

# Bioacoustic Control and Management of Invasive Silver Carp (*Hypophthalmichthys molitrix*)



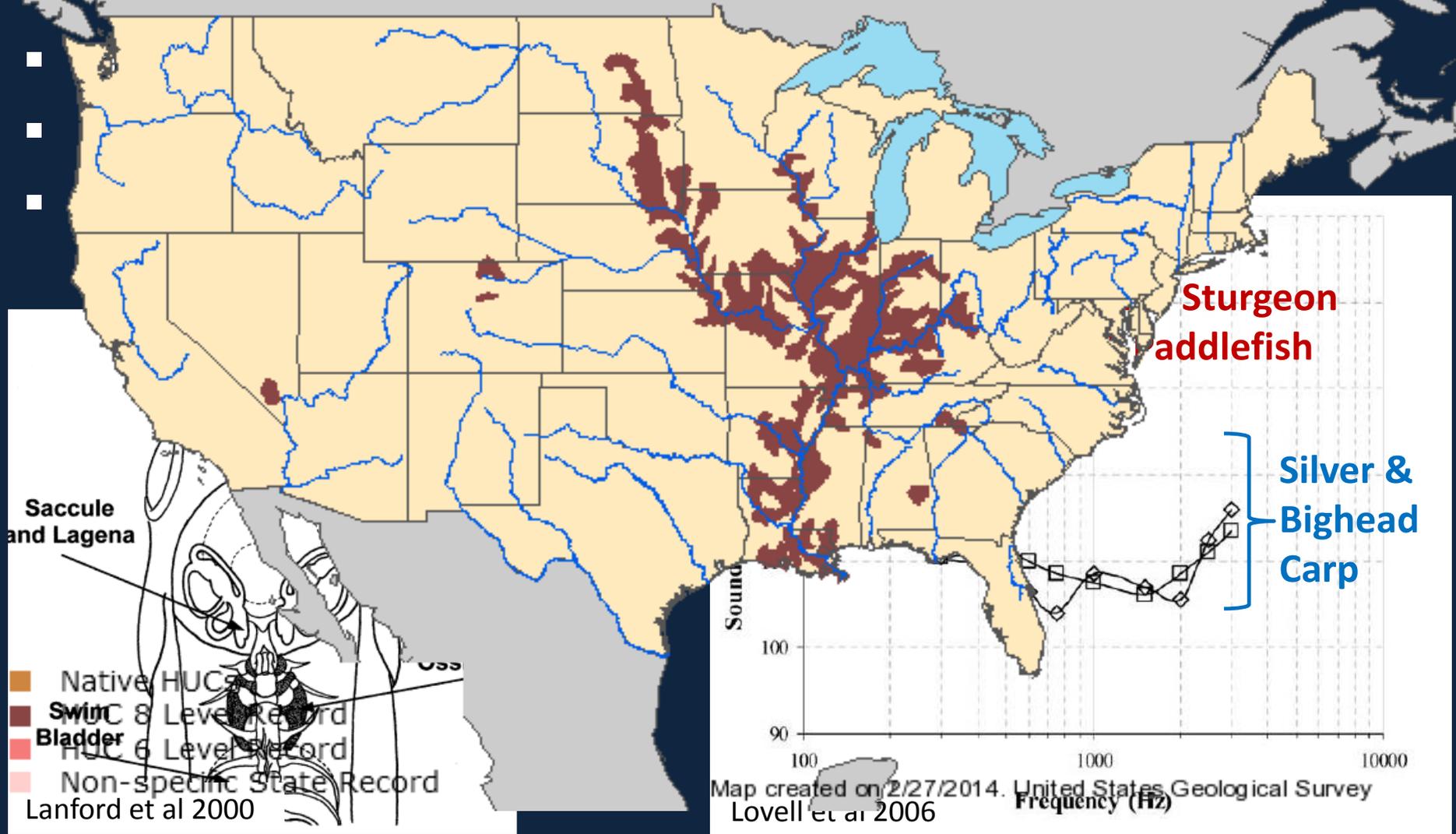
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# Outline

- Background
- Field Observations
- Behavioral Trials
- Conclusions & Future Directions



# *Hypophthalmichthys molitrix*



Tuning Curve

# Silver Carp Bioacoustics

- Jumping behavior is unusual
- What stimulates jumping?
- Is jumping related to outboard motor sound?
- Develop methods for control



United States Geological Survey

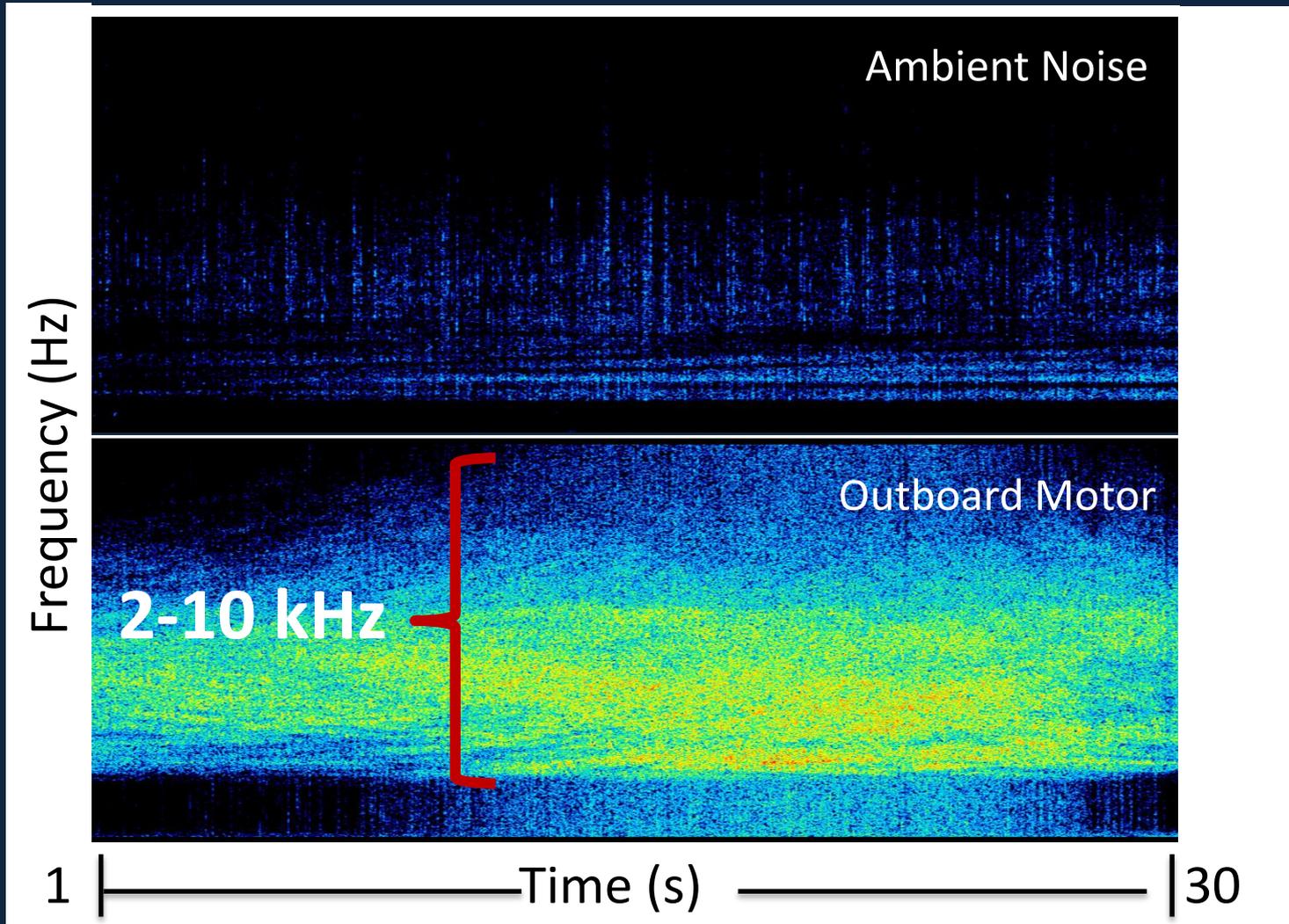
# Field Site





**100 hp at 32 km/hr**

# Sonograms



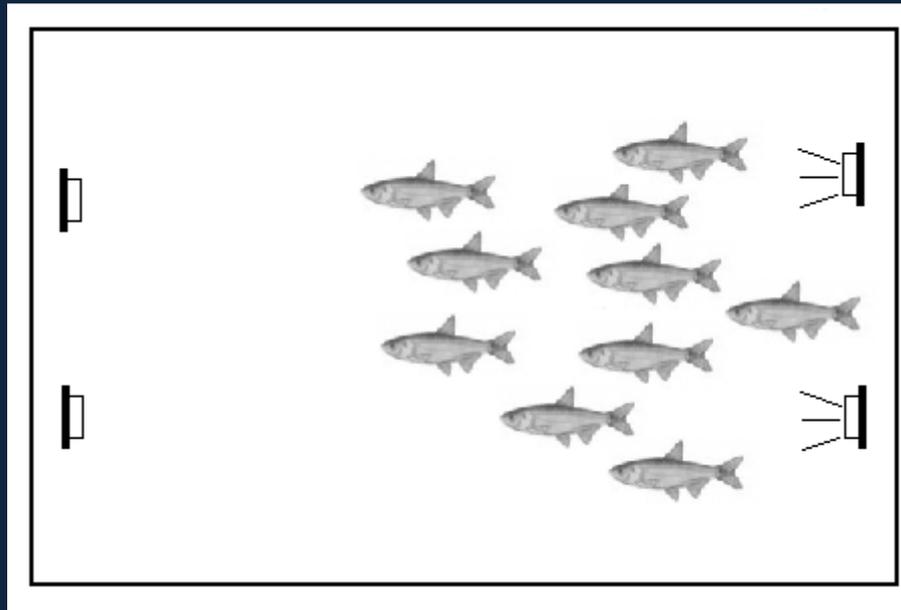
# Experimental Tanks: Bioacoustics

- Can behavior be modulated by sound?
- Will carp demonstrate negative phonotaxis?



# Experimental Methods

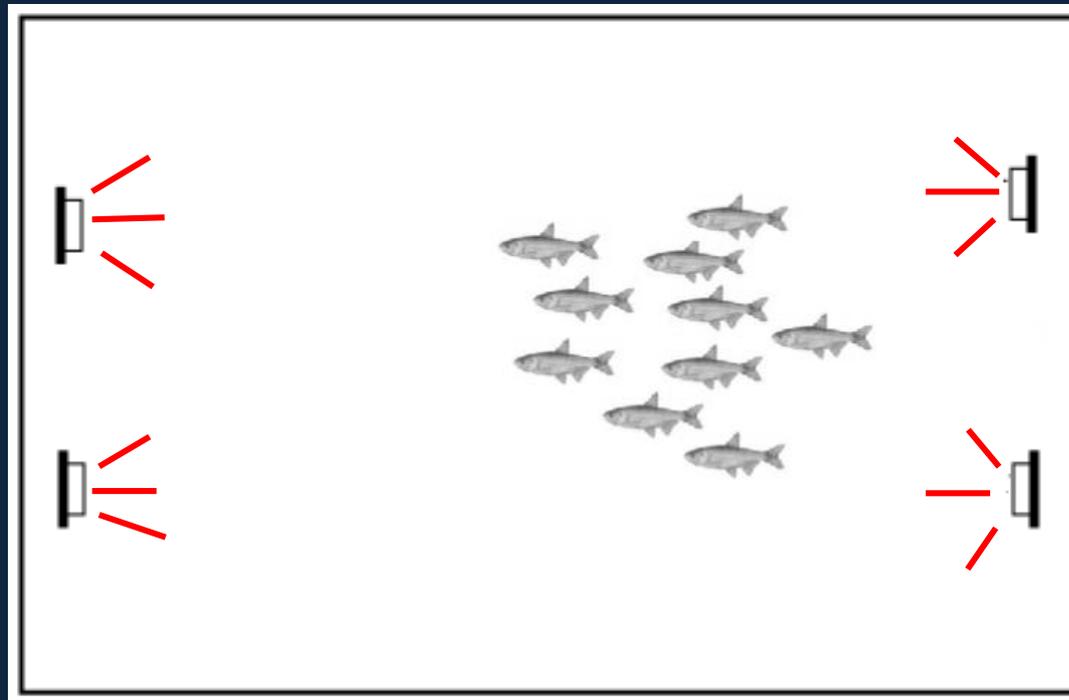
- USGS UMESC—La Crosse, WI
- 10 m x 5 m concrete tank
- 5 Groups of 10 silver carp
- 2 Speakers at each end
- Overhead cameras recording behavior
- Sound Stimuli
  - Pure Tones
    - 500-2000 Hz
  - Complex Sounds
    - Outboard Motor



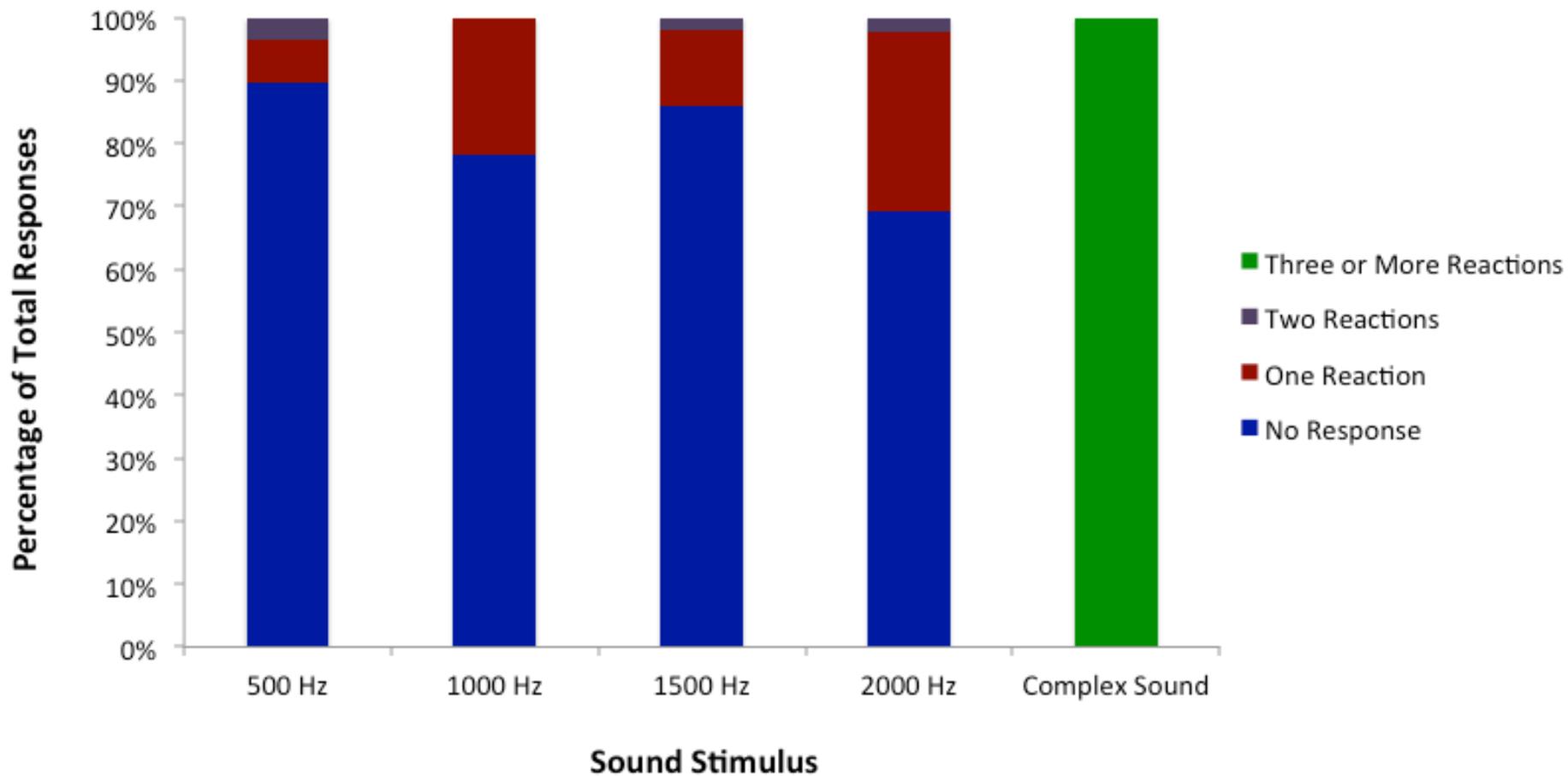
# Results Analysis

## Characterizing Responses:

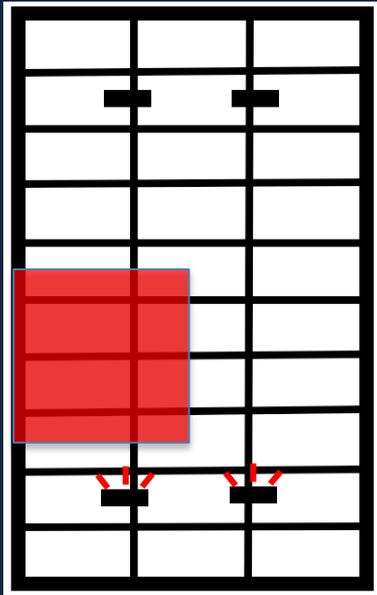
- No Response
- One Reaction
- Two Consecutive Reactions
- Ping-Pong
- (Three or More Consecutive Rxns)



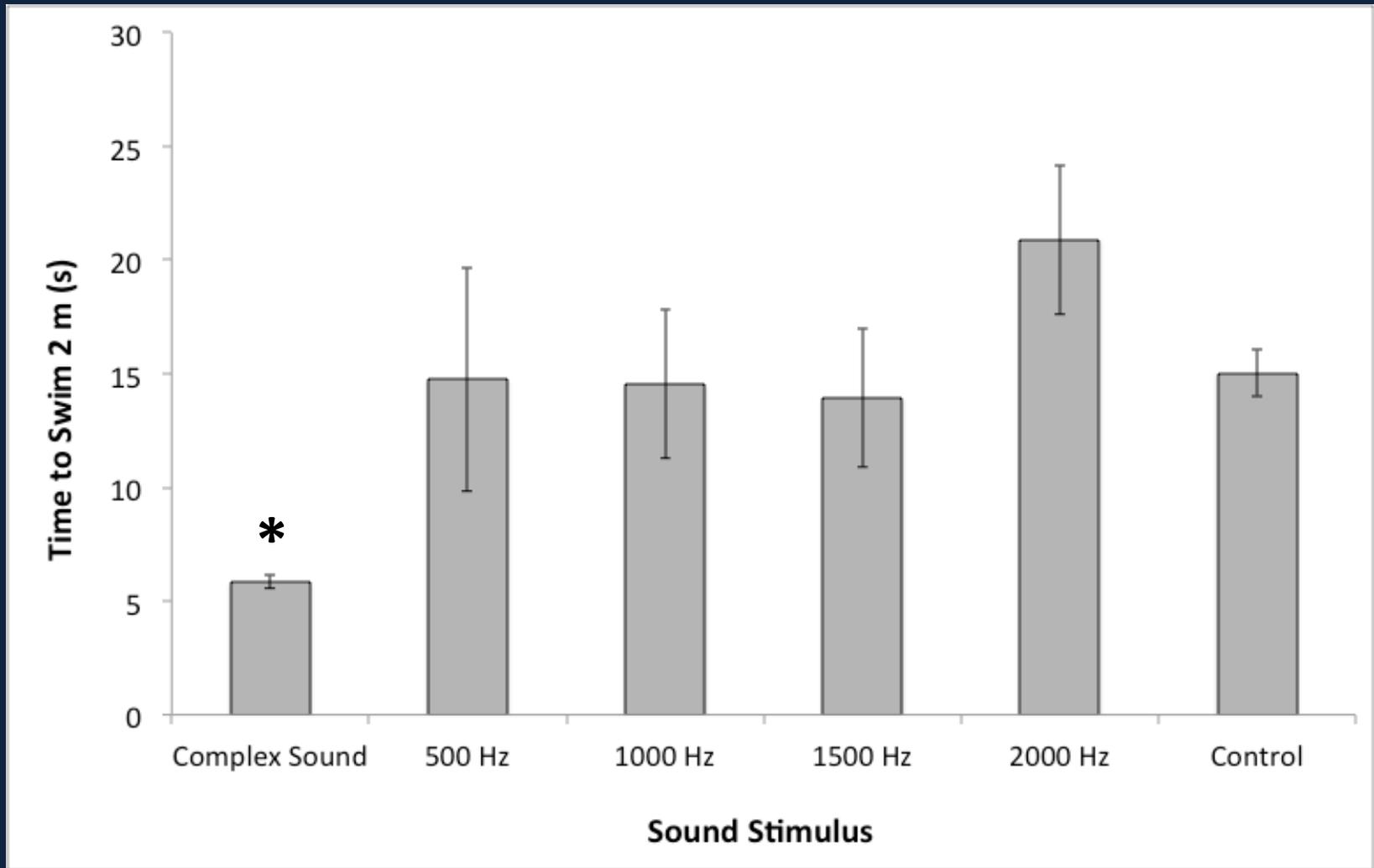
# Response Types



# Complex Sound Phonotaxis

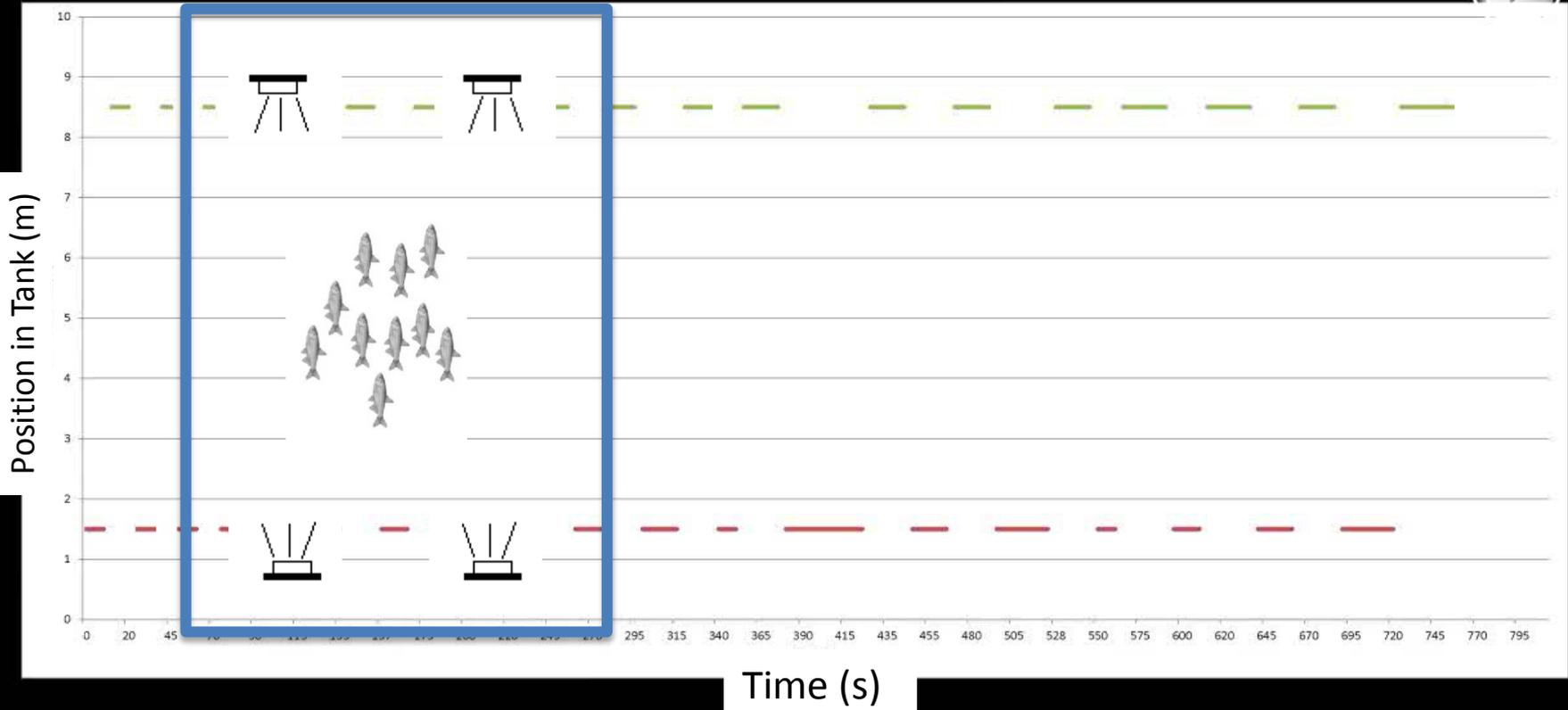


# Reaction Swim Speed



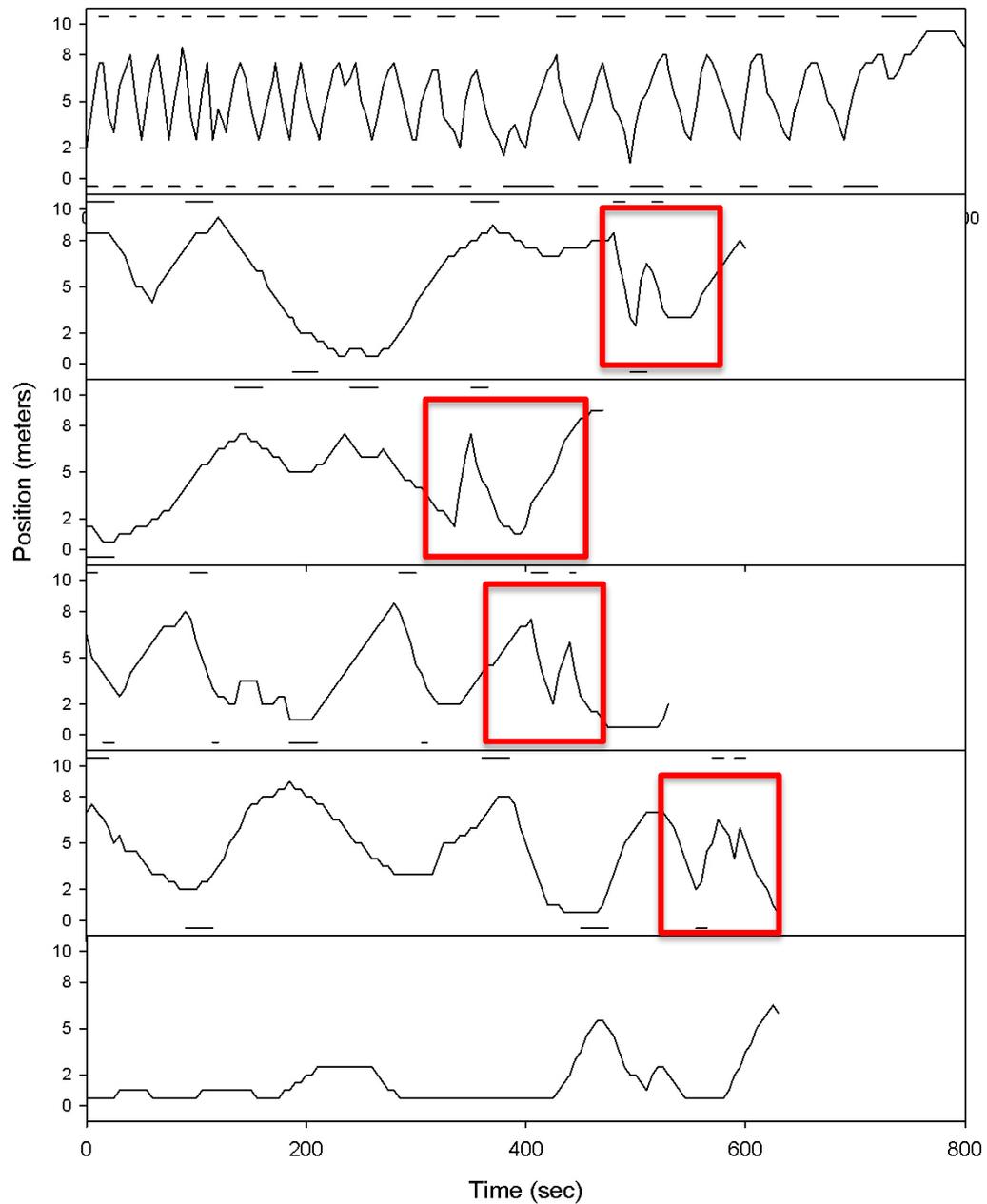
ANOVA  $P < 0.001$

# Complex Sound Results



40X

12 minute trial



**Complex  
Sound**

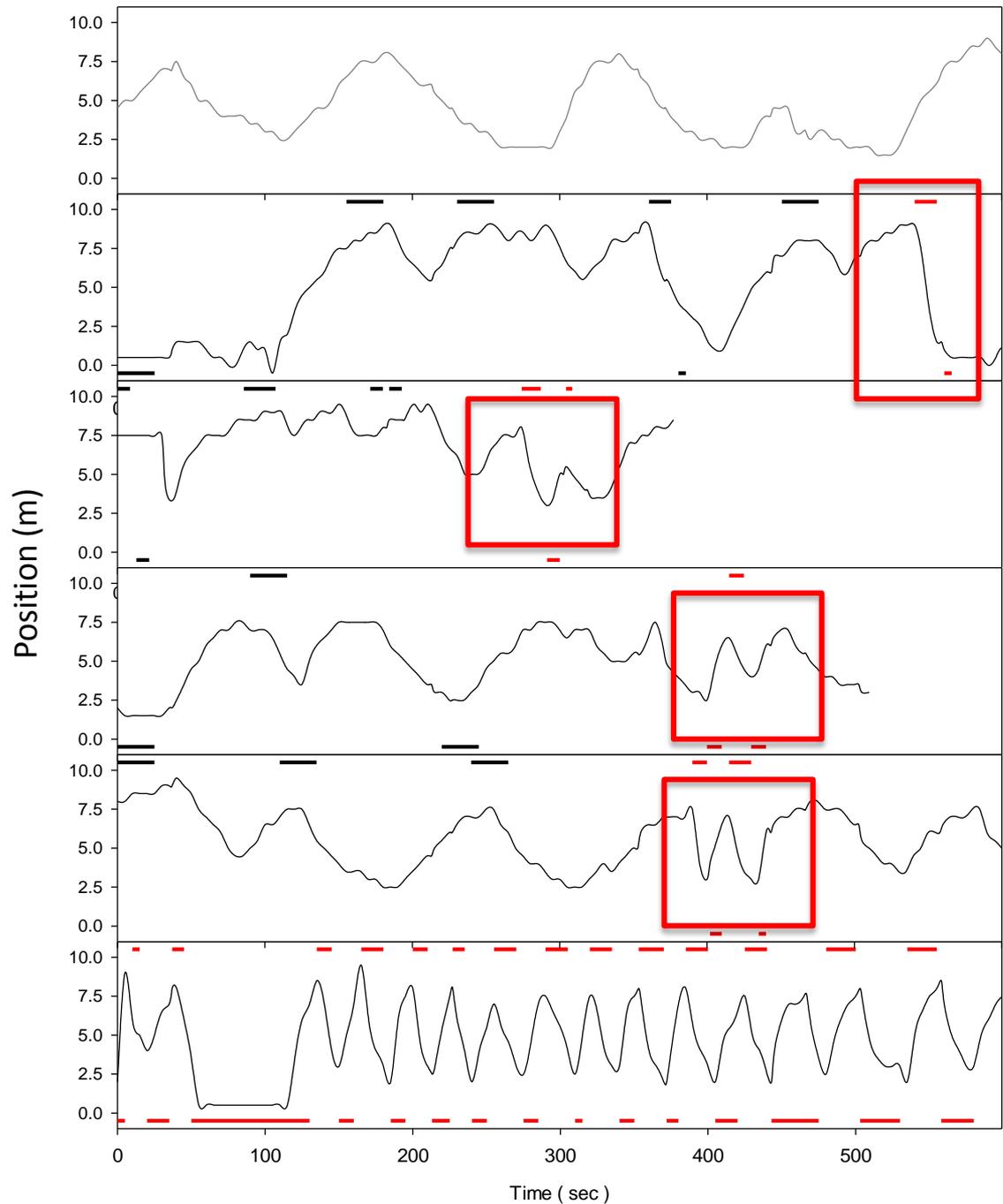
**500 Hz**

**1000 Hz**

**1500 Hz**

**2000 Hz**

**Control**



Control

500 Hz

1000 Hz

1500 Hz

2000 Hz

Complex  
Sound



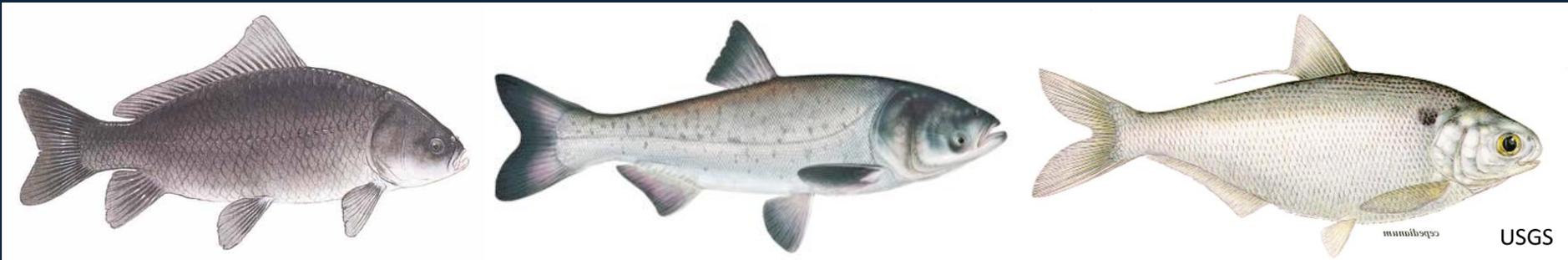
# Conclusions

- Pure Tones
  - No Response
  - Habituate Quickly
- Complex Sounds
  - Silver carp display consistent negative phonotaxis
  - Recording from an outboard motor that elicited jumping in the wild
- Sound may be an important management tool

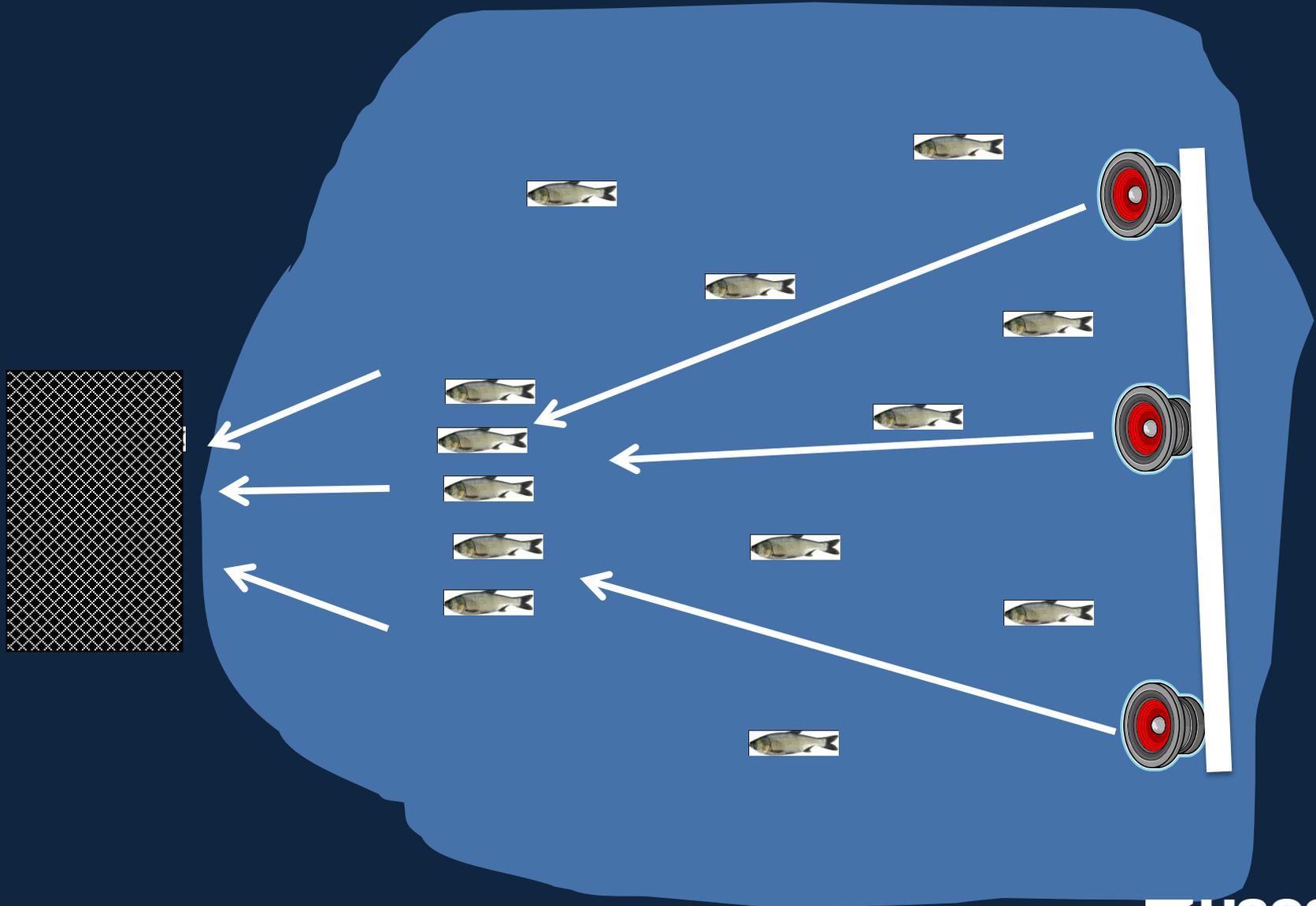


# Future Directions

- Behavioral Response to Sound
  - Bighead Carp
  - Native Species



# Herd Fish into Shore/Nets



# Early Warning & Fish Detection Buoy

- Remotely Controlled
  - Vibrational Stimuli
    - MinnKota propeller
  - Sound Stimuli
    - Underwater speaker
- Solar Powered
- Go-Pro Video Camera
  - Record fish activity



# Acknowledgements

USGS UMESC

INHS: Andrew Casper, Levi Solomon Eric

Funding: 3M Fellowship, USGS, LCCMR,  
UMD Biology

AFS Travel Funding: Great Lakes Fishery Commission



# Complex Sound Results

