Using Burrowing Mayflies as Ecosystem Indicators in the Chequamegon Bay

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INTRODUCTION

- Burrowing mayflies (*Hexagenia* spp. and *Ephemera* spp.) make good ecosystem indicators because of their historical abundance in this region, their intolerance of pollution, and their population's ability to recover when pollution abates
- Edsall *et al.* (2004) measured burrowing mayfly biomass and density in the Chequamegon Bay in 2002
- The sediments of the Superfund site are contaminated with woody debris and chemicals from previous lumber mill operations, as well as oils and tars from a manufactured gas plant
- The Northern States Power Lakefront (Superfund) site was added to the National Priority List in 2002, making it eligible for clean-up

Burrowing mayflies in Lake Superior generally spend two years in their aquatic life stage

Burrowing mayflies use their tusk-like projections to dig U-shaped burrows into the sediment

The Superfund site is located near Kreher Park in Ashland, WI

METHODS

- Burrowing mayflies were collected with a Ponar grab at 33 Chequamegon Bay (CB) sites and 10 Superfund (SF) sites in July 2012
- Total length and head width of individual mayflies were measured (±0.1 mm) using photography and ImageJ software
- Wet and dry weights of individual mayflies were recorded (±0.1 mg)
- The relationships between total length and head width, wet weight, and dry weight were examined with linear regression
- Total length, wet weight, and dry weight of broken mayflies were predicted using the relationships between these metrics calculated from intact mayflies
- Differences in mean mayfly biomass between locations (CB & SF) and among different sediment types were tested with one-way ANOVAs
- Difference in mean mayfly biomass between years (2002 & 2012) was tested with a paired t-test

OBJECTIVES

- Compare Chequamegon Bay mayfly biomass temporally between 2002 and 2012 to determine if there have been any major changes to the population
- Compare mayfly biomass spatially between the Chequamegon Bay and the Superfund site to determine if there is evidence of degraded habitat for sensitive mayfly species at the Superfund site

RESULTS

- Log head width can be used to accurately predict log total length ($p<0.01$, $R^2=0.87$; Figure 1)
- Log total length can be used to accurately predict log wet weight ($p<0.01$, $R^2=0.95$) and log dry weight ($p<0.01$, $R^2=0.92$)
- Mean log biomass of mayflies was significantly higher in the CB sites than in the SF sites ($p=0.01$; Figure 2)
- Mean log biomass of mayflies does not appear to have changed significantly from 2002 to 2012 ($p=0.08$)
- The fine sand substrate (FS) had statistically lower mean log biomass than clay (C; $p<0.01$), clay with sand (CWS; $p=0.04$), and sand with clay (SWC; $p=0.02$) substrates (Figure 3). Not enough mayflies were sampled in woody debris and coarse sand substrates to allow statistical comparisons

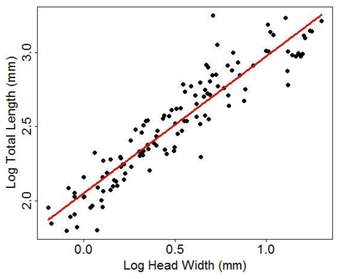

Figure 1. Log total length plotted against log head width for individual mayflies

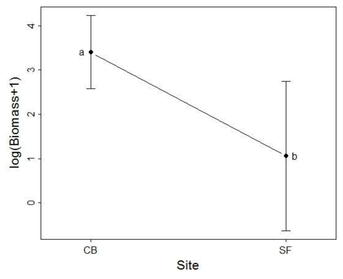

Figure 2. Mayfly log(biomass+1) difference between sites (CB=Chequamegon Bay, SF=Superfund)

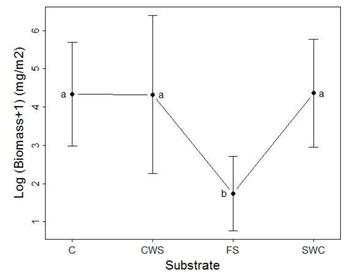

Figure 3. Mean mayfly log(biomass+1) in different substrate types

CONCLUSIONS

- Burrowing mayfly biomass in the Chequamegon Bay has not changed in the past ten years
- The Superfund site is not good habitat for burrowing mayflies, although it cannot be determined from this analysis whether this is a result of contaminants in the sediments or an abundance of unsuitable substrate types (woody debris)