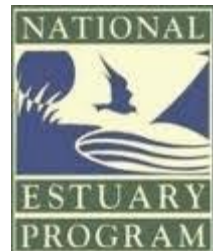




Field Work from your Desk: Water Quality Assessment using an Autonomous Vehicle

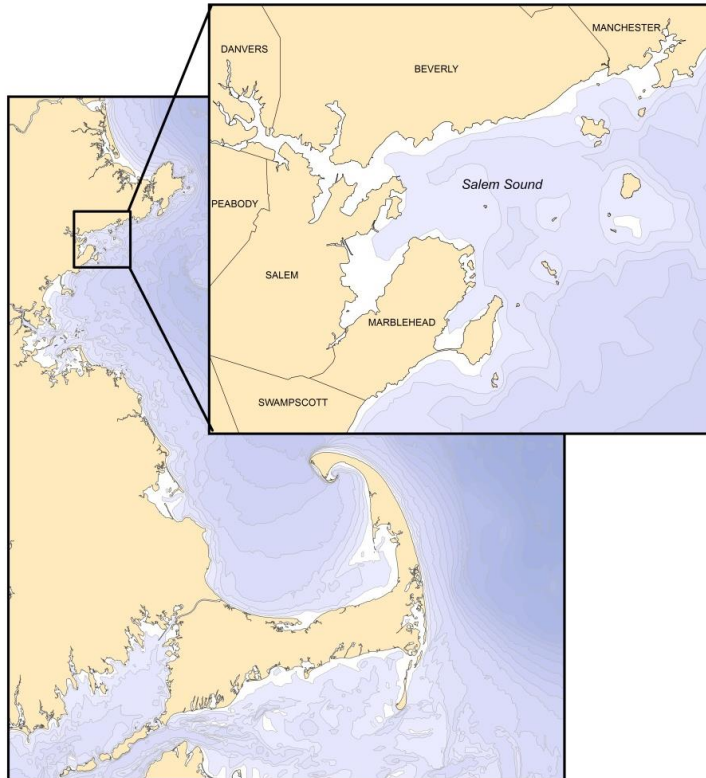
Prassede Vella
Massachusetts Bays National Estuary Program

2019 NEP Tech-Transfer Meeting
Dewey Beach, DE



About Salem Sound...

- Embayment area 3,660 ha
- Large watershed 43k ha
- 6 coastal communities
- High population density 1000 /km²



- Riverine input
- ↑ 60% urbanized area =
↑ stormwater runoff
- 2 WWTP**
- ↓ < 65.5 ac saltmarsh*
- ↓ 81% eelgrass in Salem Harbor

Purpose of the study

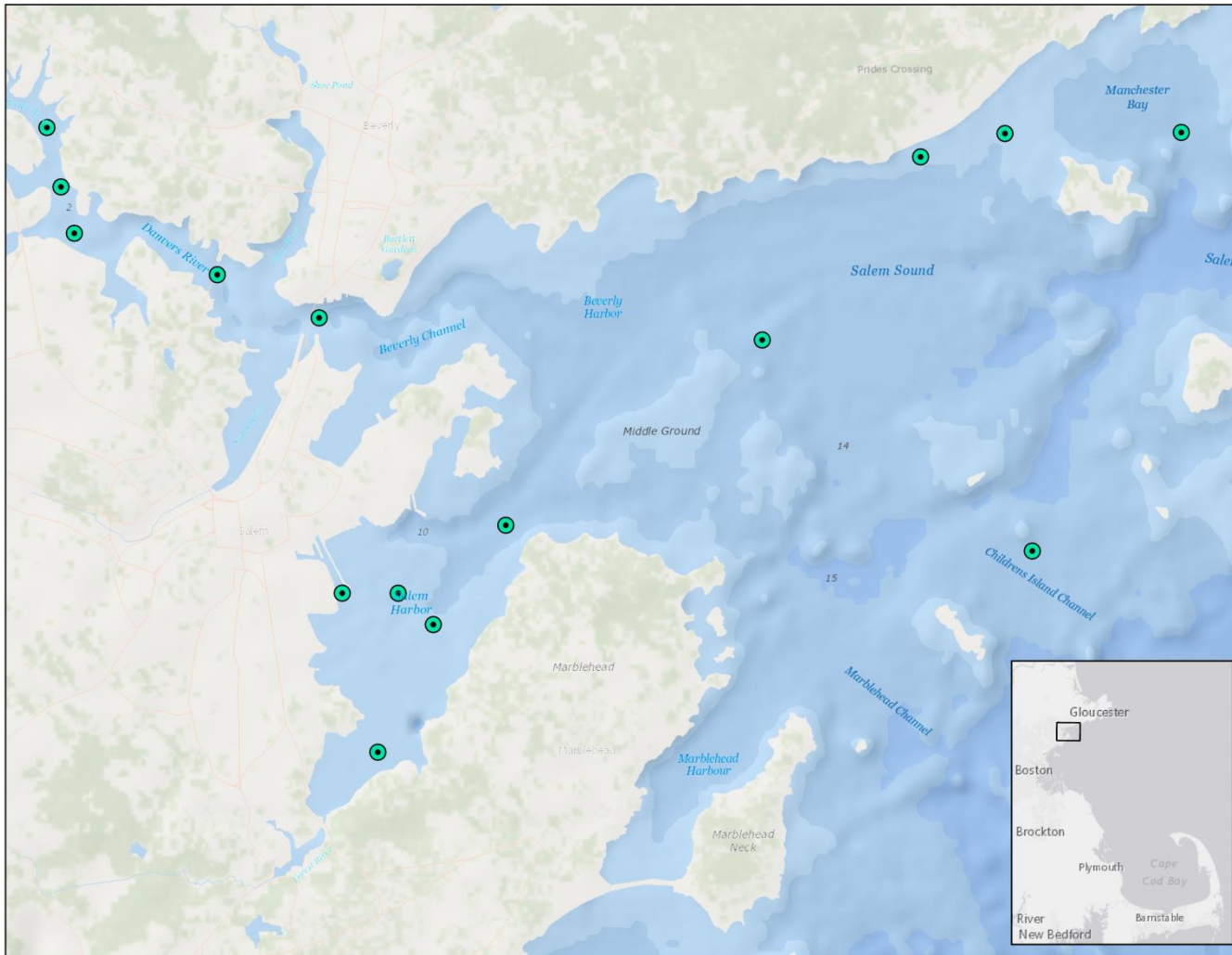
- What are the nutrient dynamics in Salem Sound?
- Do real-time monitoring data paint a different picture of nutrient conditions in the Sound than discrete samples?
- Are autonomous samplers suitable for monitoring in an urban area?



Winter Island, Salem

Survey Method 1

15 stations: Discrete water samples for nutrients and chlorophyll



- 8 Stations:
handheld sonde
- Temperature
 - Salinity
 - Turbidity
 - DO
 - pH

Secchi

6 sampling
events

Survey Method 2

Autonomous vehicle equipped with a sonde:

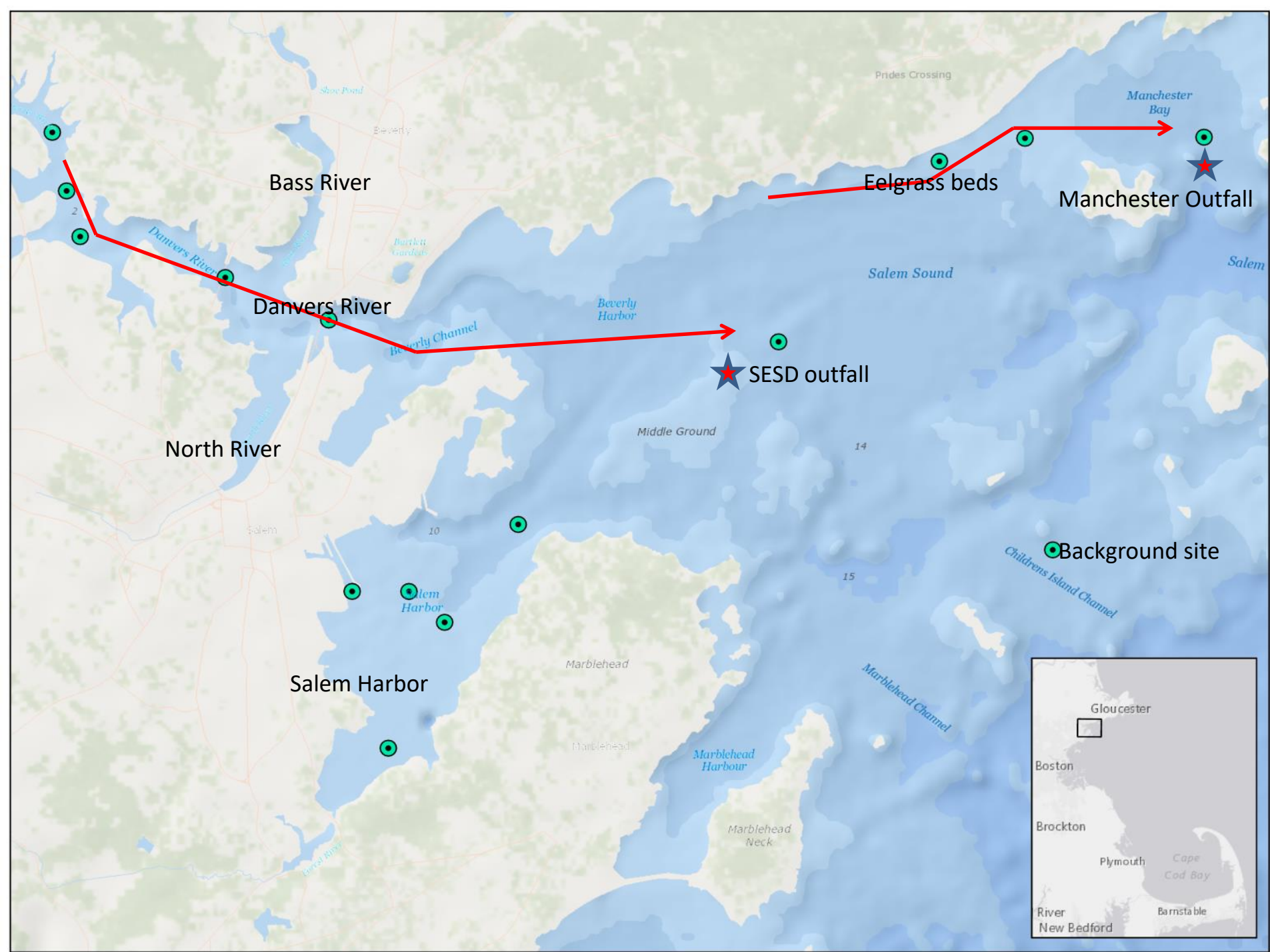
Temperature, salinity, DO, turbidity, pH and chlorophyll

8 sampling events

Gather data along transects

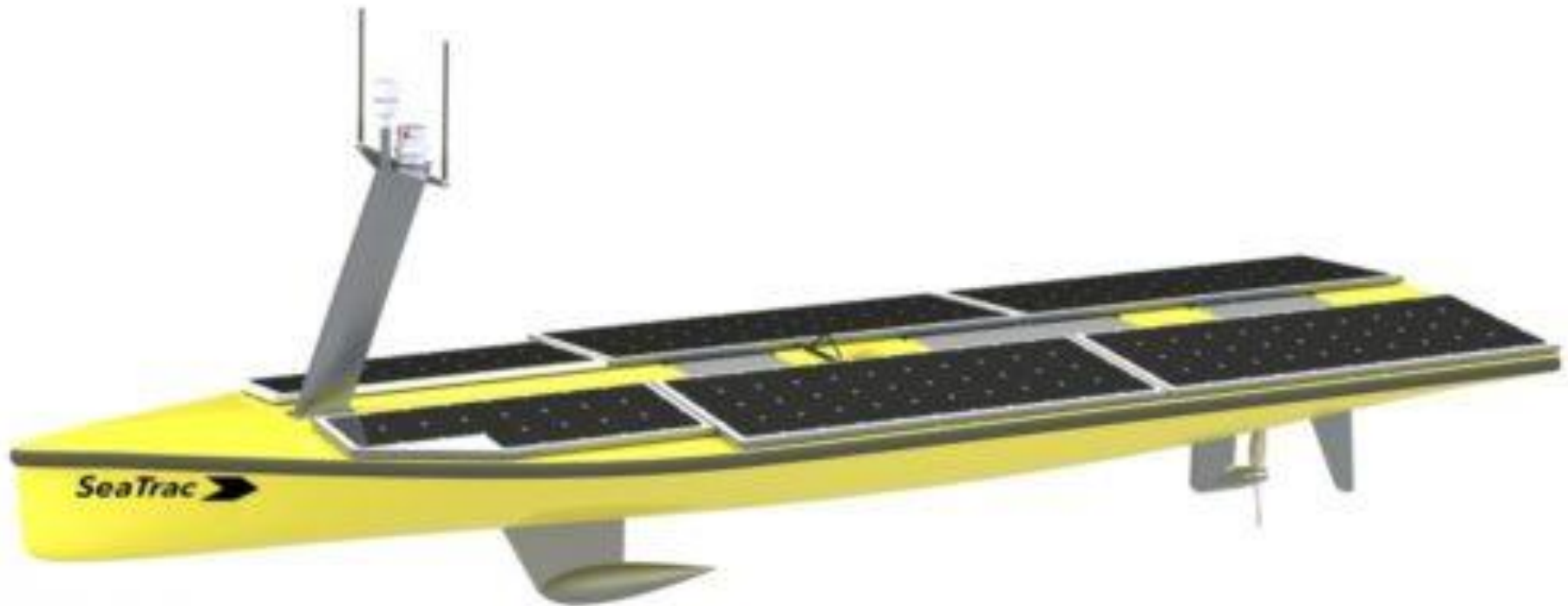
- Danvers River
- Outfalls
- Eelgrass beds





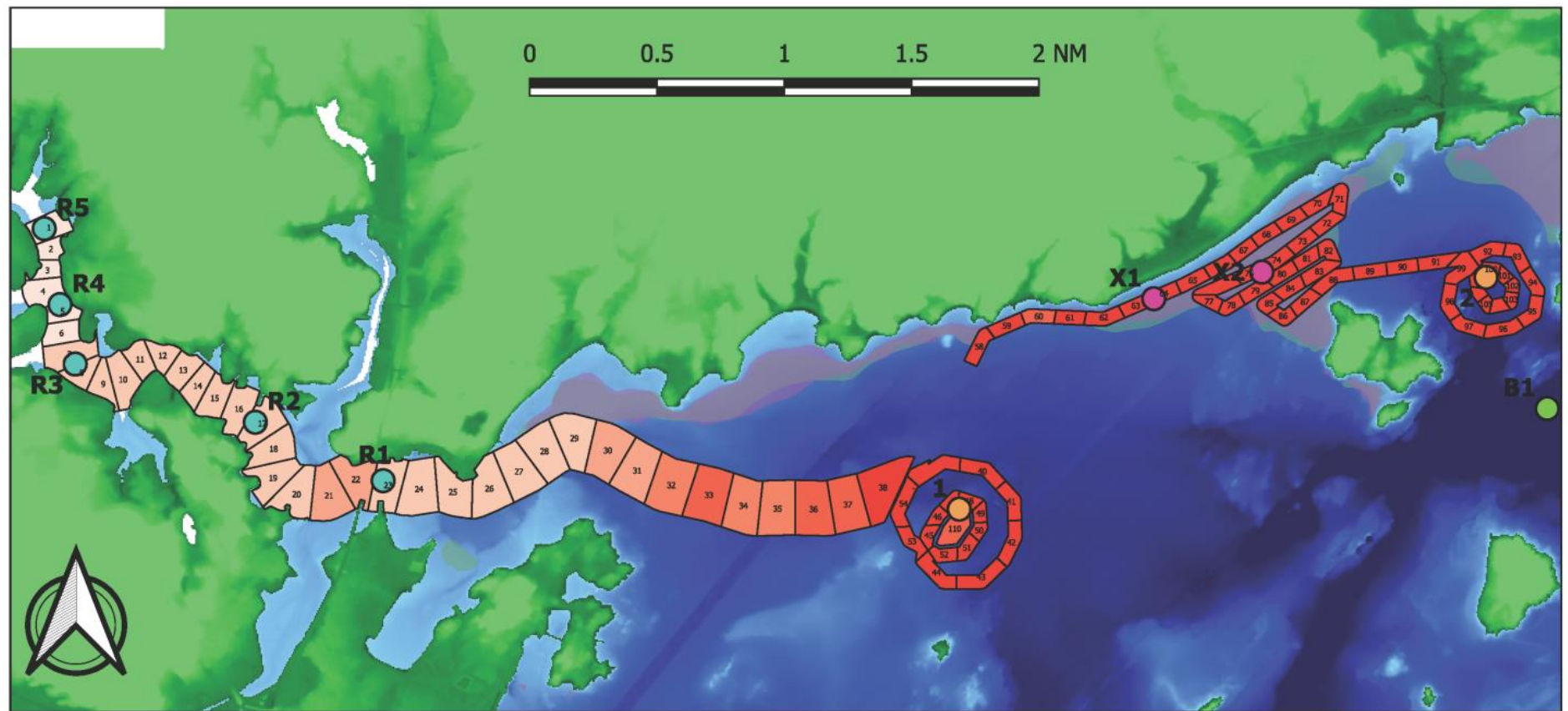
The SeaTrac System

- Solar powered unmanned surface vehicle
- Direct local piloting or remote bridge/autonomy*
- Operates in open water & shallow areas
- Carries sensors for continuous, real-time data streaming*
- Operates along pre-programmed tracks*



Preliminary Results

- Water sample analysis results still pending
 - 15 sites, 6 sampling events
- SeaTrac results available
 - 8 sampling events
 - Measured real-time conditions
 - Collected continuous data (every 10s)
 - Measured parameters over space (transect) and time (tidal)



Salem Sound SeaTrac Monitoring Data

Each colored segment represents an average of all data readings within that geographic region. SeaTrac takes readings every 10 seconds. Generally 15-20 readings per segment.

Season Averages - pH

	pH 7.70-7.78		pH 7.94-8.02		pH 8.18-8.26		pH 8.42-8.50
	pH 7.78-7.86		pH 8.02-8.10		pH 8.26-8.34		
	pH 7.86-7.94		pH 8.10-8.18		pH 8.34-8.42		

 EELGRASS1995

 EELGRASS2012

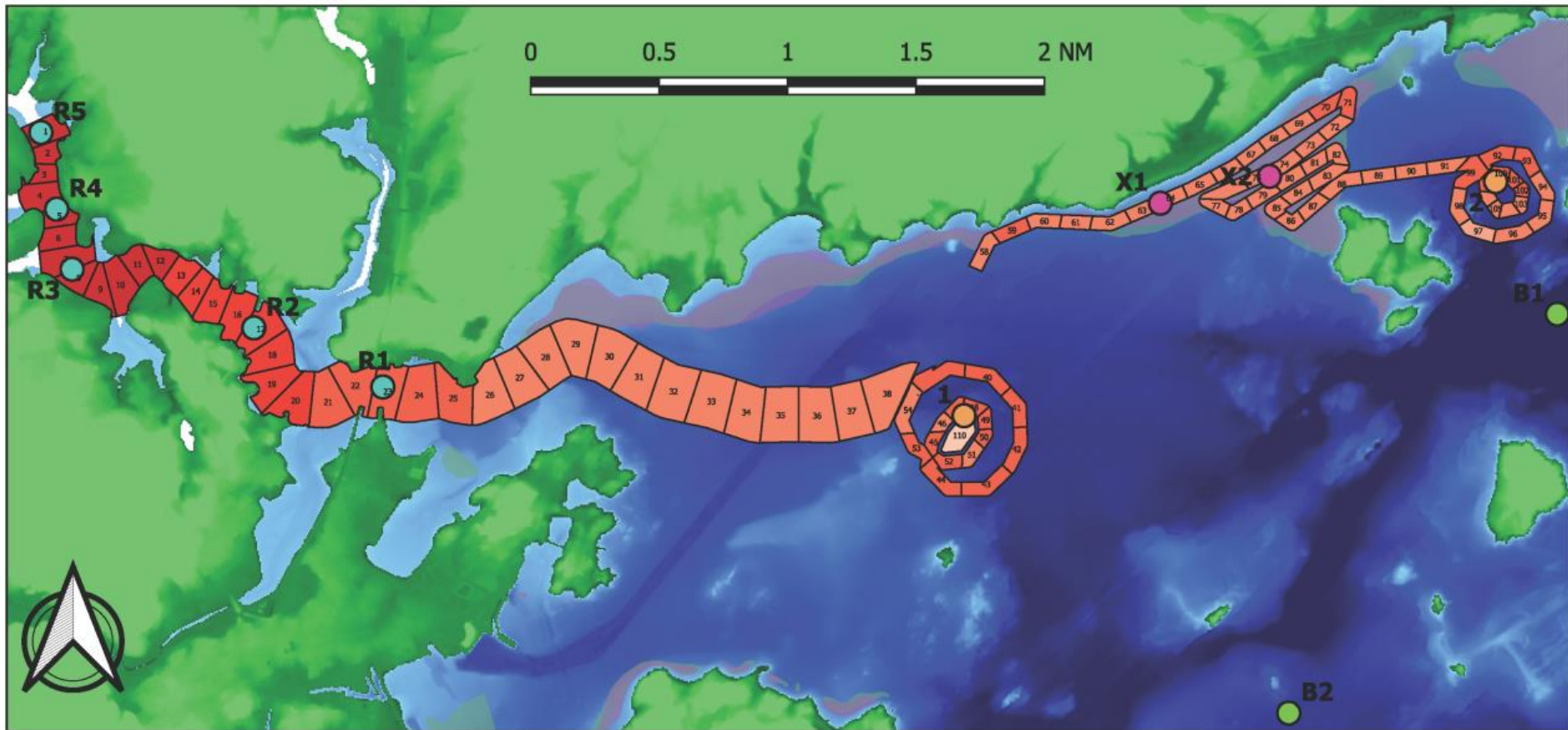
Sampling points

 Background

 Discrete

 EelGrass

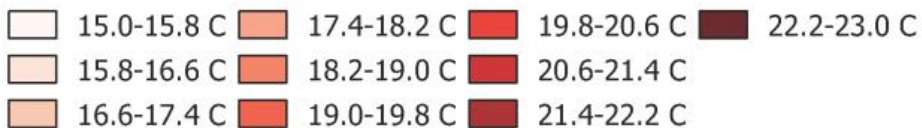
 River



Salem Sound SeaTrac Monitoring Data

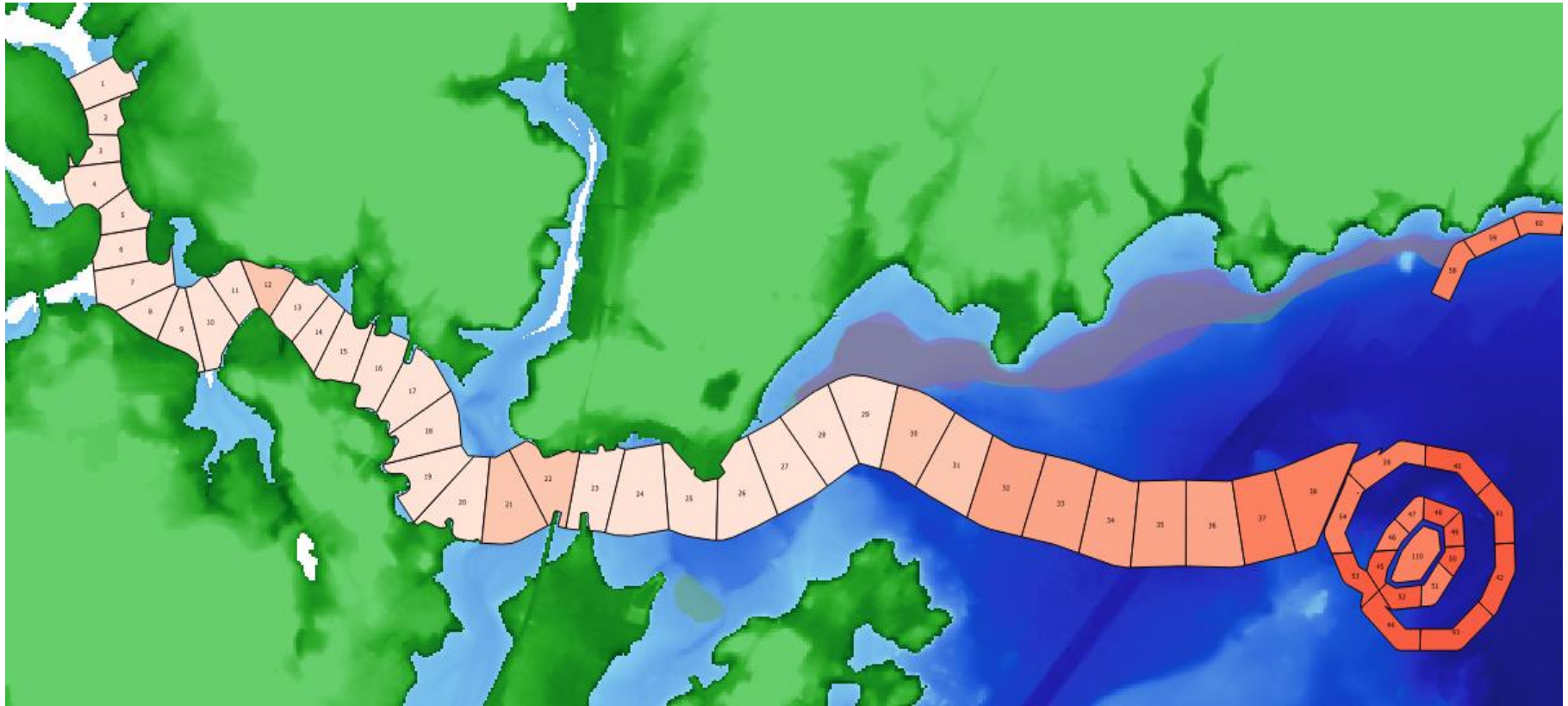
Each colored segment represents an average of all data readings within that geographic region. SeaTrac takes readings every 10 seconds. Generally 15-20 readings per segment.

Season Averages - Water Temperature

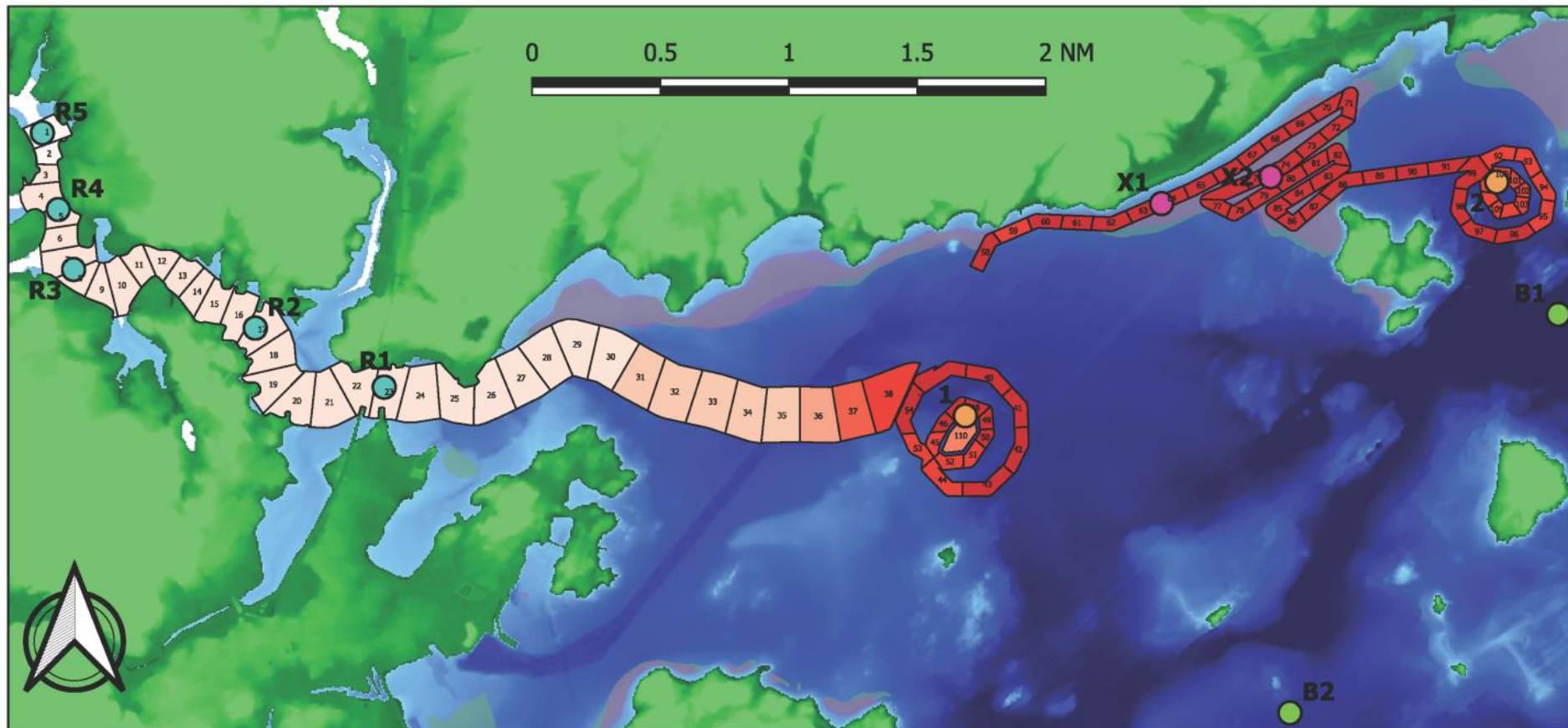


- EELGRASS1995
- EELGRASS2012

- Sampling points
- Background
 - Discrete
 - EelGrass
 - River



Seasonal Average – Dissolved Oxygen



Salem Sound SeaTrac Monitoring Data

Each colored segment represents an average of all data readings within that geographic region. SeaTrac takes readings every 10 seconds. Generally 15-20 readings per segment.

8/22/19 and 8/23/19 - Dissolved Oxygen

80-89 % sat	107-116 % sat	134-143 % sat	161-170 % sat
89-98 % sat	116-125 % sat	143-152 % sat	
98-107 % sat	125-134 % sat	152-161 % sat	

EELGRASS1995

EELGRASS2012

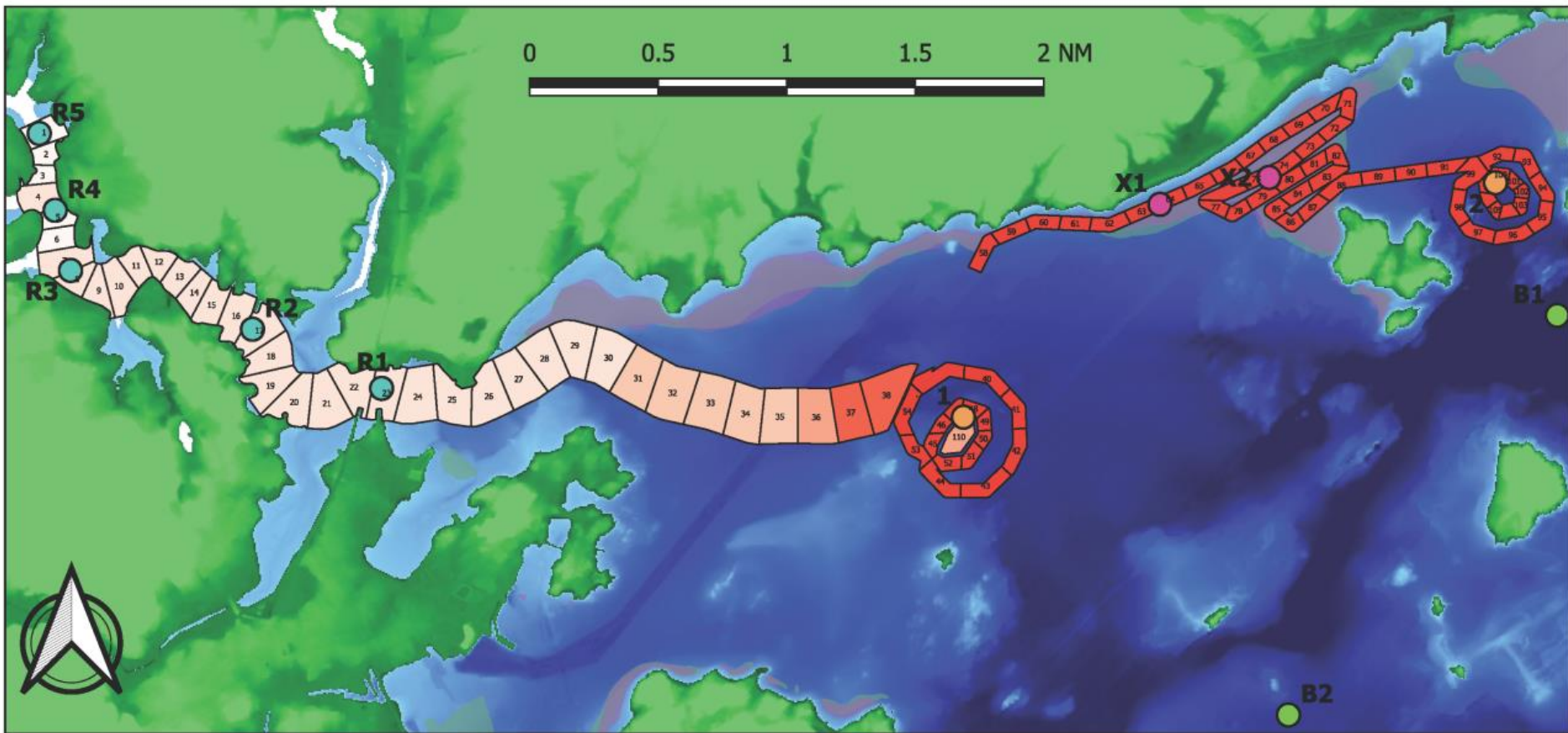
Sampling points

Background

Discrete

EelGrass

River



Salem Sound SeaTrac Monitoring Data

Each colored segment represents an average of all data readings within that geographic region. SeaTrac takes readings every 10 seconds. Generally 15-20 readings per segment.

8/22/19 and 8/23/19 - pH

 pH 7.70-7.78	 pH 7.94-8.02	 pH 8.18-8.26	 pH 8.42-8.50
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 pH 7.86-7.94	 pH 8.10-8.18	 pH 8.34-8.42	

 EELGRASS1995
 EELGRASS2012

Sampling points
 Background
 Discrete
 EelGrass
 River

Initial conclusions

- Important power of repetition in providing RT information about conditions over space and time
- Cover large area over relatively short period of time
- Can cover same area across tidal cycle
- Low cost
- Can make corrections immediately

Next steps

- Finish water sample analysis
- Continue to analyze SeaTrac data
- Compare results of discrete samples, handheld sonde and SeaTrac sonde
- Make recommendations for management and future work



Acknowledgements

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