Presented at

Great Rivers Reference Condition Workshop

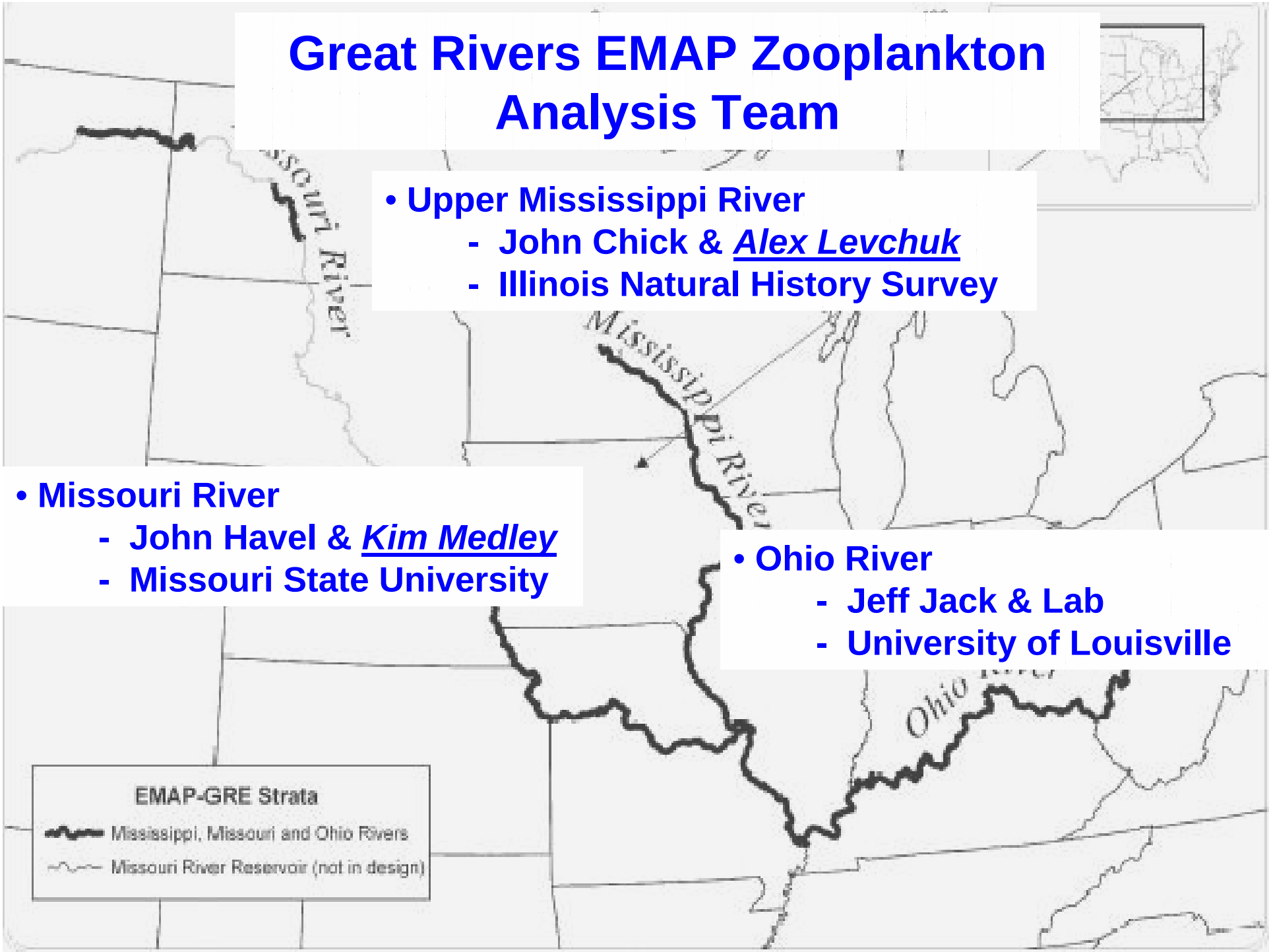
January 10-11, Cincinnati, OH

Sponsored by

The U.S. Environmental Protection Agency and The Council of State Governments

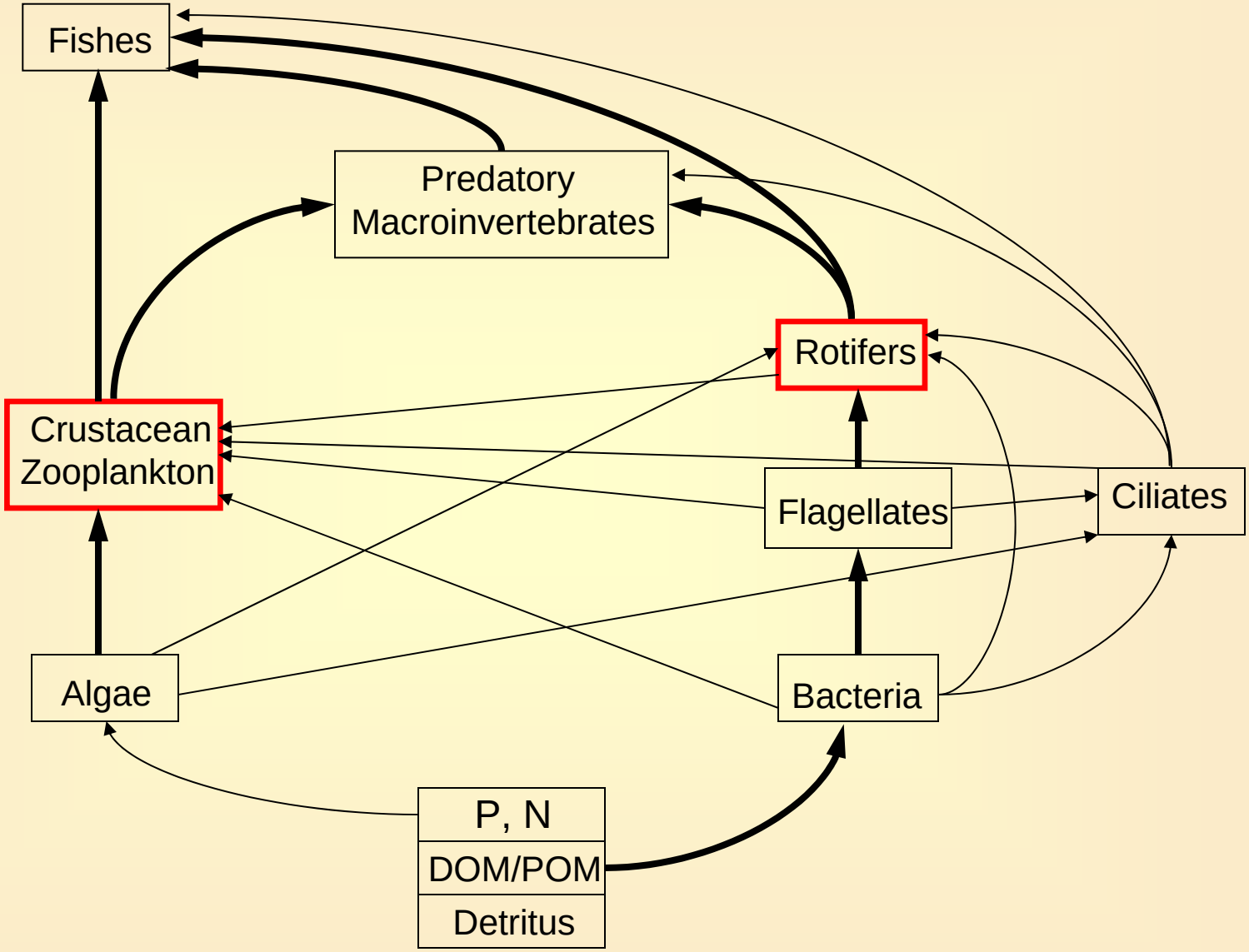
Great Rivers EMAP Zooplankton Analysis Team

- **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**



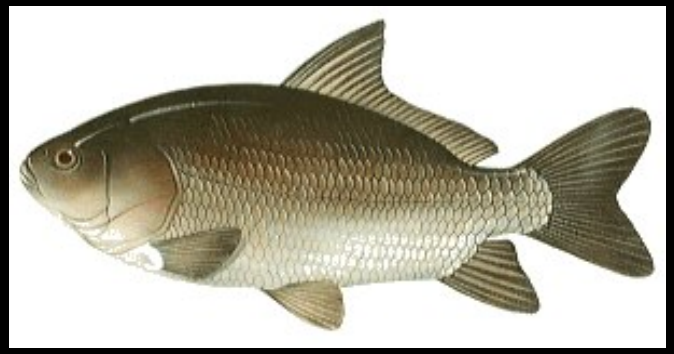
Why Might Zooplankton be a Useful Indicator Group for Great Rivers?

- Ecological importance

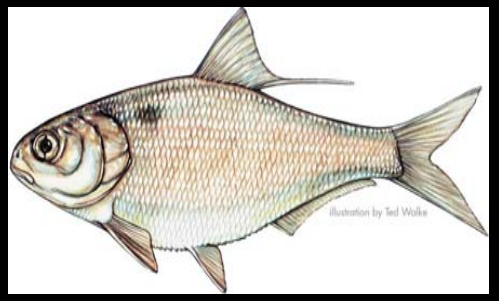


Adapted from Porter 1995

Filter-Feeding Fishes



Ictiobus cyprinellus **(Bigmouth Buffalo)**



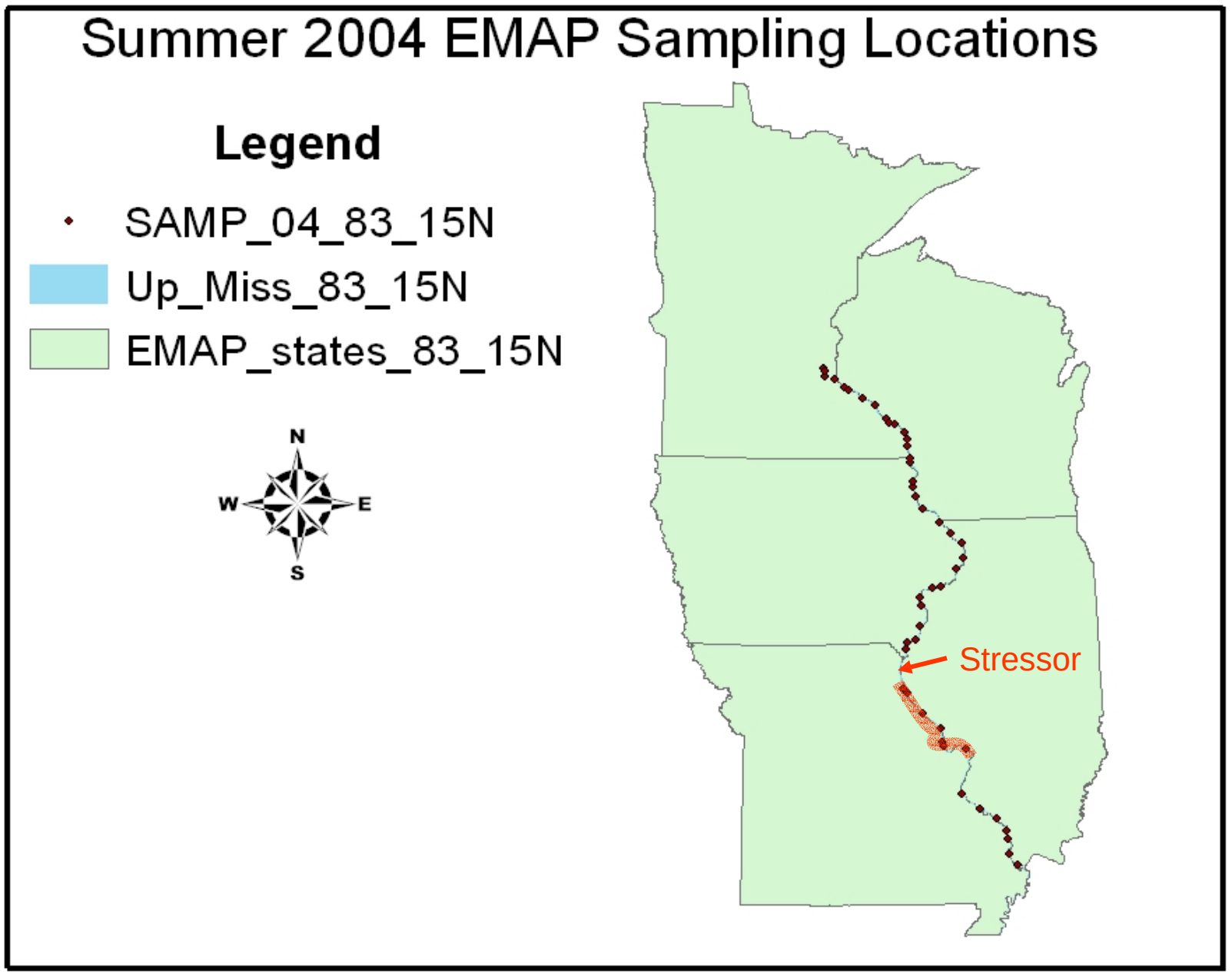
Dorosoma cepedianum **(Gizzard Shad)**

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

Summer 2004 EMAP Sampling Locations



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

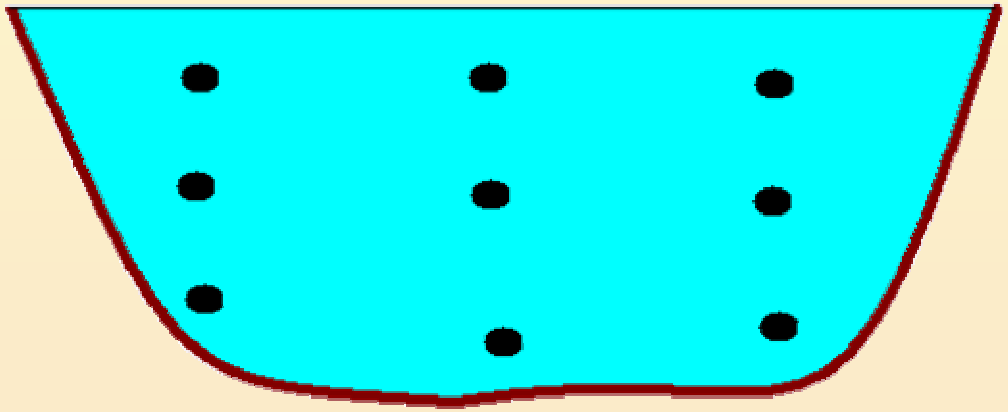
Processing Update

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

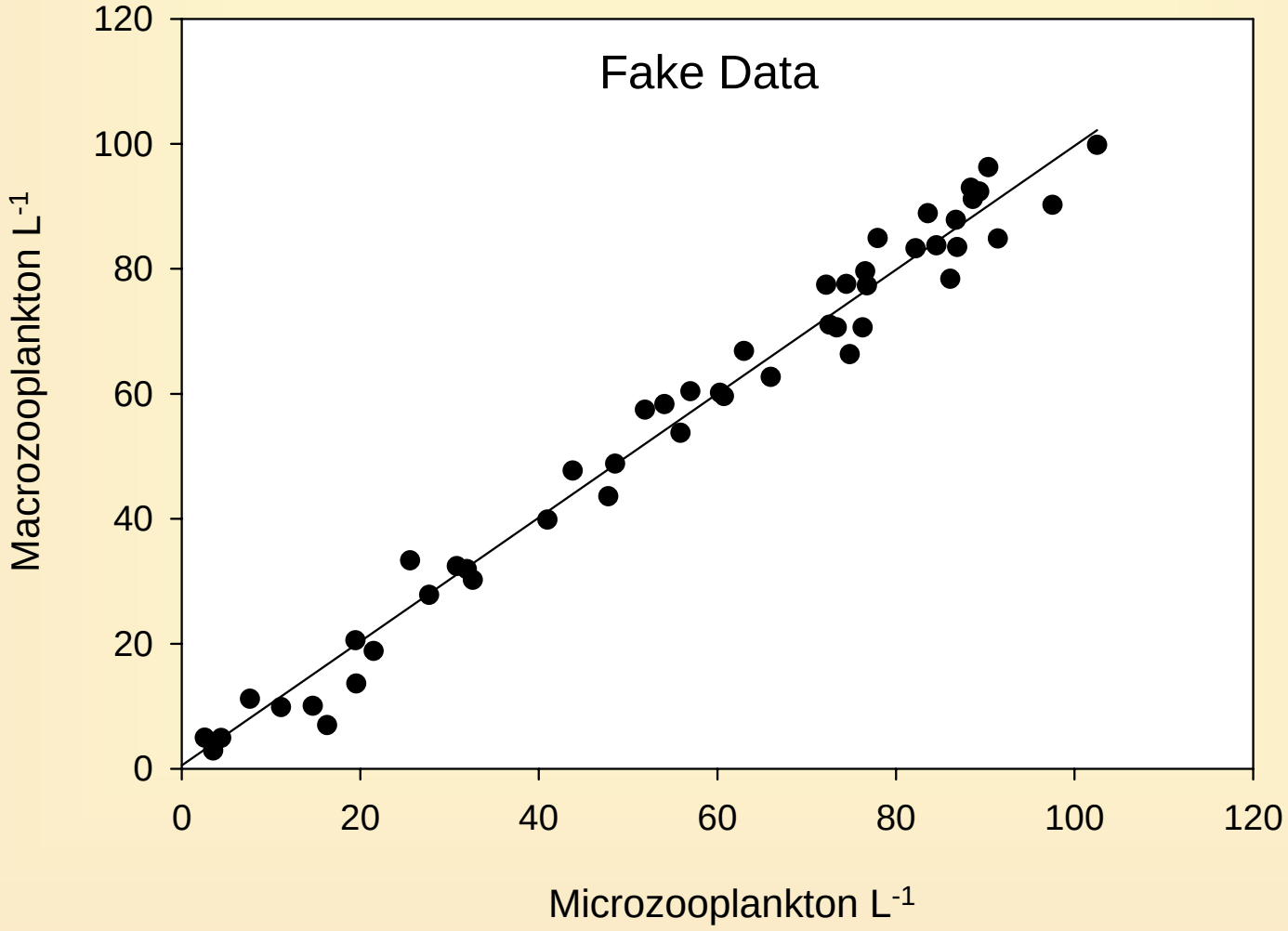
Fortunate Accident

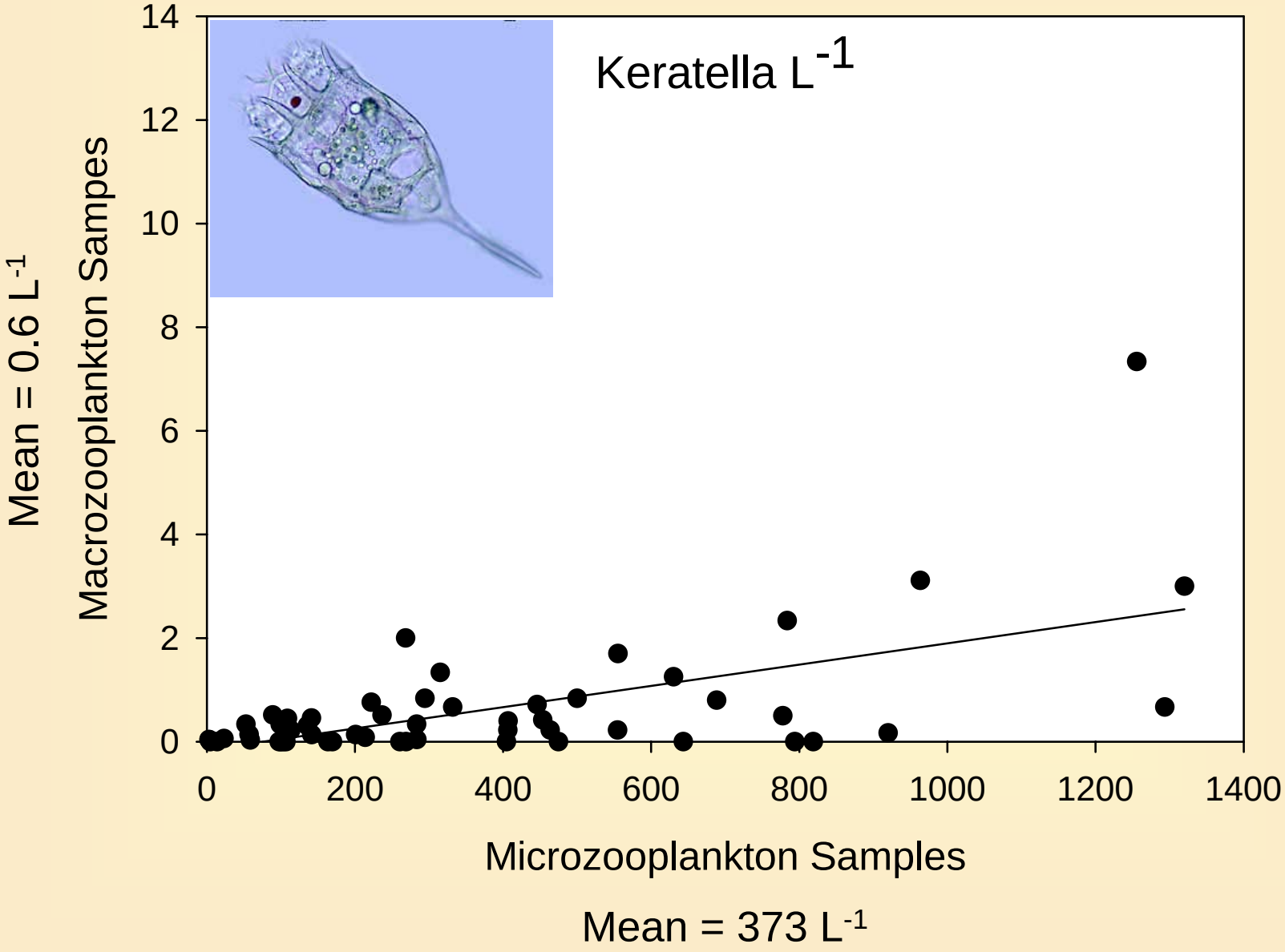
- Original Processing Scheme
  - Rotifers and copepod nauplii counted only in microzooplankton samples
  -Crustacean zooplankton counted only in macrozooplankton samples

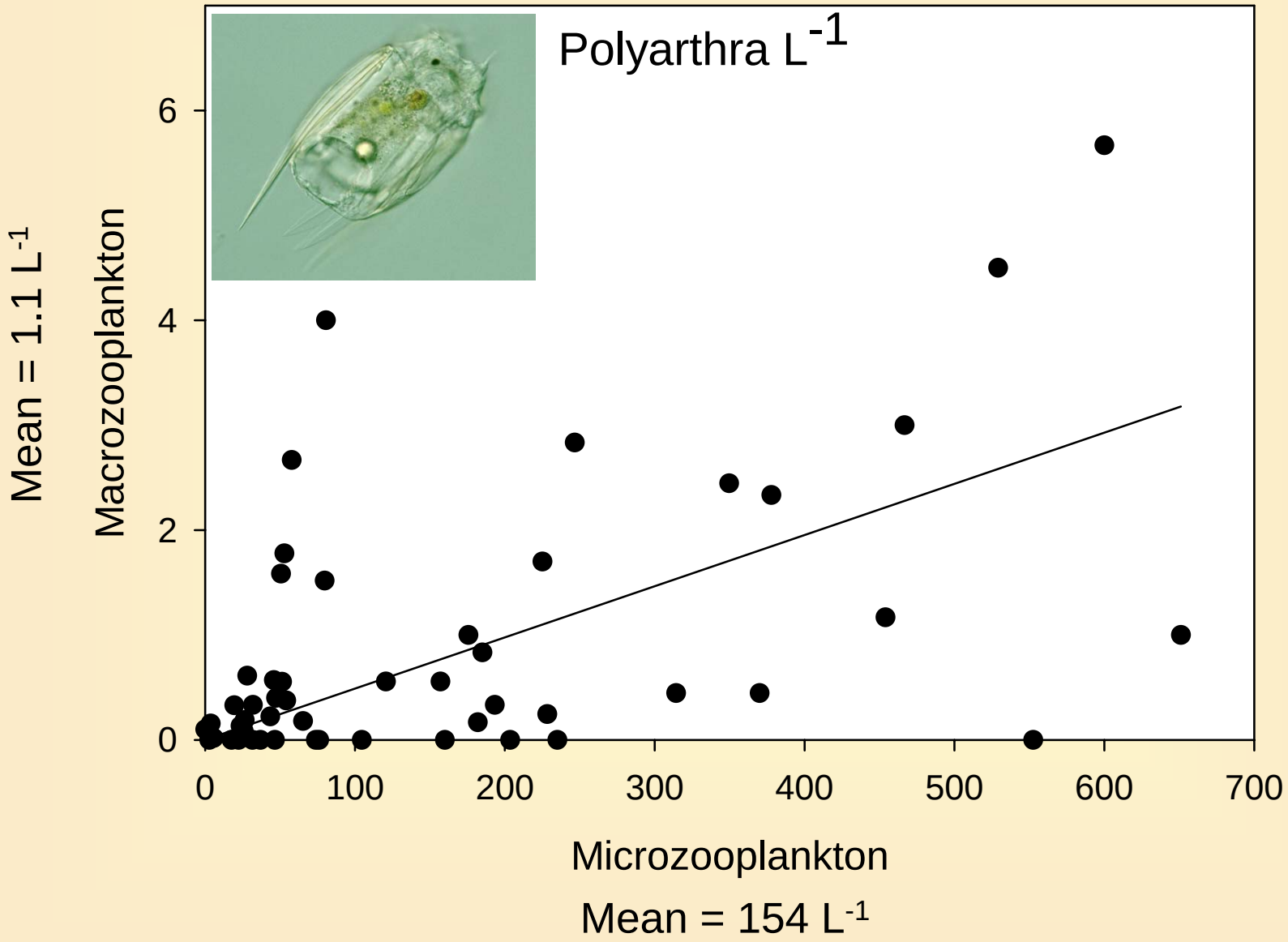
- 2004 Samples
  -Rotifers and crustacean zooplankton were “accidentally” counted in all samples

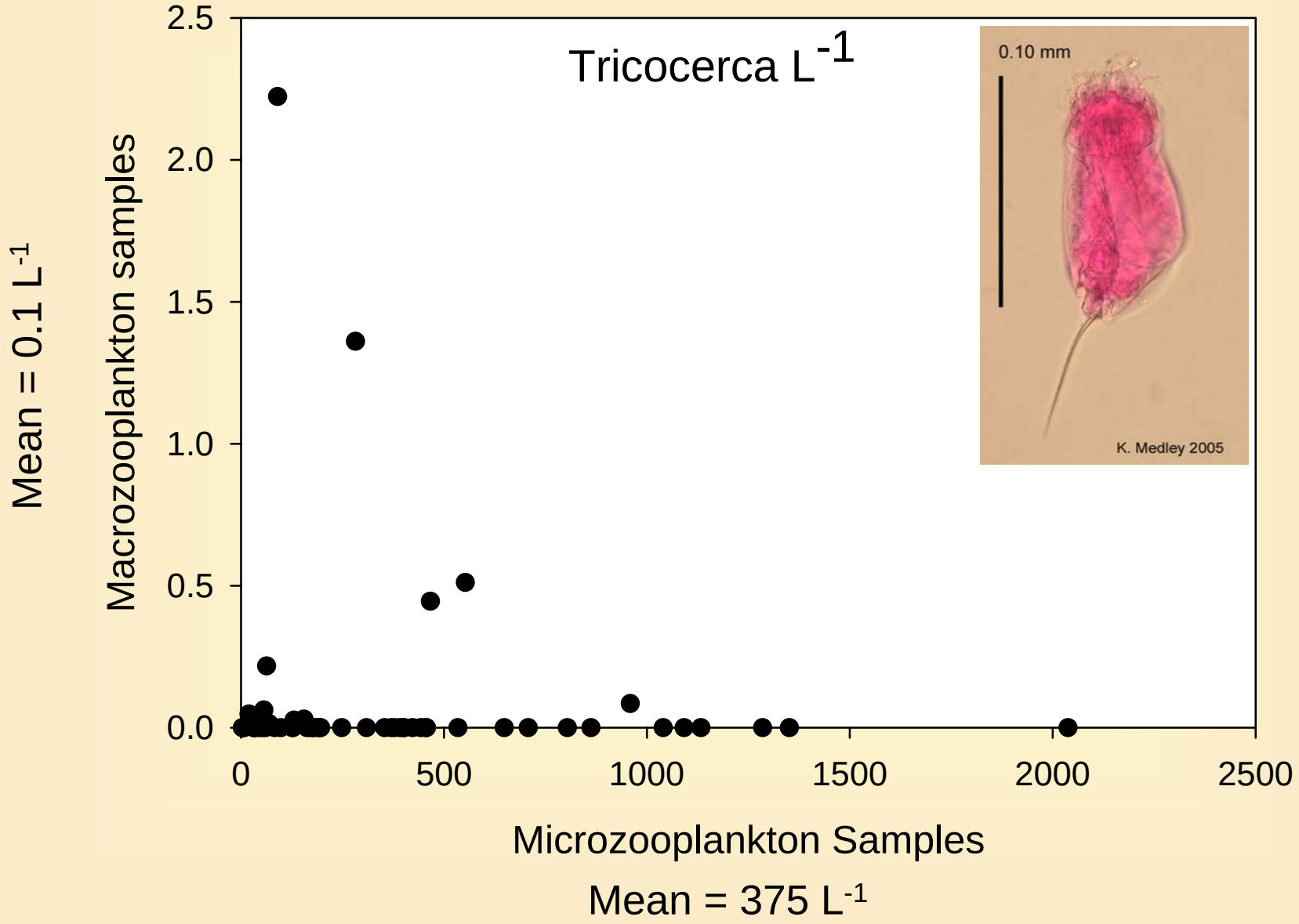
- Allows for a test to see if the two sampling methods are really necessary

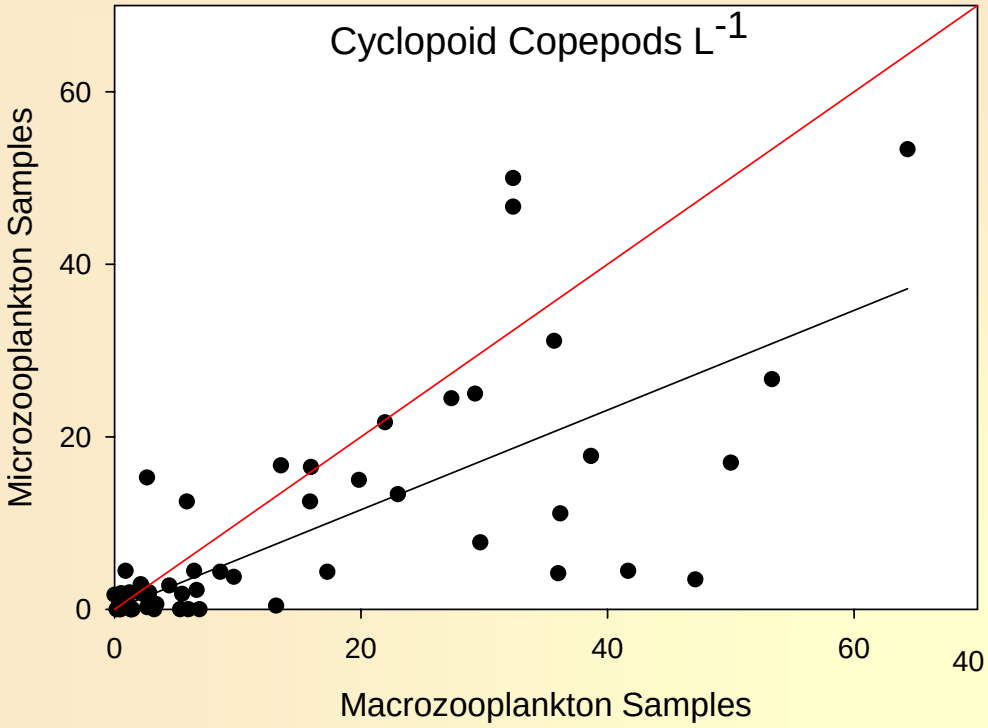
Expected Regression Plot
Assuming Both Methods Are Equivalent

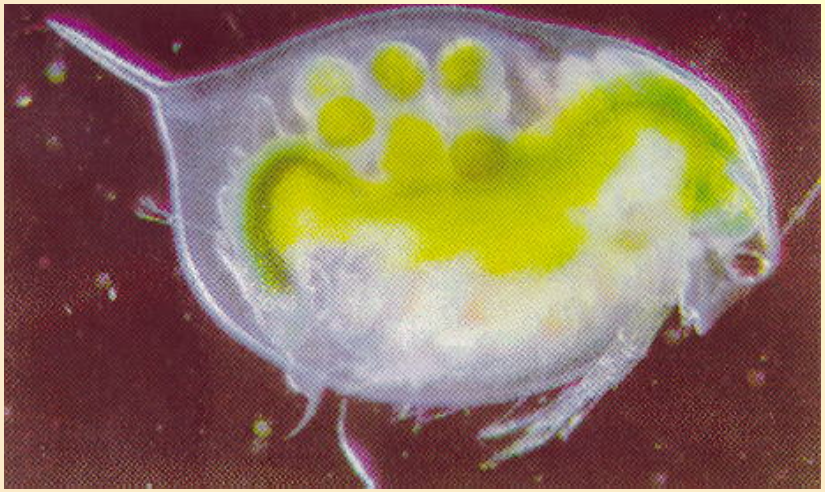


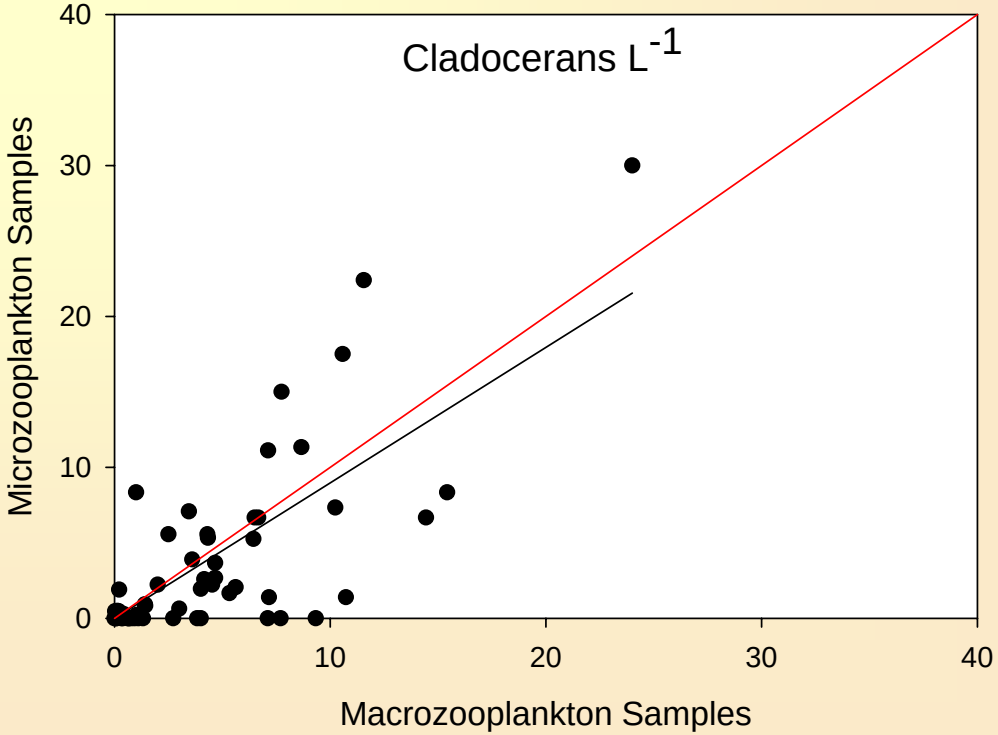

Keratella L-1
Mean = 0.6 L-1
Macrozooplankton Sampes
14
12
10
8
6
4
2
0
0
200
400
600
800
1000
1200
1400
Microzooplankton Samples
Mean = 373 L-1


Polyarthra L-1
Mean = 1.1 L-1
Macrozooplankton
0
2
4
6
0
100
200
300
400
500
600
700
Microzooplankton
Mean = 154 L-1


Tricocerca L-1
0.10 mm
K. Medley 2005
Macrozooplankton samples
Mean = 0.1 L-1
2.5
2.0
1.5
1.0
0.5
0.0
0
500
1000
1500
2000
2500
Microzooplankton Samples
Mean = 375 L-1


Cyclopoid Copepods L-1
Microzooplankton Samples
Macrozooplankton Samples
0
20
40
60




Cladocerans L-1
Microzooplankton Samples
Macrozooplankton Samples
0
10
20
30
40

Species Detection 2004 Samples Missouri River

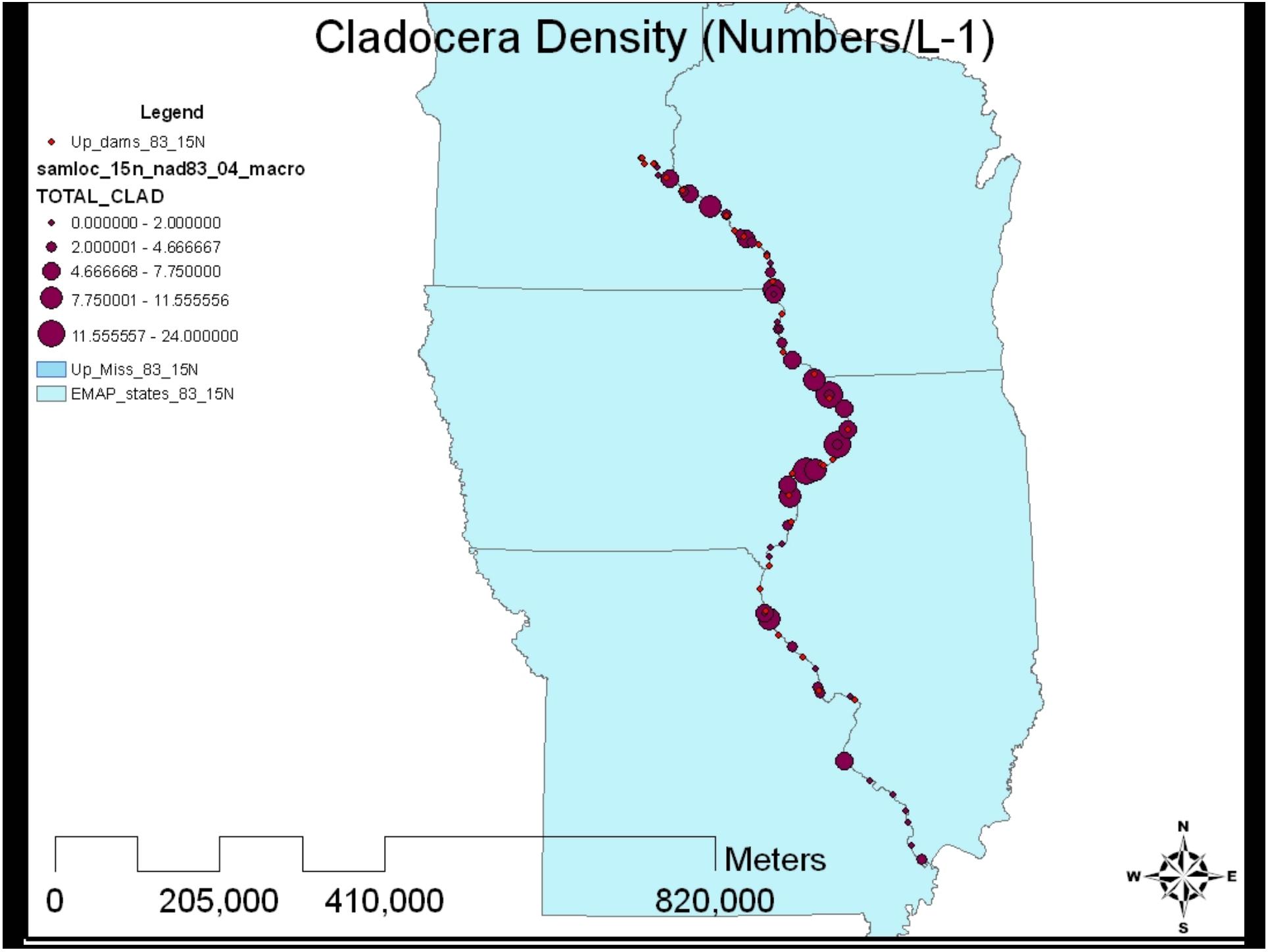
- 23 Cladoceran species detected using incorrect counting method (i.e., counting rotifers and nauplii in macrozooplankton samples
- 39 Cladoceran species detected using correct counting method (i.e., only counting cladocerans and copepods in macrozooplankton samples
- An increase of 16 species!

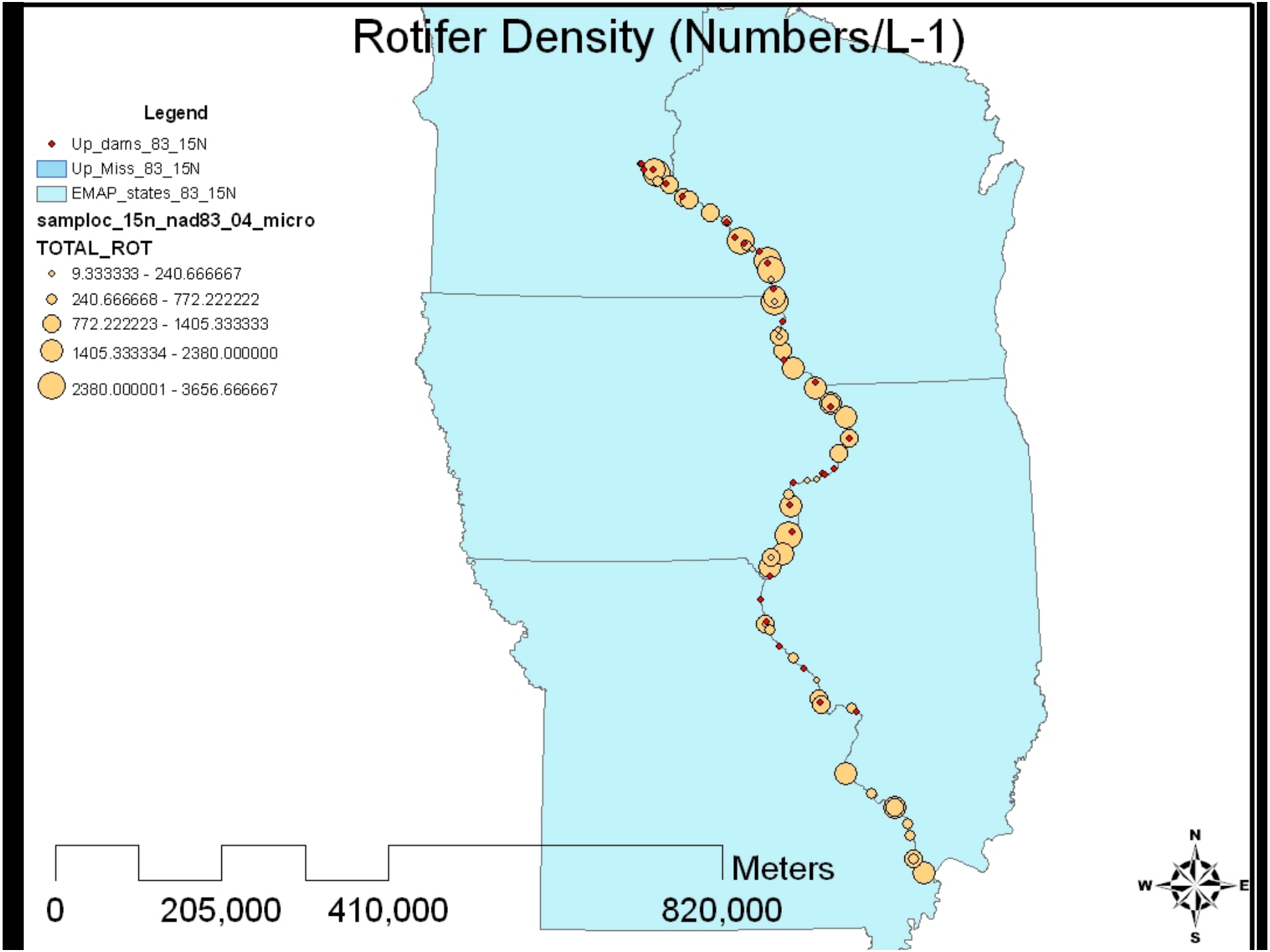
In Summary

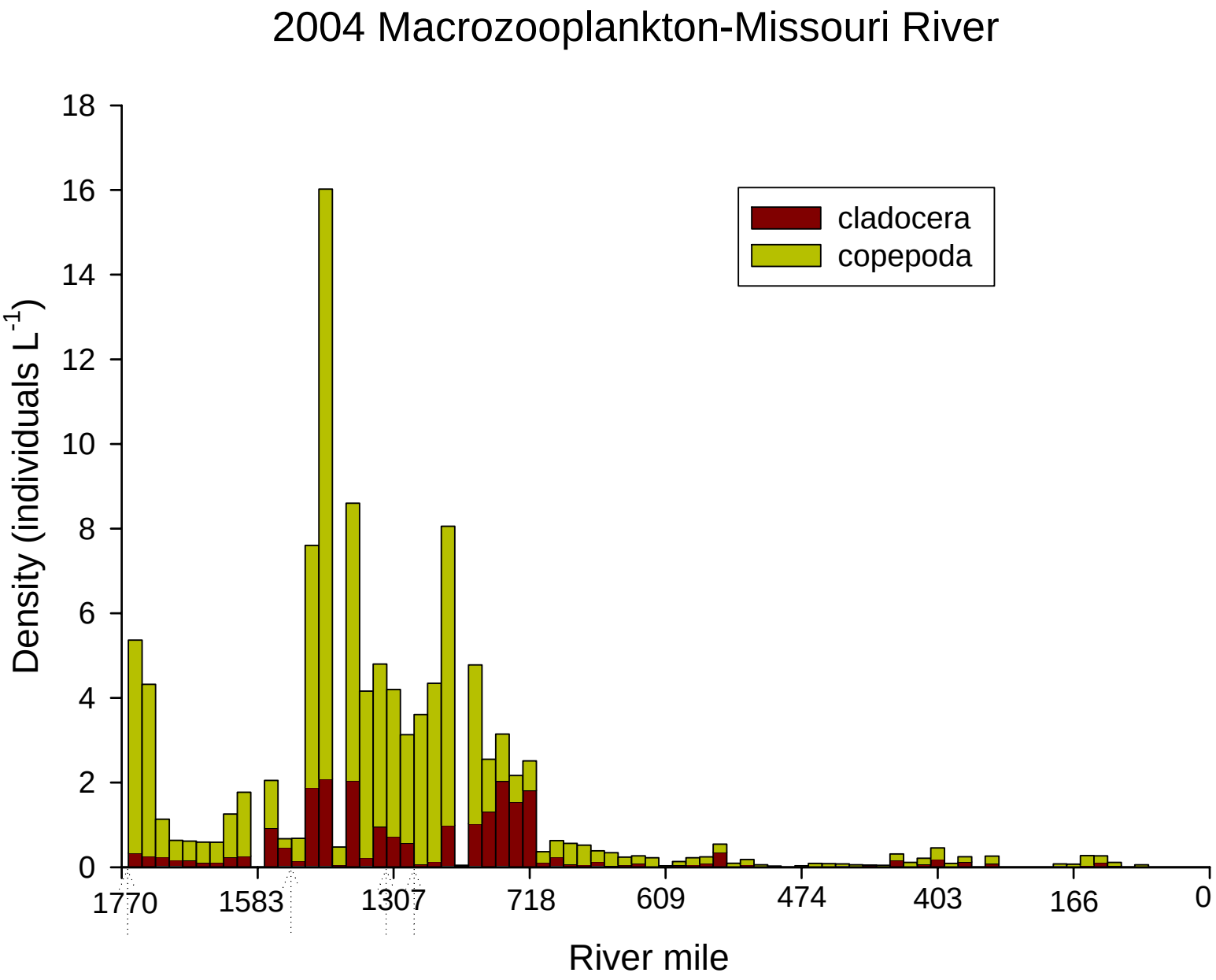
- Original methods strongly supported
- Use of a 63 µm mesh underestimates the abundance of rotifers by two to three orders of magnitude
- The small volume sampled through the 20 µm mesh is not effective for sampling cladocerans and copepods
- Most studies of zooplankton likely substantially underestimate the abundance of Rotifers
- The Great Rivers EMAP is one of a minority of studies capable of accurately describing zooplankton community structure

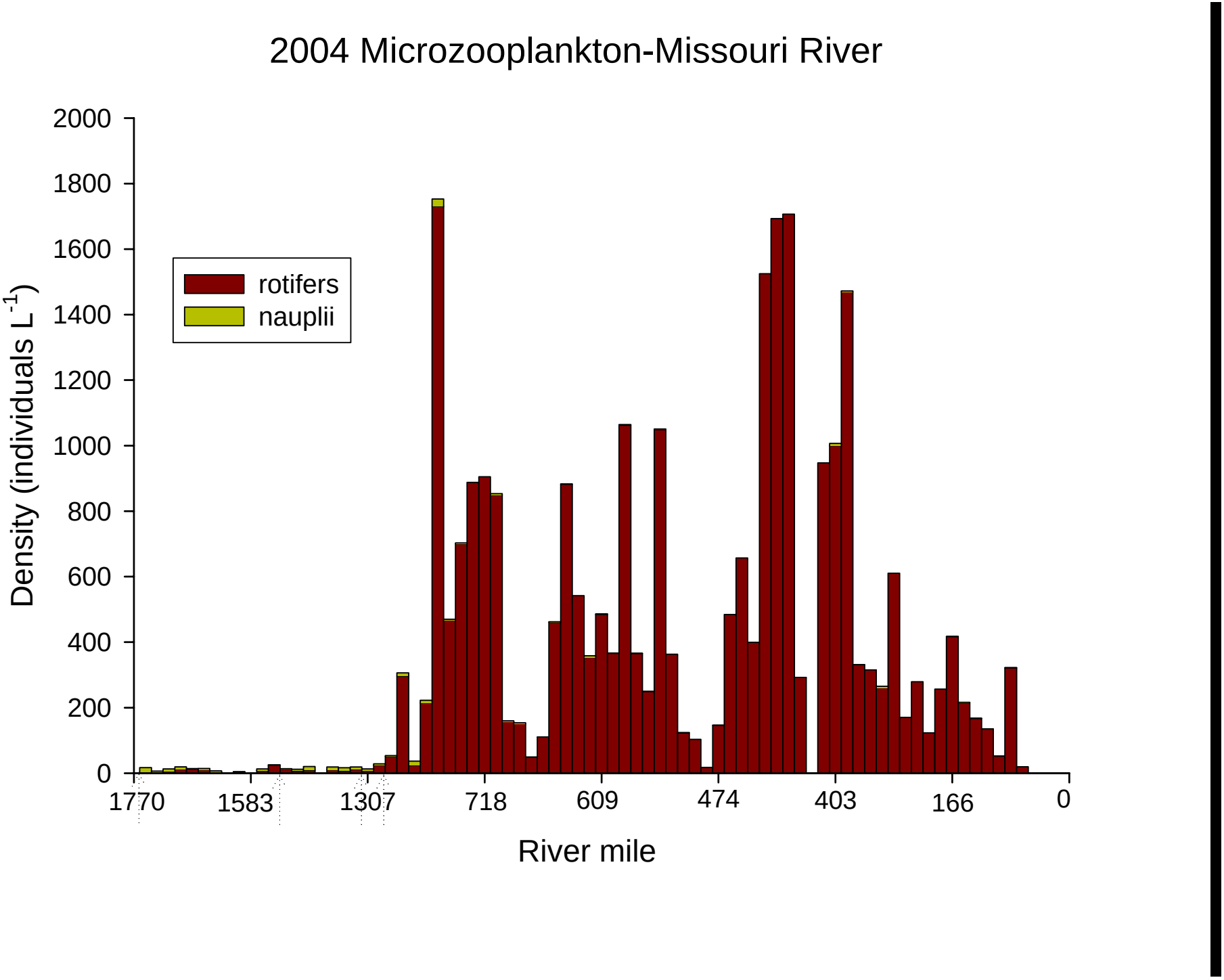
Other Cool Stuff

- Large-scale spatial patterns


Cladocera Density (Numbers/L-1)
Legend
Up_dams_83_15N
samloc_15n_nad83_04_macro
TOTAL_CLAD
0.000000 - 2.000000
2.000001 - 4.666667
4.666668 - 7.750000
7.750001 - 11.555556
11.555557 - 24.000000
Up_Miss_83_15N
EMAP_states_83_15N
0
205,000
410,000
820,000
Meters
N
W
E
S

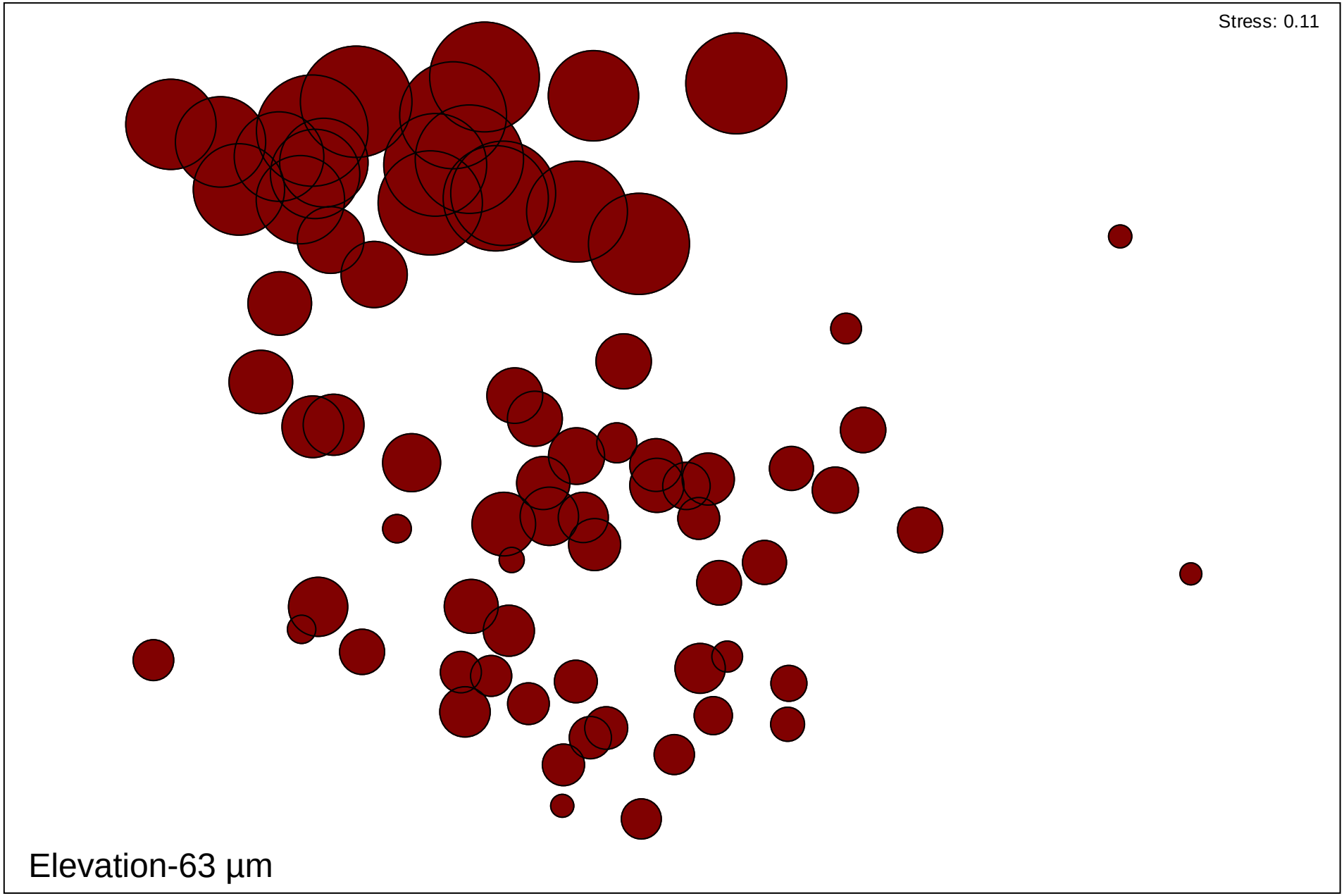

Rotifer Density (Numbers/L-1)
Legend
Up_dams_83_15N
Up_Miss_83_15N
EMAP_states_83_15N
samploc_15n_nad83_04_micro
TOTAL_ROT
9.333333 - 240.666667
240.666668 - 772.222222
772.222223 - 1405.333333
1405.333334 - 2380.000000
2380.000001 - 3656.666667
0
205,000
410,000
820,000
Meters
N
W
E
S

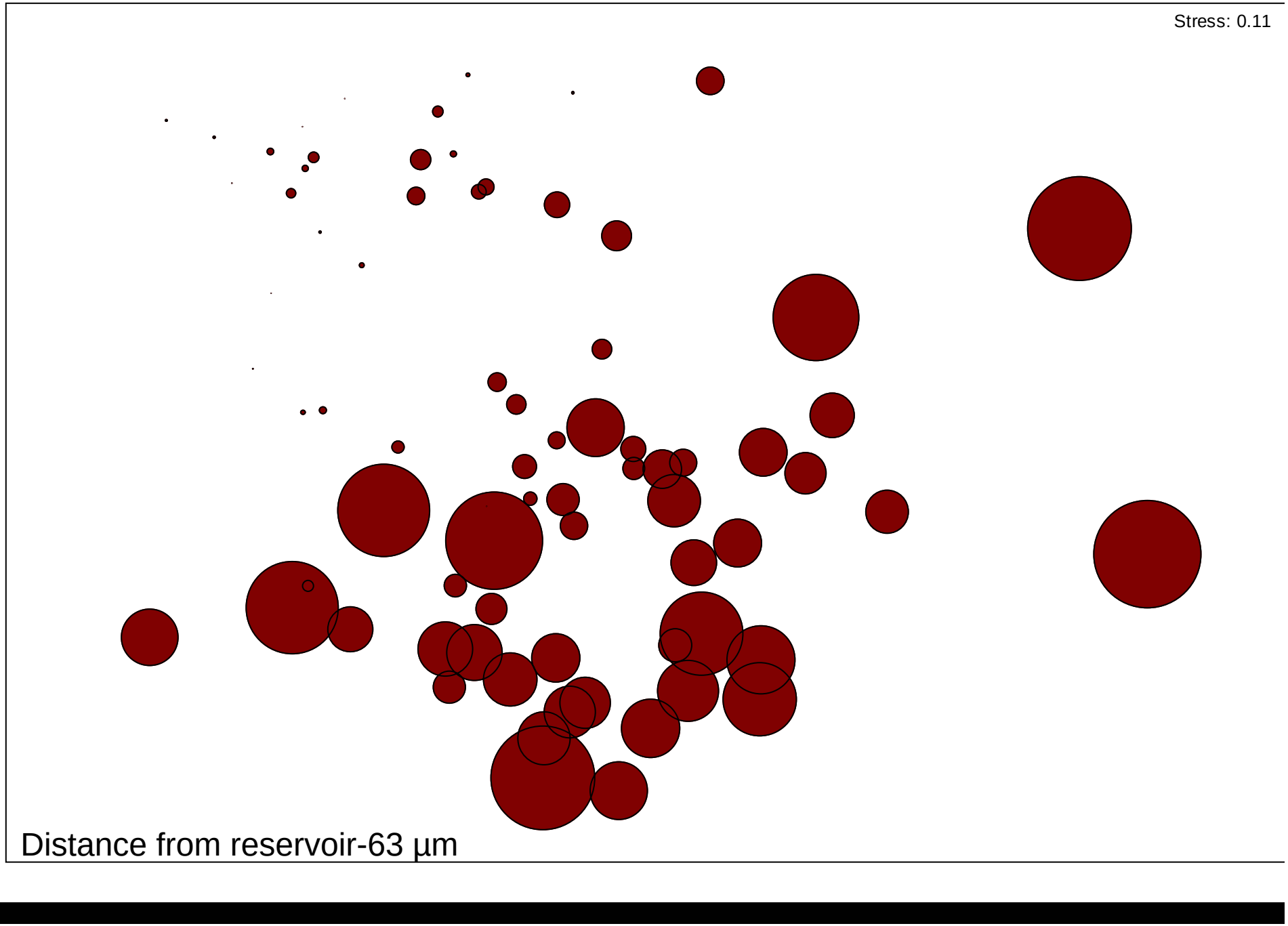

2004 Macrozooplankton-Missouri River
Density (individuals L-1)
18
16
14
12
10
8
6
4
2
0
cladocera
copepoda
1770
1583
1307
718
609
474
403
166
0
River mile

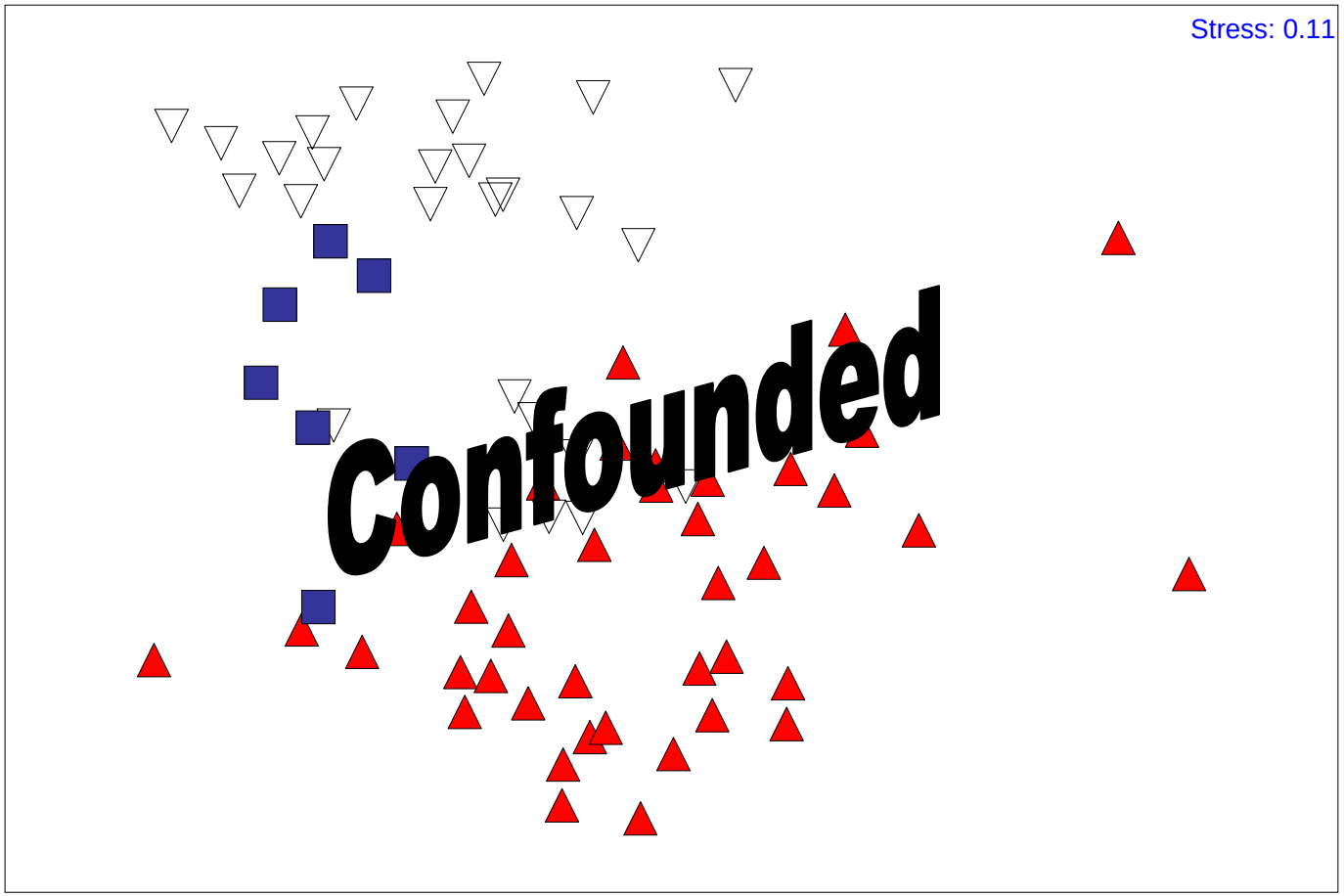

2004 Microzooplankton-Missouri River
Density (individuals L-1)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
rotifers
nauplii
1770
1583
1307
718
609
474
403
166
0
River mile

Other Cool Stuff

- Large-scale spatial patterns
- Correlations with land use patterns


Stress: 0.11
Elevation-63 µm


Stress: 0.11
Distance from reservoir-63 µm

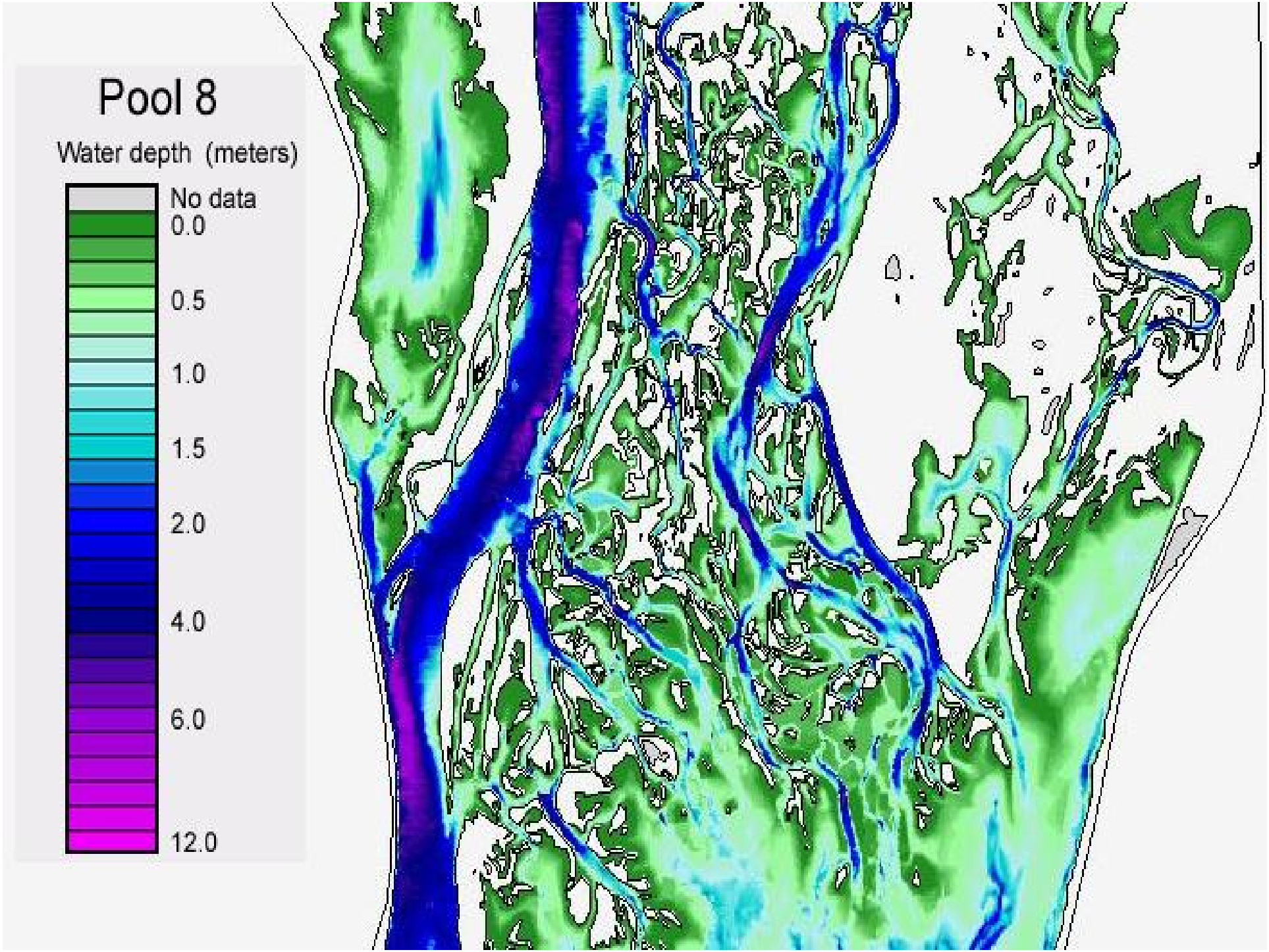


Channel constraint-63 µm
ANOSIM: Global R = 0.548, p = 0.010

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
4.0
6.0
12.0