Search for the cause for the decline of native amphipod *Diporeia* spp. in the Great Lakes by observing Finger Lakes populations

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Outline:

1) Intro to major players (benthic invertebrates)
2) Great Lakes trends
3) Why the Finger Lakes are a good site comparison
4) Summer 2006 sampling
5) Future Plans
Benthic Amphipods

deep *Diporeia* spp.  
shallow *Gammarus fasciatus*

Size range 2-10 mm

Shallow amphipods also include *Hyalella* and invasive *Echinogammarus*

-*Diporeia* (formerly *Pontoporeia*) "glacial relict" species
  - requires cool temperatures (5-10°C) below thermocline
  - dominant organism of deepwater environments
  - burrows in soft sediments and ingests settled diatoms
  - rich in lipids (30 %) and choice prey item for fish

Food Web Importance: links phytoplankton and fish
Benthic invaders

*Dreissena polymorpha* (zebra mussel)
*Dreissena bugensis* (quagga mussel)

- both introduced by shipping to Great Lakes in 1990s from E Europe
- quickly expanded to Mississippi River and Hudson River
- very efficient filter feeder
- Quagga mussels more tolerant of low temperatures, soft substrates, low food concentrations
Dreissena bugensis (quagga mussels)
Pattern repeated in Lakes Erie, Michigan, Huron but not Superior
Hypotheses for decline in Great Lakes
- food limitation
- toxicity
Timing is problematic for linking dreissenids at different sites
Dermott (2005) observed *Diporeia* coexisting with dreissenid mussels in Cayuga and Seneca Lakes.

Roger Green 1965 thesis *Diporeia* in Cayuga Lake

Six deep lakes that are potential *Diporeia* habitat differ in

- productivity
- colonization history by quagga and zebra mussels
Question: Why does Diporeia coexist with dreissenids in the Finger Lakes?

Ideas

1) abundant diatom food
2) addition of leaf litter in sediments (Ron)
3) high turbidity at sediment-water interface (John)
4) genetically different group in Finger Lakes
5) pathogen restricted to Great Lakes
Initial Surveys, Summer 2006

Study Lakes:
- Cayuga
  130 m
- Owasco
  50 m
- Skaneateles
  80 m
Benthic Sampling

- Petite Ponar (6’’x 6’’)
  - 500 µm seive
  - Preserved in ethanol
• Water Column Profiles:
  - SBE-25 (Seabird Electronics)
    • temperature
    • turbidity
    • dissolved oxygen
    • chlorophyll a
similar temperature profiles in mid-July
• Chlorophyll $a$ as index of lake productivity:

Vertical

Integrated

![Chlorophyll $a$ vs Depth and Integrated Chlorophyll $a$ for Cayuga, Owasco, and Skaneateles lakes]
2006 Upstate Freshwater Institute Buoy Data (www.ourlake.org)

Skaneateles Lake

Owasco Lake

**temperature**

chlorophyll a (note larger scale for Owasco)
2005 Hobart & William Smith & LOLA Data

Surface Chl a (ug/l)

Secchi Depth (m)
zebra mussels in shallow habitats of all three Finger Lakes
Quagga mussels in Cayuga (like Seneca) expanding to deep habitats.
Diporeia abundant in deep Cayuga Lake (similar to 1964)
Conclusions from summer 2006 sampling:

1) Confirm’s Dermott (2005)’s observation of *Diporeia* successfully coexisting with quagga mussels in Cayuga Lake (however, quaggas not as abundant at depth as Lake Ontario).

2) Abundances of *Diporeia* in Owasco Lake (quaggas absent) are similar to Cayuga Lake (to 50 m depth).

3) Abundances of *Diporeia* significantly lower in low productivity Skaneateles Lake (quaggas absent).

Overall, lake productivity is more important to *Diporeia* abundance than dreissenid mussel abundance in the three Finger Lakes.
Size distribution of *Diporeia*

### Cayuga Lake, 1964

- **Oct 1963**
- **Nov 1963**
- **Dec 1963**
- **Jan 1964**
- **Feb 1964**
- **Mar 1964**
- **Apr 1964**
- **May 1964**
- **Jun 1964**
- **Jul 1964**
- **Aug 1964**
- **Sep 1964**

### Owasco Lake

### Skaneateles

### Finger Lakes, July 2006

Roger Green
Future Plans

- analysis of field samples
  - fatty acids (Mark Teece, SUNY-ESF)
  - stable isotopes
  - genetics (Jonathan Witt, U. of Waterloo)

- additional field collection
  - phytoplankton
  - sediment trap flux
  - sediment composition, organic content
  - fish diet

- experiments at CBFS facility
  feeding trials and assess competition
Future of *Diporeia*?

Food ?

Competitors ?

Genetics ?

Predators ?
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