Early Detection of Aquatic Invasive Species Using eDNA Technology

How MiCorps Volunteers Can Help!

Maggie Kronlein

PIs: Drs. Jo Latimore, Syed Hashsham, Erin Dreelin, and R. Jan Stevenson
Michigan State University

5/1/14

What is environmental DNA?

DNA released into the environment by an organism by:

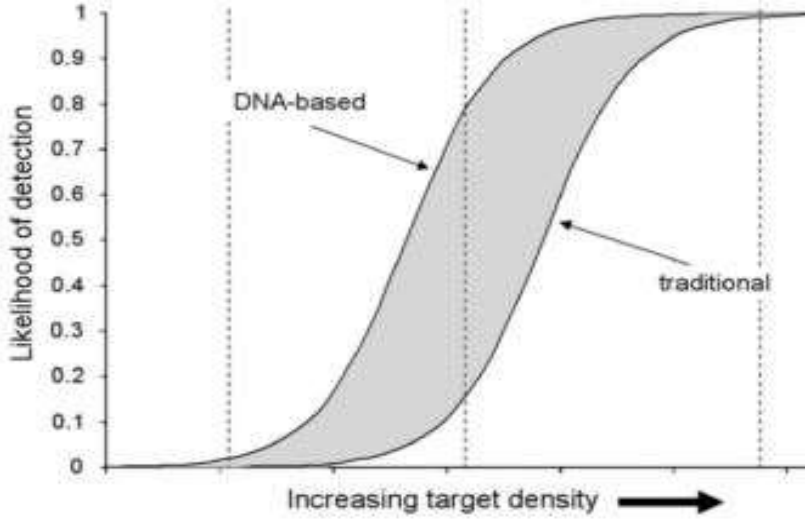
- Scraped-off tissue cells
- Feces or excrements
- Fish slime
- Reproduction: Eggs, veligers, juvenilles, larva, etc.
- Cells released after organism death/decay
- Free-floating DNA released from any cell lysis

eDNA can be used for:

- Validating presence or absence of an organism in an area
- Creating distribution maps to determine how wide-spread the invasion is
- Confirming results obtained via sightings

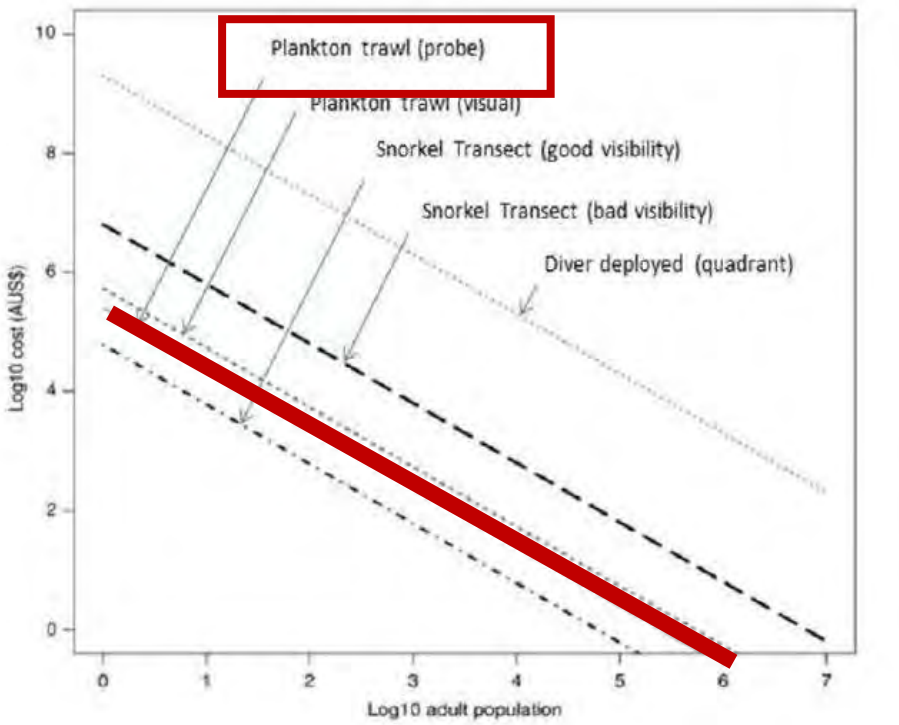
Why eDNA for detecting invaders?

1. **Sensitivity**
2. **Cost**



Above: Data from **Darling & Mahon 2011** depicting the increased likelihood of detection for lower target densities via DNA-based methods over tradition methods

Below: Data from **Hayes et al 2005** depicting the cost and 95% sensitivity of various green mussel identification methods



Project Overview

- eDNA-based monitoring
- Community-based sampling
- Smart phone-based reporting

Target Species

Hydrilla

[www.sms.si.edu]

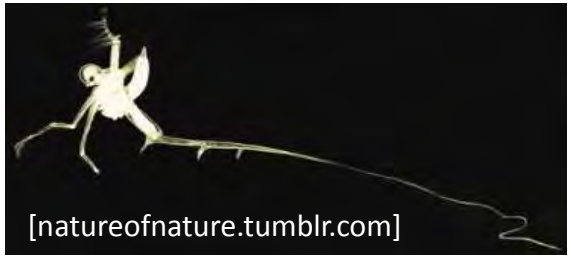
Northern Snakehead

[shopboblake.blogspot.com]

Golden Mussel

[http://biolo.bg.fcen.uba.ar/primerapagina.htm]

Fishhook Water Flea



[natureofnature.tumblr.com]

Killer Shrimp

[Michael Grabowski]

Daphnia cristata

[Medinis Biologi]

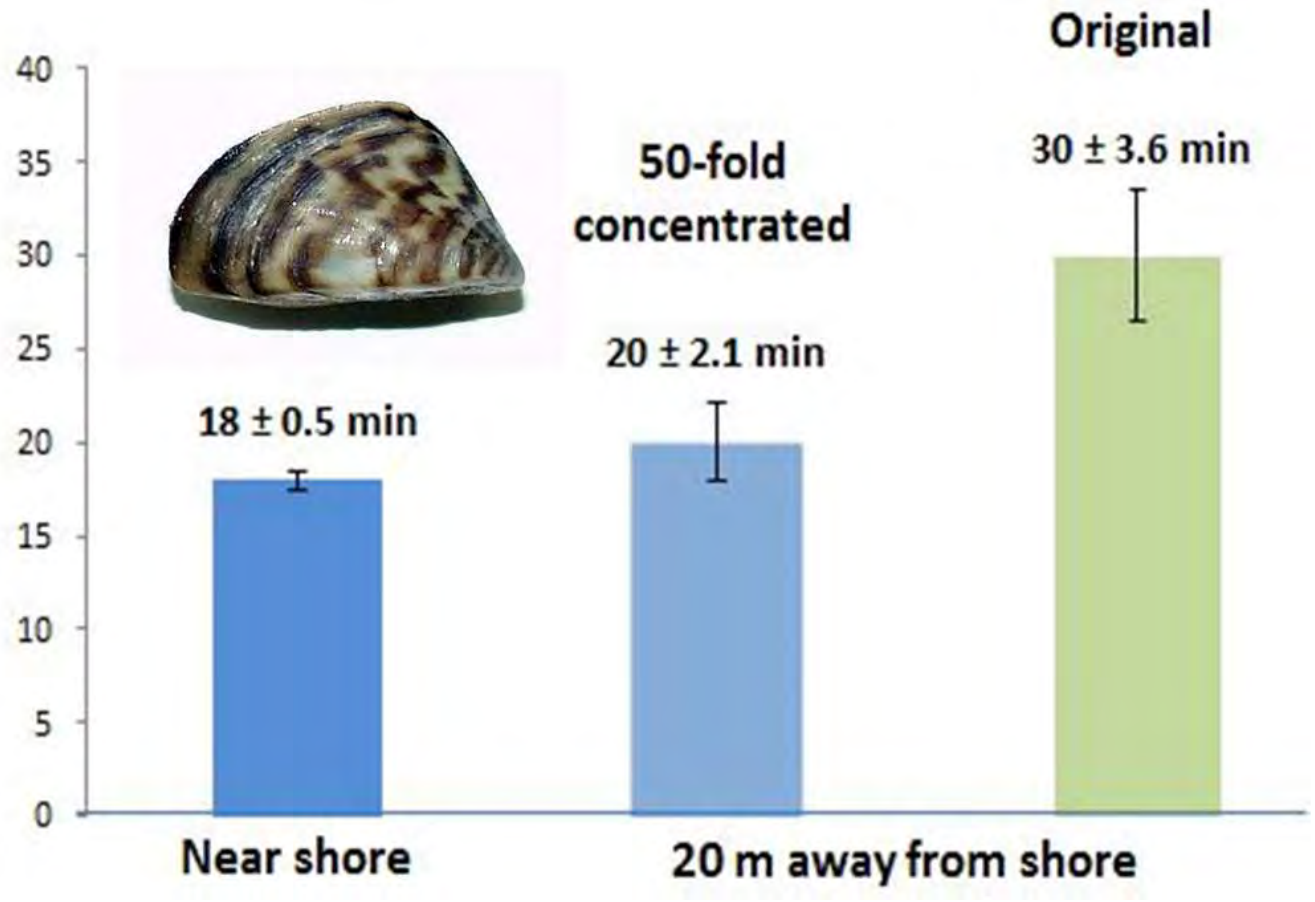
Gene-Z™ for detecting eDNA

Decentralized detection of gene targets in a field setting!

Gene-Z uses microfluidic chips that allow easy dispensing of samples into reaction wells.

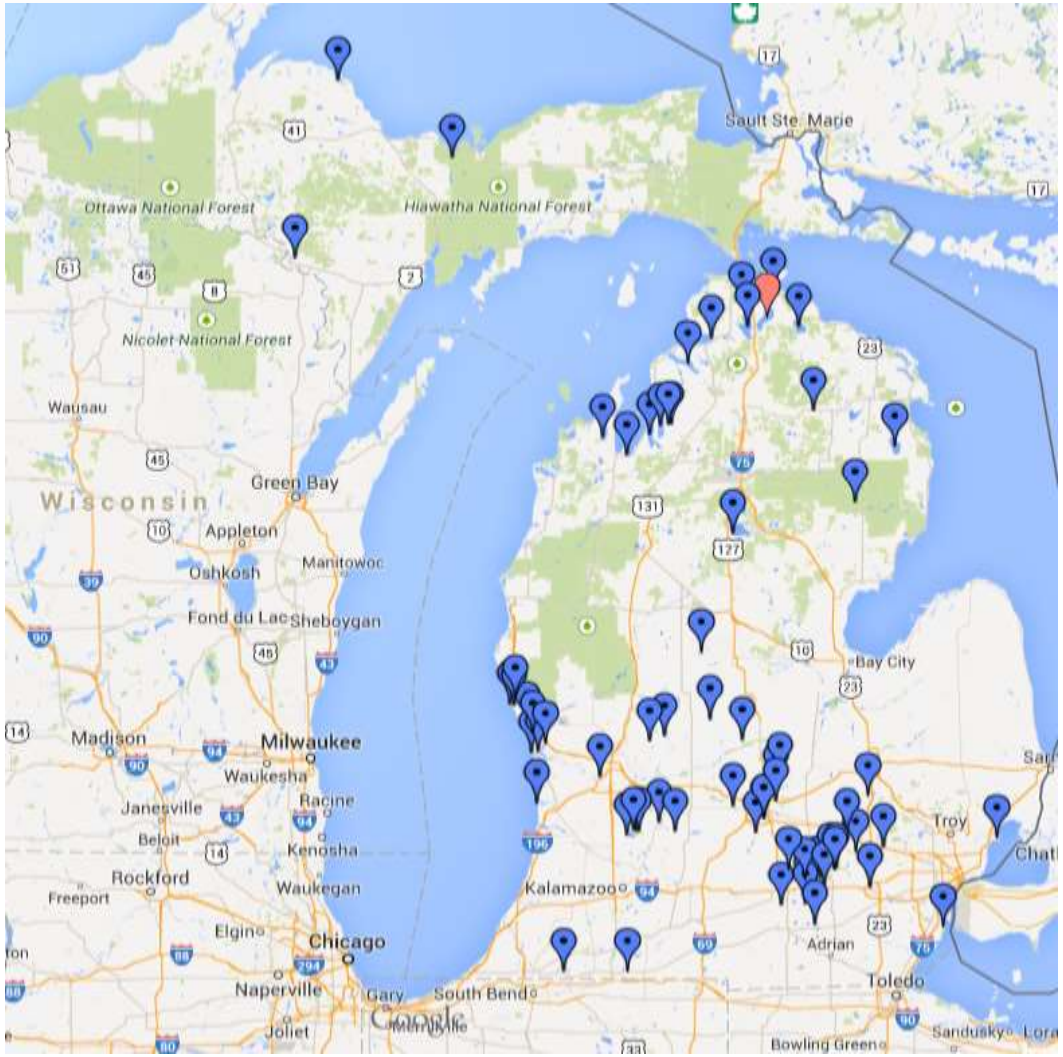
Preliminary eDNA results

Zebra Mussel primer sets in 1 µl lake water samples



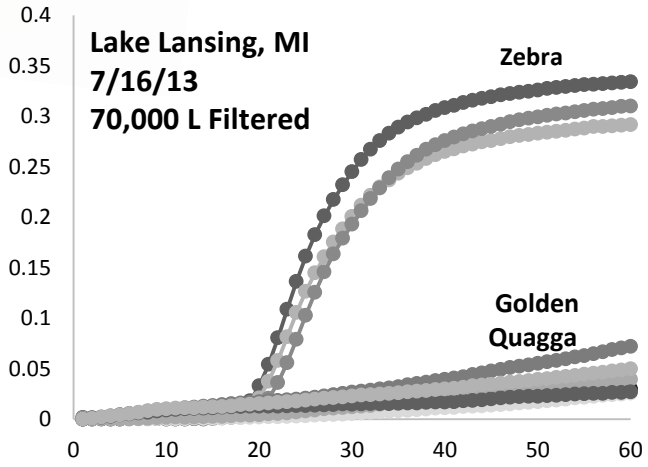
Minimal/ no sample processing is required at high abundances!

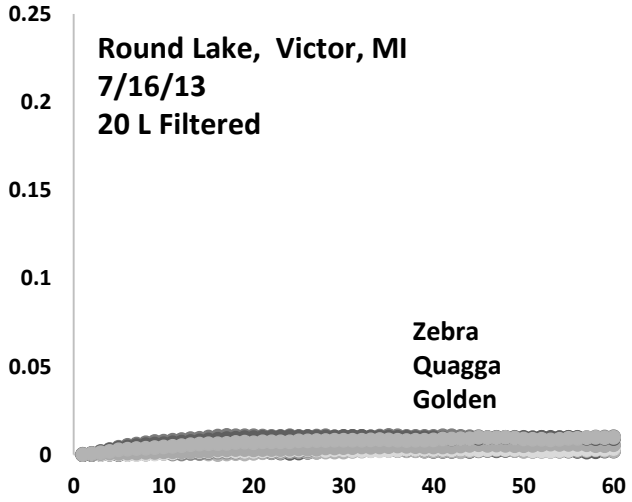
Sampled locations

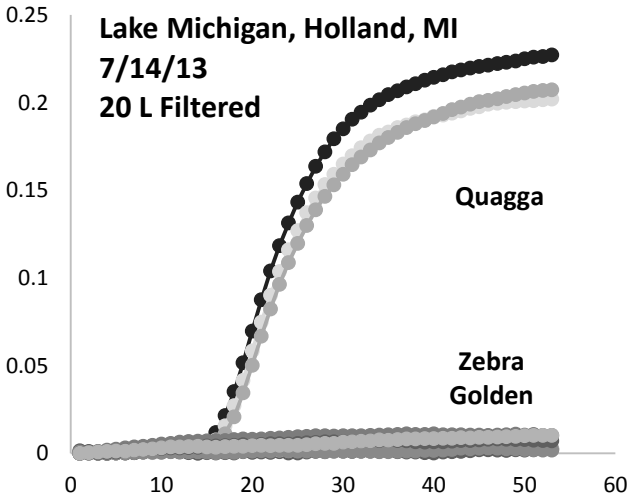


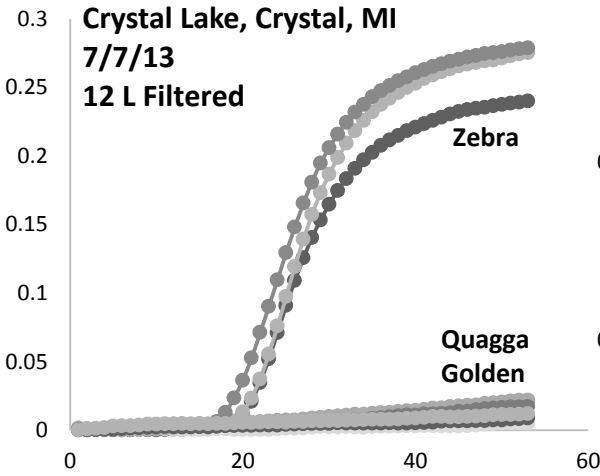
Unfortunately, a lot of these samples are from fall and winter. Results were not as sensitive as they may have otherwise been.

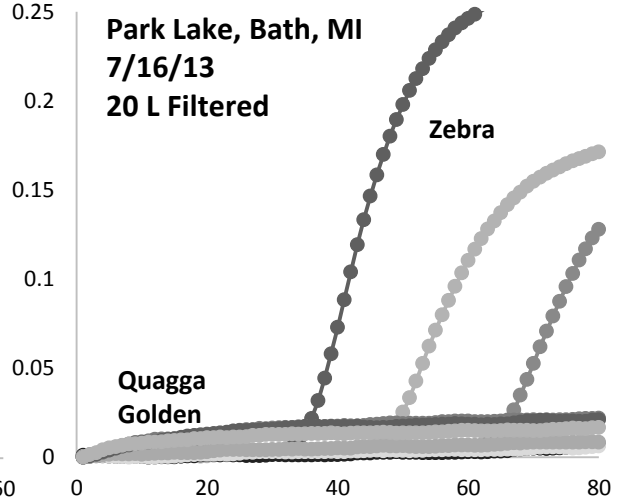
Some invasive mussel results











How can volunteers help?

We need help collecting samples!

<u>Two Types of Samples are collected:</u>

1. Collect 1 Liter of lake water sample
2. Filter 20 Liters of water through a filter funnel

The Sampling Kit

- One 1 Liter Filtration Bottle
- One 1 Liter water sample bottle
- One Sampling Information Sheet
- One Sampling Protocol Sheet
- One 50 mL Tube
- One Shipping Box with Prepaid Postage and Mailing Address

Just place samples in freezer overnight, then ship back the next day!

Samples will be tested for:

Potential Invasive Species

- Golden Mussel
- Northern Snakehead
- Hydrilla
- Daphnia cristata
- Killer Shrimp

We can also add species if there is a particular one you are interested in!

Present Invasive Species

- Spiny Waterflea
- Fishhook Waterflea
- Sea Lamprey
- Round Goby
- Zebra Mussel
- Quagga Mussel
- Rusty Crayfish
- Asian Clam
- New Zealand Mudsnail
- Rock Snot
- *Cylindrospermopsis raciborskii*
- Starry stonewort

Emailed results!

General Information	
Sample Submitted By:	**John Smith**
Lake Name:	**Lake Lansing**
Sample Collected at:	**Lake Lansing Park South Meridian Township, MI**
Sampling Date:	**10/1/2013**
Sample Types Submitted:	**1 Bottles of Pure Lake Water 1 50 mL tube with Filtrate**
Sample Analyzed by:	**Maggie Kronlein**
Analysis Date:	**10/3/13**

Emailed results!

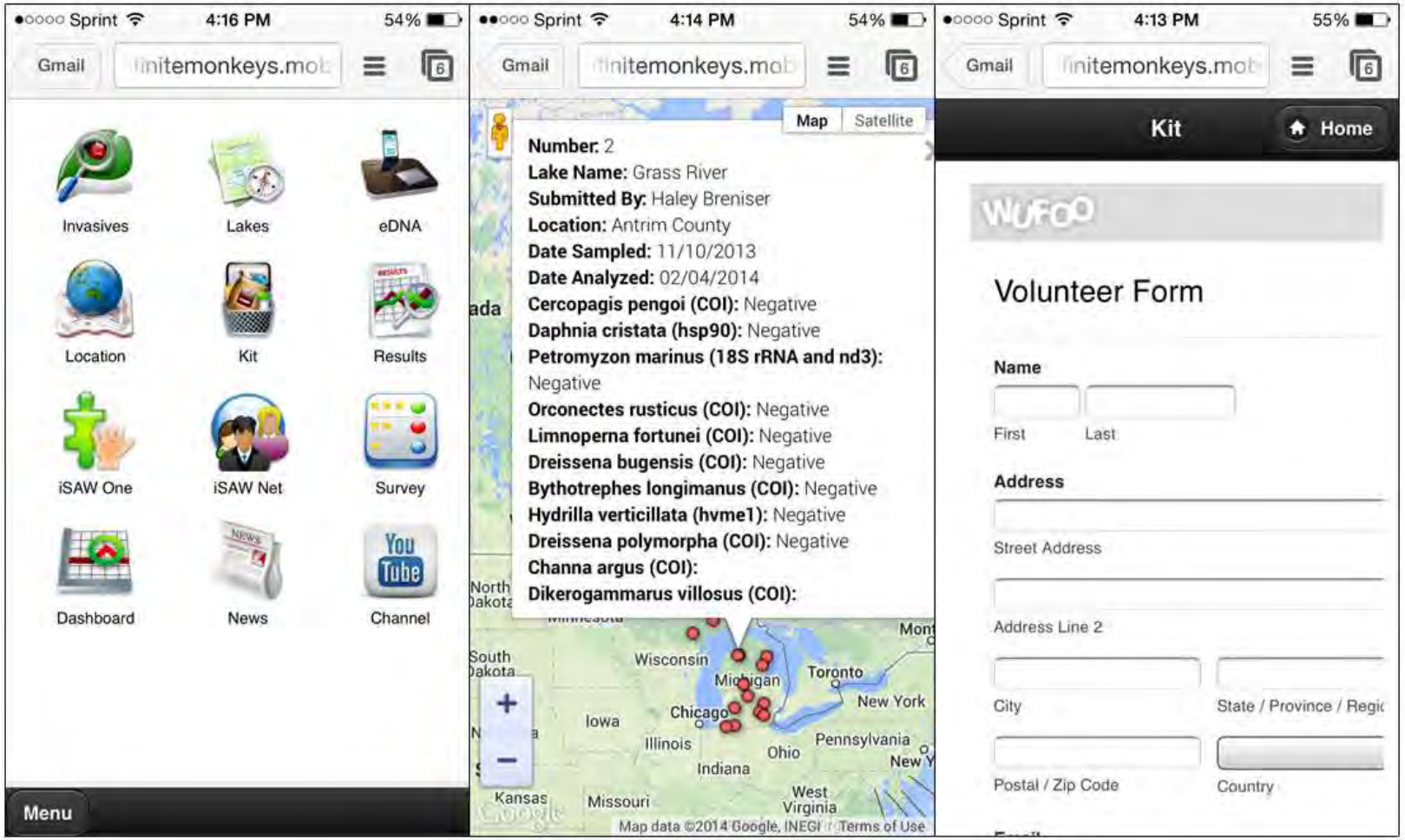
Invasive Species Results		
Common Name	**Scientific Name**	**Present/Absent**
Golden Mussel	*Limnoperna fortunei*	Not Detected
Northern Snakehead	*Channa argus*	Not Detected
Hydrilla	*Hydrilla verticillata*	Not Detected
Daphnia	*Daphnia cristata*	Not Detected
Killer Shrimp	*Dikerogammarus villosus*	Not Detected
Zebra Mussel	*Dreissena polymorpha*	Detected
Quagga Mussel	*Dreissena bugensis*	Not Detected
Fishhook Waterflea	*Cercopagis pengoi*	Not Detected
Spiny Waterflea	*Bythotrephes longimanus*	Not Detected
Sea Lamprey	*Petromyzon marinus*	Not Detected
Round Goby	*Neogobius melanostomas*	Not Detected
Rusty Crayfish	*Orconectes rusticus*	Not Detected

What comes after a positive test?

- Input eDNA results into the iSAW database for public access
- Results can assist in management / screening
  - Should we be on the lookout for invaders in the first place?
- Allow for the validation of field sampling studies
- Help determine a level of infestation (Low, Moderate, High)
- Determine the distribution of invaders in an area
- Gene-Z™ devices will be distributed to individual in MiCorps!

Early detection is crucial to successful eradication!

iSAW for results and reporting



Almost Ready!

Acknowledgements

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Special Thanks to the eDNA Team:
Dr. Robert Stedtfeld, Cathrine Kronlein, Tiffany Stedtfeld, and Michael Stevens.