Presented at

Great Rivers Reference Condition Workshop
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Sponsored by
The U.S. Environmental Protection Agency and The Council of State Governments
Great Rivers EMAP Zooplankton Analysis Team

- Upper Mississippi River
  - John Chick & Alex Levchuk
  - Illinois Natural History Survey

- Missouri River
  - John Havel & Kim Medley
  - Missouri State University

- Ohio River
  - Jeff Jack & Lab
  - University of Louisville
Why Might Zooplankton be a Useful Indicator Group for Great Rivers?

- Ecological importance
Detritus

DOM/POM

P, N
DOM/POM
Detritus

Algae

Fishes

Predatory Macroinvertebrates

Rotifers

Flagellates

Crustacean Zooplankton

Ciliates

Bacteria

Adapted from Porter 1995
Filter-Feeding Fishes

*Polyodon spathula* (Paddlefish)

*Ictiobus cyprinellus* (Bigmouth Buffalo)

*Dorosoma cepedianum* (Gizzard Shad)

*Polyodon spathula* (Paddlefish)
Why Might Zooplankton be a Useful Indicator Group for Great Rivers?

- Ecological importance
- Rapid turnover rate
- Mobile planktonic community/integrate conditions spatially
Why Might Zooplankton be a Useful Indicator Group for Great Rivers?

- Ecological importance
- Rapid turnover rate
- Mobile planktonic community/integrate conditions spatially
- Diverse, minimal zoogeographic issues
- Proven useful indicators of environmental degradation in lakes and wetlands
Processing Update
What was collected?

Zooplankton - two groups
• Macrozooplankton – Cladocerans, adult + juvenile Copepods
• Microzooplankton – Rotifers, Copepod nauplii

Main channel sampling: depth and spatially integrated

At Each Point:
20 L for Macro
2 L for Micro

Total Sample / Site:
Macro – 180 L filtered through 63 μm mesh
Micro – 18 L filtered through 20 μm mesh
Processing Update

What have we been doing?

• 3 Workshops Completed
  - Work out identification issues
  - Discuss statistical analyses

• QA/QC
  - Upper Miss and Missouri 2004 Complete
  - Issues with Ohio River being worked out

• 2004 ID and Counts
  - Upper Miss; complete, some macro samples will be recounted
  - Missouri River – complete
  - Ohio River – will be recounted to correct QA/QC issues

• 2005 samples on going
Fortunate Accident

• Original Processing Scheme
  - Rotifers and copepod nauplii counted only in microzooplankton samples
  - Crustacean zooplankton counted only in macrozooplankton samples

• 2004 Samples
  - Rotifers and crustacean zooplankton were “accidentally” counted in all samples

• Allows for a test to see if the two sampling methods are really necessary
Expected Regression Plot
Assuming Both Methods Are Equivalent

Fake Data

Macrozooplankton L\(^{-1}\)

Microzooplankton L\(^{-1}\)
Keratella L$^{-1}$

Mean = 373 L$^{-1}$

Mean = 0.6 L$^{-1}$
Polyarthra L\(^{-1}\)

Mean = 154 L\(^{-1}\)

Mean = 1.1 L\(^{-1}\)
Tricocerca L$^{-1}$

Macrozooplankton samples

Mean = 0.1 L$^{-1}$

Microzooplankton Samples

Mean = 375 L$^{-1}$
Species Detection 2004 Samples Missouri River

- 23 Cladoceran species detected using incorrect counting method (i.e., counting rotifers and nauplii in macrozooplankton samples)

- 39 Cladoceran species detected using correct counting method (i.e., only counting cladocerans and copepods in macrozooplankton samples)

- An increase of 16 species!
In Summary

• Original methods strongly supported

• Use of a 63 μm mesh underestimates the abundance of rotifers by two to three orders of magnitude

• The small volume sampled through the 20 μm mesh is not effective for sampling cladocerans and copepods

• Most studies of zooplankton likely substantially underestimate the abundance of Rotifers

• The Great Rivers EMAP is one of a minority of studies capable of accurately describing zooplankton community structure
Other Cool Stuff

• Large-scale spatial patterns
2004 Microzooplankton-Missouri River

Density (individuals L⁻¹)

River mile

rotifers
nauplii

River mile

0 1770 1583 1307 718 609 474 403 166 0
Other Cool Stuff

- Large-scale spatial patterns
- Correlations with land use patterns
Elevation-63 µm

Stress: 0.11
Distance from reservoir - 63 µm
Channel constraint-63 μm
ANOSIM: Global R = 0.548, p = 0.010
Where Are We Going?
Next Steps in Indicator Development

• Links with chl-a and biogeochemical indicators

• Correlations with other EMAP indicators

• Correlations with channel complexity
Pool 8
Water depth (meters)

No data
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
10.0
11.0
12.0