Phantom midge mandibles in lake sediments as bioindicators of historic fish absence in Minnesota’s shallow lakes

Holly Kundel  
*Augsburg University*

Isabelle Natrop  
*Augsburg University*

Follow this and additional works at: [https://idun.augsburg.edu/zyzzogeton](https://idun.augsburg.edu/zyzzogeton) 
Part of the [Biodiversity Commons](https://idun.augsburg.edu/zyzzogeton)

Recommended Citation
[https://idun.augsburg.edu/zyzzogeton/10](https://idun.augsburg.edu/zyzzogeton/10)
Background

The phantom midge Chaoborus americanus (Diptera: Chaoboridae) is restricted to fishless habitats due to their vulnerability to fish predation (Von Ende, 1979; Schilling et al. 2009).

Their chitinous mandibles are preserved in pond sediments, making this species an excellent bioindicator of historical fish absence in waterbodies with unknown fish colonization history (Lamontagne and Schindler, 1994; Schilling et al. 2008).

Our research is part of a larger project using paleolimnological techniques to understand historical regime shifts (from clear to turbid states) in shallow lakes in the Prairie Pothole Region (PPR) of Minnesota (Hobbs et al. 2016).

As part of the larger study, fish and macroinvertebrate communities were sampled and sediment cores were collected from a large set of study lakes in the PPR (Hobbs et al. 2016).

We are interested in examining the role that fish colonization/extinction has played in triggering regime shifts in shallow lakes.

Our current research objective is to test methods for detecting fish presence/absence developed in Maine (Schilling et al. 2008, 2009) to see if they are applicable to lakes in the PPR.

Methods

Objective 1: Examine contemporary lake Chaoborus assemblages relative to fish presence/absence

- We searched macroinvertebrate samples collected in 69 shallow lakes for Chaoborus.
- We identified each specimen to species using a taxonomic key (Uutala, 1990).

Objective 2: Examine Chaoborus remains in top sediments relative to fish presence/absence

- We are searching for Chaoborus subfossil remains in top sediment from cores taken in 15 of the 69 study lakes in Objective 1.
- Here, we report data from 6 lakes, as we are still processing sediment.
- Freeze dried sediment [-2g per lake] was rehydrated by mixing with deionized water.
- Hydrated sediment was heated for deflocculation and then divided into scintillation vials labeled with information about the lake of origin.
- We searched for Chaoborus mandibles in small aliquots of rehydrated sediment in a Bogorov counting chamber (Figure 2) under a dissecting scope at ~25x magnification.
- Mandibles were extracted using a 200 μL micropipette and were mounted on slides using DPX mounting media.
- Mandibles were identified under a dissecting scope at 115x magnification to species using a taxonomic key (Uutala, 1990).

Results

Objective 1 Results

- Chaoborus were found in macroinvertebrate samples collected in 10/69 lakes.
- C. americanus was collected only in fishless lakes (Figure 3).

Objective 2 Results

- C. americanus mandibles were found in both fishless and fish containing lake sediments (Figure 4).

Discussion

- Our contemporary Chaoborus assemblage results indicate that C. americanus is restricted to fishless lakes and is a useful indicator of fish absence. This corresponds to a similar study in Maine (Schilling et al. 2008).
- Our sediment results do not confirm that C. americanus presence strictly corresponds to fish absence.
- This could be due to sediment mixing, especially in top-sediments, or to low numbers of C. americanus persisting in lakes with fish.
- These results are preliminary as our data collection is on-going.

Next Steps

- Search for mandibles in sediments from nine remaining study lakes.
- Collect additional sediment from study lakes to increase our sample size.
- Compare our sediment results to contemporary Chaoborus assemblages to determine the accuracy of our methodology.
- If presence/absence of C. americanus in lake sediments is not useful, employ logistic regression analysis to model likelihoods of lakes being fishless relative to the abundance of mandibles in a sediment sample.
- Search for mandibles down-core to relate historical fish presence/absence to lake state (clear vs. turbid).
- Continue to document microplastics as this may develop into a future study (Figure 5).

References


* Collaborators: St. Croix Watershed Research Station, University of St. Thomas Departments of Biology and Geology, Minnesota Department of Natural Resources, and University of Minnesota Department of Ecology, Evolution and Behavior.