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

THE INVASION CURVE

- Species absent
- Small number of localized populations; eradication possible
- Rapid increase in distribution and abundance; eradication unlikely
- Invasive species widespread and abundant; Long-term management aimed at population suppression and asset protection

- Prevention
- Eradication
- Containment
- Asset Based Protection & Long-term Management

Area Infested → Control Costs

Time →
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!

Our Network of Michigan qPCR Labs

- Marquette Area Wastewater Treatment Plant
- Lake Superior State University
- Northwest Michigan Regional Lab
- NPS-Sleeping Bear Dunes
- Central Michigan Health District
- Ferris State University
- Saginaw County Dept of Public Health
- Saginaw Valley State University
- Grand Valley State University
- Hope College
- Kalamazoo County Health & Community Services
- Michigan State University
- USGS- Lansing
- Oakland County Health Department
- Oakland University
Early Detection for Bighead & Silver Carp

- Coordination with USFWS
- Target high risk habitats

2016 results
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)

Lake Michigan
Swan Creek Marsh
Allegan Dam
Lake Allegan

eDNA Sample Points
- Positive Silver Carp
- Negative (July)
- Negative (June)
## Response to Positive eDNA Finding

<table>
<thead>
<tr>
<th>Response Options</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. In-river response limited to communication and awareness.</td>
<td>1. Cost: staff time for communication and messaging is minimal; USFWS will cover all costs for eDNA sampling</td>
<td>1. May not be perceived as aggressive enough.</td>
</tr>
<tr>
<td>2. Increase awareness for the potential for a silver carp in the river through local and media messaging.</td>
<td>2. In line with other Great Lakes agency eDNA response (e.g. Green Bay, WI)</td>
<td>2. May miss a fish if one is out there.</td>
</tr>
<tr>
<td>3. Re-sample for eDNA to see if there is a local hot spot to target for action.</td>
<td>3. Demonstrates prudent response in use of eDNA.</td>
<td></td>
</tr>
<tr>
<td>4. Re-consider response with results of eDNA re-sampling.</td>
<td>4. Engages public in assistance in detection.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Will not disrupt salmon fishing in Kalamazoo River</td>
<td></td>
</tr>
<tr>
<td>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.</td>
<td>1. Cost: staff time for travel, e-fishing approx $2000; USFWS will cover all costs for eDNA sampling</td>
<td>1. May not be perceived as aggressive enough.</td>
</tr>
<tr>
<td>2. Increase awareness of a potential silver carp in the river through local and media messaging.</td>
<td>2. Demonstrates prudent response in use of eDNA and the need for multiple lines of evidence.</td>
<td>2. May still miss a fish if one is out there; could give an indication of a problem as a second line of evidence.</td>
</tr>
<tr>
<td>3. Re-sample for eDNA to see if there is a local hot spot to target for action.</td>
<td>3. Engages public in assistance in detection.</td>
<td>3. Will be fairly disruptive to anglers fishing that stretch of the river.</td>
</tr>
<tr>
<td>4. Re-consider response with results of eDNA re-sampling.</td>
<td>4. Will not disrupt salmon fishing in Kalamazoo River</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Engages public in assistance in detection.</td>
<td></td>
</tr>
<tr>
<td>1. Send out a full response similar to St. Joe Exercise; several crews, block nets; invoke Mutual Aid Agreement;</td>
<td>1. Cost: staff time for travel, e-fishing approx $75,000; USFWS will cover all costs for eDNA sampling</td>
<td>1. May be perceived as disproportionately aggressive by partners.</td>
</tr>
<tr>
<td>2. Increase awareness for the exercise and the need for reporting through local and media messaging.</td>
<td>2. Demonstrates aggressive response to eDNA results.</td>
<td>2. May still miss a fish if one is out there; could give an indication of a problem as a second line of evidence.</td>
</tr>
<tr>
<td>3. Do not re-sample for eDNA to see if there is a local hot spot to target for action.</td>
<td>3. No further eDNA results to work from.</td>
<td>3. Will be very disruptive to anglers fishing that stretch of the river and will require a river closure.</td>
</tr>
<tr>
<td></td>
<td>4. Could give an indication of a problem as a second line of evidence.</td>
<td>4. Costs may be disproportional to desired results.</td>
</tr>
<tr>
<td></td>
<td>5. Sets future expectations to this level of response for eDNA evidence, regardless of the significance of the findings.</td>
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</tr>
<tr>
<td>1. Send out a full response similar to St. Joe Exercise; several crews, block nets; invoke Mutual Aid Agreement;</td>
<td>1. Cost: staff time for travel, e-fishing approx $75,000; USFWS will cover all costs for eDNA sampling</td>
<td>1. May be perceived as disproportionately aggressive by partners.</td>
</tr>
<tr>
<td>2. Increase awareness of the potential for a silver carp in the river through local and media messaging.</td>
<td>2. Demonstrates aggressive response to eDNA results.</td>
<td>2. May still miss a fish if one is out there; could give an indication of a problem as a second line of evidence.</td>
</tr>
<tr>
<td>3. Re-sample for eDNA to see if there is a local hot spot to target for additional response action.</td>
<td>3. Second sampling eDNA results to work from will help guide additional efforts.</td>
<td>3. Will be very disruptive to anglers fishing that stretch of the river and will require a river closure.</td>
</tr>
<tr>
<td></td>
<td>4. Could give an indication of a problem as a second line of evidence.</td>
<td>4. Costs may be disproportional to desired results.</td>
</tr>
<tr>
<td></td>
<td>5. Additional eDNA results could then require a second effort.</td>
<td>5. Additional eDNA results could then require a second effort.</td>
</tr>
<tr>
<td></td>
<td>6. Sets future expectations to this level of response for eDNA evidence, regardless of the significance of the findings.</td>
<td>6. Sets future expectations to this level of response for eDNA evidence, regardless of the significance of the findings.</td>
</tr>
</tbody>
</table>

*at 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

<table>
<thead>
<tr>
<th>Communication Recipient</th>
<th>Message</th>
<th>By Whom</th>
<th>By When</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newcomb, Dexter</td>
<td>eDNA Results</td>
<td>USFWS</td>
<td>10/02/2014</td>
<td>complete</td>
</tr>
<tr>
<td>Creagh, Moritz, Golder, VanDyke, Knapp</td>
<td>potential response options &amp; timeline</td>
<td>Newcomb/Dexter</td>
<td>10/02/2014</td>
<td>complete</td>
</tr>
<tr>
<td>USFWS</td>
<td>what we plan to do -</td>
<td>Dexter</td>
<td>10/03/2014</td>
<td>complete</td>
</tr>
<tr>
<td>Lake Michigan Committee</td>
<td>Phone call, response plan</td>
<td>Wesley</td>
<td>Tuesday a.m. (10/7/2014)</td>
<td>complete</td>
</tr>
<tr>
<td>Fisheries Division</td>
<td>email w/briefing document embedded</td>
<td>Popoff</td>
<td>Tuesday a.m. (10/7/2014)</td>
<td>complete</td>
</tr>
<tr>
<td>DEQ/OGL</td>
<td>verbal talking points</td>
<td>Creagh</td>
<td>QOL ex-com meeting</td>
<td>complete</td>
</tr>
<tr>
<td>Asian Carp Regional Coordinating Committee:</td>
<td>email w/briefing document embedded</td>
<td>Newcomb</td>
<td>Tuesday a.m. (10/7/2014)</td>
<td>complete</td>
</tr>
<tr>
<td>this will get to all regional partners and</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>federal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural Resources Commission</td>
<td>email w/briefing document</td>
<td>Knapp</td>
<td>Tuesday a.m. (10/7/2014)</td>
<td>complete</td>
</tr>
<tr>
<td>Legislative Members</td>
<td>select - email w/briefing document; all - press release</td>
<td>VanDyke</td>
<td>Tuesday a.m. (10/7/2014)</td>
<td>complete</td>
</tr>
<tr>
<td>Congressional Members</td>
<td>email w/briefing document and press release (Eric Brown)</td>
<td>VanDyke</td>
<td>Tuesday a.m. (10/7/2014)</td>
<td>complete</td>
</tr>
<tr>
<td>General Media</td>
<td>press release</td>
<td>Golder</td>
<td>9:30 Tuesday</td>
<td>complete</td>
</tr>
<tr>
<td>Lake Michigan Citizens Advisory Committee</td>
<td>email with briefing document embedded and press release</td>
<td>Wesley</td>
<td>Tuesday 9:00 a.m. (10/7/2014)</td>
<td>complete</td>
</tr>
<tr>
<td>General Public</td>
<td>eDNA Results via USFWS posting to website</td>
<td>USFWS</td>
<td>Wednesday a.m.</td>
<td>complete</td>
</tr>
<tr>
<td>1836 tribes</td>
<td>electronic w/press release</td>
<td>Knapp</td>
<td>Tuesday a.m. (10/7/2014)</td>
<td>complete</td>
</tr>
<tr>
<td>Council of Great Lakes Governors</td>
<td>Phone call/follow up with press release</td>
<td>Newcomb</td>
<td>Tuesday a.m. (10/7/2014)</td>
<td>complete</td>
</tr>
<tr>
<td>Waterways Commission</td>
<td>email with briefing document embedded</td>
<td>Knapp</td>
<td>Tuesday a.m. (10/7/2014)</td>
<td>complete</td>
</tr>
<tr>
<td>Gun Lake, Huron Pottawattomi</td>
<td>phone call w/briefing document follow up</td>
<td>Knapp</td>
<td>Tuesday a.m. (10/7/2014)</td>
<td>complete</td>
</tr>
</tbody>
</table>
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
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
Sampling timeframe
1st round: 1.5 months prior = (+) (+) (+)
2nd round: 1.5 weeks prior = (+) (+) (+)
3rd round: 4 days prior = (+) (+) (+)
Sampling timeframe
1st round: 1.5 months prior = (-) (+) (++)
2nd round: 1.5 weeks prior = ▲ ▲ ▲

Results
Huron River area

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
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?