Turbidity-Induced Changes in Prey Selection by Largemouth Bass

Daniel E. Shoup
W. Drew Lane
Oklahoma State University
Department of Natural Resource Ecology & Management

David H. Wahl
Illinois Natural History Survey
Center for Aquatic Ecology
Kaskaskia Biological Station

ILLINOIS NATURAL HISTORY SURVEY

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Introduction

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- Effects of turbidity on predators are not well understood.
  - Effects of turbidity on planktivores/insectivores.
    - ★ Foraging return—typically decrease (but species specific).
    - ★ Possibly change anti-predation behavior.

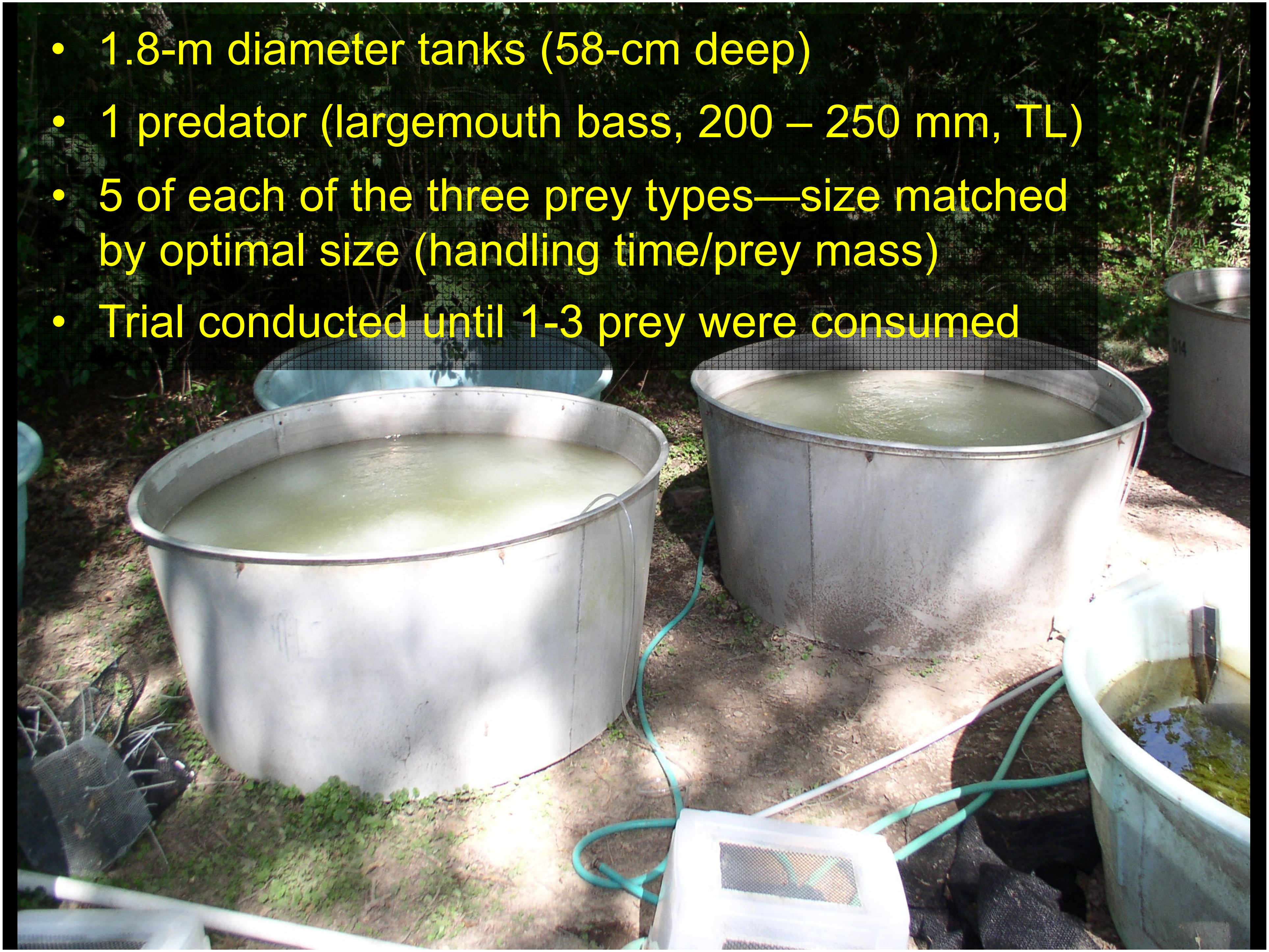
Introduction

- Effects of turbidity on piscivores studied very little:
  - Contrast Degradation Theory
    - Turbidity effects most pronounced for predators eating large prey.
  - Quicker to strike at prey (less discriminating).
  - Become less active.
- Do largemouth bass select different prey types at different turbidities?

Methods

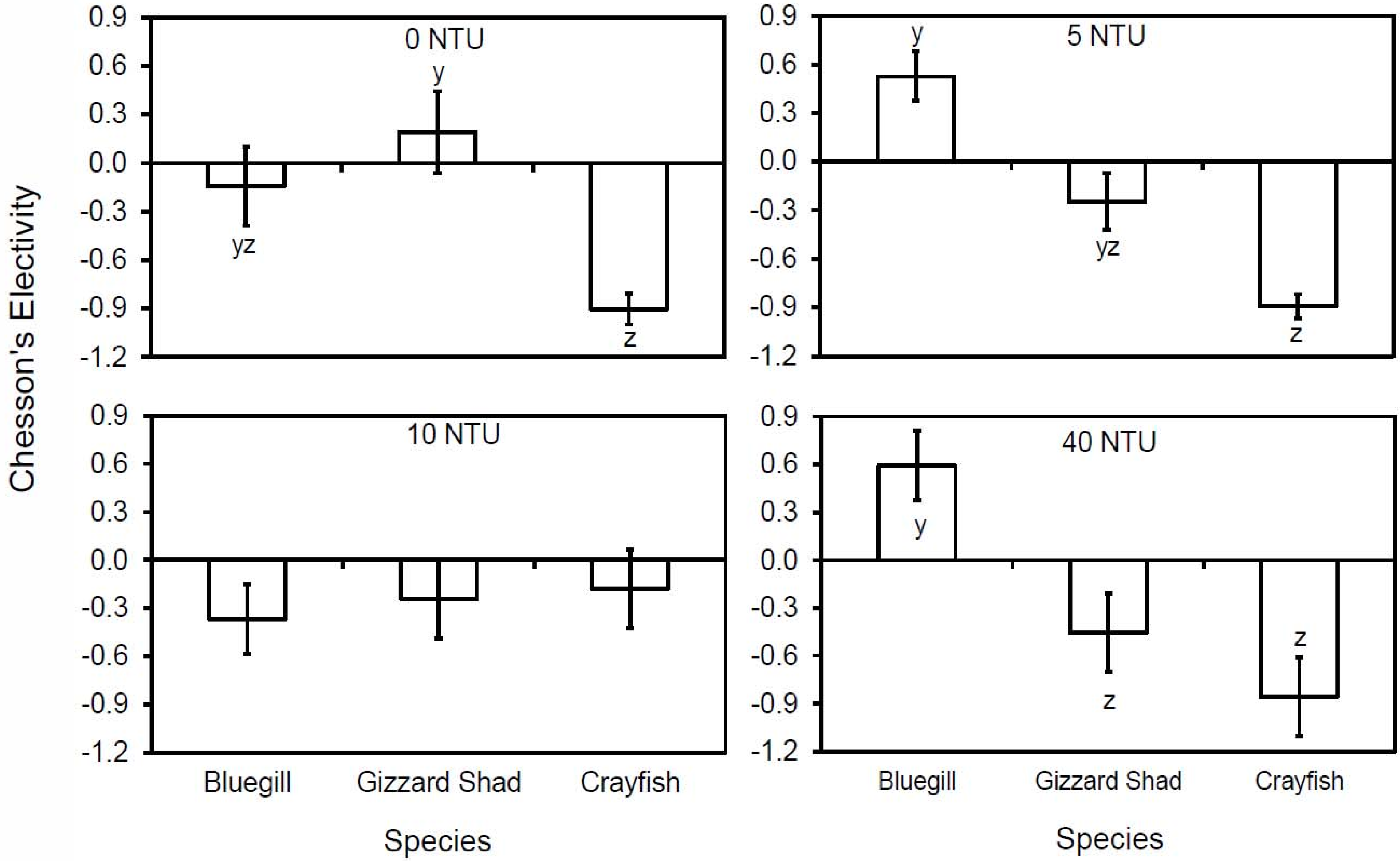
- 3 prey types:
  - Bluegill (*Lepomis macrochirus)*
  - Gizzard shad (*Dorosoma cepedianum*)
  - Northern crayfish (*Orconectes virilis*)

- 4 turbidity levels:
  - 0 NTU
  - 5 NTU (49 cm Secchi)
  - 10 NTU (30 cm Secchi)
  - 40 NTU (12 cm Secchi)


• 1.8-m diameter tanks (58-cm deep)
• 1 predator (largemouth bass, 200 – 250 mm, TL)
• 5 of each of the three prey types—size matched by optimal size (handling time/prey mass)
• Trial conducted until 1-3 prey were consumed

- N = 14 largemouth bass-tank units
- Chesson’s Selectivity (not effected by depletion effects)
- Repeated measures MANOVA design

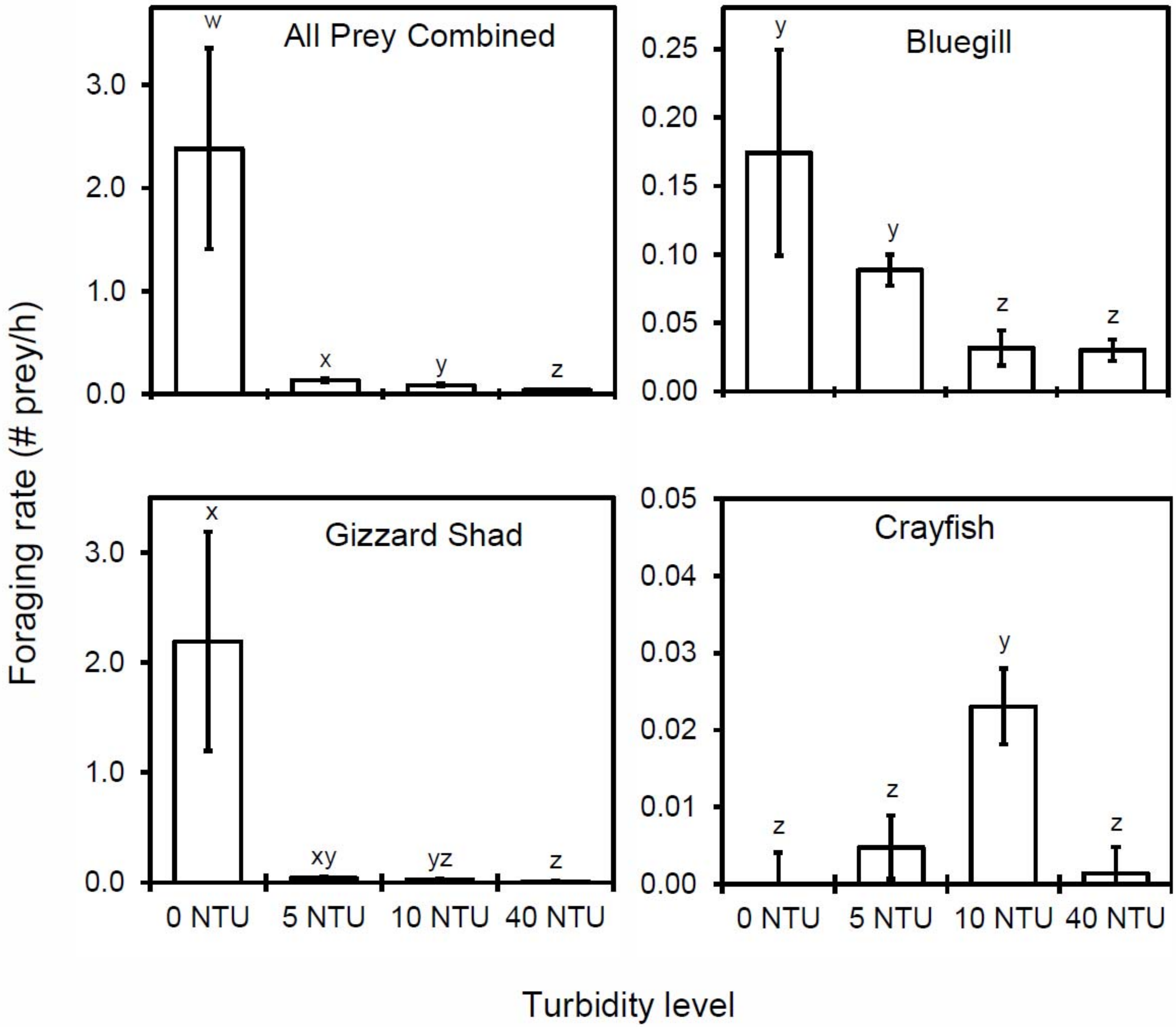
Results



Chesson's Electivity
0 NTU
5 NTU
10 NTU
40 NTU
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
y
yz
z
Bluegill
Gizzard Shad
Crayfish
Species

Summary

- Crayfish selected against except at 10 NTU (where all 3 prey had similar selectivity).
- Gizzard Shad or Bluegill positively selected at 0 and 5 NTU.
- Only bluegill selected for at 40 NTU—apparently due to change in antipredatory behavior.
- Time required for predator to eat 1 prey item increased with turbidity.
  - Different rates of decline for different prey?
  - Could this be mechanism for change in prey selection?


All Prey Combined
Bluegill
Gizzard Shad
Crayfish
Foraging rate (# prey/h)
Turbidity level
0 NTU
5 NTU
10 NTU
40 NTU
w
x
y
z
xy
yz
0.0
1.0
2.0
3.0
0.00
0.05
0.10
0.15
0.20
0.25
0.01
0.02
0.03
0.04

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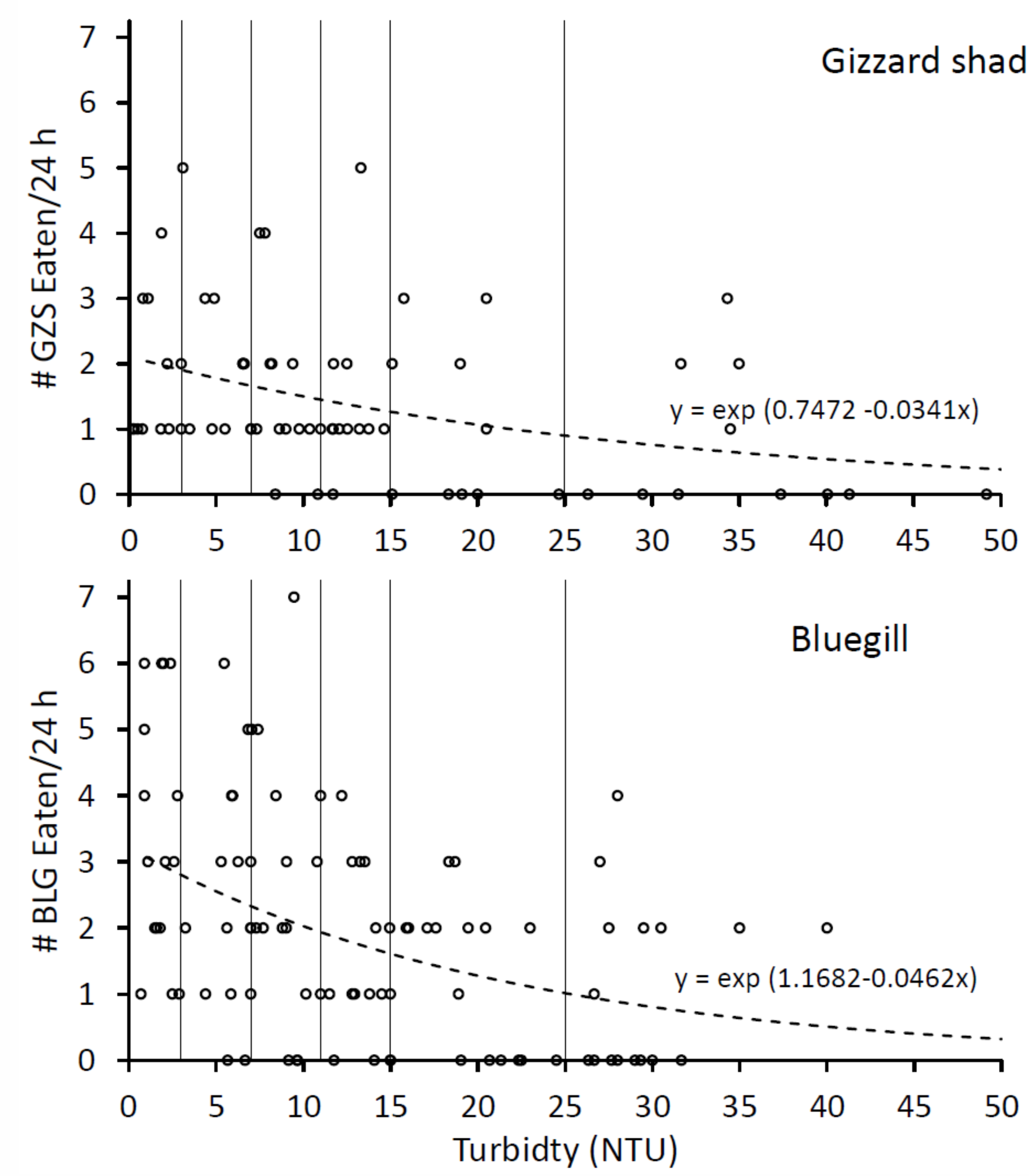
  - Could this be mechanism for change in prey selection?
- EXPERIMENT 2: quantify effects of turbidity on foraging return of largemouth bass.

Methods – experiment 2

- 2-m diameter circular tanks.
- 10 prey of same type / trial (bluegill or gizzard shad).
- 24-h trials with 1 predator.
- Each predator (N=16 for bluegill, N=12 for gizzard shad) tested c



- Slopes not significantly different.
- >25 NTU (15 cm Secchi), foraging return < 1 fish/d
  - This is less than typical daily ration (1-2.2 fish/d)

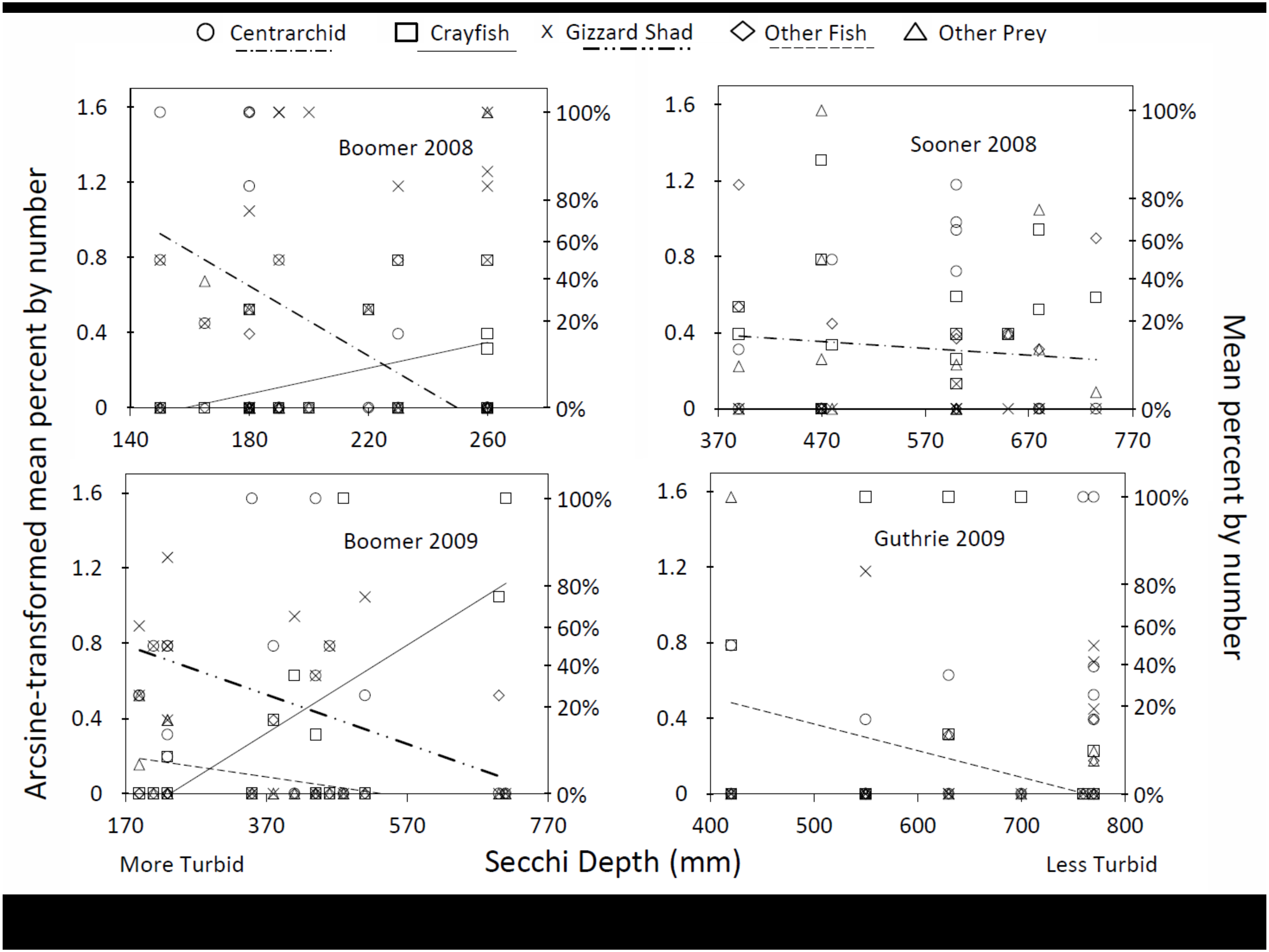
Summary

- Experiment 1: Turbidity changes prey selection in lab.
- Experiment 2: Turbidity reduces foraging return in lab.

- EXPERIMENT 3: Do these patterns occur in the field?

Methods – field Study

- Electrofish largemouth bass in field at different turbidities
  - Samples ≈ 6 week during spring – prey assemblage similar
  - Diet tubes – extracted diet of all largemouth bass
  - Quantified diet as % by number of each major prey type
  - Used multivariate linear regression to test for patterns between secchi depth and diet.



Centrarchid
Crayfish
Gizzard Shad
Other Fish
Other Prey
Boomer 2008
Sooner 2008
Boomer 2009
Guthrie 2009
Arcsine-transformed mean percent by number
Mean percent by number
1.6
1.2
0.8
0.4
0
100%
80%
60%
40%
20%
0%
140
180
220
260
370
470
570
670
770
170
370
570
770
400
500
600
700
800
More Turbid
Secchi Depth (mm)
Less Turbid

Conclusions

- Experiment 1: Turbidity changes prey selection in lab.
  - Eat mostly fish prey at low turbidity.
  - Ate fish and crayfish at similar rates at intermediate turbidity.
  - Ate mostly bluegill at high turbidity.
- Experiment 2: Turbidity reduces foraging return in lab.
  - >25 NTU (15-cm Secchi Depth) eat less than typical daily ration.
- Experiment 3: Field data
  - Diets are highly variable.
  - Where patterns exist, they typically support results of experiment 1.
- Future research:
  - Do bluegill use cover (vegetation) less at higher turbidity.