
New Technology for Old Problems
Using eDNA Methods to Monitor Invasive Species and Biodiversity in Estuarine Systems
NH Water & Watershed Conference
March 15, 2019

A little introduction to me…

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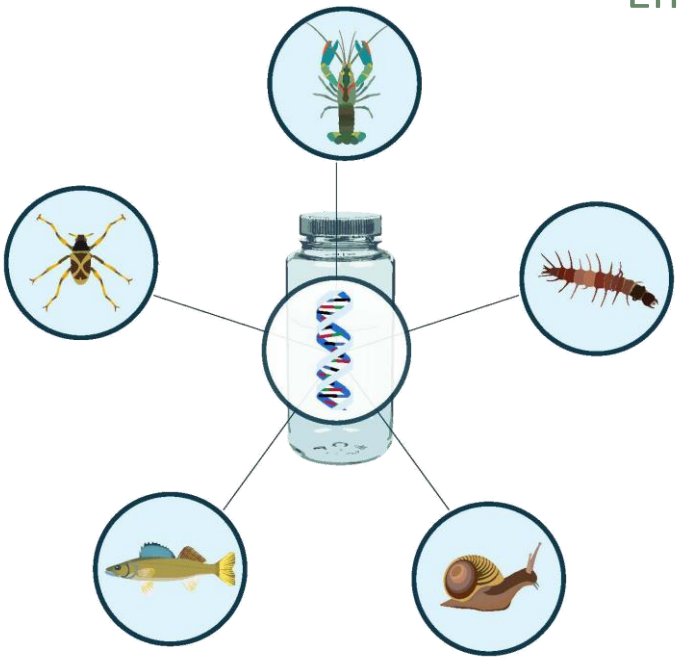
Does not float on mud.

estuaries eDNA

A little introduction to eDNA



Environmental DNA (eDNA)

- All living things have and shed DNA
- eDNA is DNA released from an organism into the environment
- eDNA can come from:
  - Hair, scales, skin
  - Waste products
  - Reproductive cells
  - Entire organism (diatoms)

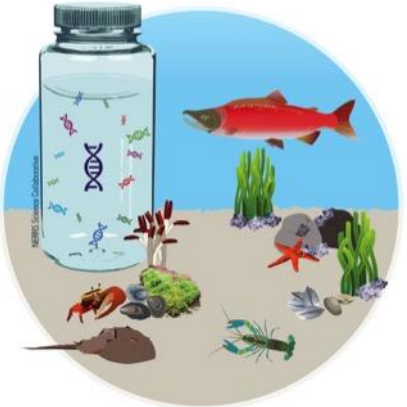
Often only used for qPCR or amplicon analysis

eDNA Methods

Single-species PCR (qPCR)

+ Simple, cheap, fast
- Only identifies one species
- Needs follow-up confirmation

Invasive or rare species



Metabarcoding (amplicon)

+ Identifies multiple species
- More complex, harder to interpret

Community assemblages, IBI, trophic structures

eDNA Process

- Collect samples (water, sediment, ect)

- Standard kits
- QIAGENPower Soil Blood and Tissues
- Biofilm, etc
- Lab specific methods

- **PCR:** Amplify DNA with species specific probes
- **Metabarcode:** Amplify and sequence DNA

- Analysis and interpretation (bioinformatics)
- That's me!

eDNA Reality Check… It's Not Magic

eDNA can:

- Provide information on species presence
- Help target field sampling programs
- Reduce sampling effort
- Provide non-destructive, non-invasive sampling method

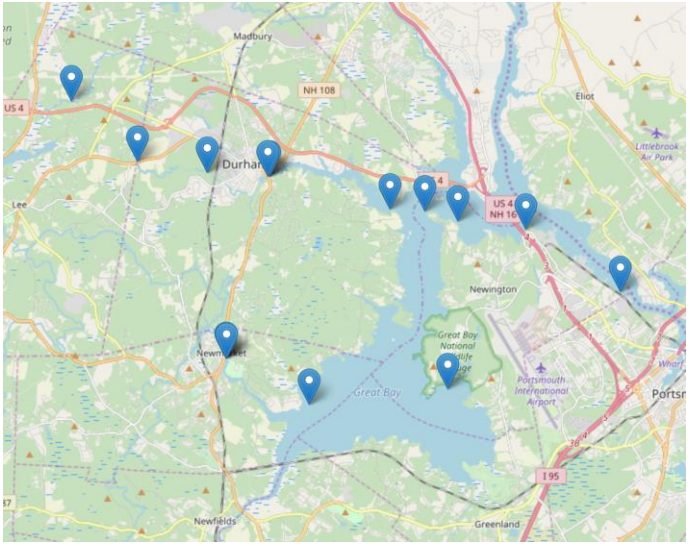
eDNA cannot:

- Confirm absolute absence
- Determine species abundance
- Determine life stage or condition
- Identify species without known DNA sequences

Finding fish (and other critters) with eDNA in NH

Results from 2018 Sampling season:

- Concurrent Seining/eDNA by Great Bay NERR
- Anadromous* fish returns in the Oyster and Lamprey Rivers
- Concurrent Larval Fish tow/eDNA by Wells NERR



2018 Great Bay Watershed Sampling Sites

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Benchmark eDNA with Traditional Biological Monitoring Methods

New Hampshire - seining, coastal streams

Oregon - seining, crab trapping

Maine - plankton tows, crab trapping

How does eDNA compare?

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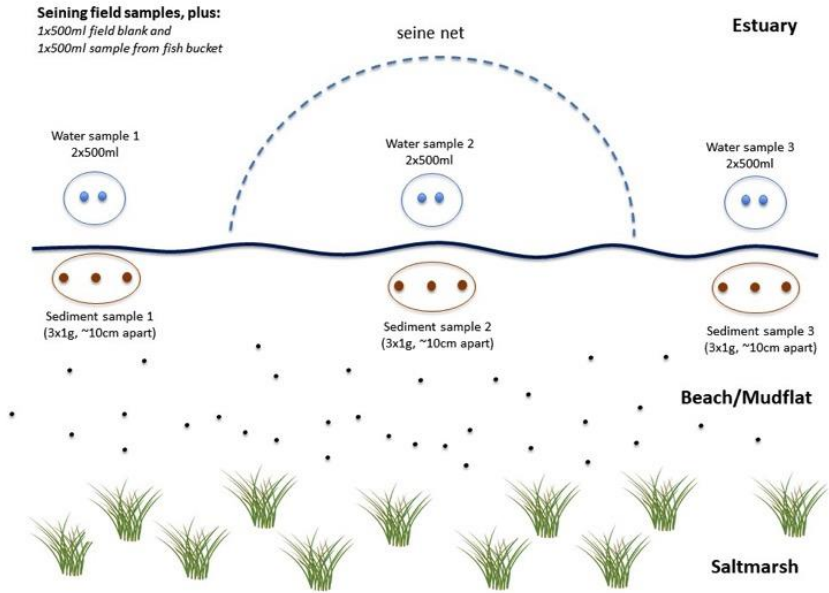
Seining sample collection



1-L water samples at 3 locations, 3 composite sediment samples at tideline

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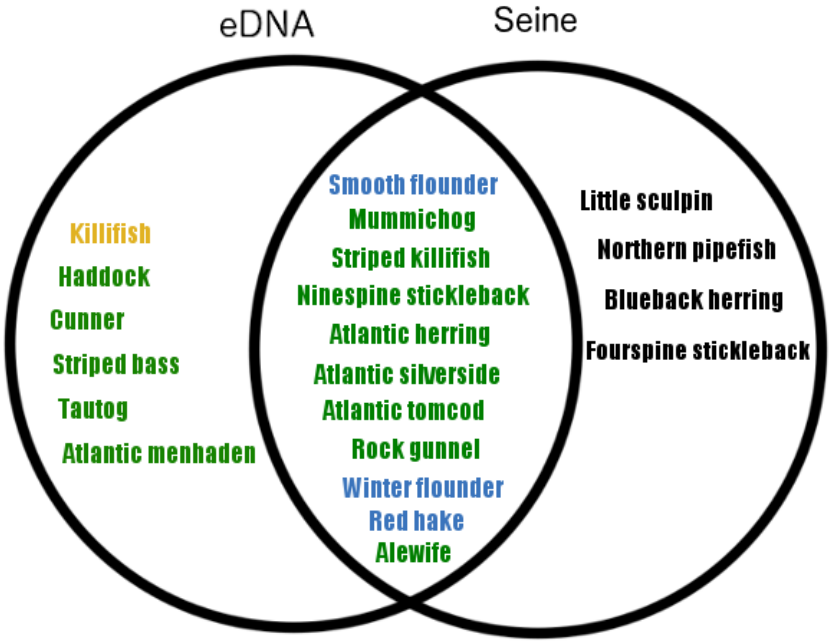
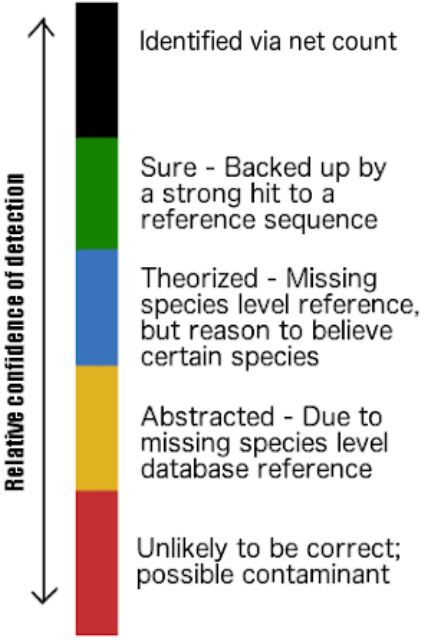
Seining – New Hampshire

5 sites, 2 sampling events





Anadromous fish counts

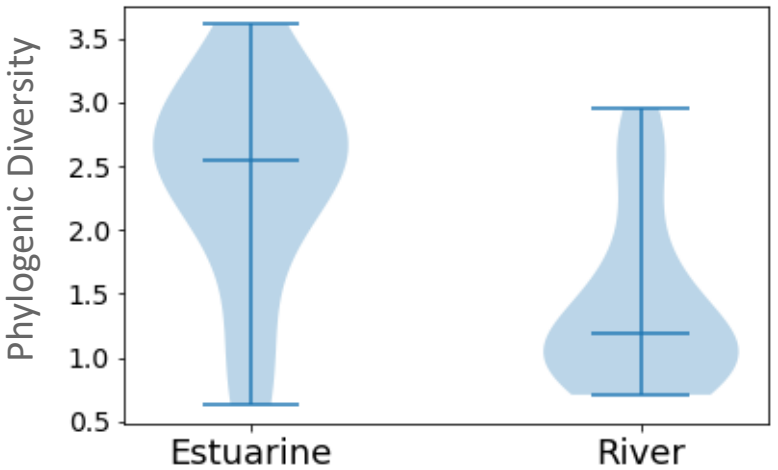
Triplicate 1-liter water samples collected above dam and at base of fish ladder, 2-3 times/week May-June (Oyster and Lamprey Rivers, NH)

26 fish species

Also American beaver, Common Muskrat, Common Tern, Cow, Eastern Gray Squirrel, Eastern Newt, Pig, Mallard, Human & invertebrates

eDNA & Anadromous Fish

Can we measure the difference in fish assemblage above and below a stream barrier? Yes, different species and higher diversity in estuarine samples



47 species, including non-fish, detected with 12S primer (MyFish)

eDNA & Anadromous Fish

How does our survey of two rivers (Oyster & Lamprey) compare to the NH Resident Freshwater species list from Fish and Game?

Undetected	Detected	Limited	No ID

Alewife	Creek chub	Redfin pickerel
American brook lamprey	Creek chubsucker	Rock bass
American eel	Eastern silvery minnow	Round whitefish
American shad	Fallfish	Sea lamprey
Atlantic salmon	Fathead minnow	Shortnose sturgeon
Atlantic sturgeon	Finescale dace	Slimy sculpin
Banded killifish	Golden shiner	Smallmouth bass
Banded sunfish	Lake chub	Spottail shiner
Black crappie	Lake trout	Swamp darter
Blacknose dace	Lake whitefish	Tessellated darter
Blueback herring	Landlocked salmon	Walleye
Bluegill	Largemouth bass	White perch
Bridle shiner	Longnose dace	White sucker
Brook trout	Longnose sucker	Yellow bullhead
Brown bullhead	Margined madtom	Yellow perch
Brown trout	Northern Pike	Fourspine stickleback
Burbot (freshwater cusk)	Northern redbelly dace	Menhaden
Chain pickerel	Pumpkinseed	Perch 1
Channel catfish	Rainbow smelt	Perch 2
Common carp	Rainbow trout	Shad 1
Common shiner	Redbreast sunfish	Mystery Fish ~*H. flammea*

We detected 26 of the 57 species on the NH Fish and Game "Resident Freshwater Species List" (listed to the right). Green indicates the species we identified that are on their list.

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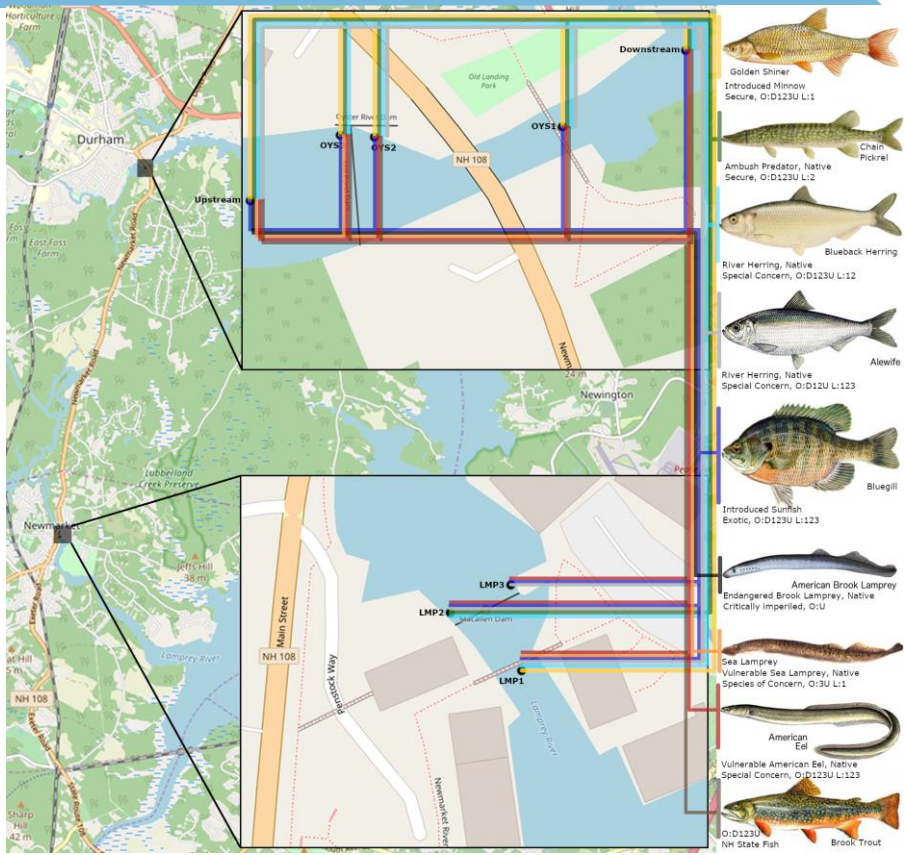
All Fish detections – Oyster & Lamprey Rivers

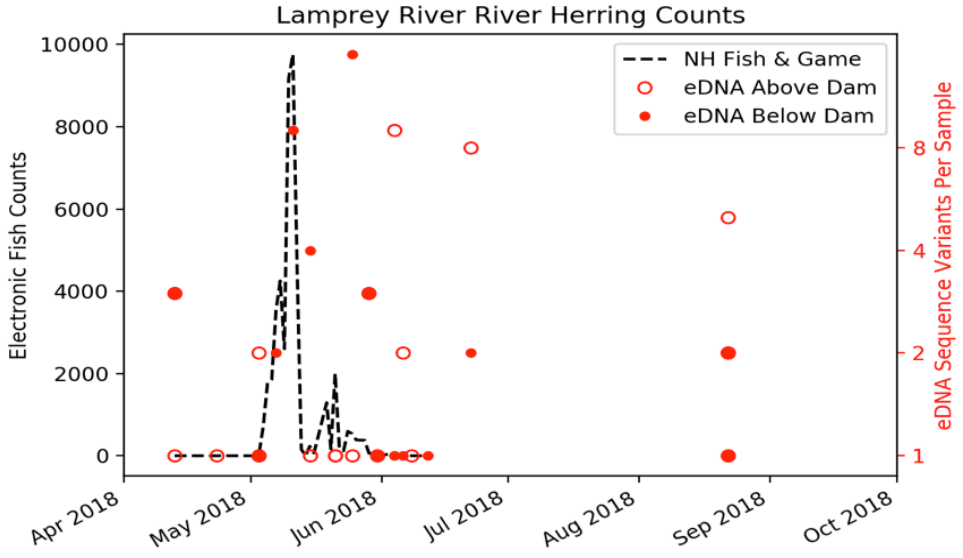
Detected 26 species - most of the fish that would be expected to be in that section of the rivers.

Did NOT correlate well with fish counts

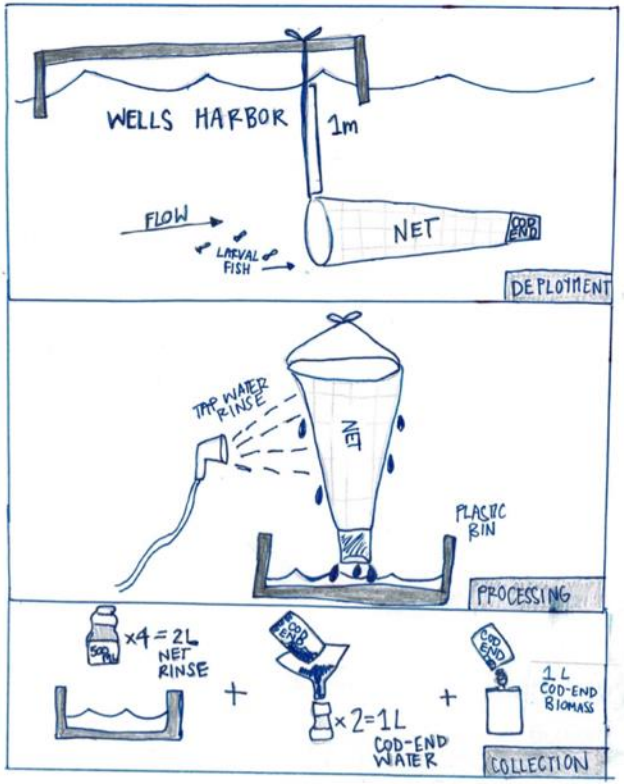


Anadromous fish counts

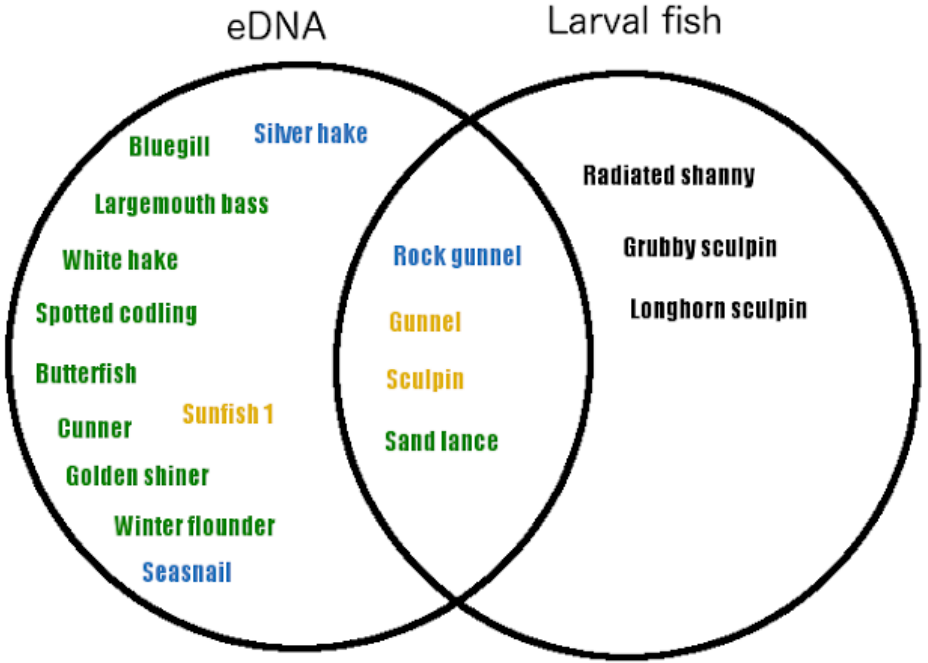
DNA increases when fish return, but doesn't correlate with abundance

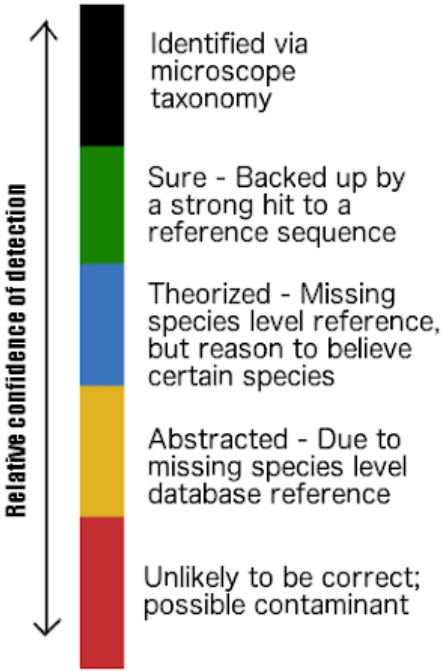


Larval Trawl (Wells)

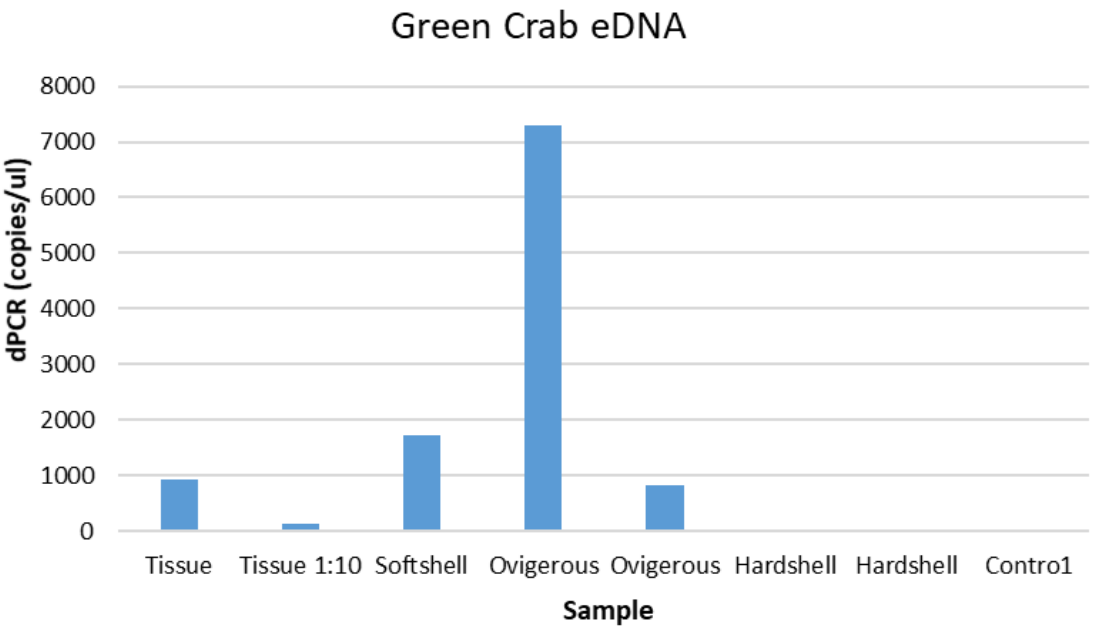


Larval trawl results(Wells)





Crab Experiment – Maine



Green crab DNA only detected from softshell and gravid crabs in tank experiment

Lessons so far:

- Methods matter! How samples are collected, processed, interpreted will effect results.
- Contamination (primarily lab) is challenging.
- This is very interdisciplinary – biology, water quality, computer science, resource managers, communication.

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Next steps for this project (summer 2019)

Still deciding, but possibly:

- Developing recommendations for fish surveys in estuaries – how many samples, volume, analysis
- More larval fish surveys – comparison between microscope, DNA from tow sample and DNA from water samples.
- Sampling algae in streams
- Invasive species (zebra mussels) in lakes

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Questions?


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Developing DNA Methods to Monitor Invasive Species and Biodiversity in Estuaries
Photo - South Slough Reserve at high tide.
www.estuarydna.org

The only thing you have to remember from this talk

If you are developing any form of taxonomy based criteria you should be considering molecular methods

Really

Take home slide from Northeast Aquatic Biologists Conference, Feb 2019

Biodiversity

18S analysis of estuarine sediment samples
Several hundred eukaryote species in each sample