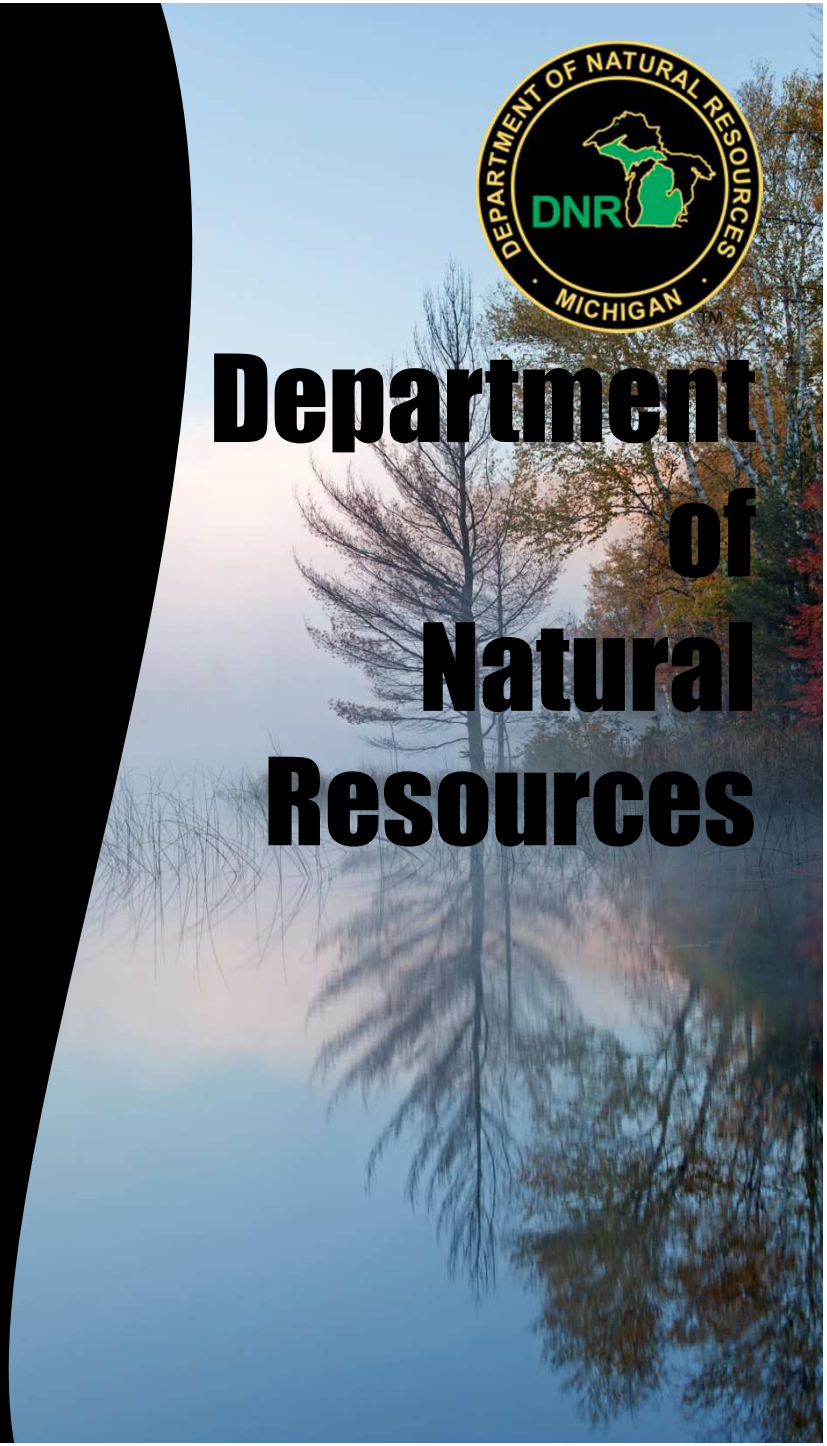
eDNA and the Manager's Dilemma

Cornell University

September 21, 2017

Tammy J. Newcomb, Ph.D.
Senior Water Policy Advisor, Executive Division
newcombt@michigan.gov; 517-284-5832

Seth Herbst, Ph.D.
Invasive Species Coordinator, Fisheries Division



Understanding the Tension

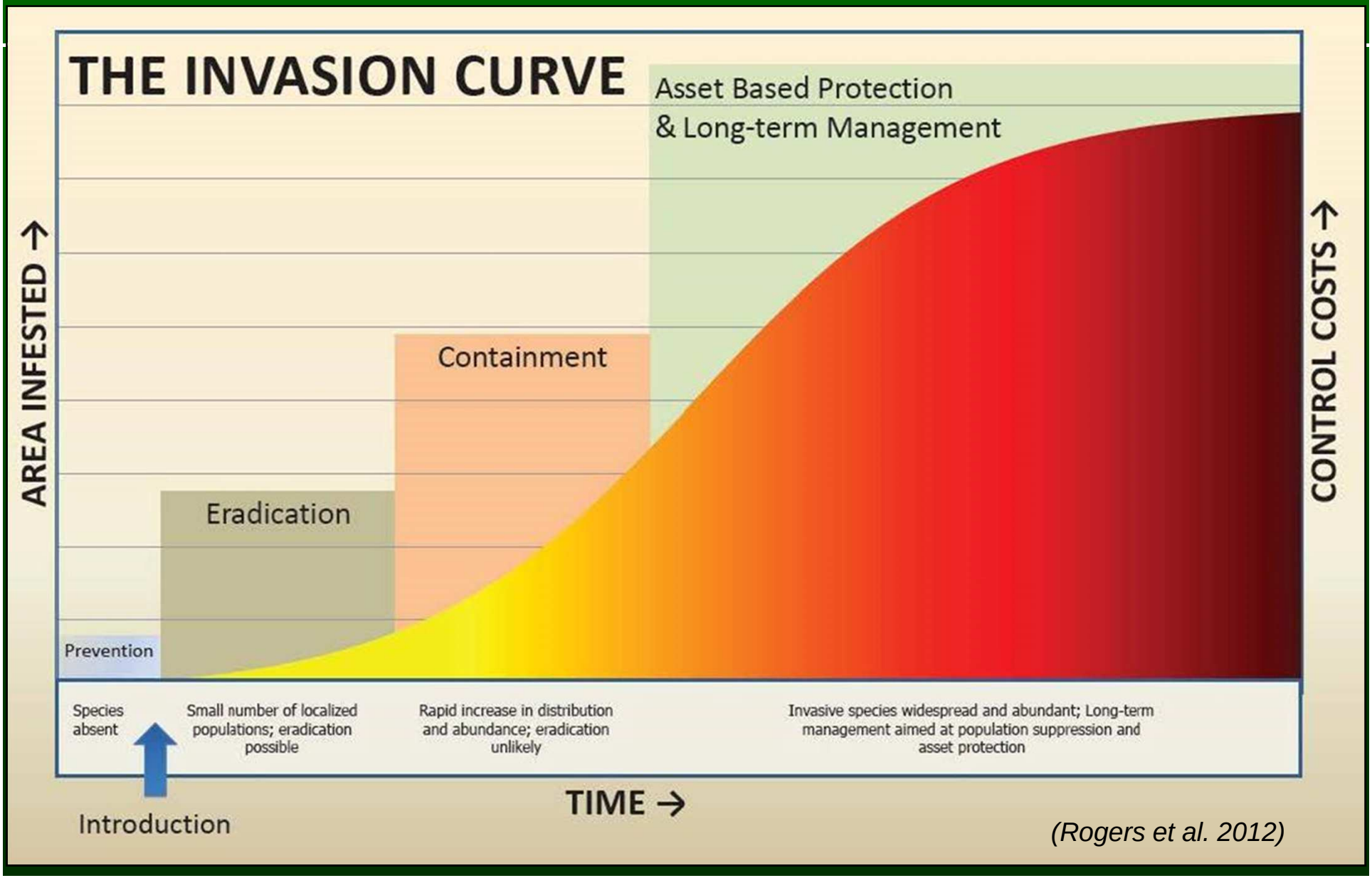
- Technology through time
- Tool experience and deployment
- Frequency of use & specialization

Understanding the Tension

An accelerated pace from development to implementation to policy can result in bad management decisions, bad policies, and regrettably bad laws that are difficult to reverse.

How can we be thoughtful and proactive in the promise of eDNA technology?

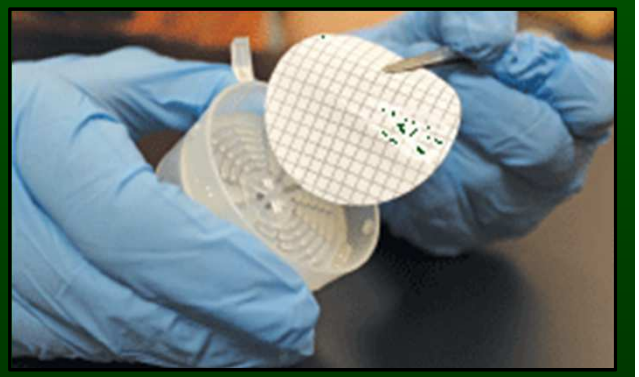
Adapting to Emerging Detection Technologies



(Rogers et al. 2012)

Adapting to Emerging Detection Technologies

- Environmental DNA methods are highly sensitive for species detections at low abundance
- Learning curve for new technology and interpretation of results
- eDNA positive doesn't always mean a live fish.....



Adapting to Emerging Detection Technologies

- What does a positive finding mean?
- What is the uncertainty around the results?
- How much will it cost?
- What are the implications to the finding?

RISK & UNCERTAINTY

Risk & Uncertainty to Resource Managers in Michigan

- **High Risk** = compelled to action, large costs, social outcry, impediment/detriment to programs

- **Low Risk** = may or may not require action, cost is within reason, public doesn't care, no consequences to programming

Risk & Uncertainty to Resource Managers in Michigan

- **High Uncertainty** = protocols unknown, presence of eDNA suspect, no known vectors or they are unknown or many, unsure how long the eDNA has been around

- **Low Uncertainty** = protocols are trusted/tested, good idea of how it got there, vectors can be identified, reasonable estimate of how long its been there

Examples of Michigan's Use of eDNA

Monitoring & Assessment

1. Beach monitoring public health and safety (high risk; low uncertainty)
2. Fish community assessments for invasive species (low risk; high uncertainty)
3. Early detection for silver and bighead carp (high risk; high uncertainty)

Response Actions

4. Grass carp in Lake Erie (low risk; low-medium uncertainty)
5. Red swamp crayfish (low risk; high uncertainty)

Law Enforcement

6. Field detection kits for bighead and silver carp (low risk; low-medium uncertainty)

Implementing qPCR Technology for Fecal Indicator Bacteria (FIB)

Water Quality Standards based on *E. coli*

Dr. Shannon Briggs
Michigan Department of Environmental Quality

Change in Measurement

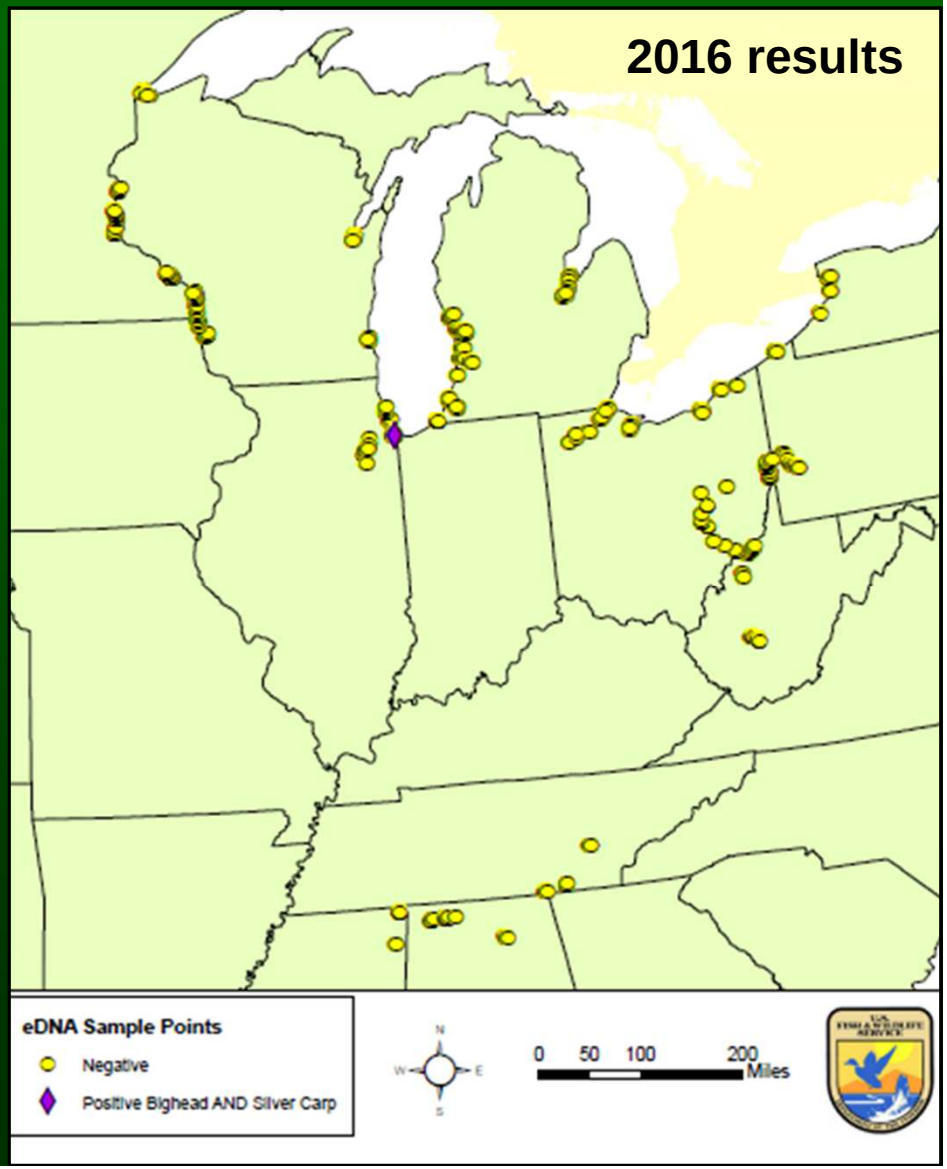
- Measures different things
- Culture based methods require a minimum of 18 hours
- qPCR techniques 2-4 hours

Multi-Lab Validation Study for draft Method C (qPCR & *E. coli*)

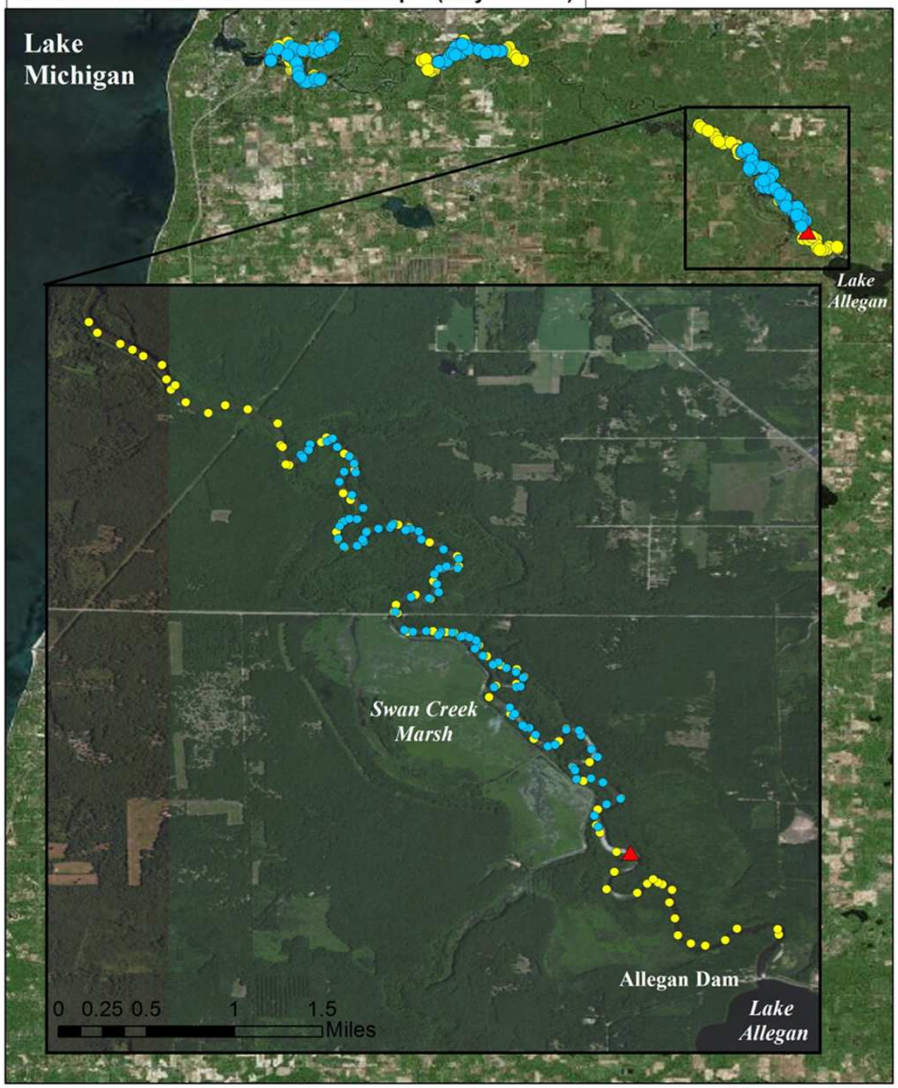
- Determined that labs and method produced consistent results
- Working with EPA on standard
- Plan to implement in 2018
- Safer beaches!

Early Detection for Bighead & Silver Carp

- Coordination with USFWS
- Target high risk habitats



Bighead and Silver Carp eDNA Early Detection Results:
Kalamazoo River
Sampling Period: Weeks of June 1 and July 7, 2014
Number of Samples Collected: 400
Number of eDNA Positives: Silver Carp 1 (July 7 event)

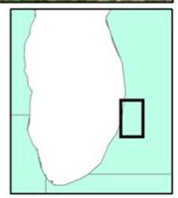


eDNA Sample Points

- Positive Silver Carp
- Negative (July)
- Negative (June)

N W E S

0 0.5 1 2 3 4 Miles



DEPARTMENT OF NATURAL RESOURCES · DNR · MICHIGAN

Response to Positive eDNA Finding

ONSE POSSIBILITIES FOR THE e-DNA FINDING IN THE KZOO RIVER		
Response Options	**Pros**	**Cons**
1. In-river response limited to communication and awareness. 2. Increase awareness for the potential for a silver carp in the river through local and media messaging. 3. Re-sample for eDNA to see if there is a local hot spot to target for action. 4. Re-consider response with results of eDNA re-sampling.	1. Cost: staff time for communication and messaging is minimal; USFWS will cover all costs for eDNA sampling 2. In line with other Great Lakes agency eDNA response (e.g. Green Bay, WI) 3. Demonstrates prudent response in use of eDNA. 4. Engages public in assistance in detection. 5. Will not disrupt salmon fishing in Kalamazoo River	1. May not be perceived as aggressive enough. 2. May miss a fish if one is out there.
1. Send one electrofishing boat out to go up and down the river in the area of likely places to see if a jumping response is stimulated showing a silver carp. 2. Increase awareness of a potential silver carp in the river through local and media messaging. 3. Re-sample for eDNA to see if there is a local hot spot to target for action. 4. Re-consider response with results of eDNA re-sampling.	1. Cost: staff time for travel, e-fishing approx $2000; USFWS will cover all costs for eDNA sampling 2. Demonstrates prudent response in use of eDNA and the need for multiple lines of evidence. 3. Engages public in assistance in detection.	1. May not be perceived as aggressive enough. 2. May still miss a fish if one is out there; could give an indication of a problem as a second line of evidence. 3. Will be fairly disruptive to anglers fishing that stretch of the river.
1. Send out a full response similar to St. Joe Exercise; several crews, block nets; invoke Mutual Aid Agreement; . 2. Increase awareness for the exercise and the need for reporting through local and media messaging. 3. Do not re-sample for eDNA to see if there is a local hot spot to target for action.	1. Cost: staff time for travel, e-fishing approx $75,000; USFWS will cover all costs for eDNA sampling 2. Demonstrates aggressive response to eDNA results. 3. No further eDNA results to work from. 4. Could give an indication of a problem as a second line of evidence.	1. May be perceived as disproprtionately aggressiveby partners. 2. May still miss a fish if one is out there; could give an indication of a problem as a second line of evidence. 3. Will be very disruptive to anglers fishing that stretch of the river and will require a river closure. 4. Costs may be disproportional to desired results. 5. Sets future expectations to this level of response for eDNA evidence, regardless of the signficiance of the findings.
1. Send out a full response similar to St. Joe Exercise; several crews, block nets; invoke Mutual Aid Agreement; . 2. Increase awareness of the potential for a silver carp in the river through local and media messaging. 3. Re-sample for eDNA to see if there is a local hot spot to target for additional response action.	1. Cost: staff time for travel, e-fishing approx $75,000; USFWS will cover all costs for eDNA sampling 2. Demonstrates aggressive response to eDNA results. 3. Second sampling eDNA results to work from will help guide additional efforts. 4. Could give an indication of a problem as a second line of evidence.	1. May be perceived as disproprtionately aggressive by partners. 2. May still miss a fish if one is out there; 3. Will be very disruptive to anglers fishing that stretch of the river and will require a river closure. 4. Costs may be disproportional to desired results. 5. Additional eDNA results could then require a second effort. 6. 5. Sets future expectations to this level of response for eDNA evidence, regardless of the signficiance of the findings.
best case scenario, eDNA results from a second sampling will come back at the end of October.		

Communication Regarding Response Plan

Asian Carp eDNA positive result Communiation				
Communication Recipient	**Message**	**By Whom**	**By When**	**Status**
Newcomb, Dexter	eDNA Results	USFWS	10/02/2014	complete
Creagh, Moritz, Golder, VanDyke, Knapp	potential response options & timeline	Newcomb/Dexter	10/02/2014	complete
USFWS	what we plan to do -	Dexter	10/03/2014	complete
Lake Michigan Committee	Phone call, response plan	Wesley	Tuesday a.m. (10/7/2014)	
Fisheries Division	email w/briefing document embedded	Popoff	Tuesday a.m. (10/7/2014)	complete
DEQ/OGL	verbal talking points	Creagh	QOL ex-com meeting	complete
Asian Carp Regional Coordinating Committee: this will get to all regional partners and federal	email w/briefing document embedded	Newcomb	Tuesday a.m. (10/7/2014)	complete
Natural Resources Commission	email w/briefing document	Knapp	Tuesday a.m. (10/7/2014)	complete
Legislative Members	select- email w/briefing document; all - press release	VanDyke	Tuesday a.m. (10/7/2014)	complete
Congressional Members	email w/briefing document and press release (Eric Brown)	VanDyke	Tuesday a.m. (10/7/2014)	complete
General Media	press release	Golder	9:30 Tuesday	complete
Lake Michigan Citizens Advisory Committee	email with briefing document embedded and press release	Wesley	uesday 9:00 a.m. (10/7/2014)	complete
General Public	eDNA Results via USFWS posting to website	USFWS	Wednesday a.m.	
1836 tribes	electronic w/press release	Knapp	Tuesday a.m. (10/7/2014)	complete
Council of Great Lakes Governors	Phone call/follow up with press release	Newcomb	Tuesday a.m. (10/7/2014)	complete
Waterways Commission	email with briefing document embedded	Knapp	Tuesday a.m. (10/7/2014)	complete
Gun Lake, Huron Pottawattomi	phone call w/briefing document follow up	Knapp	Tuesday a.m. (10/7/2014)	complete

Status and Trends Community Assessments
Dr. Kim Scribner, MSU

- Evaluation of using eDNA for added early detection of AIS during standard fisheries surveys
  - Community assessment with metabarcoding techniques

- Compare eDNA detection with captures from traditional netting survey
  - Building body of evidence to assist with result interpretation

Great Lakes RESTORATION

DEPARTMENT OF NATURAL RESOURCES · DNR · MICHIGAN

Fisheries Division Status and Trends Sampling Sites

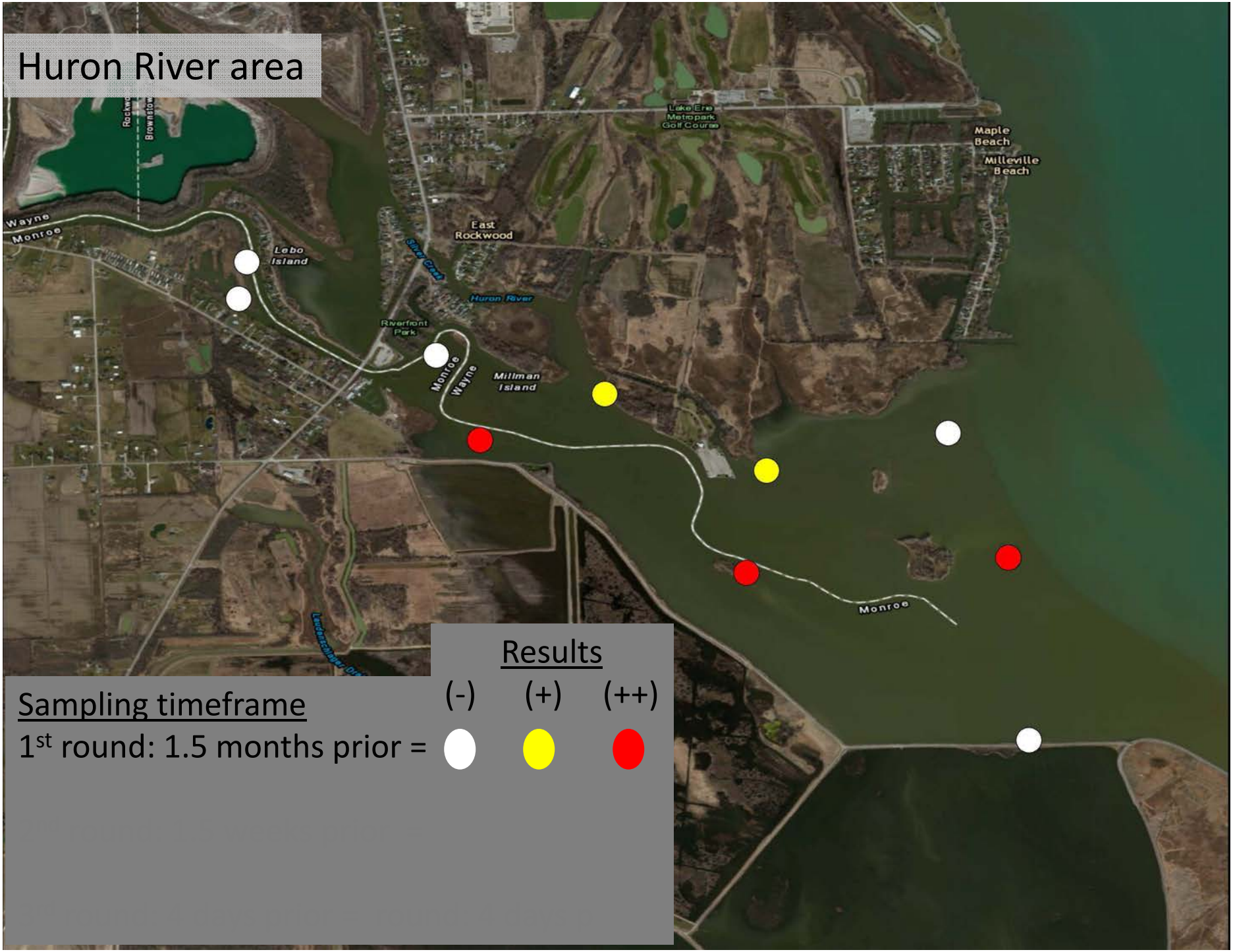
and Paired eDNA Sampling Sites

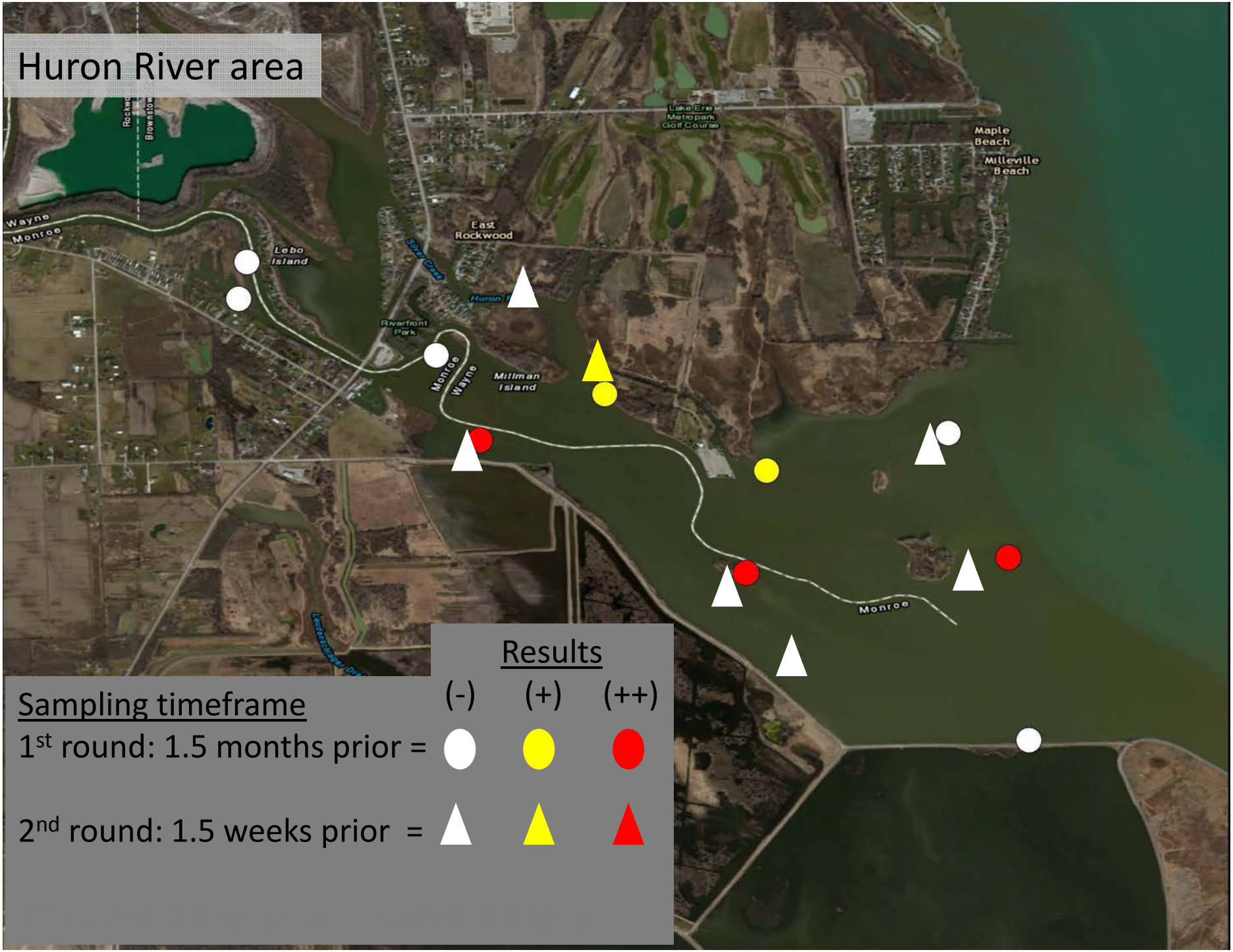
= benthic collection

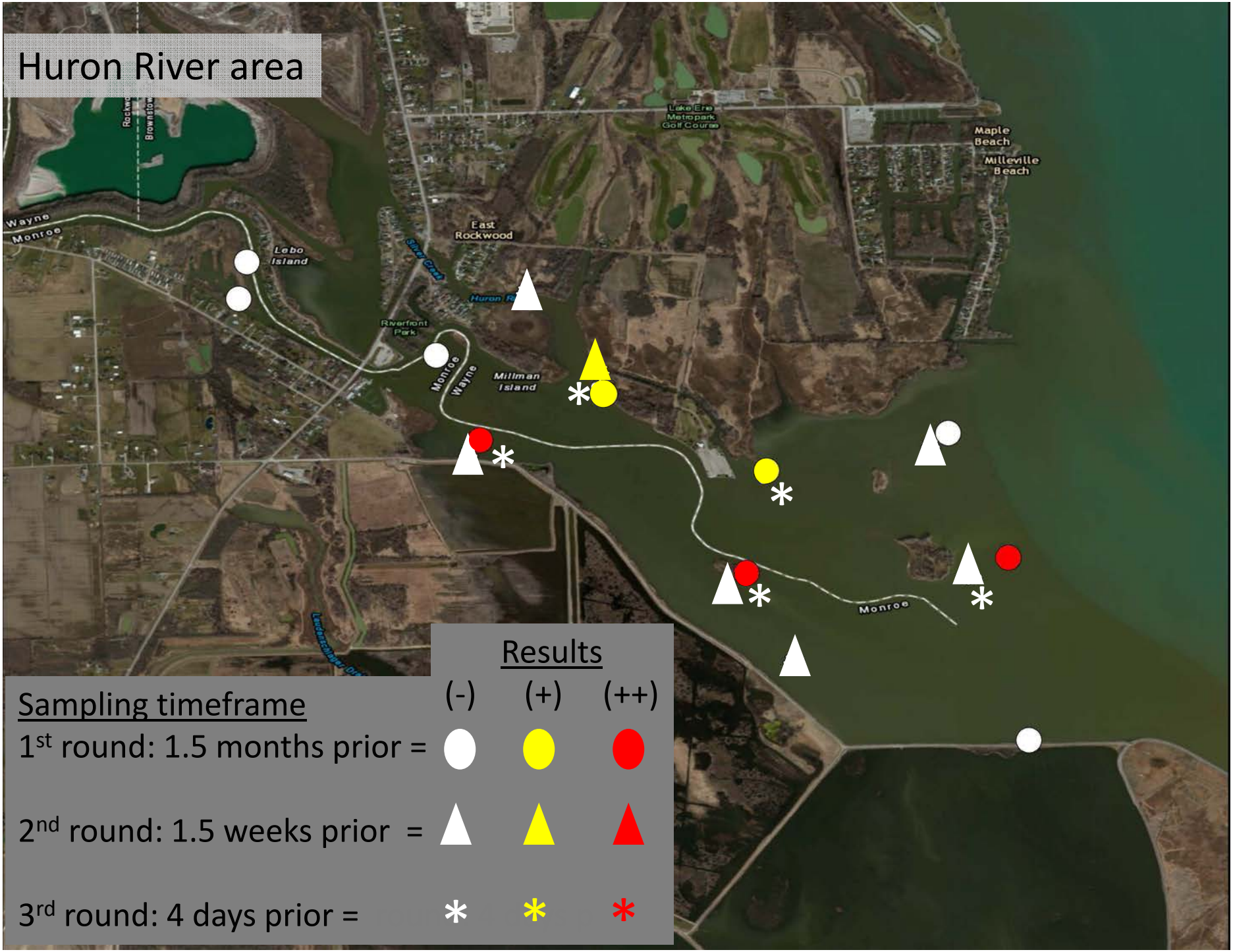
= surface collection

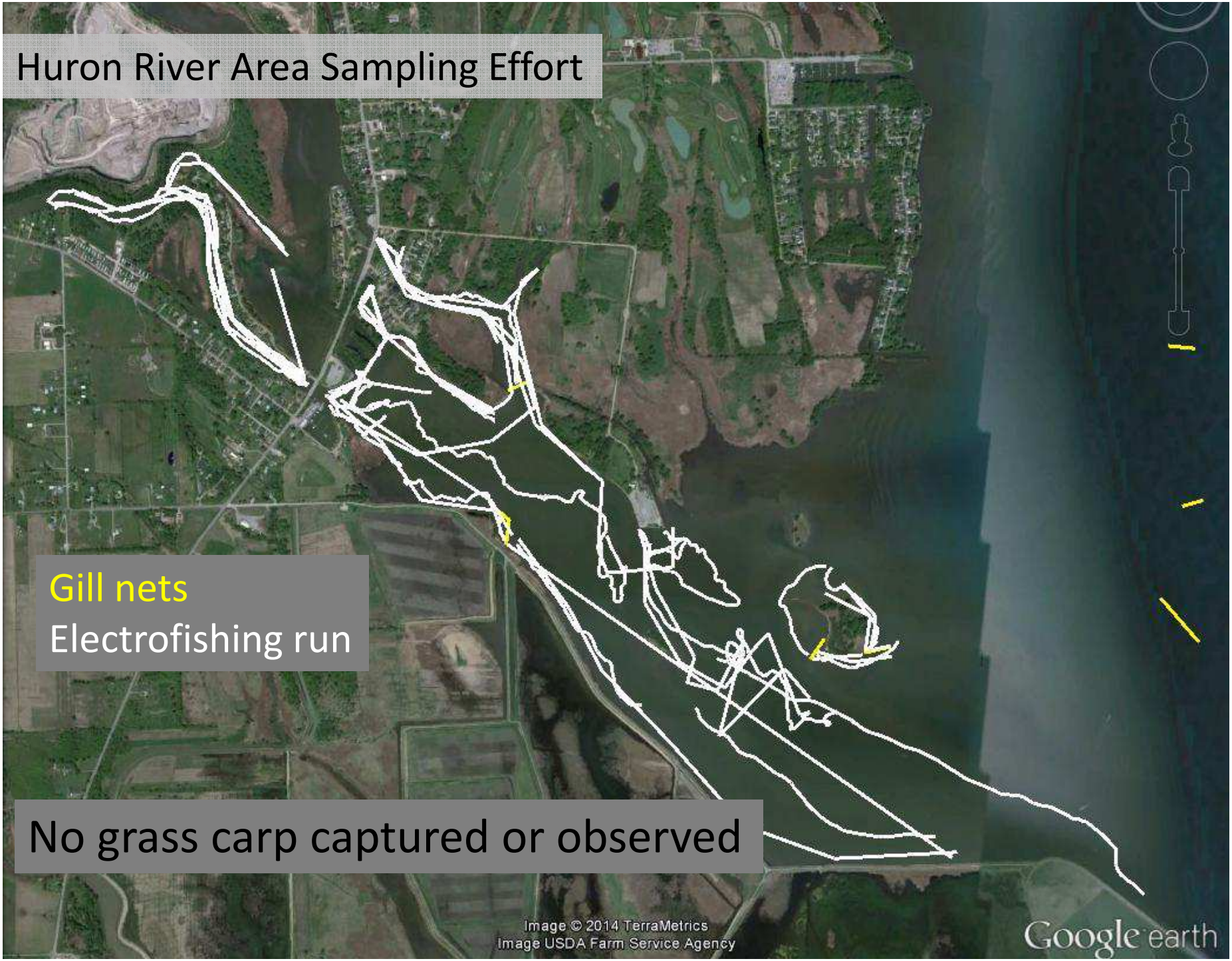
Grass Carp Response in Lake Erie
Dr. Andy Mahon, Central Michigan University

- Pilot use of eDNA for targeted removal efforts
- Lake Erie Grass Carp Response Exercise
- Grass carp eDNA results exhibited temporal variation


Huron River area
Lake Erie Metropark Golf Course
Maple Beach
Milleville Beach
Wayne
Monroe
Lebo Island
East Rockwood
Silver Creek
Huron River
Riverfront Park
Monroe
Wayne
Millman Island
Monroe
Results
(-)
(+)
(++)
Sampling timeframe
1st round: 1.5 months prior =


Huron River area
Lake Erie Metropark Golf Course
Maple Beach
Milleville Beach
East Rockwood
Wayne
Monroe
Lebo Island
Silver Creek
Riverfront Park
Millman Island
Monroe
Wayne
Monroe
Results
(-)
(+)
(++)
Sampling timeframe
1st round: 1.5 months prior =
2nd round: 1.5 weeks prior =


Huron River area
Lake Erie Metropark Golf Course
Maple Beach
Milleville Beach
East Rockwood
Wayne
Monroe
Lebo Island
Riverfront Park
Millman Island
Monroe
Wayne
Monroe
Results
(-)
(+)
(++)
Sampling timeframe
1st round: 1.5 months prior =
2nd round: 1.5 weeks prior =
3rd round: 4 days prior =


Huron River Area Sampling Effort
Gill nets
Electrofishing run
No grass carp captured or observed
Image © 2014 TerraMetrics
Image USDA Farm Service Agency
Google earth

Lessons Learned to Date: Advice for Resource Managers

- Identify potential uses and directions and communicate with researchers
- Candidly discuss concerns
- Embrace the ambiguity – plan for outcomes
- Engage in dialogue for advancement
- Foster the relationships – find the trusted leaders that can translate

Lessons Learned to Date: Suggestions for Research Scientists

- Aim to integrate science to relevant outcomes of interest/need
- Listen to the concerns and integrate into process
- Strive to reduce the ambiguity
- Work at the dialogue
- Foster the relationships – find the trusted leaders that can translate

Desired Outcomes

- New tool in the tool box
- Continued refinement
- Value added for resource managers
- Smart policy implementation
- Regional coordination?