Temporal and spatial variability in midge assemblages from a backwater lake in Pool 2, Mississippi River

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Abstract

The temporal and spatial variability in the midge assemblage found in a backwater lake of the Mississippi River was examined. Bi-weekly samples were taken during the summers of 1987 and 1988. Four taxa of chironomids were found. The population density and sizes of chironomids, and the proportion that each taxon comprised of the midge assemblage, varied significantly in time and space. In an attempt to examine whether the variability noted was related to sediment accretion in the lake, sedimentation rates were measured. There were few correlations among sedimentation rate or the organic matter content of the collected sediment and the structure of the midge assemblage. Those few correlations that were statistically significant were low and often paradoxical. For example negative relationships were found between the density and size of Chironomus spp., a detritivore, and the amount of sediment deposited or its organic matter content. Also no significant relationships were found between the density of the predator Cryptochironomus spp. and the density of other chironomids (potential prey). These negative findings indicate that factors other than food, such as sediment texture, may be more important than food availability in structuring chironomid assemblages in backwater areas. There was spatial variability in the densities and sizes of chironomids that may be explained by differences in sediment texture and organic matter. This suggests that short-term inputs of sediment (as ascertained by sediment traps) may not greatly influence midge assemblages while the long-term changes in sediment composition may have large influences.

Introduction

Backwater regions are among the most productive areas in large river systems and support large populations of macroinvertebrates which serve as food for fish and ducks (Eckblad et al., 1977). Backwaters also contribute significantly to the allochthonous invertebrate drift in large rivers (Eckblad et al. 1984). There is concern, however that these highly productive regions are threatened by high rates of sedimentation (Smart et al., 1985; Bhowmik & Adams, 1989).

The Chironomidae constitute a large proportion of the benthos of many aquatic systems and their production is often a significant component of the total invertebrate production in stream systems (Grzybkowska, 1989). This is especially true in backwater areas where they can colonize both macrophytes and soft sediments (Oliver, 1971; Pinder, 1986). Few studies have examined the production dynamics of midges in backwater lakes in large river systems although it is clear they are major components of the benthos in these systems (Eckblad, 1986; Jahn & Anderson, 1986).
It has been suggested that sediment deposition can significantly alter macroinvertebrate communities. Grzybkowska (1989) found major differences in chironomid assemblages in two branches of a river that were attributed to long-term, human-induced sedimentation in one of the areas. Robbins et al., (1989) found a positive correlation between oligochaete density and rates of sediment accumulation and organic carbon flux. Rae (1985) indicated that sediment size, sediment heterogeneity and organic deposition are important in determining midge community structure.

This study examined the temporal and spatial variability in midge assemblages in a backwater lake of the Mississippi River. In particular we investigated the relationship between midge assemblage structure, midge population structure, sediment composition and the rate of sediment accumulation.

**Materials and methods**

River Lake is a 59.5-hectare backwater in Pool 2 of the upper Mississippi River located between River Mile 825 and 828 near Inver Grove Heights Minnesota (Fig. 1). It is an abandoned channel lake in the floodplain of the Mississippi River whose primary source of water is the main channel of the Mississippi River. Water flows through River Lake from north to south only during periods of high river discharge (not found during the sampling periods in this study). The runoff area is small, thus most of the sediment input to the lake is from the river. The lake is shallow with a maximum depth of less than 2 m and has few emergent (Sagittaria) or submerged macrophytes. Other components of the lake are described in Hornbach et al. (1989).

To examine spatial variability in midge assemblages, three north/south transects were set up parallel to the river's flow, each with three sampling stations. To examine temporal variability, biweekly samples were taken from May 26–August 18, 1987 and May 18–August 23, 1988. Samples were taken by pushing a 7.62 cm (diameter) core at least 15 cm into the substrate. Samples were then passed through a 0.6 mm sieve and preserved in the field in equal amounts of absolute alcohol. In the laboratory, midge larvae were removed from the preserved sample under a dissecting microscope, identified, and their length was measured with the aid of a camera lucida and a digitizing pad interfaced to a microcomputer. Nolte (1990) found that alcohol preserved chironomid larvae had lengths comparable to freshly killed larvae.

Sediment accumulation rates were assessed biweekly using sediment traps. Nine PVC tubes (height:diameter ratio 10:1 = 38.1:3.81 cm), arranged in a 3 by 3 array (on a board 30 cm by 30 cm) were used at each station. The dry weight of the deposited sediment was determined by drying to constant weight at 100 °C. Ash-free dry weight was estimated by burning the sediment at 500 °C for > 24 hours, then weighing the remaining material (ash). Ash-free dry weight as a proportion of dry weight was taken as a measure of the organic matter in the deposited sediment.

All statistical analyses were conducted using SAS version 6.03 on a VAX 6300-310.