Using environmental DNA for Sea Lamprey assessments in Great Lakes tributaries

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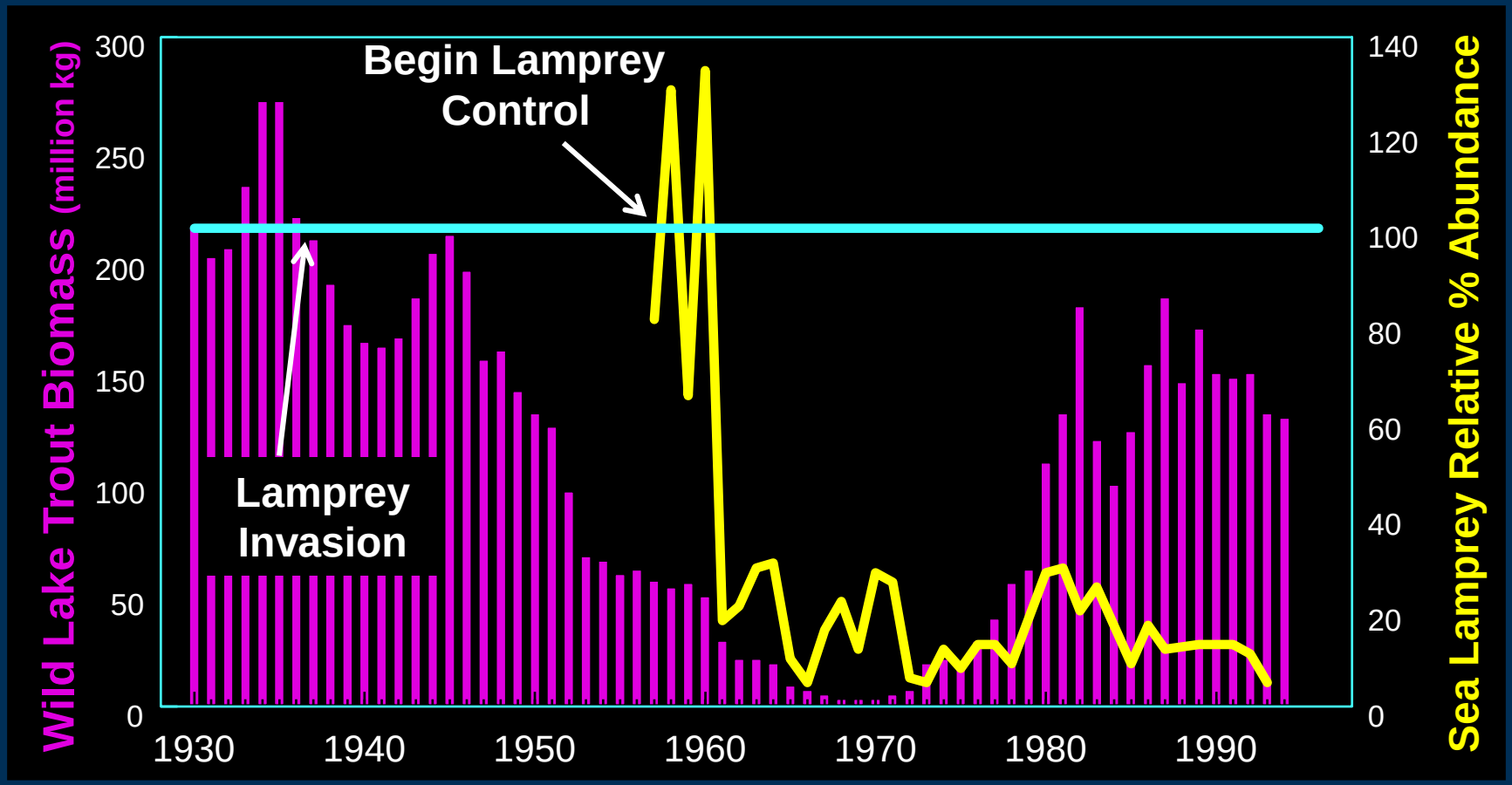
Chris Merkes[1], Nick Schloesser[1], Chris Rees[2], Jon Amberg[1]
1: Upper Midwest Environmental Sciences Center, USGS
2: Northeast Fishery Center, USFWS

U.S. Department of the Interior
U.S. Geological Survey

Lake Trout and Sea Lamprey in Lake Superior



GLFC

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Efficient control requires accurate assessment

- Streams are ranked into 4 habitat types along a given reach

  (Type 1, 2, 3, 4)

- The area of suitable sea lamprey nesting habitat is then calculated based on total stream area and proportion of reach ranked as suitable habitat types

  Suitable Area ($A_{Suit} = A_{Tot} * \alpha_{1+2}$)

- 2 subsections of suitable habitat are then sampled by electrofishing to determine the number of larval sea lamprey per square meter

  Density ($d = \frac{n}{A_n}$)

- Larval density is then extrapolated to estimate population size for the reach

  Larval Population ($\mathrm{N} = \overline{d} * A_{Suit}$)

USGS

Using eDNA for larval assessments

Objective:

- **Simplify larval assessments – or –**
- **Increase accuracy and precision by supplementing traditional assessment with eDNA**

Site:	Estimate 1:	Estimate 2:
2518	10	25
2519	142	214
2494	Not Sampled	124
2489	947	74
2493	2377	394

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Developed new sea lamprey markers

Previously 1 conventional PCR marker (Gingera *et al*., 2016)

New markers are qPCR
- *coi*
- *cytb*
- *nd1*
- *nd4*

Tested against sea lamprey plus 27 non-target species

All 4 markers performed Equally well

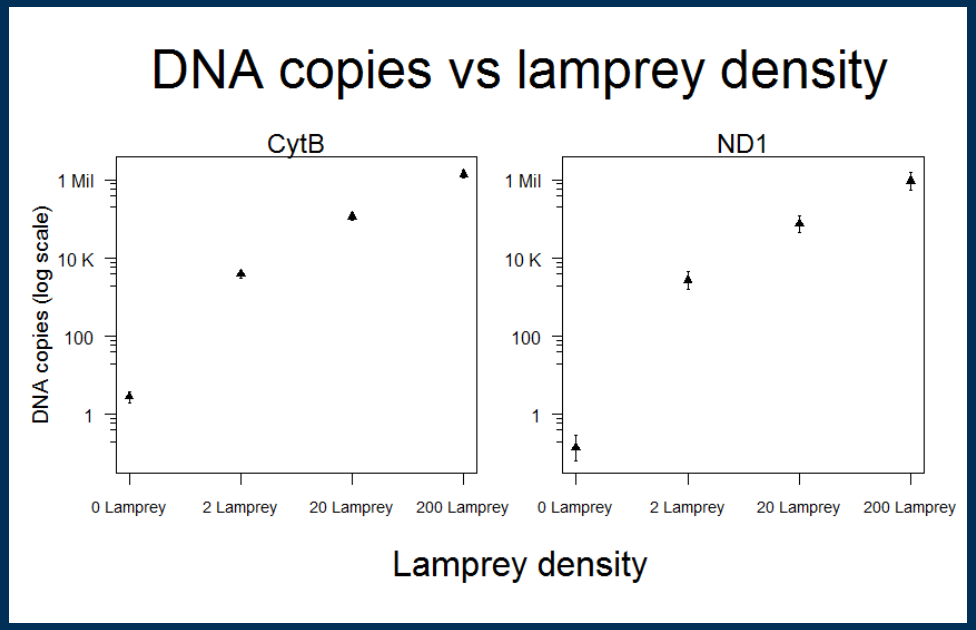
- Grass carp
- Lake trout
- Brook trout
- Brown trout
- Pallid Sturgeon
- Spotfin shiner
- Fathead minnow
- Rainbow trout
- Paddlefish
- Silver carp
- Bighead carp
- Bigmouth buffalo
- Gizzard shad
- Catfish
- Common carp
- Mosquito fish
- Golden shiner
- Yellow perch
- Tilapia
- Largemouth bass
- Bluegill
- Walleye
- Blue head sucker
- Speckled Dace
- American brook lamprey
- Northern brook lamprey
- Chestnut lamprey

USGS

Evaluating the [eDNA : biomass] relationship

Pilot study at Hammond Bay Biological Station

- 2000L tanks held 6 days
- 3 replicate tanks each
  - 0 Lamprey
  - 2 Lamprey
  - 20 Lamprey
  - 200 Lamprey
- 3 replicate samples / tank
- 4 replicate qPCRs / sample
- Averaged over
  n = 36 per treatment



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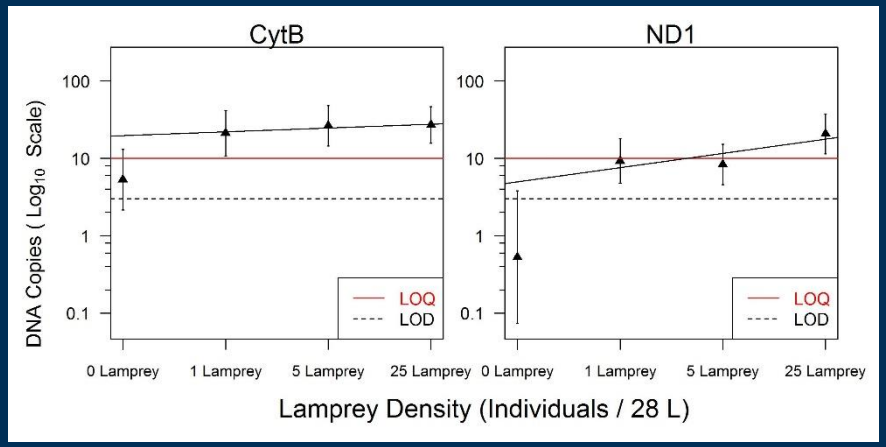
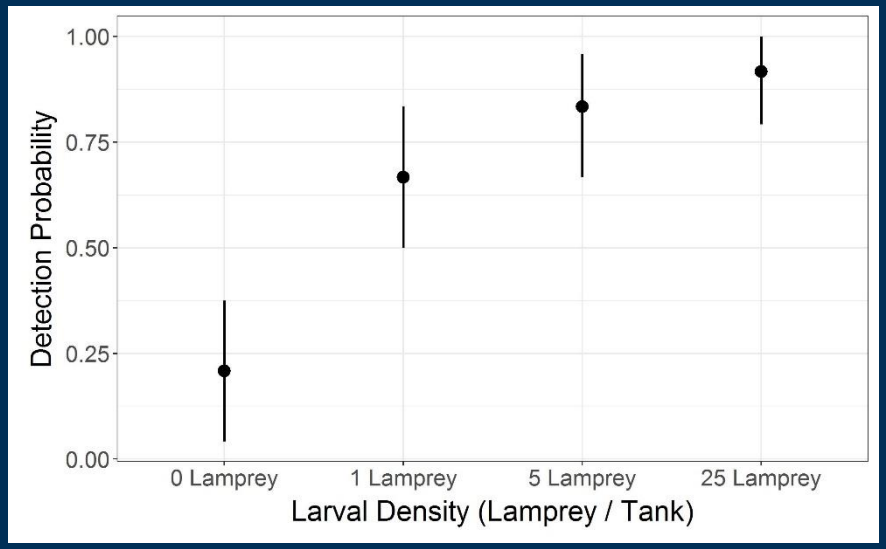
Evaluating the [eDNA : biomass] relationship





Pilot study at
Hammond Bay Biological Station
(with larvae)

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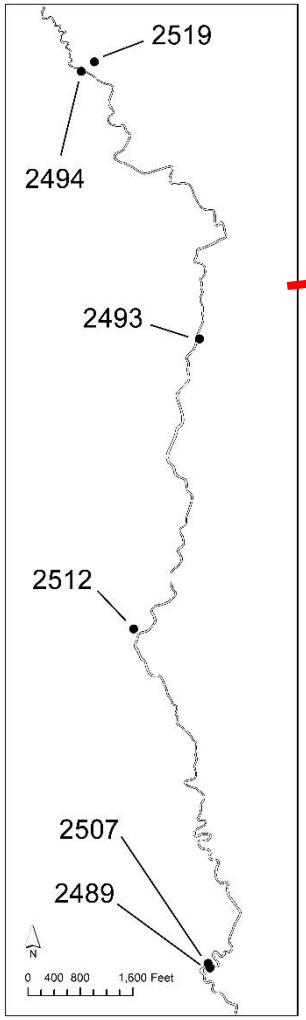
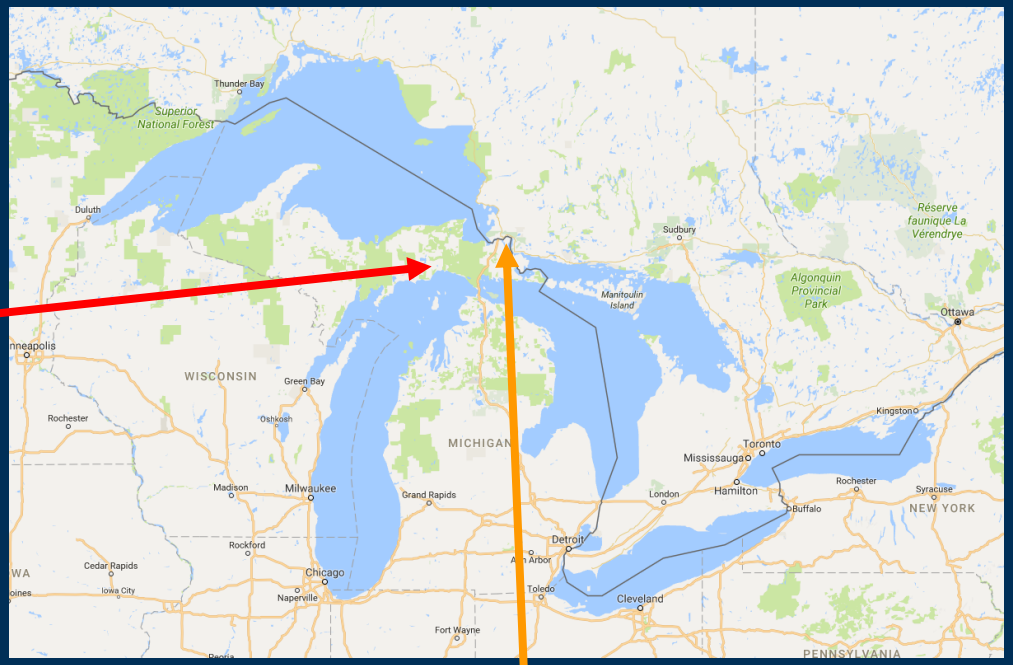
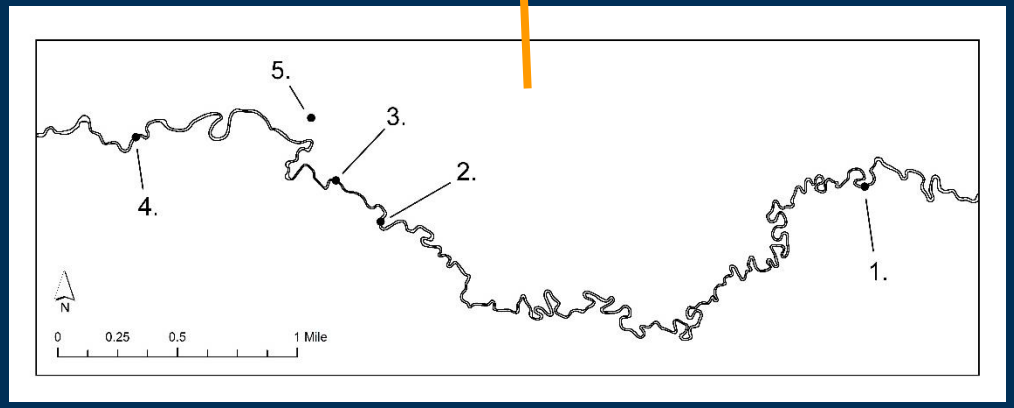
Estimating Larval Density in the Field

Black River, Upper Michigan







Root River, Ontario

Estimating Larval Density in the Field

Classifications (larval lamprey / 36m^2

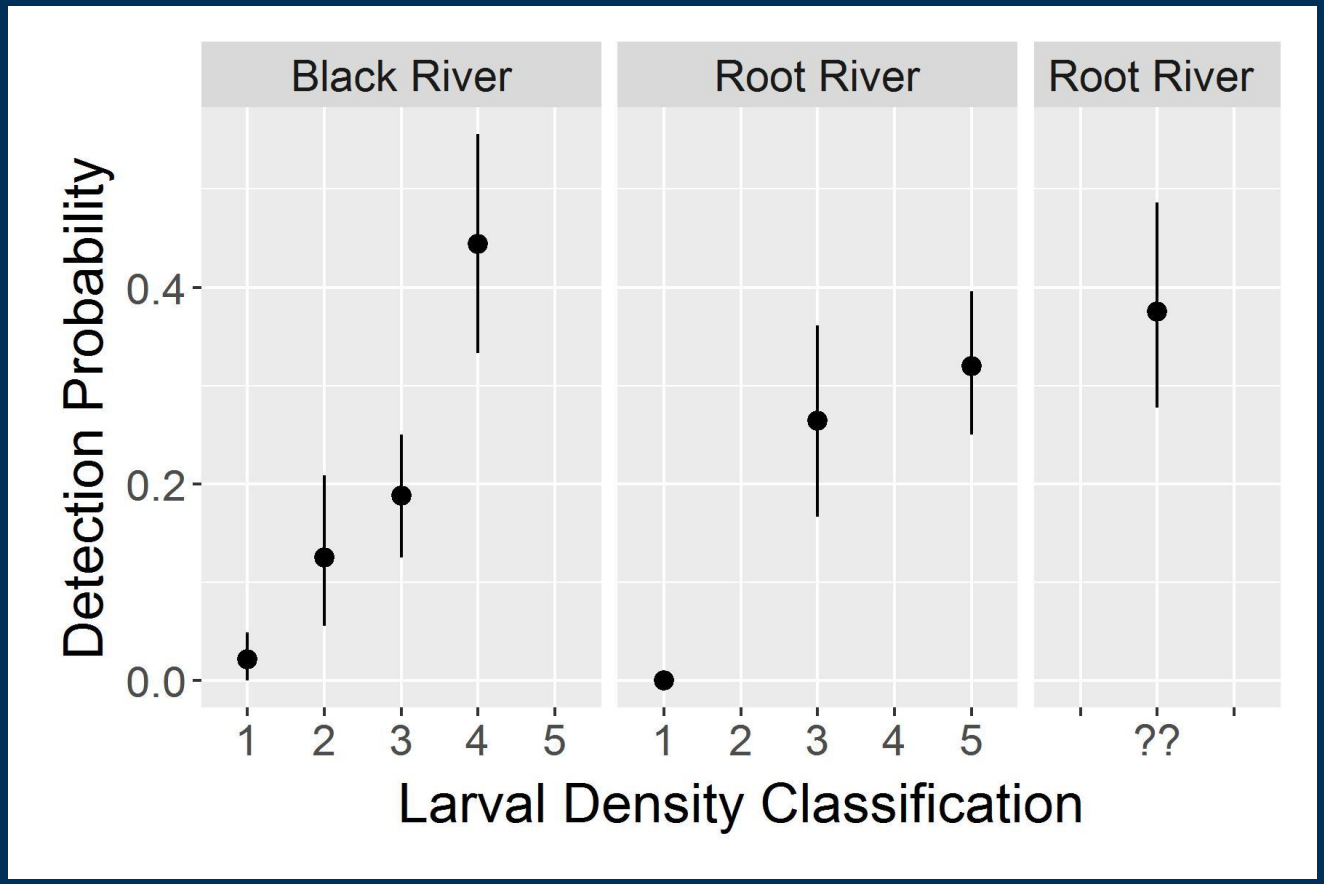
1: Absent

2: 1-100

3: 101-300

4: 301-600

5: 601+



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