



Complex Sound as a Deterrent to Asian Carp

Marybeth Brey, Aaron Cupp, Jon Amberg, Justin Smerud, and Richard Erickson

USGS—Upper Midwest Environmental Sciences Center, La Crosse, WI

Kelsie Murchy, Brooke Vetter, and Allen Mensinger

University of Minnesota-Duluth

International Conference on Aquatic Invasive Species

Winnipeg, MB, Canada

11 April 2016



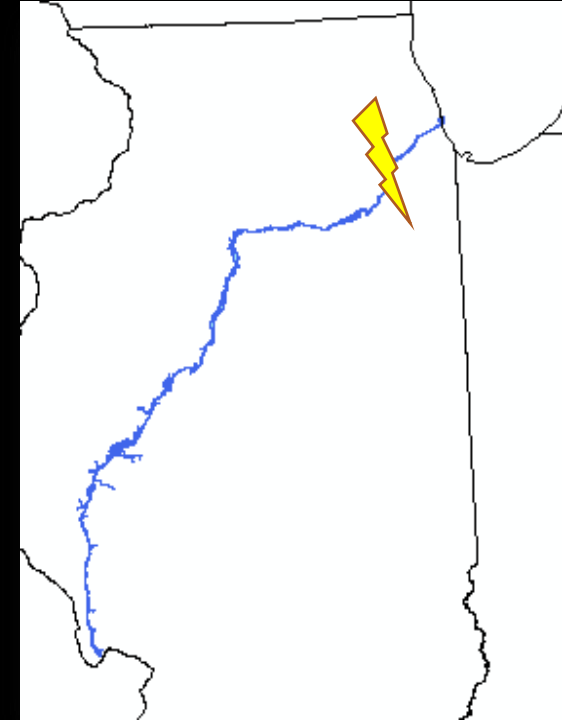
Active Control Measures

Commercial Harvest: Reduce propagule pressure



Active Control Measures

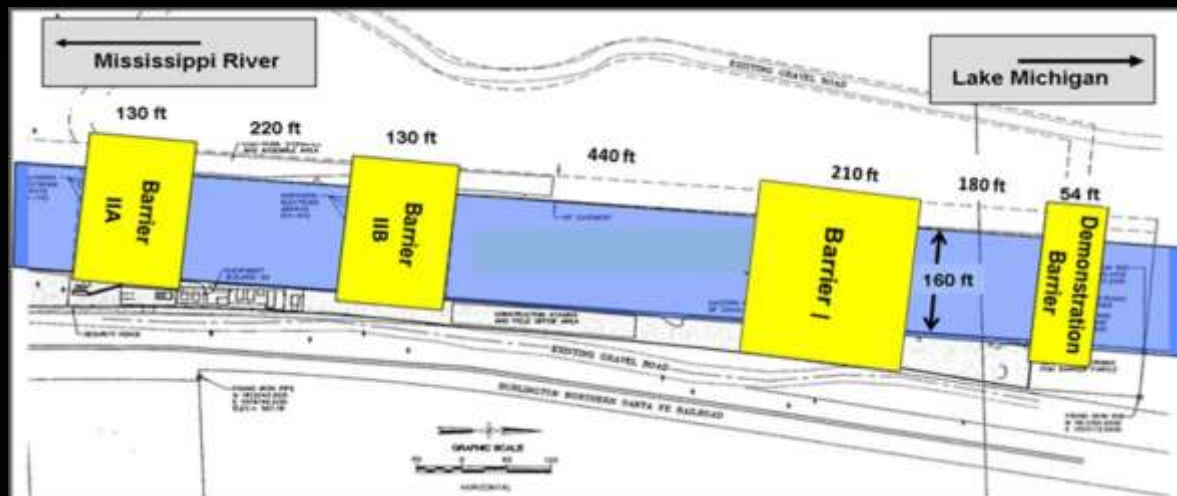
Electric Barrier: Deter fish movement upstream



However,...

The electric barrier has weaknesses

- ✓ Power outages
- ✓ Requires maintenance
- ✓ Barge vessels traveling downstream can reverse flow in CSSC
- ✓ Small bighead carp found to continuously challenge an electrical barrier in lab (Holliman 2011)

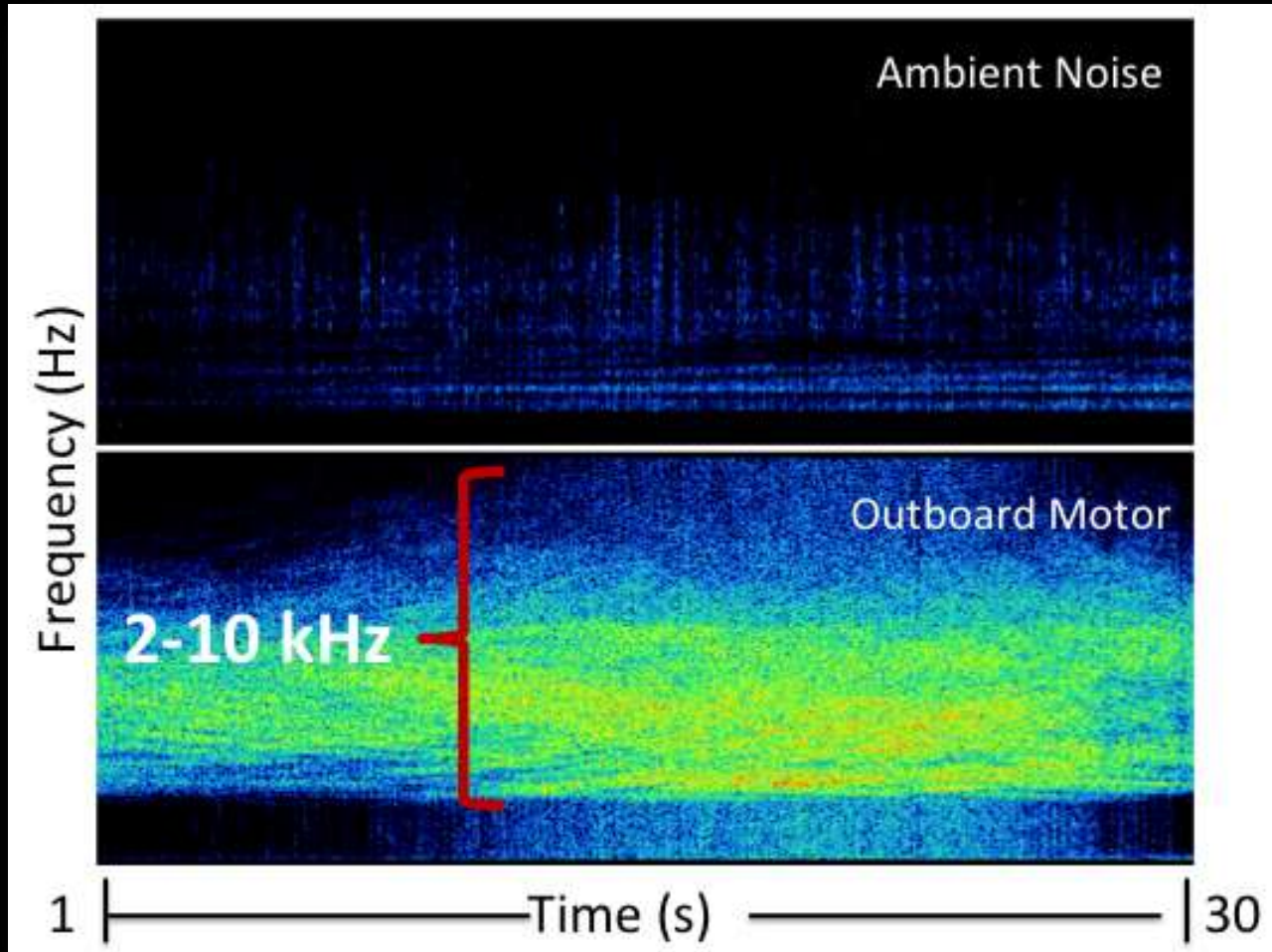


Therefore,...

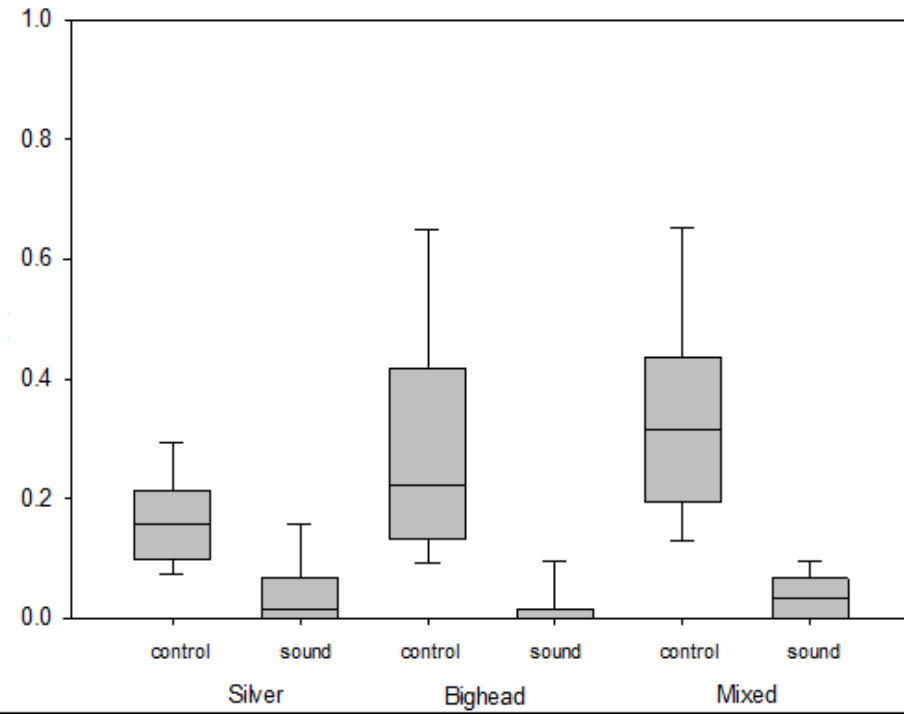
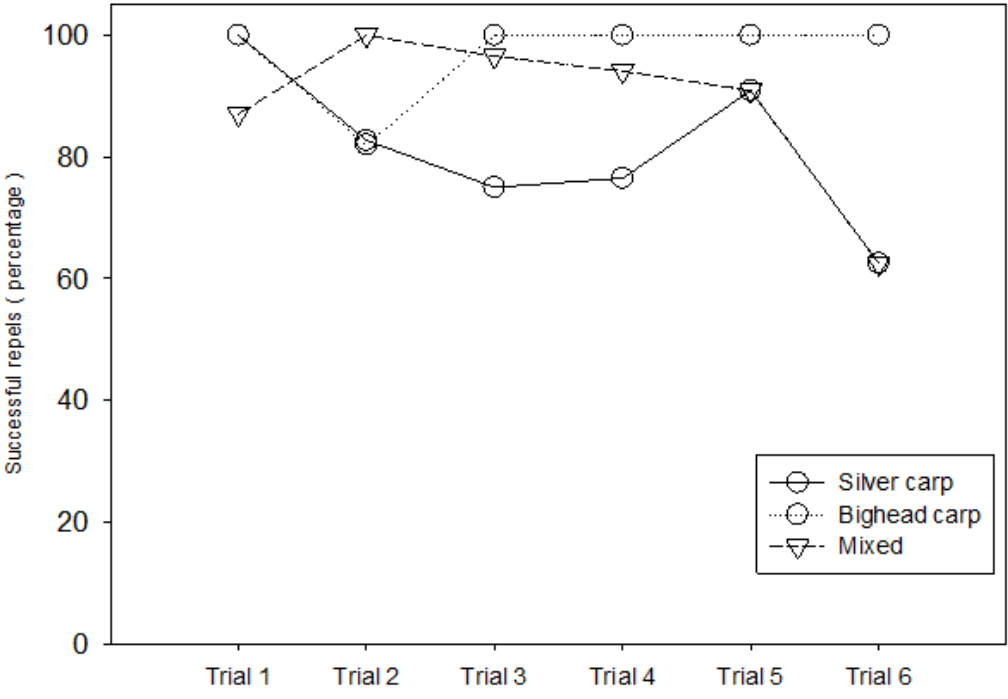
We need to develop alternate technologies to enhance removal and/or deter upstream movement



Complex Sound



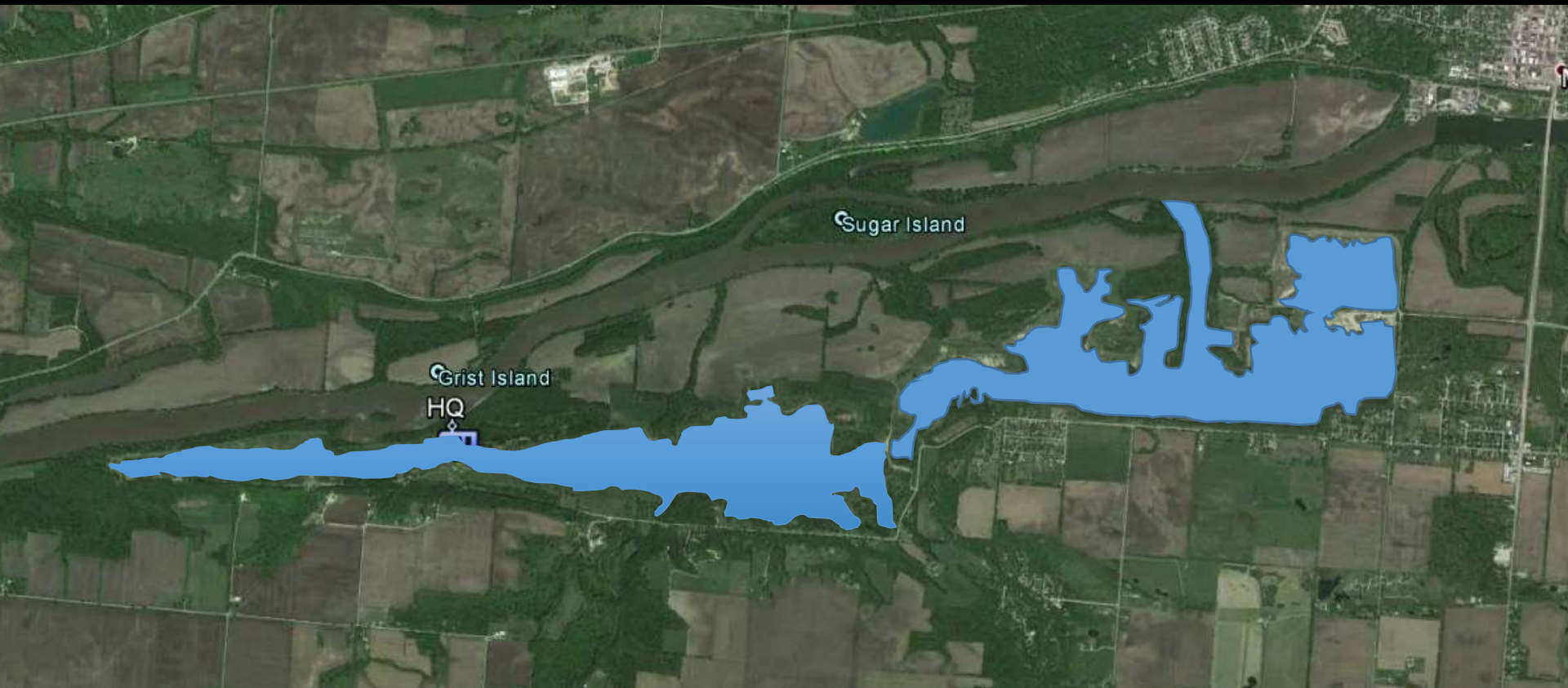
Lab Results



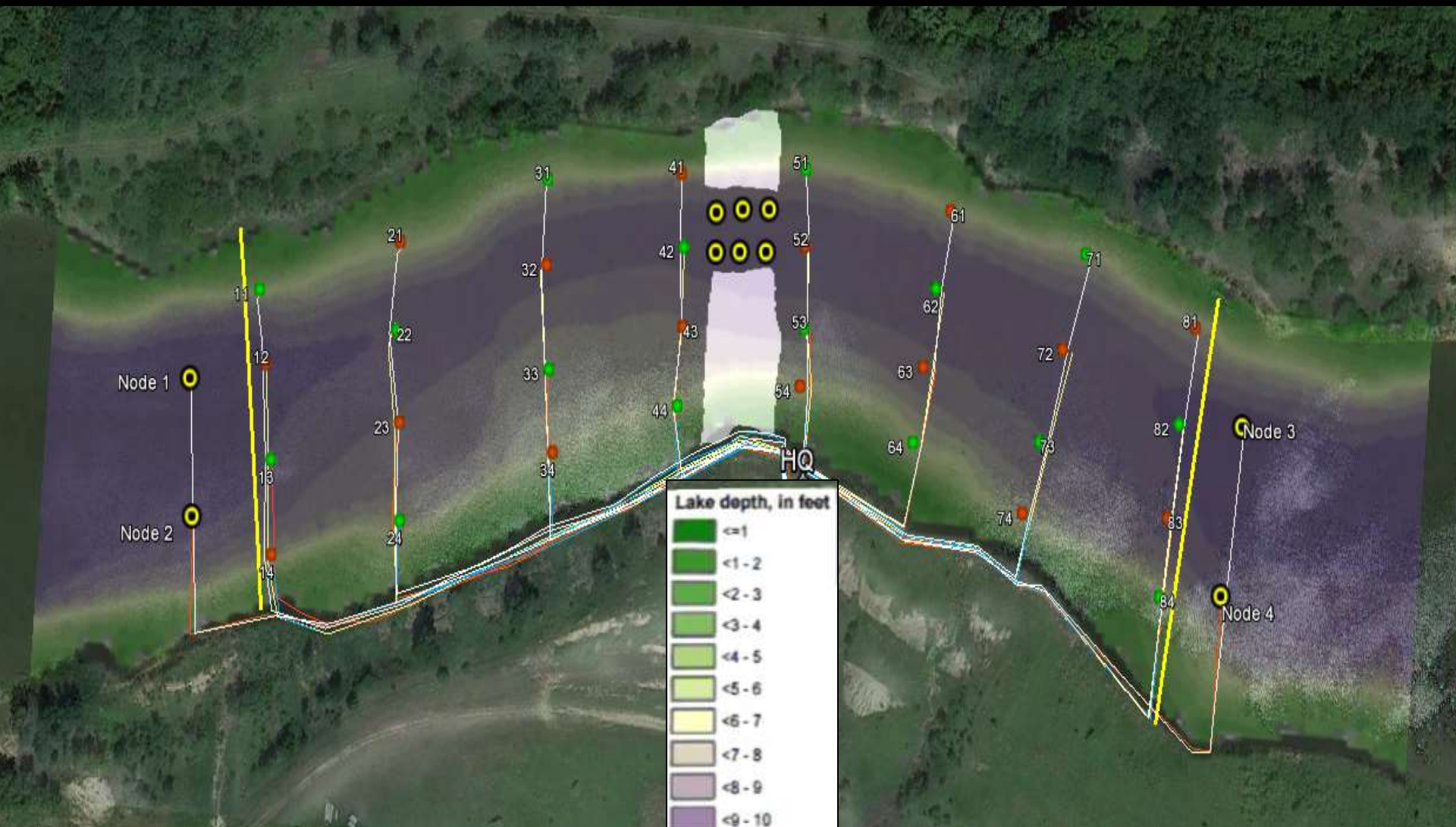
Vetter, B. J., Cupp, A. R., Fredricks, K. T., Gaikowski, M. P., & Mensinger, A. F. (2015). Acoustical deterrence of Silver Carp (*Hypophthalmichthys molitrix*). *Biological Invasions*, 17(12): 3383-3392



Morris Field Site

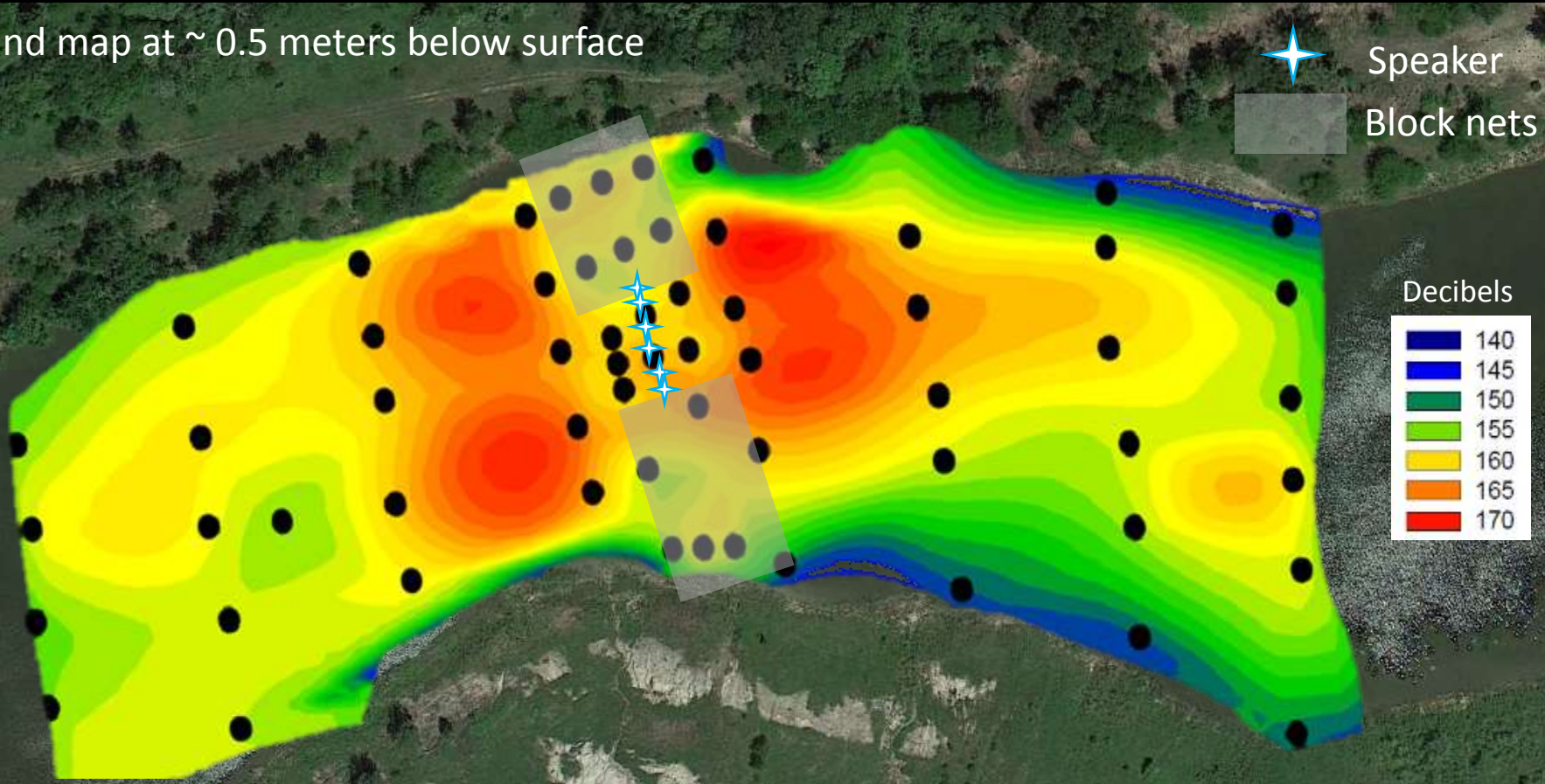


Morris Field Site



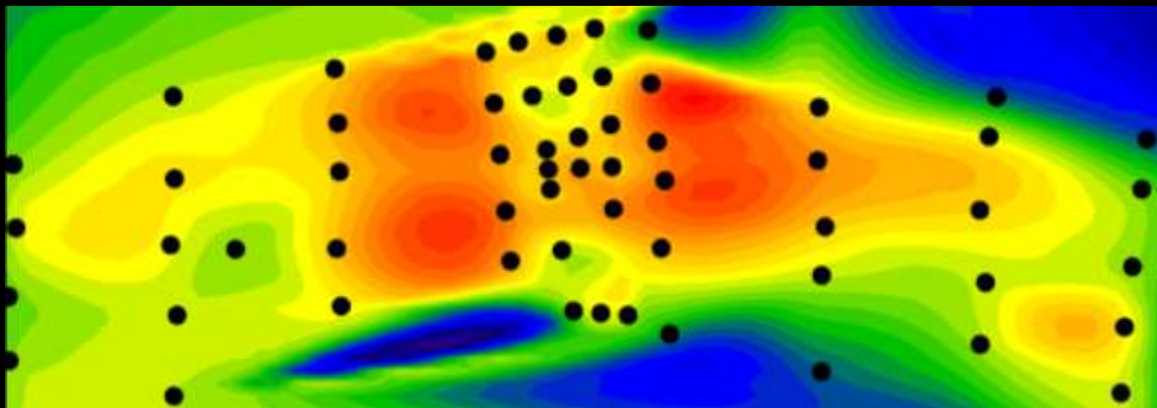
Sound mapping

Sound map at ~ 0.5 meters below surface

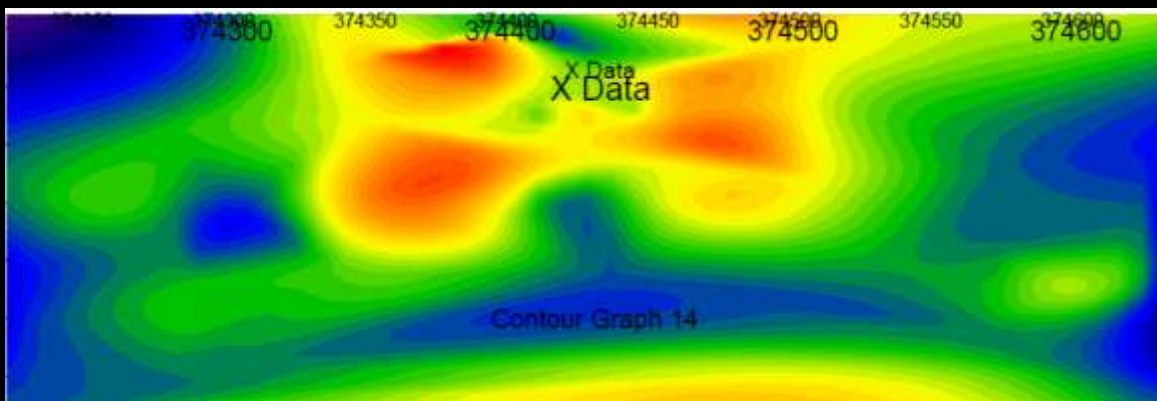


Sound Maps

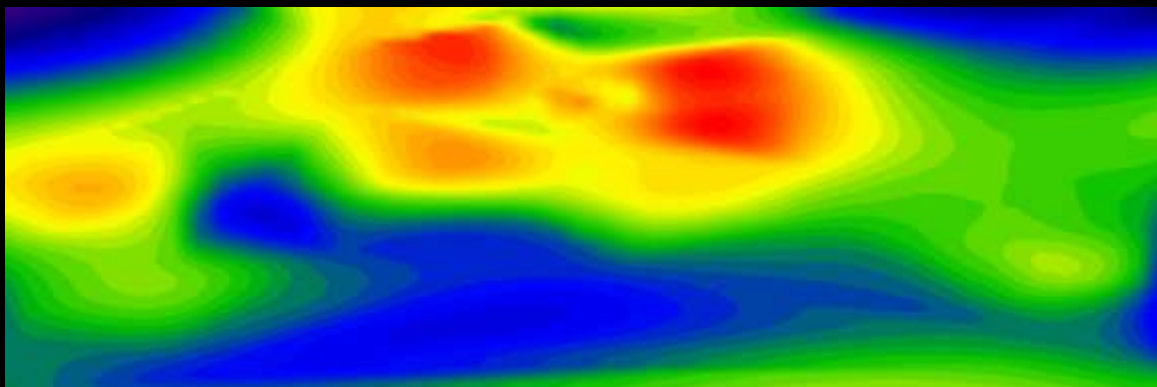
Surface
0.5 m



Middle
~ 1.8 m



Bottom
~ 3 m



Decibels

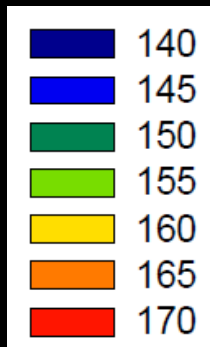




Photo: Justin Smerud (USGS)





Photos: Mark Roth, USGS



Control Trials

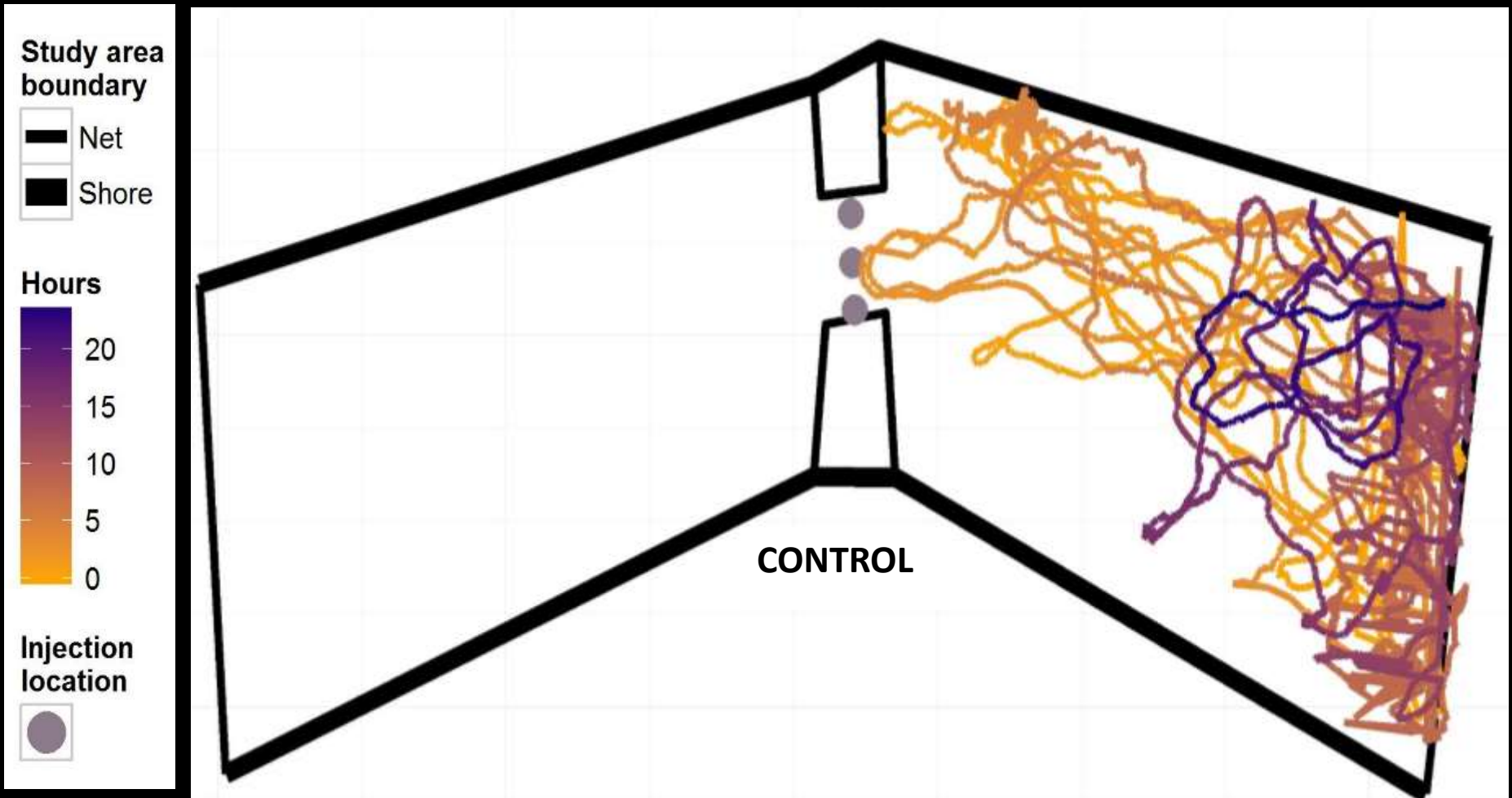
- Three trials, naïve fish each trial
- 32 fish tagged per trial
- Half released on west side, half on east side
- 24-hour trial, no sound played
- 24 hour quiet period where nets were lifted in between each trial

Sound Trials

- Three trials, naïve fish each trial
- 32 fish tagged per trial
- Half released on west side, half on east side
- **Sound played (boat motor) for 24 hours straight**
- 24 hour quiet period where nets were lifted in between each trial



Examples of Fish Paths



Number of Channel Crossings

	N	No	Yes	% crossing	Avg. # Crossings	SE
Control	84	16	68	81.0%	2.79	0.33
7/24/2015	26	8	18	69.2%	2.77	0.54
7/30/2015	27	6	21	77.8%	1.78	0.43
8/1/2015	31	2	29	93.5%	3.68	0.66
Sound	82	29	53	64.6%	2.35	0.33
7/22/2015	30	12	18	60.0%	3.57	0.74
7/26/2015	26	11	15	57.7%	1.65	0.40
7/28/2015	26	6	20	76.9%	1.65	0.29

- Generalized Linear Model in R (Regression with Poisson distribution) for # of crossings
- Binary GLM for fish crossing (Yes or No)

*No difference between Crossings (Y/N) or Number of Crossings between Treatments or Trials

Successful Repels



Successful Repels



	N (Repels)	Repels (mean + SE)	% Successful Repels (mean ± SE)
Control	81	1.77 ± 0.18	45.0 ± 0.04 %
7/24/2015	24	1.08 ± 0.27	39.4 ± 0.07%
7/30/2015	27	2.41 ± 0.40	58.2 ± 0.07%
8/1/2015	30	1.74 ± 0.22	37.4 ± 0.05%
Sound	82	1.84 ± 0.19	59.4 ± 0.04%
7/22/2015	30	2.03 ± 0.36	54.2 ± 0.07%
7/26/2015	26	1.96 ± 0.38	68.1 ± 0.07%
7/28/2015	26	1.50 ± 0.24	56.6 ± 0.06%

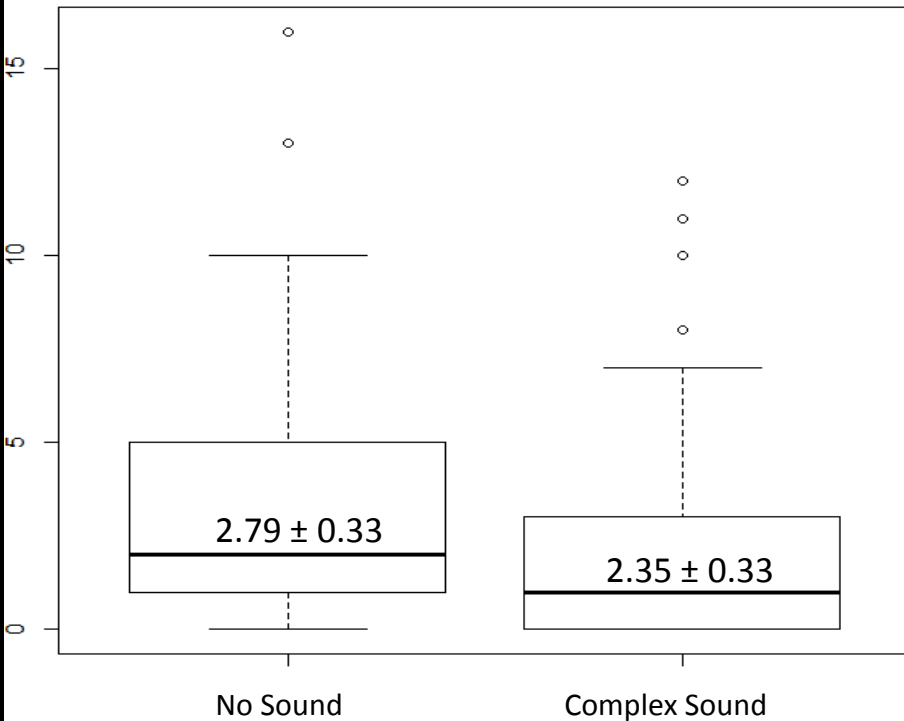
- Generalized Linear Model in R (Regression with Poisson distribution) for # of crossings
- Binary GLM for fish crossing (Yes or No)

*No sig. difference between absolute number of repels or % of successful repels between treatments or trials

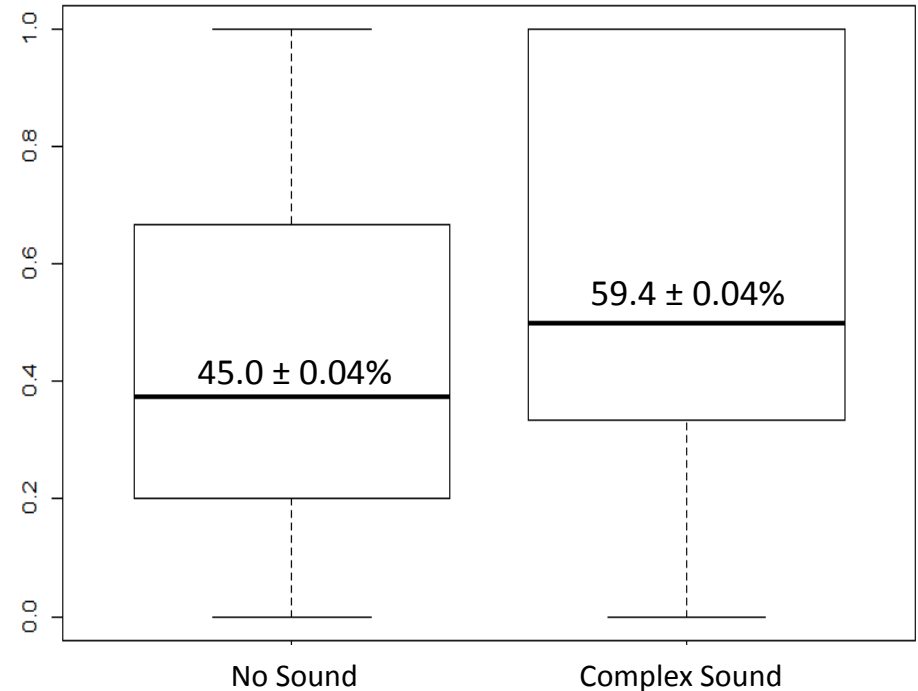
Crossings and Successful Repels



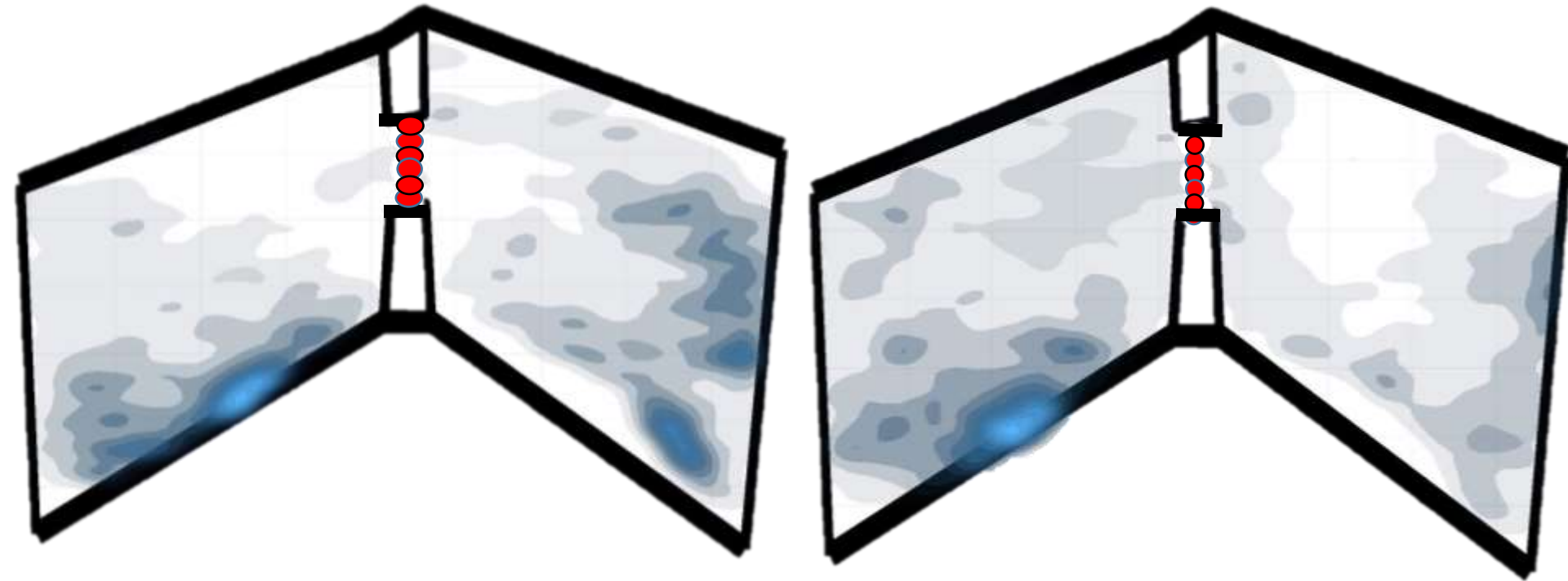
Barrier Crossings—Trials Combined



Successful Repels—Trials Combined

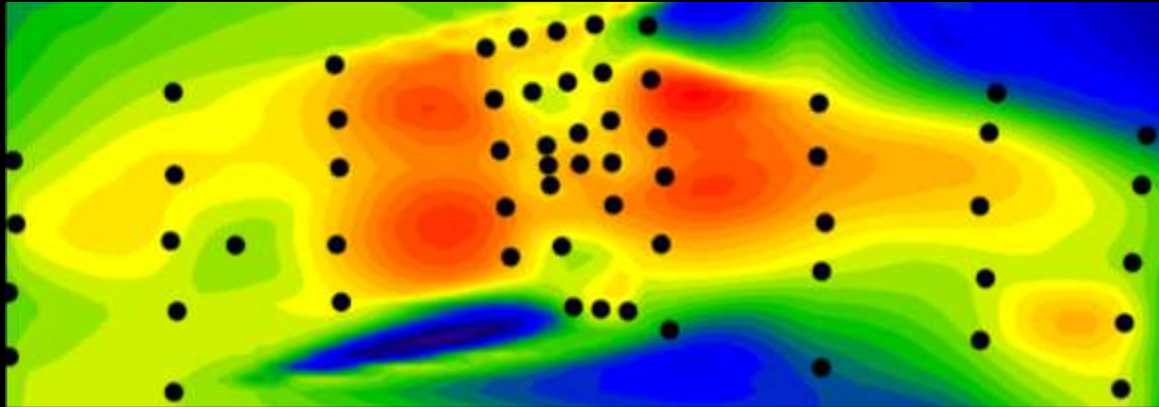


Density plot

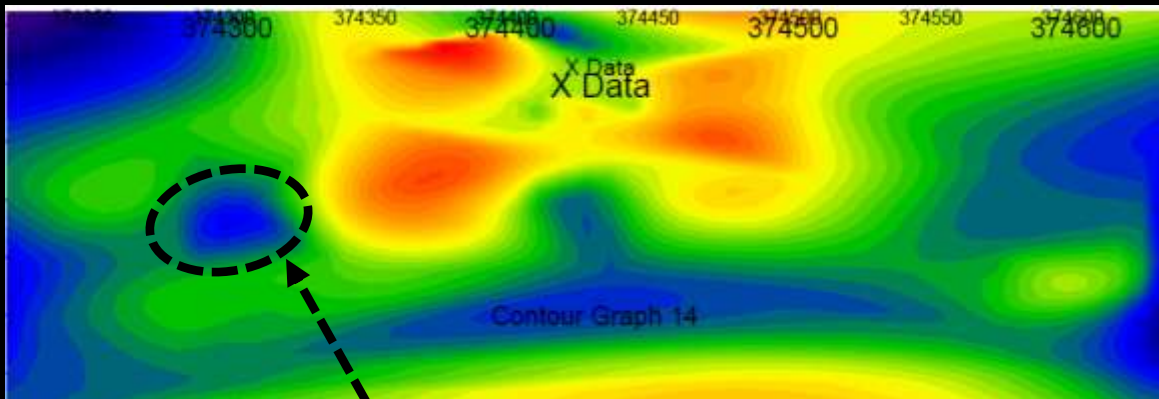


Sound Maps

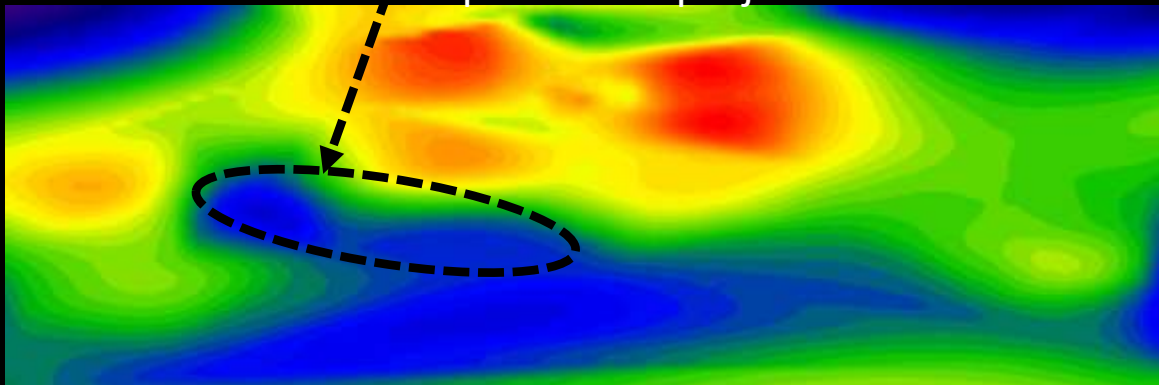
Surface
0.5 m



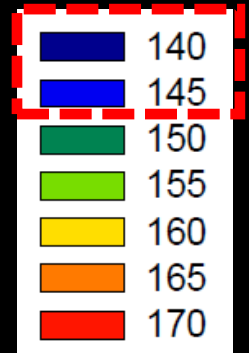
Middle
~ 1.8 m



Bottom
~ 3 m



Decibels



What does this mean?


- Fish may still cross—not a barrier!
 - Multiple tests to conduct in 2016
- Still a promising technology
 - Too loud
 - Nowhere for fish to go
- Additional studies for 2016



Acknowledgements

- U.S. Fish and Wildlife Service-Carterville and Wilmington
- Illinois DNR
 - (Kevin Irons, Matt O'Hara, Blake Ruebush, David Wyffels)
- IDNR contracted commercial fishers
- Illinois Water Science Center
- USGS Western Science Center





Complex Sound—Additional Studies

- Non-target Effects
- Temperature effects on response time
 - Bighead carp exhibit slower reaction time at lower temps.
 - Fewer responses to sound at high and low temps.

No reaction

- Rainbow Trout
- Walleye
- Bluegill
- Paddlefish
- Channel Catfish
- Lake Sturgeon

Low or moderate reaction

- Bigmouth Buffalo
- Common Carp
- Grass Carp
- Fathead Minnows
- Gizzard Shad

Still testing

- Banded Killifish
- American Eel
- Shovelnose sturgeon

Intensity Plots

