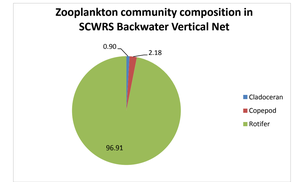


Figure 6. Using a vertical tow, however, picks up more rotifers, showing that zooplankton tow method can strongly affect results because different habitats are emphasized (pelagic by the horizontal tow, benthic by the vertical tow).

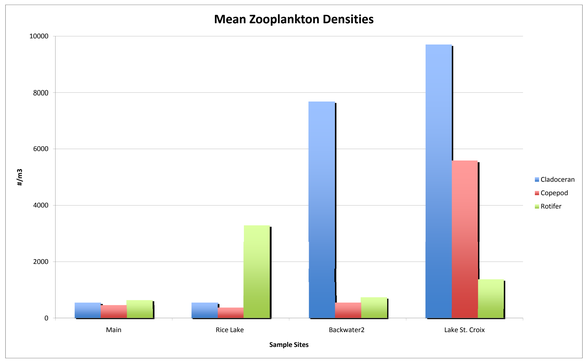
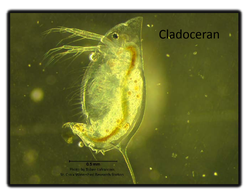
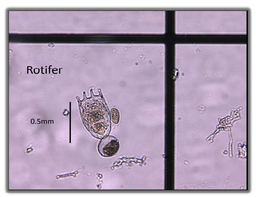


Figure 4. The mean zooplankton densities compared across sites show the difference between lotic and lentic systems of the St. Croix River. (1) Far higher densities of zooplankton were found in Lake St. Croix and the backwater2 that are lentic systems. (2) Lake St. Croix and backwater2 are cladoceran dominated and the main channel and Rice Lake are rotifer dominated.





Zooplankton Analysis

Zooplankton were collected using two different plankton nets. The vertical tow net has a 30um mesh size and is much smaller compared to the horizontal net. The net was lowered into the water as far as possible without touching the bottom and pulled up at a constant rate. Zooplankton samples were collected using the vertical net doing 3 tows from each site with a total of 3 zooplankton samples from each zooplankton site. The horizontal (aka Wisconsin) tow net has a 54um mesh size and thrown at about 10m three times surfacing across the water surface. The horizontal tow net was only used at the SCWRS backwater. The samples were concentrated into centrifuge tubes 80-90% ETHO, settled out and drained to 25mL. Each sample was agitated to get evenness all around and 1mL was taken by a Hempsten-Stempel pipette to be counted on a Sedgwick rafter cell. Abundance per cubic meter was calculated from the subsamples. An Olympus BX50F4 Microscope was used for counting and digital pictures of whole organisms. The zooplankton samples were classified into the 3 main groups (Cladoceran, Copepod, and Rotifer). Taxonomic keys from books and online were used to help identify zooplankton (Balcer et al., 1984; Thorp et al., 1997; Smith et al., 2001) and (U. New Hampshire, 2003).

Vinai doing 1 of 3 tows collecting for zooplankton at Lake St. Croix.

Aaron and Vinai trying to condensed zooplankton into tubes.

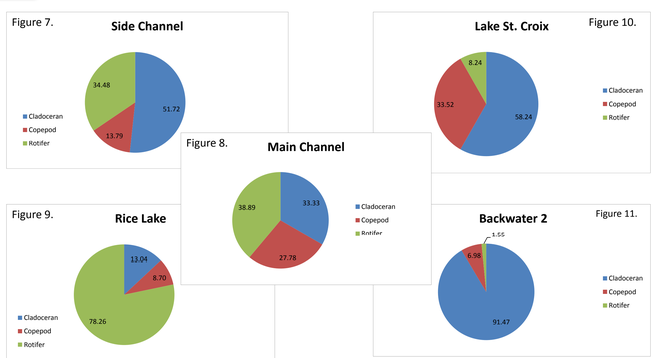


Figure 7-11. Zooplankton community composition of sub-habitat of the Lower St. Croix River.

Conclusion

◆Rotifers were expected to be the dominant zooplankton in the river but I found that is not universally true. The side channel, backwater2, and Lake St. Croix were dominated by cladocerans.

◆Standard plankton sampling methods were used, however differences were found between two mesh sizes and tow methods. The larger (54um) mesh horizontal tow net lost more rotifers, which biased our sample to crustaceans. Whereas the vertical smaller (30um) mesh net captured more rotifers gave a more accurate representation of the zooplankton community composition of the SCWRS backwater.

◆Lotic vs. lentic systems show a big difference in the number of zooplankton densities (Figure 4). Lotic systems had less numbers whereas lentic systems have far more numbers of zooplankton.

◆This study is a snapshot of zooplankton community during the peak of summer but it is an ongoing analysis part of the NPS study: Assessing pelagic zooplankton in Lake St. Croix in anticipation of invasive Asian Carp by Toben Lafrancois, SCWRS; Byron Karns NPS. 2010-2011.

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