Lucas Nathan, Andrew Mahon, Michelle Budny, Margaret McVeigh, and Christopher Jerde

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Overview

- Threat of bait as a vector for invasive species
- Chicago pilot study using eDNA
- Bait shops in the Great Lakes
- A meta-genetics approach to surveillance
- Outreach

The bait threat

LETTER

"Sight-unseen" detection of rare aquatic species using environmental DNA

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[2] Great Lakes Project, The Nature Conservancy

If Asian carp are "close " to the Great Lakes, then could juveniles be in the bait?

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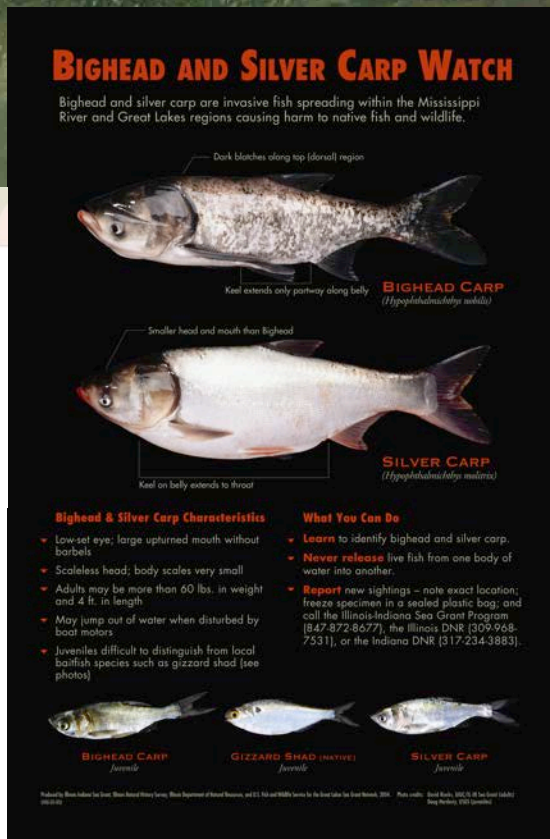
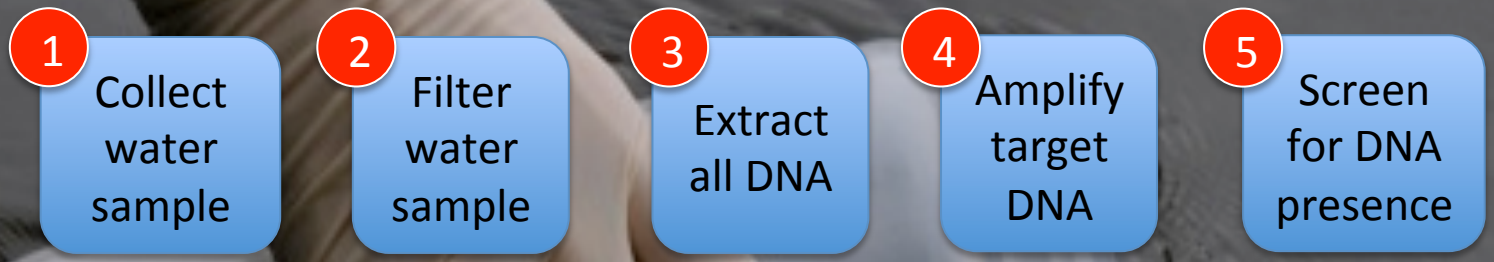


Environmental DNA approach

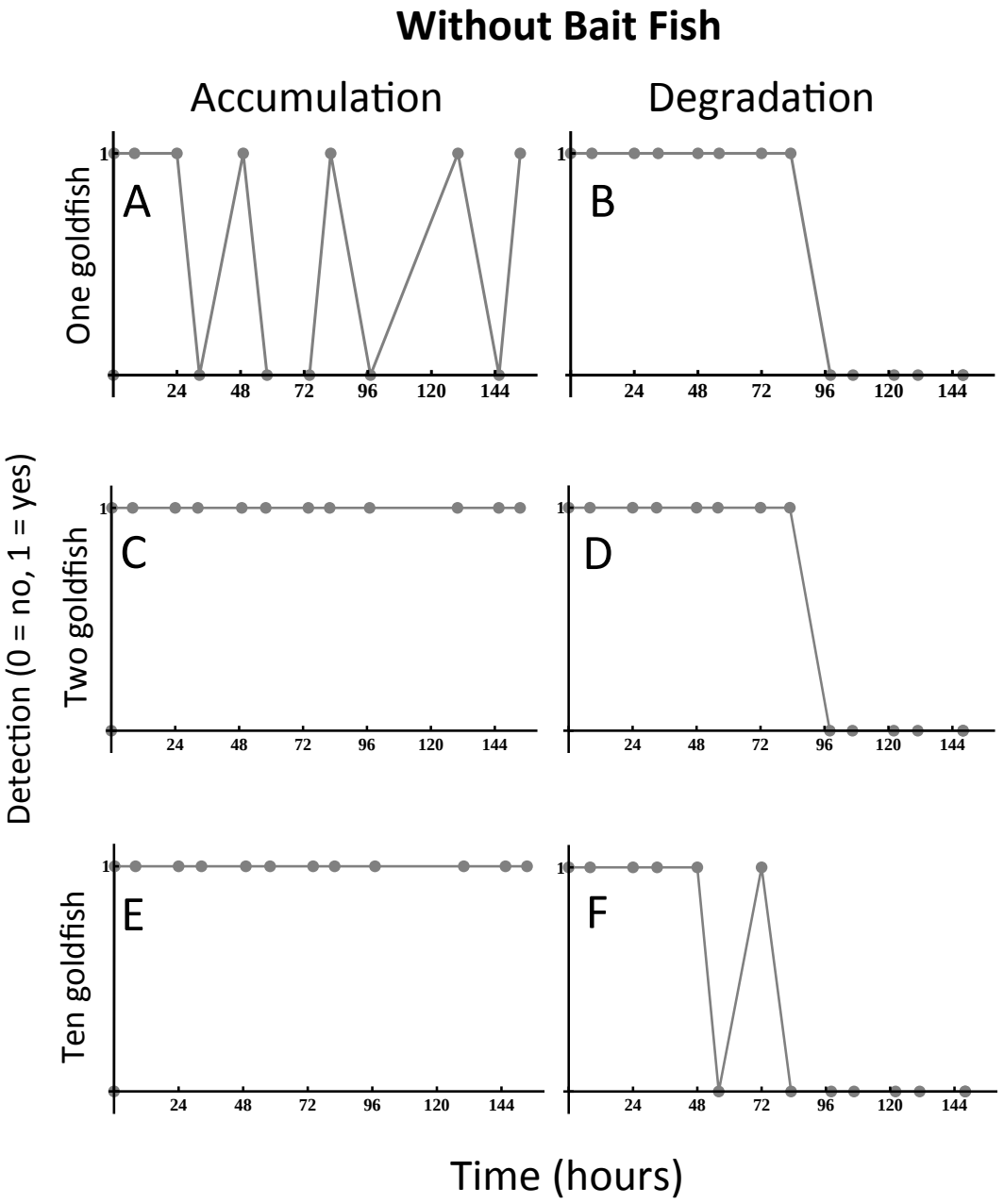


Benefits:

- **No taxonomic expertise needed**
- **No direct handling of minnows**
- **Quick**
- **Can be done overtly or covertly**
- **Can be done cheaply (although not in these studies)**

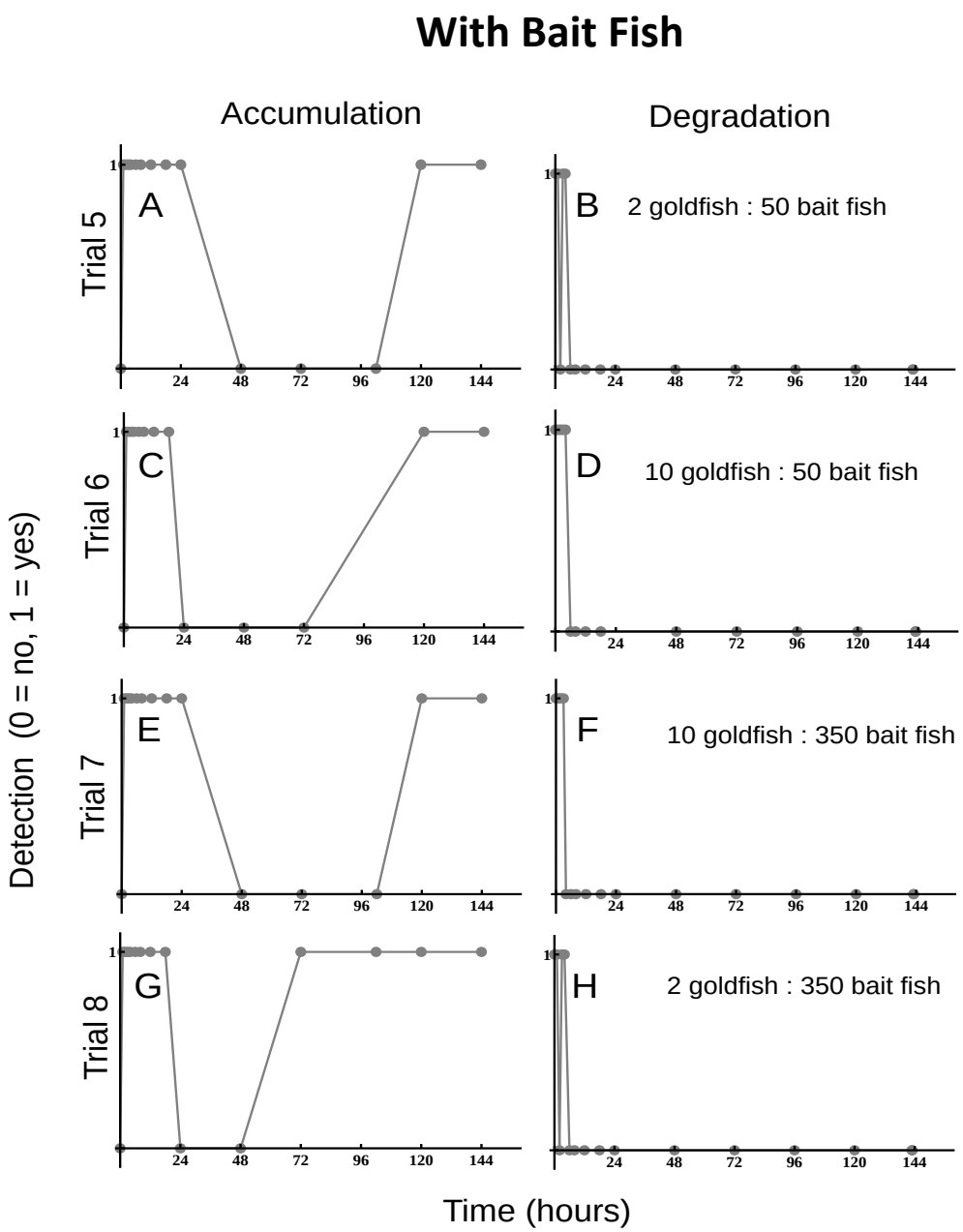
Bait tank calibration

Using eDNA for bait is very effective and DNA does not persist at detectable levels for more than 4 days



Bait tank calibration

- Target DNA degrades much quicker in mixed environments
- DNA of rare species is detectable
- False negatives are possible (failure to detect)
- No indication of contamination in any of the controls



Barnes, MA, CR Turner, CL Jerde, MA Renshaw, WL Chadderton, and DM Lodge. 2014. Environmental conditions influence eDNA persistence in aquatic systems. Environmental Science and Technology. 48(3): 1819-1827.

Chicago bait shops (2010)

Bait Shops in Northeast Illinois

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Legend

- Bait shop locations
- States
- Great Lakes

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Chicago bait shops (2010)

- 136 water samples collected
- 52 bait shops
- 79% of bait sourced from two wholesalers

- No bighead or silver carp observed with visual inspection or detected with eDNA
- However, 14 shops had gold fish DNA and that corresponded to 8 visual detections
- However, Chicago bait is regionally sourced. Not so elsewhere in GL

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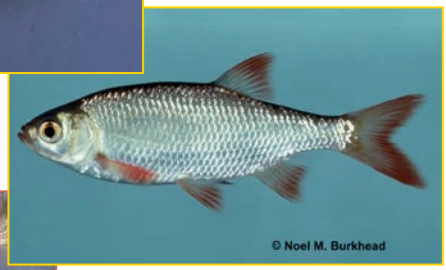
Species of concern

- Goldfish (*Carassius auratus auratus*)
- Round and tubenose gobies (*Neogobius melanostomus* and *Proterorhinus semilunaris*)
- Eurasian rudd (*Scardinius erythrophthalamus*)
- Bighead and silver carp (*Hypophthalmichthys nobilis and Hypophthalmichthys molitrix*)

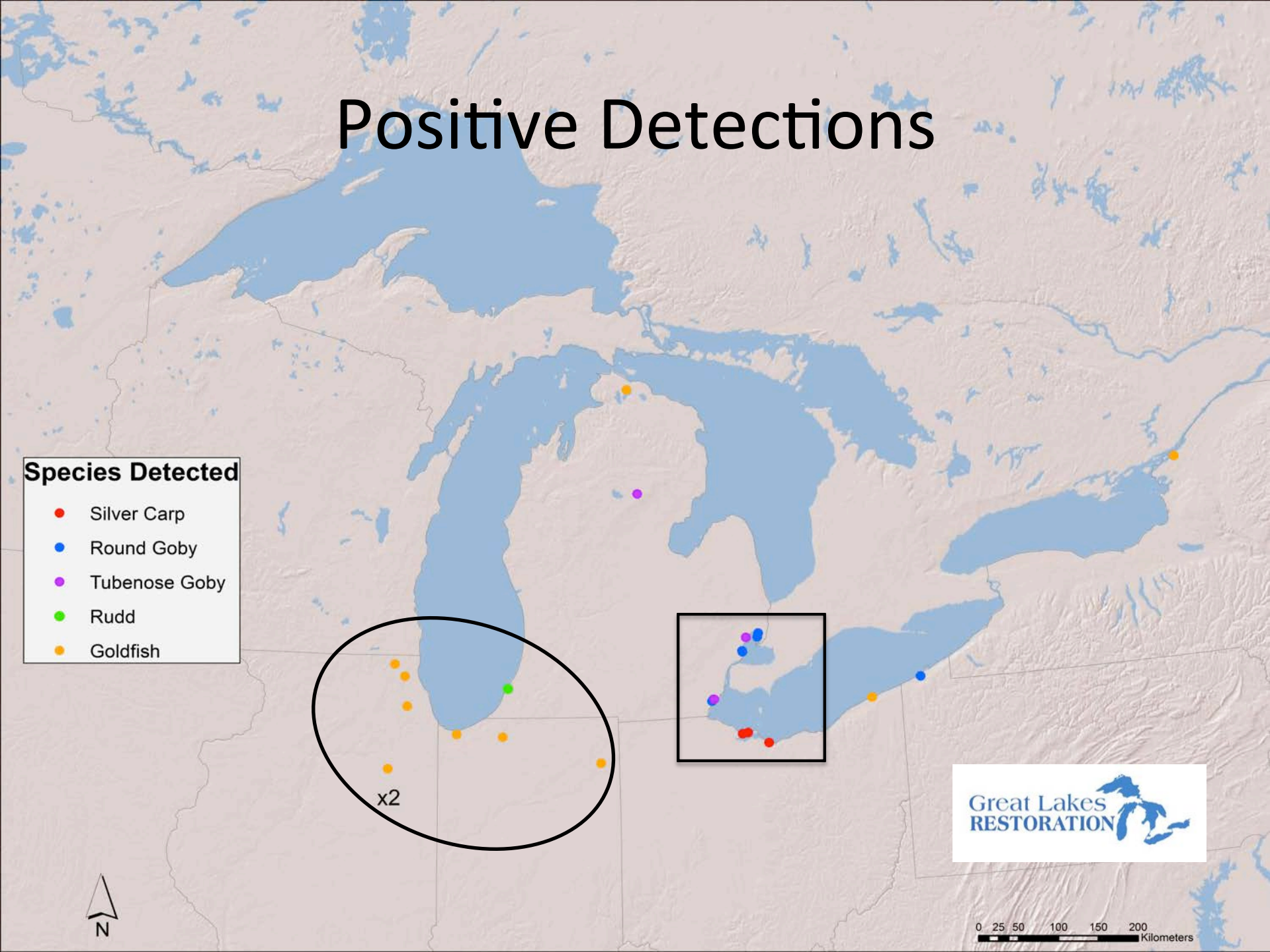


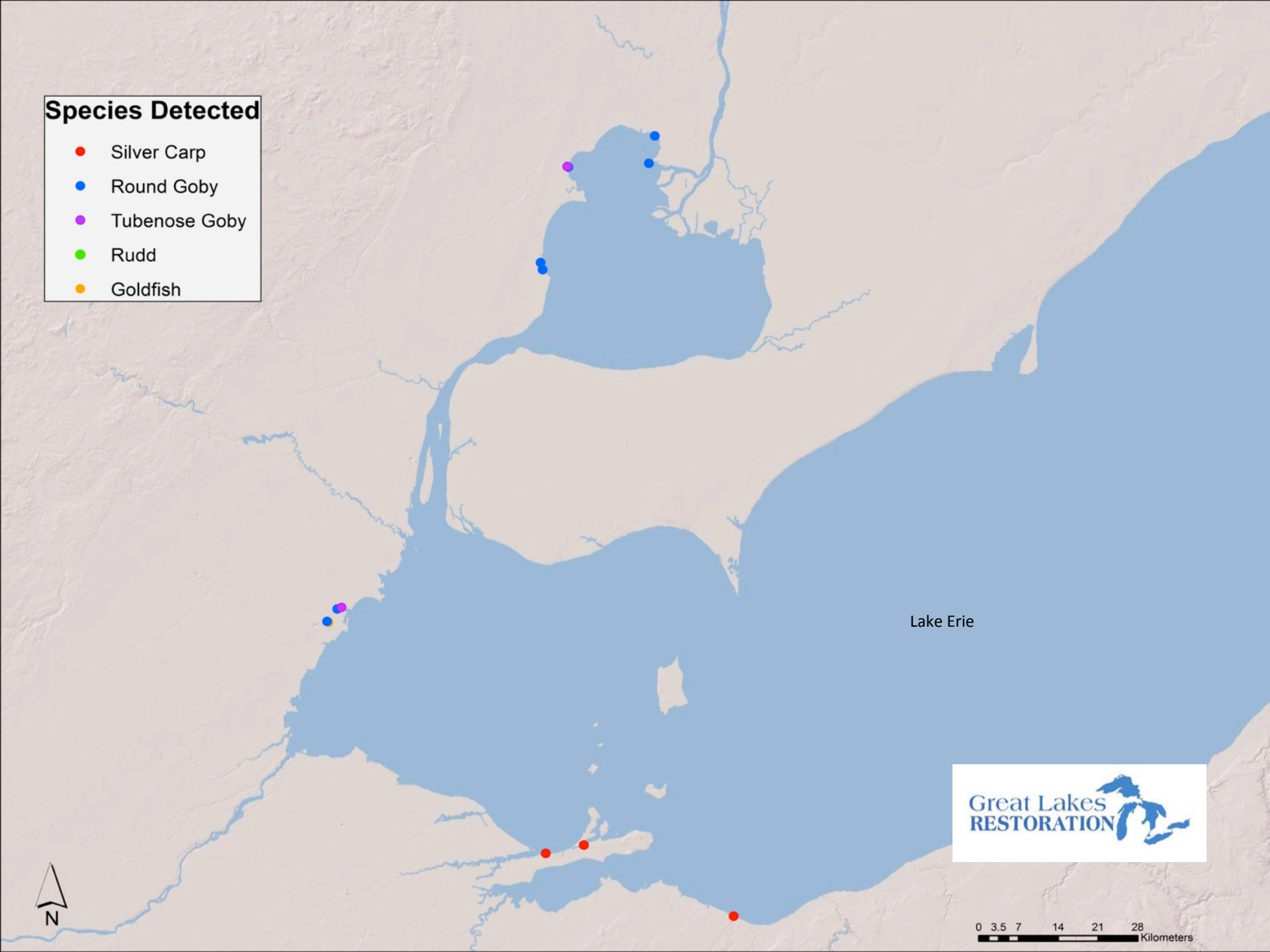
Targets selected with input from the Management Transition Board

Center for Sponsored Coastal Ocean Research

Great Lakes bait shop visits

Positive Detections




Species Detected
Silver Carp
Round Goby
Tubenose Goby
Rudd
Goldfish
Lake Erie
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N
0 3.5 7 14 21 28
Kilometers

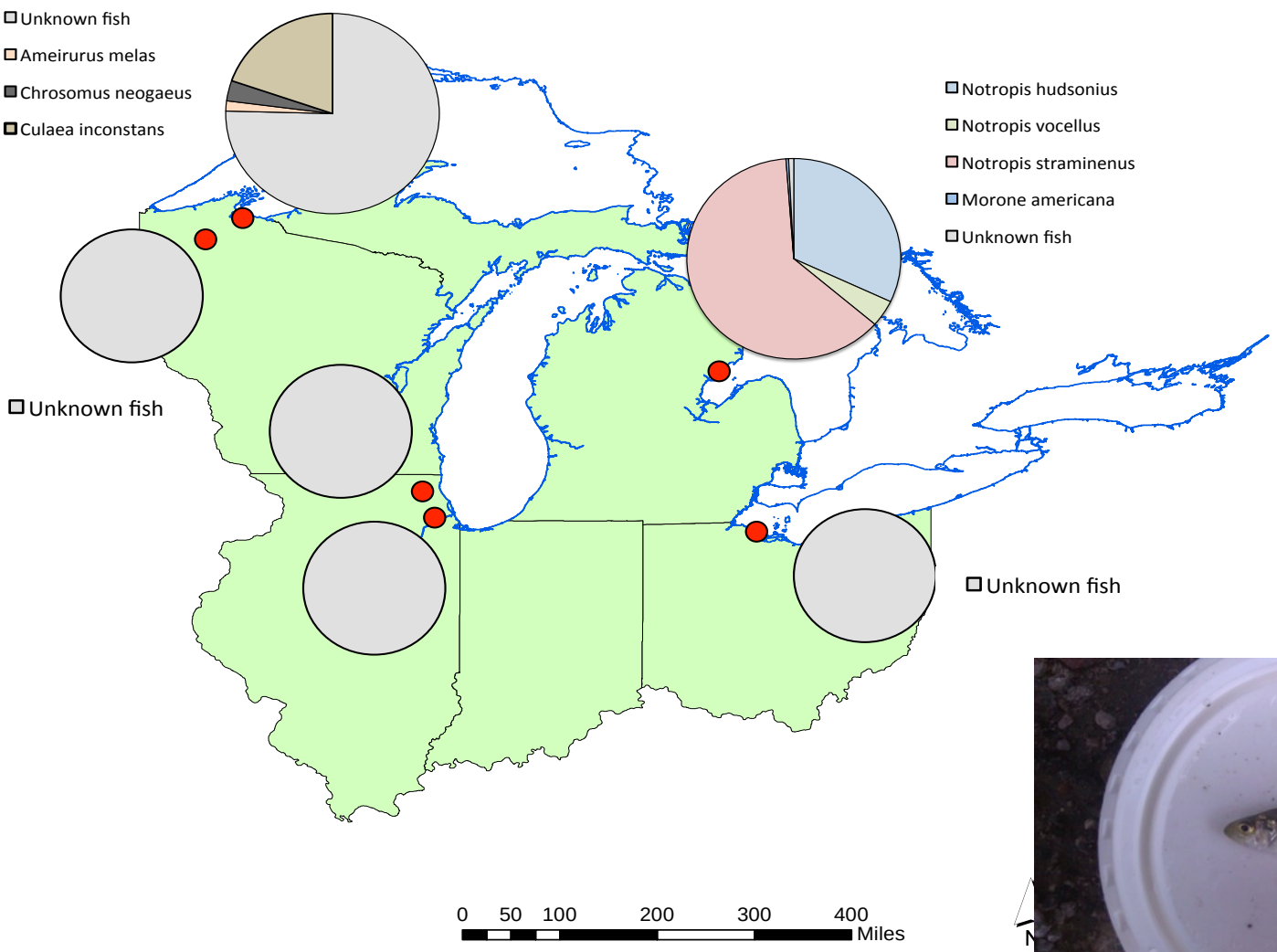
Bait trade eDNA results

- Second set of samples show goldfish presence
- Gobies entering regional bait trade
  - Perils of local bait production
- Silver carp positive detection. Same bait hauler transported on the same day to these three shops. From Southern US.
- In the same vicinity of positive silver carp eDNA detections in Lake Erie
- Overall 4.7% contamination rate of samples

A meta-genetics approach

- Active surveillance: “Is Asian carp DNA present in this sample?”
- Passive surveillance: “What fish species’ DNA are present in this sample and are there any DNA sequences identified to invaders?”
- Uses rapidly developing technology of high-throughput sequencing and computing power to clean, sort, and identify DNA to species

Six bait shops



Surveillance Synthesis

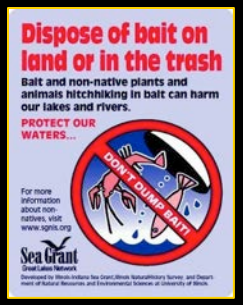
- Anglers do not want AIS, bait shops do not want AIS, natural resource managers do not want AIS, scientists do not want AIS
- Bait is a potential vector for introduction
- Profit margin on bait sales is small
- Potential for screening at the wholesale level
- Current work ignores sometimes illegal transport of bait from anglers and retailers (wild capture)

Outreach signage

- Document AIS signage during bait shop visits (Total = 525)
- Distribute window statics posters to all accepting retailers
- Re-visit ≈ 20% of shops after one year

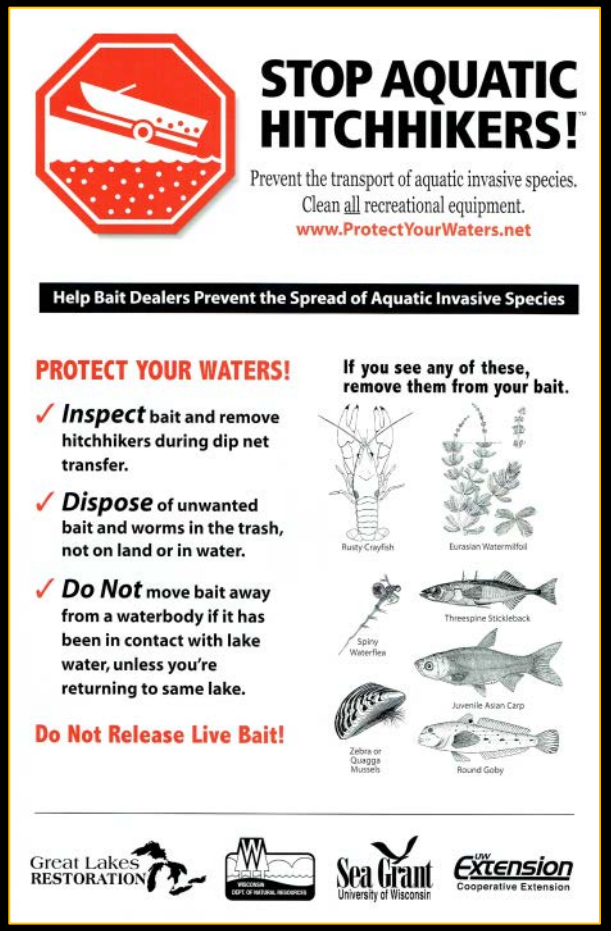
Thank you Pat Charlebois and Sarah Zack!

Signage Observations



Sign Retention

- 135 shops re-visited
- 54% of signs remained posted
- No differences between states or posted vs. handed out
- Retailer responses



Bait bucket stickers

Outputs

Nathan, LR, AR Mahon, ML Budny, and CL Jerde. Invasive species surveillance of the Great Lakes' commercial bait trade using environmental DNA. Conservation Biology. In revision.

Mahon AR, L Nathan, and CL Jerde. Use of meta-genetics to identify rare invasive species contaminants in the bait trade. Conservation Genetics Resources. Accepted

Mahon AR, CL Jerde, and L Waits. Investigating error and quality assurance in environmental DNA surveillance. Submitted

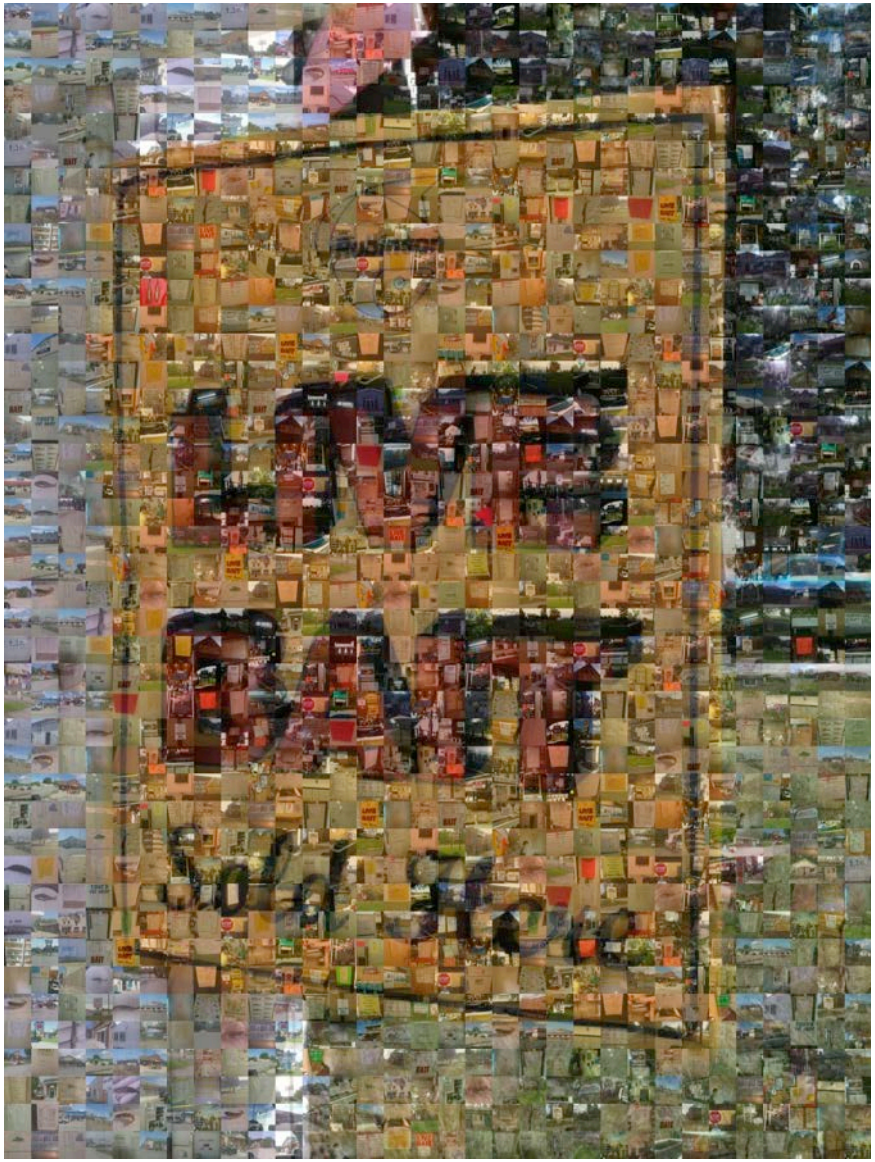
Nathan, LR, CL Jerde, M McVeigh, and AR Mahon. Preventing Great Lakes invasive species introductions through bait trade regulations and angler education. Submitted.

Budny, ML, CL Jerde, AR Mahon, MA Barnes, MP Galaska, JM Deines, WL Chadderton, and DM Lodge. Invasive species surveillance of the bait trade using environmental DNA. Nearing submission.

Mahon, AR, CL Jerde, M Galaska, CR Turner, WL Chadderton, and DM Lodge. Failure to detect: the influences of on-target DNA on environmental DNA surveillance in aquatic systems. Nearing submission

Invasive species surveillance of the bait trade. US Environmental Protection Agency. 2011 Great Lakes Restoration Initiative. COMPLETED

Environmental DNA surveillance for Asian carp in Chicago area bait shops. 2010 Great Lakes Restoration Initiative to Illinois Department of Natural Resources. COMPLETED



Thank you

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