Nearshore-Offshore Differences in Mesozooplankton Community Structure during the Recurrent Coastal Plume in Southern Lake Michigan

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INTRODUCTION

As part of the *Episodic Event: Great Lakes Experiment* (EEGLE), we are investigating the effects of the Lake Michigan Recurrent Coastal Plume (LMRCP) on mesozooplankton community structure. The LMRCP is a nearshore phenomenon that may affect nearshore zooplankton communities differently from offshore communities. Therefore, the objective of this research is to compare the near-shore-offshore differences in zooplankton species composition at five different regions around the southern basin of the lake (Figure 1). Results presented here describe zooplankton community structure during the plume in March from both 1998 and 1999.

In addition to investigating the impact that the LMRCP has on the ecosystem,this research will also provide valuable information on the zooplankton community structure during the winter. Preliminary evidence shows that when the LMRCP occurs, there is an increase in nutrient supply, bacterial abundance and production, and a shift in microbial food web and phytoplankton community structure. It is important to understand how zooplankton populations respond to the physical and biotic effects of this large-scale episodic event. A comparison of zooplankton species composition, biomass and production from nearshore to offshore regions will improve our understanding of the spatial dynamics of zooplankton in the southern basin of Lake Michigan.

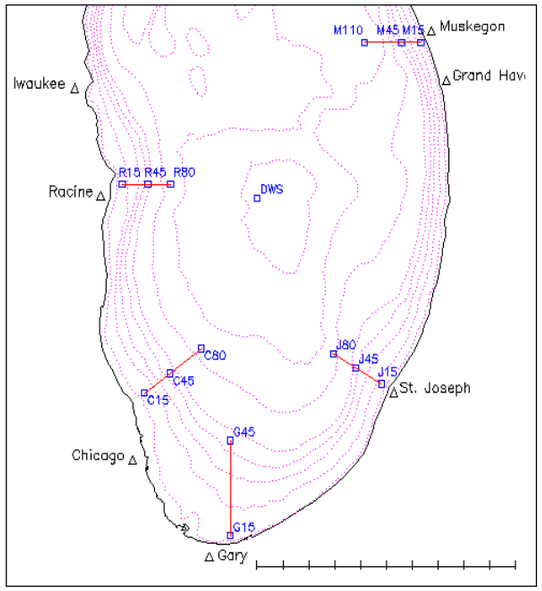

Figure 1. Location of EEGLE sampling stations and transects in southern Lake Michigan.

METHODS

Survey cruises for EEGLE took place aboard the R/V LAKE GUARDIAN in January, March and May of 1998 and in February, March, April and June of 1999. On most cruises, samples were collected at a shallow site (10-15 m), a mid-depth site (45 m) and a deep site (80-110 m). Replicate samples for determining zooplankton community structure were collected by vertical hauls of a metered 153 mm mesh zooplankton net (0.5 m diameter) from 2 meters above the bottom to the surface. For each net towed, flow meter readings were recorded and the nets were hosed down to collect zooplankton in a screened collection bottle at the cod-end of the net (Figure 2). The zooplankton were narcotized and then preserved with sugar formalin (Haney and Hall 1973).

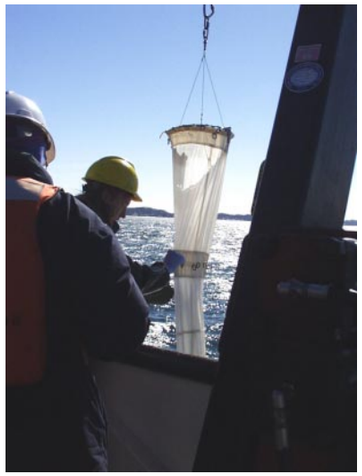

Figure 2. Retrieving zooplankton net tow during the March 1999 cruise.

In the laboratory, two or more subsamples of a well-mixed sample were taken with a Stempel pipette until at least 600 animals were identified. Another subsample, equal in volume to the sum of the subsamples, was examined for the rare taxa whose total count in the first set of subsamples was less than forty. All adult copepods and cladocerans in each subsample were identified to sex and species (Figure 3). Immature copepodites were identified to genus, while nauplii were combined into one group. Zooplankton were enumerated in a circular counting dish using an Olympus dissecting microscope at a magnification of 20 to 57X (Table 1).

Figure 3. Adult copepods from Lake Michigan.

Table 1. Copepod species (in order of increasing length) found during the March cruises for 1998 and 1999.

Cyclopoids	Calanoids
Tropocyclops prasinus	*Diaptomus minutus*
Cyclops bicuspidatus	*Diaptomus ashlandi*
	Diaptomus oregonensis
	Diaptomus sicilis
	Epischura lacustris
	Senecella calanoides
	Limnocalanus macrurus

RESULTS

Copepods are the dominant members of the mesozooplankton community in Lake Michigan during the winter-spring transition (>95%). For most of the transects sampled, copepod abundance decreased as station depth increased (Figure 4). The 1998 Gary transect was the exception to this trend however the deepest station sampled was only 30 m. Due to inclement weather, the Chicago transect was not sampled during March 1998.

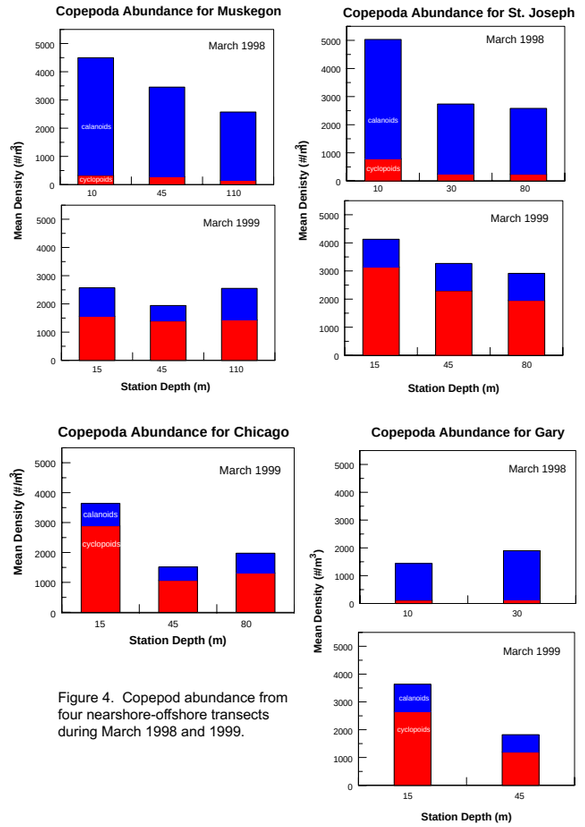

Figure 4. Copepod abundance from four nearshore-offshore transects during March 1998 and 1999.

Since these collections were made at the same time of the year, using the same techniques, we expected that the results would not exhibit dramatic variations in species abundance and distribution. However, there was a substantial shift in the ratio of calanoids to cyclopoids between 1998 and 1999. Calanoids dominated the composition of zooplankton at all stations in March 1998, whereas in March 1999, cyclopoids dominated at every station. Specifically, the cyclopoids sampled from the St. Joseph transect increased four-fold at the nearshore station (10-15 m), and increased eight-fold at the offshore station (80 m) (Figure 5). Results reflect a change in the community size structure since cyclopoids are smaller in length than calanoids. The community has also become more predacious with the switch over from calanoids to cyclopoids. This dramatic shift in the ratio of calanoids to copepods is not unprecedented in Lake Michigan. Calanoids are typically greater in abundance compared to cyclopoids however there was a reversal of dominance in 1966 as cyclopoids were three times greater in number over calanoids (Makarewicz *et al.* 1995).

Figure 5. Female and male *Cyclops bicuspidatus.* Dominant cyclopoid species in Lake Michigan.

The most significant change between March 1998 and 1999 was the dramatic decrease in the overall number of diaptomids (Figure 6). Specifically, the density of adult diaptomids in 1999 at St. Joseph was three to four times less than the density in 1998. Another interesting trend from these data is that *D. ashlandi* decreased in relative abundance from 1998 to 1999 whereas the relative abundance of *D. minutus*, the smallest of the diaptomid species, increased. The largest diaptomid, *D. sicilis*, decreased in relative abundance as well (Figure 7).

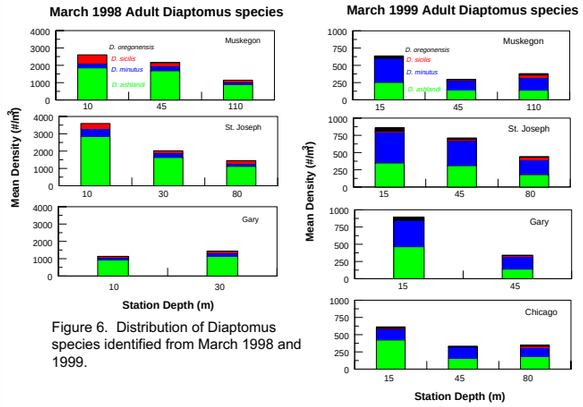

Figure 6. Distribution of Diaptomus species identified from March 1998 and 1999.

Figure 7. Female *Diaptomus sicilis.*

SUMMARY/FUTURE RESEARCH

The next phase of this research is to analyze and compare the net tow data from cruises before and after the LMRCP in 1998 and 1999. These data will enable us to better understand changes in zooplankton community structure during the winter-spring transition. In addition to looking at the distribution of zooplankton populations, we will also measure zooplankton biomass and egg production before, during and after the winter-spring transition in areas within and outside the influence of the LMRCP. Future research will address the drastic changes in copepod abundance and composition observed between March 1998 and 1999 during the LMRCP (Figures 4 and 5). Factors that influence this dramatic shift in zooplankton composition may include the introduction of exotic species, such as *Bythotrephes cederstroemi* and *Dreissena polymorpha*; the occurrence of tumors on zooplankton (Omair *et al.* In press); the tremendous decline in the macroinvertebrate *Diporeia* (Nalepa *et al.* 1998); and a potential shift in fish predation pressure (Evans 1990); all of which may alter zooplankton community structure.

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