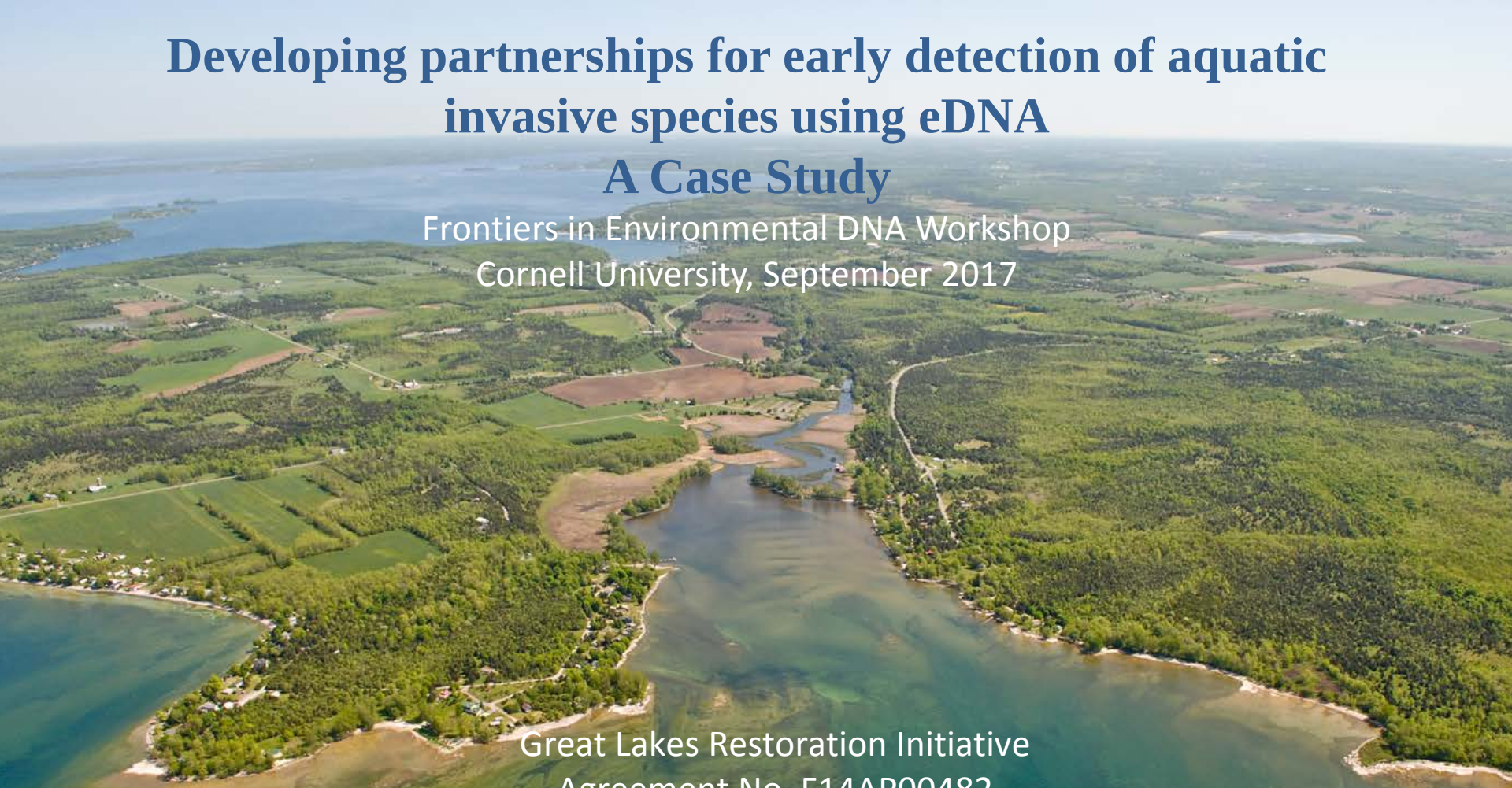
# Developing partnerships for early detection of aquatic invasive species using eDNA

## A Case Study

Frontiers in Environmental DNA Workshop
Cornell University, September 2017



Great Lakes Restoration Initiative
Agreement No. F14AP00482

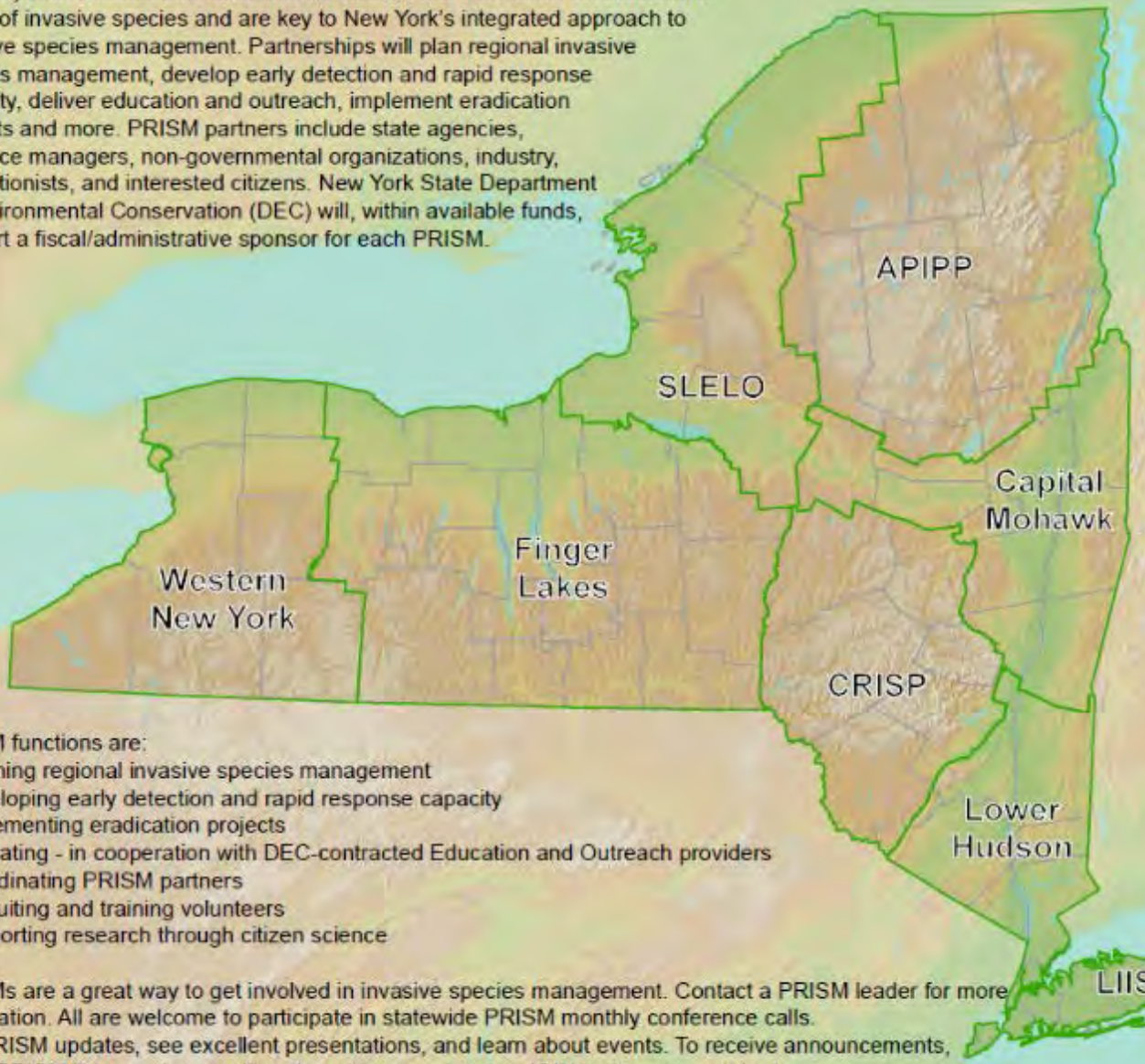
Rob Williams, Nate Fedrizzi, Zach Bengtsson

SLELO PRISM
*Teaming up to stop the spread of invasive species*

The Nature Conservancy

# New York State's Partnerships for Regional Invasive Species Management (PRISMs)

What's a PRISM? They are Partnerships for Regional Invasive Species Management (PRISM) that stakeholders have formed across New York State to address the threat of invasive species and are key to New York's integrated approach to invasive species management. Partnerships will plan regional invasive species management, develop early detection and rapid response capacity, deliver education and outreach, implement eradication projects and more. PRISM partners include state agencies, resource managers, non-governmental organizations, industry, recreationists, and interested citizens. New York State Department of Environmental Conservation (DEC) will, within available funds, support a fiscal/administrative sponsor for each PRISM.




**PRISM Contacts and Listserves**

APIPP(Adirondack Park Invasive Plant Program)
Brendan Quirion: (518)576-2082
bquirion@tnc.org

Capital Mohawk PRISM
Laurel Gallor: (518)885-8995
lrg6@cornell.edu

CRISP (Catskill Regional Invasive Species Partnership)
Molly Marquand: (845)586-2611
mmarquand@catskillcenter.org

Finger Lakes PRISM
Hilary Mosher: (315)781-4385
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LIISMA (Long Island Invasive Species Management Area)
Steve Young: (518) 402-8951
steve.young@dec.ny.gov

Lower Hudson PRISM
Linda Rohleder: (201)512-9348
lrohleder@nynjtc.org

SLELO (St. Lawrence & Eastern Lake Ontario)
Robert Williams: (315)387-3600
rwilliams@tnc.org

Western New York PRISM
Andrea Locke: (716)878-4708
lockeas@buffalostate.edu

For more information on PRISMs and to subscribe to a PRISM listserve visit:

**WWW.NYIS.INFO**

PRISM functions are:
- Planning regional invasive species management
- Developing early detection and rapid response capacity
- Implementing eradication projects
- Educating - in cooperation with DEC-contracted Education and Outreach providers
- Coordinating PRISM partners
- Recruiting and training volunteers
- Supporting research through citizen science

PRISMs are a great way to get involved in invasive species management. Contact a PRISM leader for more information. All are welcome to participate in statewide PRISM monthly conference calls.
Get PRISM updates, see excellent presentations, and learn about events. To receive announcements, join a PRISM listserve by e-mailing the address and typing JOIN in the message body.

Initial Partners and Roles:

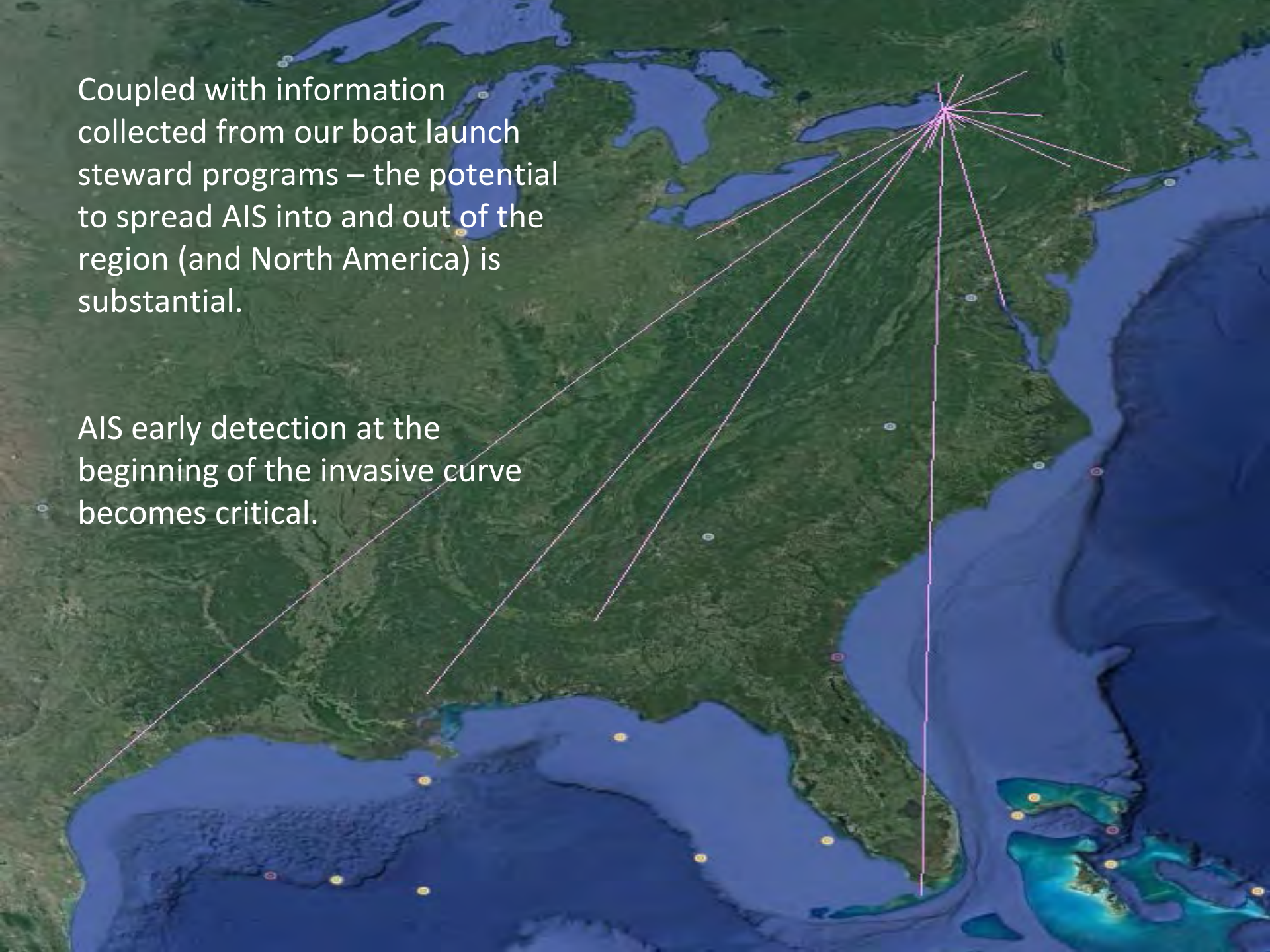
SLELO PRISM Partners – Project Concept
The Nature Conservancy, CWNY – Project Support
Volunteers – Sample Collection
Great Lakes Restoration Initiative - Funder
NYS Department of Environmental Conservation, ISCU - Collaborator
Cornell University, Dept. Microbiology & Immunology – Collaborator, lab services
United States Fish & Wildlife Service – Application Review

**These partnerships became more important as the project progressed.**

## Basis for Concern:

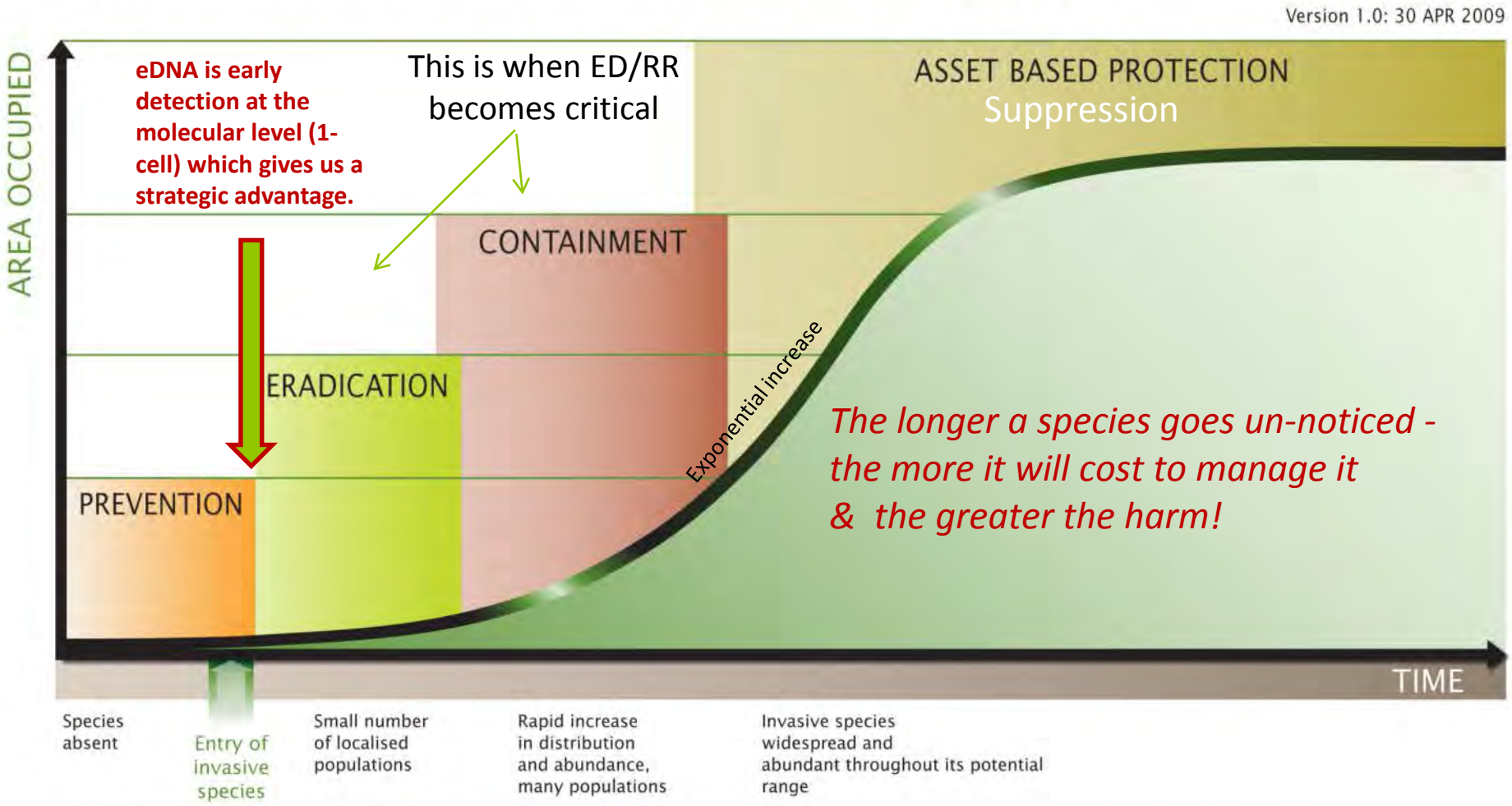
Connectivity between St. Lawrence River, Eastern Lake Ontario, The Great Lakes, Inland Waters and New York State


CANAL MAP
OF THE STATE OF
NEW YORK
TO ACCOMPANY THE ANNUAL REPORT OF THE
STATE ENGINEER AND SURVEYOR
1912.
Basis for Concern:
Connectivity Across New York
Overseas
St. Lawrence &
Eastern Lake Ontario
Upper
Great Lakes
Oswego River
Champlain
Canal
Genesee
River
Cayuga-Seneca
Canal
Hudson River
Port of
NY
LONG ISLAND
PROFILE OF BARGE CANAL


Coupled with information collected from our boat launch steward programs – the potential to spread AIS into and out of the region (and North America) is substantial.
AIS early detection at the beginning of the invasive curve becomes critical.

# Why eDNA you ask!

## Generalized Invasion Curve Showing Actions Appropriate To each Stage



# Questions:

- Is eDNA Practical ?
- Can eDNA be used by volunteers, citizen scientists, partners?
- What happens if/when we get a positive test for an aquatic invasive species.
- Who will help us with a strategic response?

# Project Orientation

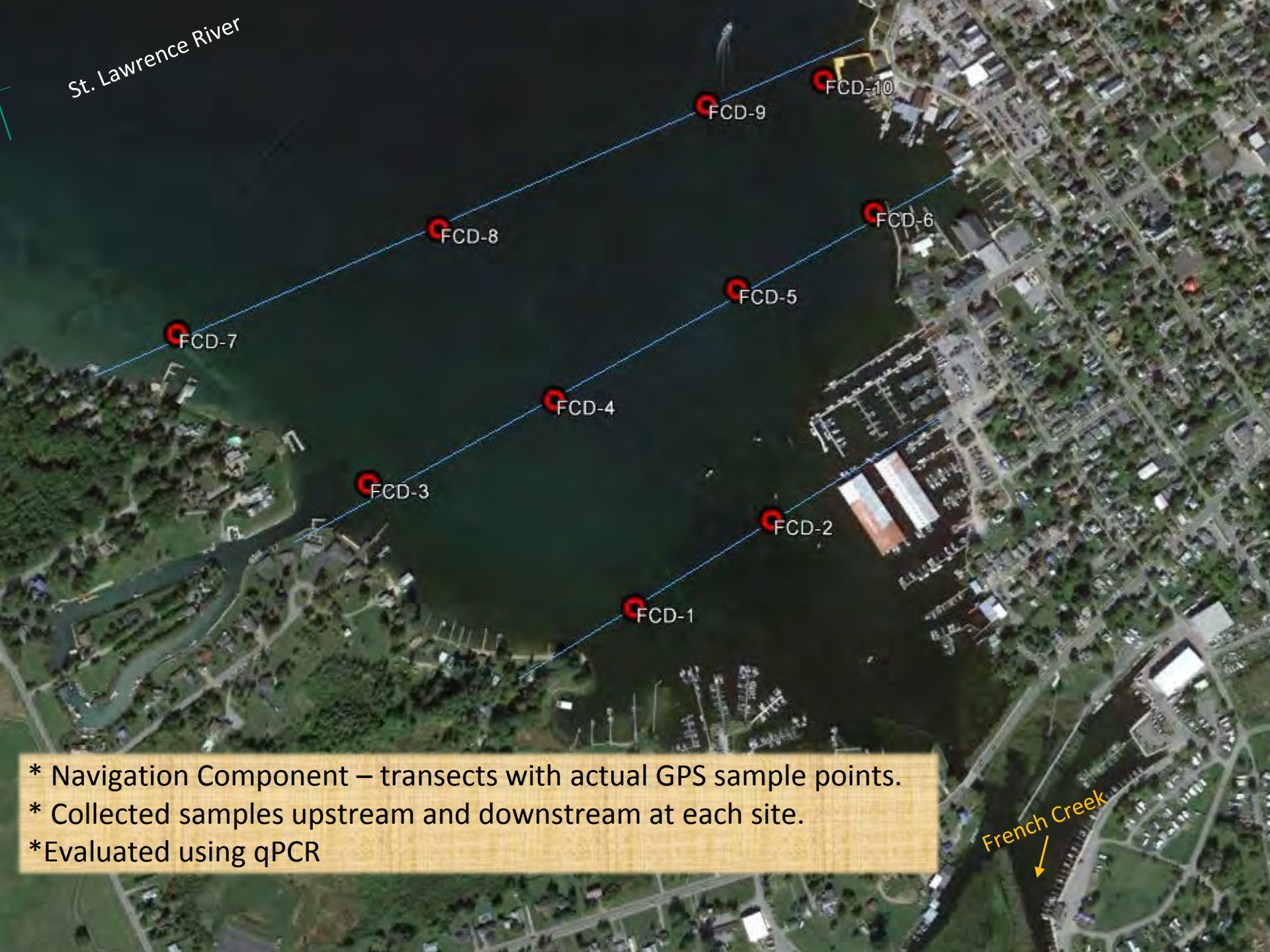

Considered as connecting waterways between Lake Ontario, St. Lawrence River and inland waters (multidirectional)

**Non-native Species**
(tentative)

- Asian Carp x 4 - *(Hypophthalmichthys spp.)*
- Northern Snakehead - *(Channa argus)*
- Rusty Crayfish - *(Orconectes rusticus)*
- Round goby - *(Atherina boyeri)*

**Native Species**
(tentative)

- Lake Herring/Cisco – *Coregonus spp.)*
- Rock Bass – *(Ambioplites rupestris*)




* Navigation Component – transects with actual GPS sample points.
* Collected samples upstream and downstream at each site.
*Evaluated using qPCR

# Environmental DNA

Target Species:

**Bighead carp**
(*Hypophthalmichthys nobilis*)

**Black carp**
(*Mylopharyngodon piceus*)

**Grass carp**
(*Ctenopharyngodon idella*)

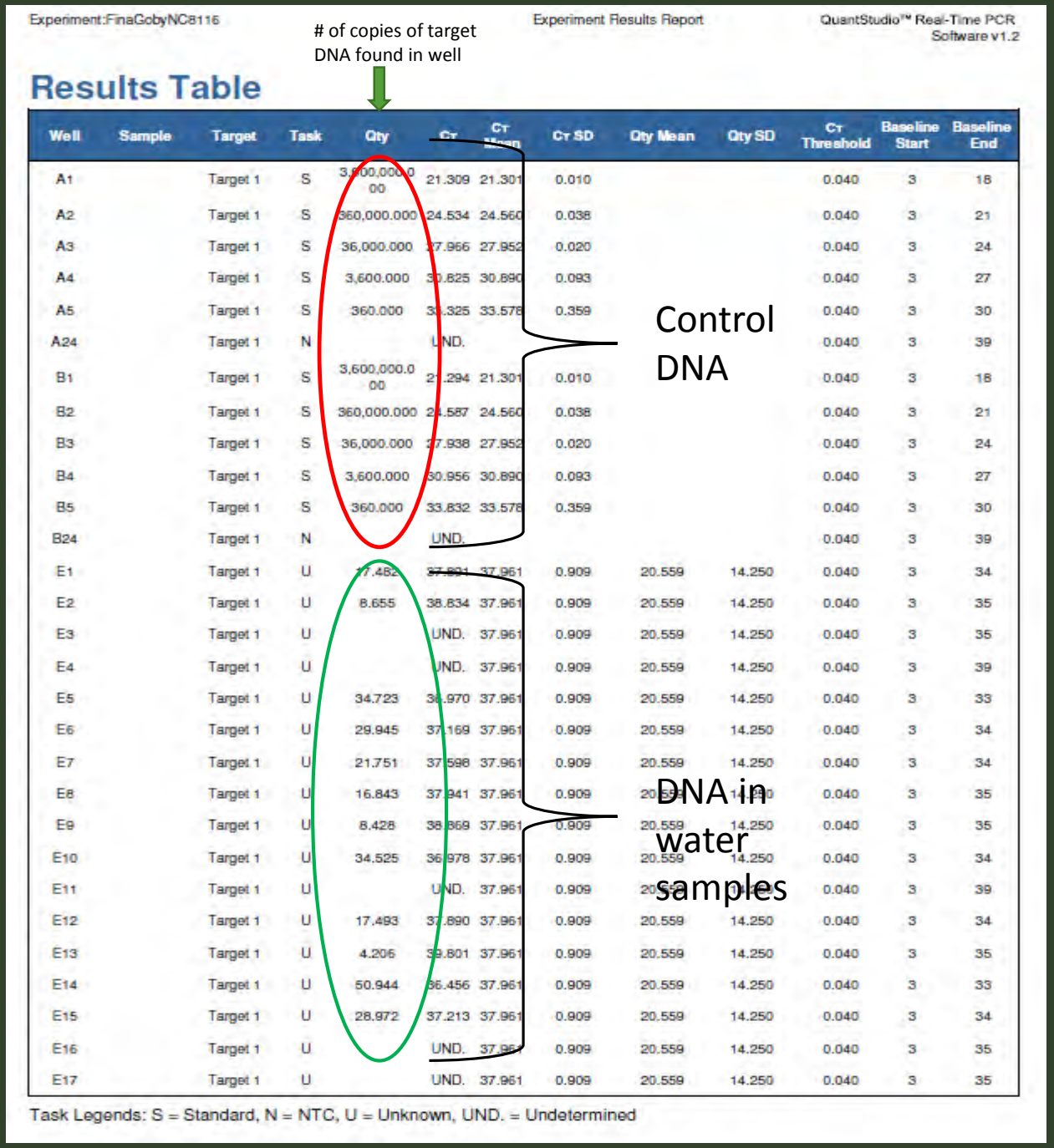
**Silver carp**
(*Hypopthalmichthys molitrix*)

**Northern snakehead**
(*Channa argus*)

**Round goby**
(*Neogobius melanostomus*)

**Lake Herring**
(*Coregonus artedi)*

**Rock bass**
(*Ambioplites rupestris*)



Experiment:FinaGobyNC8116

Experiment Results Report

QuantStudio™ Real-Time PCR Software v1.2

# of copies of target DNA found in well

## Results Table

| Well | Sample | Target | Task | Qty | Cт | Cт Mean | Cт SD | Qty Mean | Qty SD | Cт Threshold | Baseline Start | Baseline End |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | | Target 1 | S | 3,600,000,000 | 21.309 | 21.301 | 0.010 | | | 0.040 | 3 | 18 |
| A2 | | Target 1 | S | 360,000,000 | 24.534 | 24.560 | 0.038 | | | 0.040 | 3 | 21 |
| A3 | | Target 1 | S | 36,000,000 | 27.966 | 27.952 | 0.020 | | | 0.040 | 3 | 24 |
| A4 | | Target 1 | S | 3,600,000 | 30.825 | 30.890 | 0.093 | | | 0.040 | 3 | 27 |
| A5 | | Target 1 | S | 360,000 | 33.325 | 33.578 | 0.359 | | | 0.040 | 3 | 30 |
| A24 | | Target 1 | N | | UND. | | | | | 0.040 | 3 | 39 |
| B1 | | Target 1 | S | 3,600,000,000 | 21.294 | 21.301 | 0.010 | | | 0.040 | 3 | 18 |
| B2 | | Target 1 | S | 360,000,000 | 24.587 | 24.560 | 0.038 | | | 0.040 | 3 | 21 |
| B3 | | Target 1 | S | 36,000,000 | 27.938 | 27.952 | 0.020 | | | 0.040 | 3 | 24 |
| B4 | | Target 1 | S | 3,600,000 | 30.956 | 30.890 | 0.093 | | | 0.040 | 3 | 27 |
| B5 | | Target 1 | S | 360,000 | 33.832 | 33.578 | 0.359 | | | 0.040 | 3 | 30 |
| B24 | | Target 1 | N | | UND. | | | | | 0.040 | 3 | 39 |
| E1 | | Target 1 | U | 17.482 | 37.891 | 37.961 | 0.909 | 20.559 | 14.250 | 0.040 | 3 | 34 |
| E2 | | Target 1 | U | 8.655 | 38.834 | 37.961 | 0.909 | 20.559 | 14.250 | 0.040 | 3 | 35 |
| E3 | | Target 1 | U | | UND. | 37.961 | 0.909 | 20.559 | 14.250 | 0.040 | 3 | 35 |
| E4 | | Target 1 | U | | UND. | 37.961 | 0.909 | 20.559 | 14.250 | 0.040 | 3 | 39 |
| E5 | | Target 1 | U | 34.723 | 36.970 | 37.961 | 0.909 | 20.559 | 14.250 | 0.040 | 3 | 33 |
| E6 | | Target 1 | U | 29.945 | 37.169 | 37.961 | 0.909 | 20.559 | 14.250 | 0.040 | 3 | 34 |
| E7 | | Target 1 | U | 21.751 | 37.598 | 37.961 | 0.909 | 20.559 | 14.250 | 0.040 | 3 | 34 |
| E8 | | Target 1 | U | 16.843 | 37.941 | 37.961 | 0.909 | 20.559 | 14.250 | 0.040 | 3 | 35 |
| E9 | | Target 1 | U | 8.428 | 38.869 | 37.961 | 0.909 | 20.559 | 14.250 | 0.040 | 3 | 35 |
| E10 | | Target 1 | U | 34.525 | 36.978 | 37.961 | 0.909 | 20.559 | 14.250 | 0.040 | 3 | 34 |
| E11 | | Target 1 | U | | UND. | 37.961 | 0.909 | 20.559 | 14.250 | 0.040 | 3 | 39 |
| E12 | | Target 1 | U | 17.493 | 37.890 | 37.961 | 0.909 | 20.559 | 14.250 | 0.040 | 3 | 34 |
| E13 | | Target 1 | U | 4.206 | 39.601 | 37.961 | 0.909 | 20.559 | 14.250 | 0.040 | 3 | 35 |
| E14 | | Target 1 | U | 50.944 | 36.456 | 37.961 | 0.909 | 20.559 | 14.250 | 0.040 | 3 | 33 |
| E15 | | Target 1 | U | 28.972 | 37.213 | 37.961 | 0.909 | 20.559 | 14.250 | 0.040 | 3 | 34 |
| E16 | | Target 1 | U | | UND. | 37.961 | 0.909 | 20.559 | 14.250 | 0.040 | 3 | 35 |
| E17 | | Target 1 | U | | UND. | 37.961 | 0.909 | 20.559 | 14.250 | 0.040 | 3 | 35 |

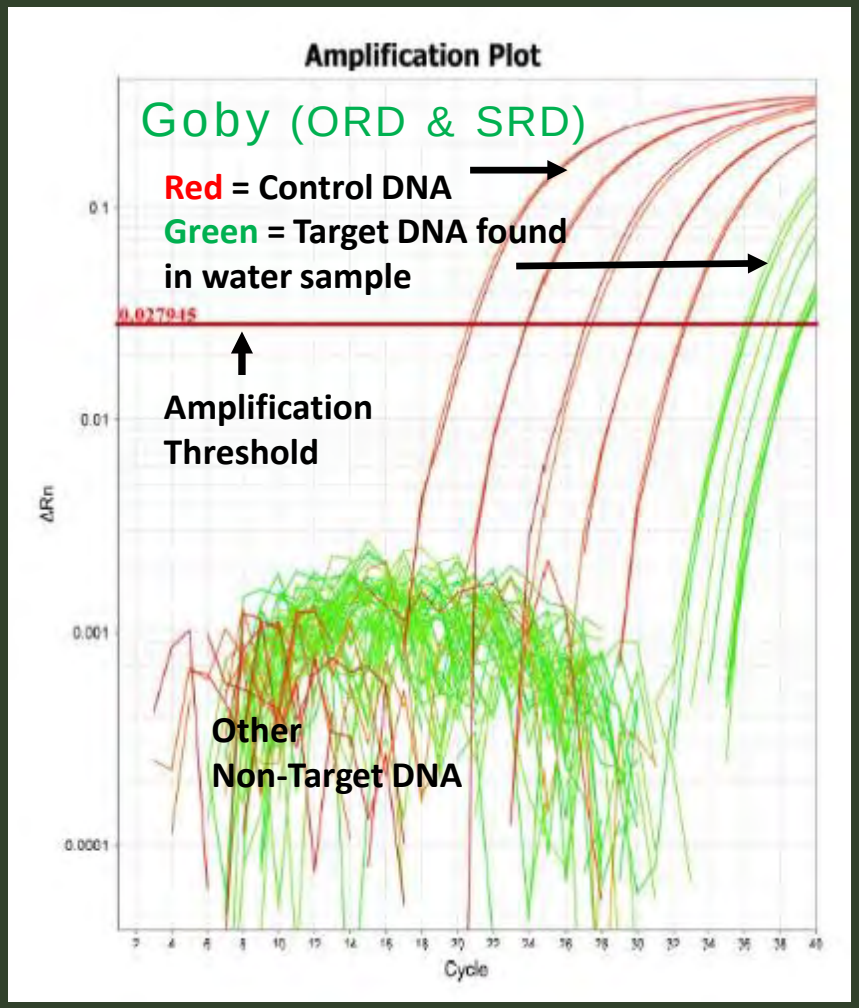
Task Legends: S = Standard, N = NTC, U = Unknown, UND. = Undetermined

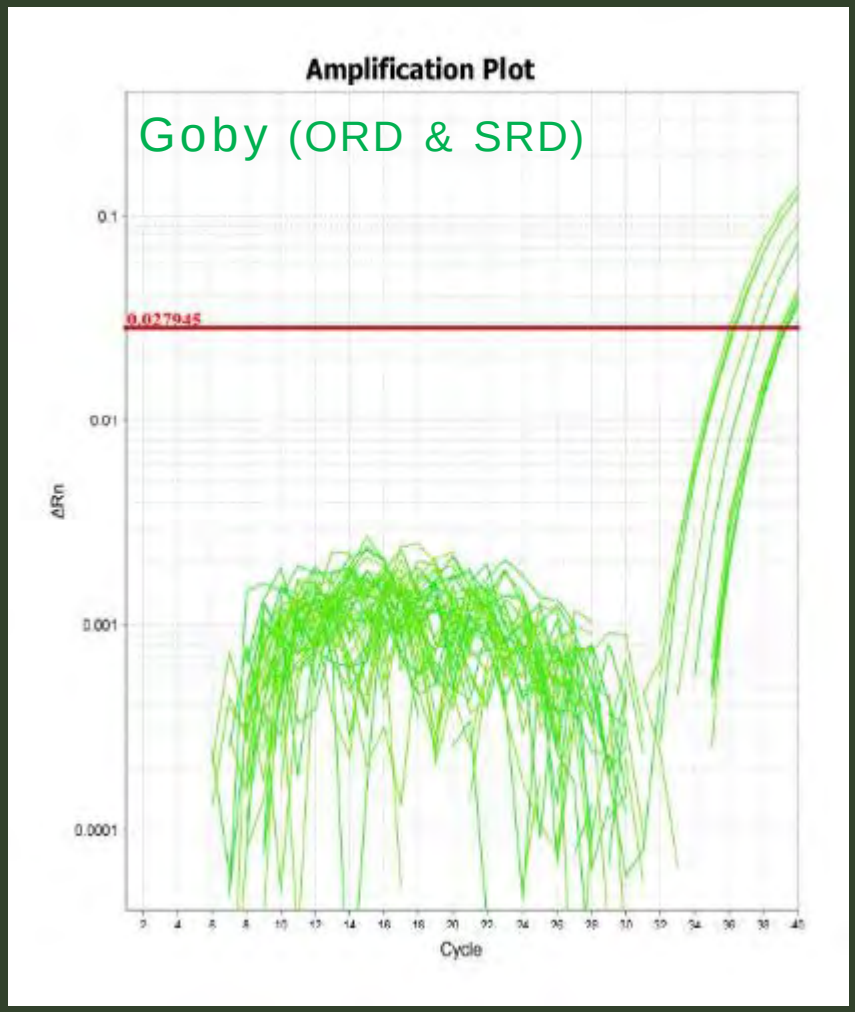
Control DNA

DNA in water samples

Results are quantified in tabular format

# PCR Amplification Plots




The amount of the fluorescence released during amplification is directly proportional to the amount of amplified DNA.

# Is eDNA Practical ?

- We engaged numerous volunteers who engaged in the process of collecting samples and/or interpreting results.
- Is eDNA cost effective means by which to conduct AIS early detection? Yes = $137.50 per sample for 8 species using qPCR.

# Citizen Scientists

Ed Demattia

Tommy Brodeur, Daniel Novak

## Question

What happens if/when we get a positive test for a high profile aquatic invasive species ?

And

Who will help us with a strategic response?

## Question

Who will help us with a strategic response and what will the response look like?

**Rapid Response:**

**Level 1:** ☐ Small to medium scale. Organize a volunteer event. Canoes, hand pulls, etc. to address the threat. Use seasonal employees too!

**Level 2:** ☐ Medium scale & difficulty, determine costs and funding source, apply for permits, hire licensed pesticide applicator/contractor, machinery, etc.

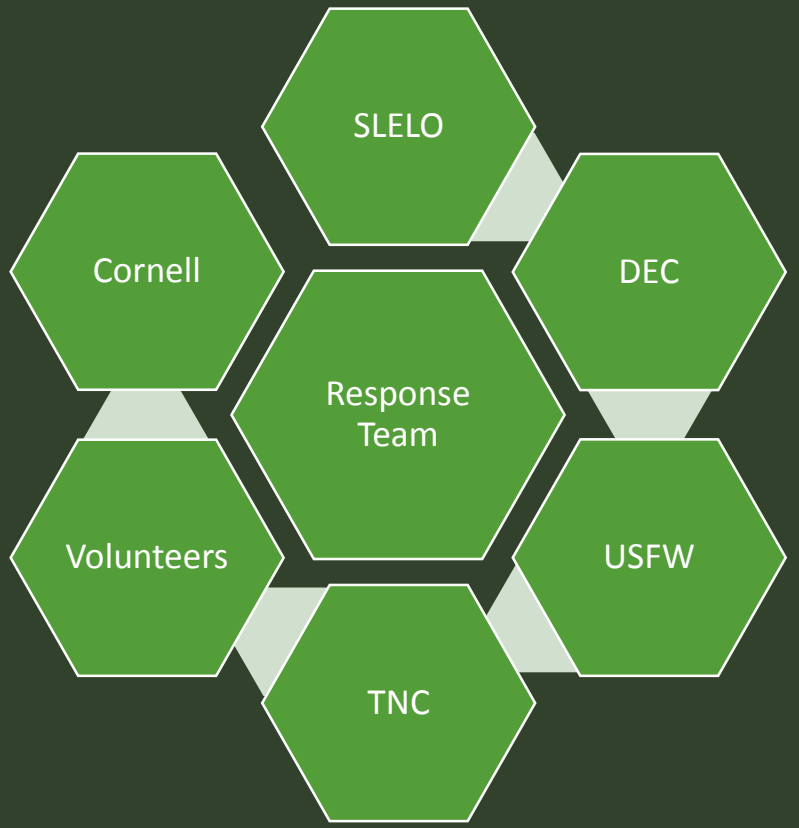
**Level 3:** ☐ Primarily for new "large scale" detections such as a large Hydrilla infestation. *Activate Flow Chart Action Plan below.*

**RAPID RESPONSE FLOW CHART ACTION PLAN**

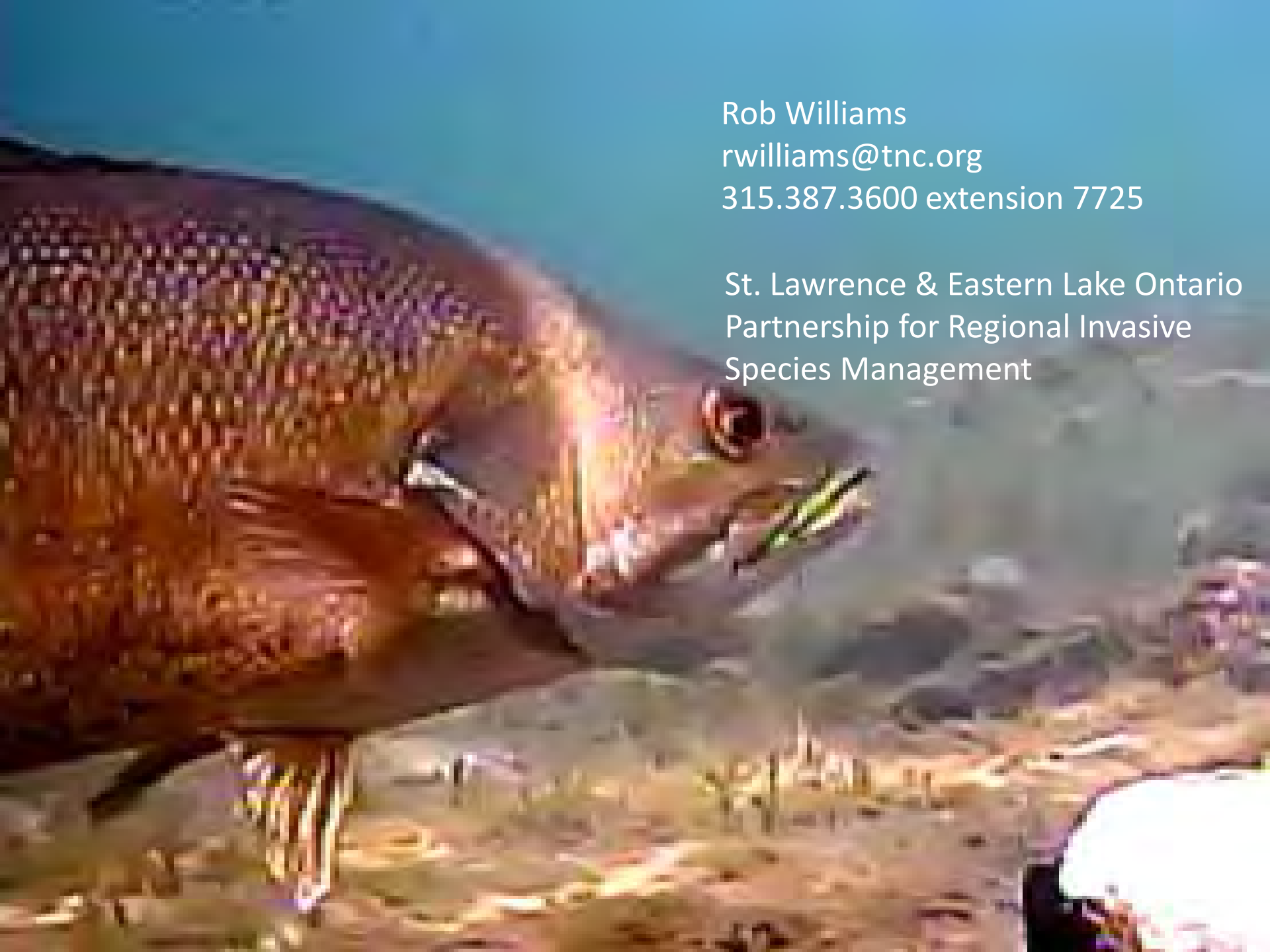
| | | |
|---|---|---|
| ☐ | Obtain Positive I.D. of Species | ☐ •**Aquatics:** R.Williams, Scott Kishbaugh, Justin White-canada *613.389.0418*<br>☐ •**Terrestrial:** M.Lavine, S.Young, Sandy Bonano, Cornell<br>☐ •**Insects:** Mark Whitmore - Cornell |
| ☐ | Contact Rapid Response Team | •**Current Team Leader:** Rob Williams, 315.387.3600 x7725<br>•This team will need to coordinate the rest of the activities in this flow chart. |
| ☐ | Conduct Survey | ☐ •Survey the site to determine the extent of the infestation/outbreak.<br>☐ •Implement Decision Analyses Tool |
| ☐ | Determine Best Approach | ☐ •Method of Control (which BMP would likely work best)<br>☐ •Contractor or in-house. (begin the contracting process)<br>☐ •Costs<br>☐ •Determine funding source or combined sources. |
| ☐ | Community Outreach | ☐ •Educate the public<br>☐ •Seek community support |
| ☐ | Seek Permits | ☐ •DEC, USACE, DOS, others? |
| ☐ | Implement | ☐ •Implement the Plan |
| ☐ | Monitor Results | ☐ •Release the results to the RR team, partners and to the community. |

**Response Approach**

- SLELO Partners – informed
- SLELO PRISM – additional DNA sampling
- TNC GLT – Additional eDNA sampling and labor
- USFW – DNA lab analysis, electroshocking, fyke nets
- Cornell – additional (limited) qPCR analysis.
- NYS DEC – electroshocking & communications plan
- Volunteers / anglers – posters have been posted
- 2018 Spring Blitz – All parties


SLELO
Cornell
DEC
Response Team
Volunteers
USFW
TNC


Partnerships are key to success
Identify partners early, be inclusive
Share information
We are in this together



Rob Williams
rwilliams@tnc.org
315.387.3600 extension 7725

St. Lawrence & Eastern Lake Ontario Partnership for Regional Invasive Species Management