St. Louis River estuary as possible Dreissena veliger source to western Lake Superior

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Background *(2017 survey overview & findings)*

In 2017 EPA conducted early detection case study in western Lake Superior around the Apostle Islands addressing concerns over adult Dreissena finds on shipwrecks & native mussels by Nat'l Park Service

- What is dreissena prevalence and distribution?
- Baseline and potential impacts on zooplankton and benthos community?

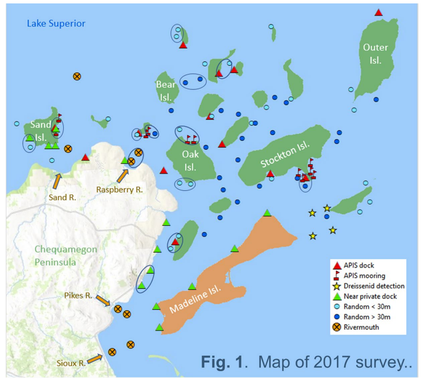


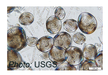
Fig. 1. Map of 2017 survey..

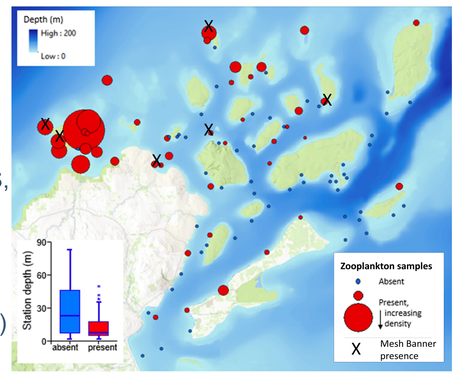
50 random depth-stratified sites & 50 sites targeting likely Dreissena location sampled using multiple gear types

Sample types , # samples collected
PONAR grab, benthos, N = 89
Hester Dendy (HD), benthos, N = 52
Rock bag, benthos, N = 11
Zooplankton tow, 63µ, water column, N = 98
Mesh banner (on HD lines), water column, N=37
eDNA 500mL water, 2m above benthos, N = 99
eDNA 500mL water, 1m below surface, N = 33
Video – benthos, N = 93
Ca2+, nutrients, chlorophyll A & B, N=85
Temp, conductivity, turbidity, pH, DO, N = 99

- ***Intensive survey found no settled juvenile or adult Dreissena.***
- ***Dreissena veligers were present in 43 zooplankton samples***
- ***D. polymorph DNA was detected using qPCR in 6 mesh banners***

Fig. 2 Map of Dreissena detections. Veligers found at very low densities (max 39/m^3, most <5/m^3). DNA detections were also at very low concentrations.





Veliger spatial patterns

- Consistently present in west APIS, sporadic to east
- Densities highest around Sand Island and along north island fringe
- Finds primarily along NW (not SE) side of big Islands

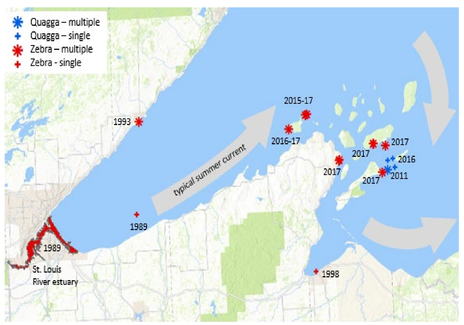


Fig. 3. Map of settled Dreissena known from Lake Superior (with year) and typical circulation patterns.

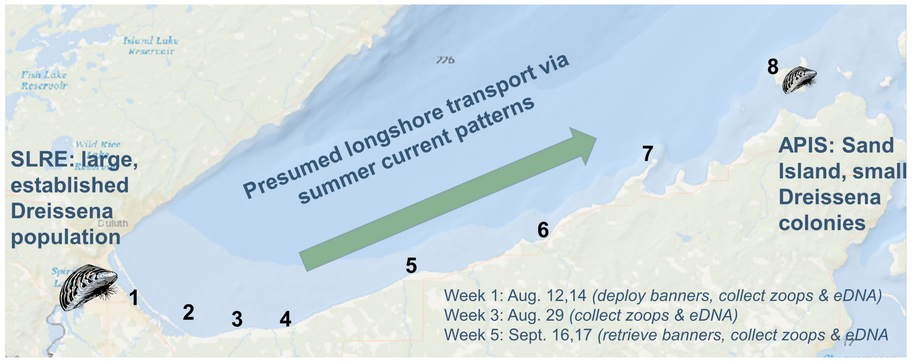
Transport of veligers from the St. Louis River to Apostle Islands???

- SLRE has largest, most established Dreissena population in Lake Superior
- Typical summer current patterns consistent with transport from SLRE to APIS

Survey Overview, Design, & Methods *(2019 W. Lake Superior south shore survey)*

Objectives: *Follow up 2017 survey by sampling along SLRE to APIS gradient to evaluate if the SLRE is the veliger source to APIS Dreissena.*

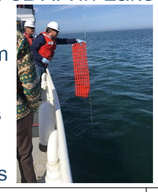
- We expect to see a pattern of veliger density declining with distance from the SLRE to APIS (and possibly size increasing over this distance)
- 2017 methods modified to increase probability of detecting low abundance Dreissena veligers and eDNA in Lake Superior

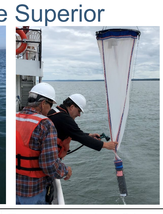


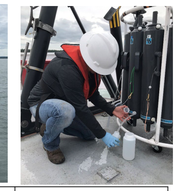
Study Design
8 sites (10 – 15m depth)

3 visits (2 weeks apart)

3 sampling gears







Gear	2(2'x4') mesh banners (N = 16)	Zooplankton tow 64µm mesh (N = 24)	eDNA (N = 48)
Sampling modifications	2, larger, more rigid banners. Sampled 1m below surface & 2m above benthos	Composited 4 tows per sample. Saved decanted EtOH for DNA analysis	Increased water volume sampled to 1L. Sampled 3m below surface & 2m above benthos
Processing & analysis	qPCR targeting Dreissenids	Zoops: full enumeration Zoop EtOH: qPCR targeting Dreissenids	Filtered samples & qPCR targeting Dreissenids

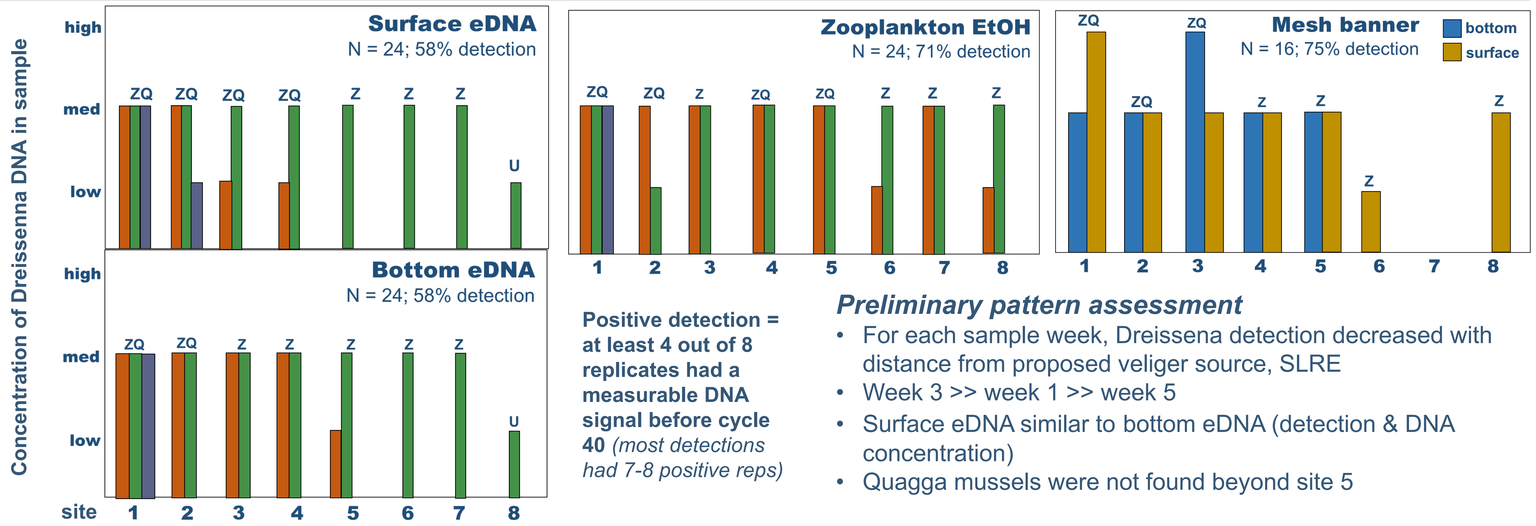
Findings *(preliminary qPCR results)*

- ***qPCR (quantitative polymerase chain reaction): Is target DNA is present?***
- ***Fewer PCR cycles to detect target = higher DNA concentration in sample***

45 total cycles

DNA concentration: High=DNA detected < 29 PCR cycles; Med=DNA detected 29-38 cycles; Low=DNA detected 38-40 cycles

Week 1 | Week 3 | Week 5 | **ZQ** = zebra & quagga detected | **Z** = only zebra detected | **Q** = only quagga detected | **U** = undefined, Dreissenid DNA detected; species DNA may be below detectable limit

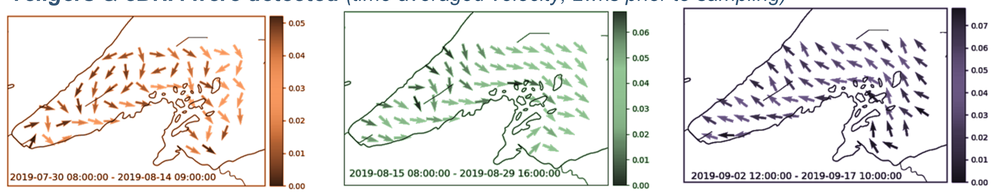


Positive detection = at least 4 out of 8 replicates had a measurable DNA signal before cycle 40 *(most detections had 7-8 positive reps)*

Preliminary pattern assessment

- For each sample week, Dreissena detection decreased with distance from proposed veliger source, SLRE
- Week 3 >> week 1 >> week 5
- Surface eDNA similar to bottom eDNA (detection & DNA concentration)
- Quagga mussels were not found beyond site 5

Surface current patterns leading up to each sampling week correspond to where Dreissena veligers & eDNA were detected *(time averaged velocity; 2wks prior to sampling)*



Still to come…

- More endpoints: zooplankton enumeration (veliger densities, zooplankton community gradient?)
- In depth analysis
  - qPCR data, calculate DNA copy numbers
  - longshore current patterns leading up to sampling trips

U.S. Environmental Protection Agency
Office of Research and Development

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