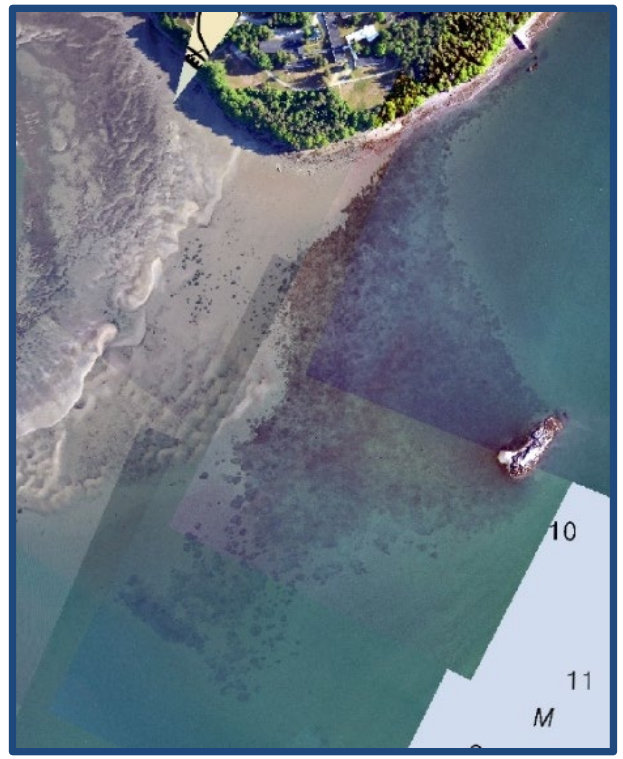
York River Estuary Water Quality Characterization

Angela Brewer
Section Leader, Marine Unit
Division of Environmental Assessment
Bureau of Water Quality

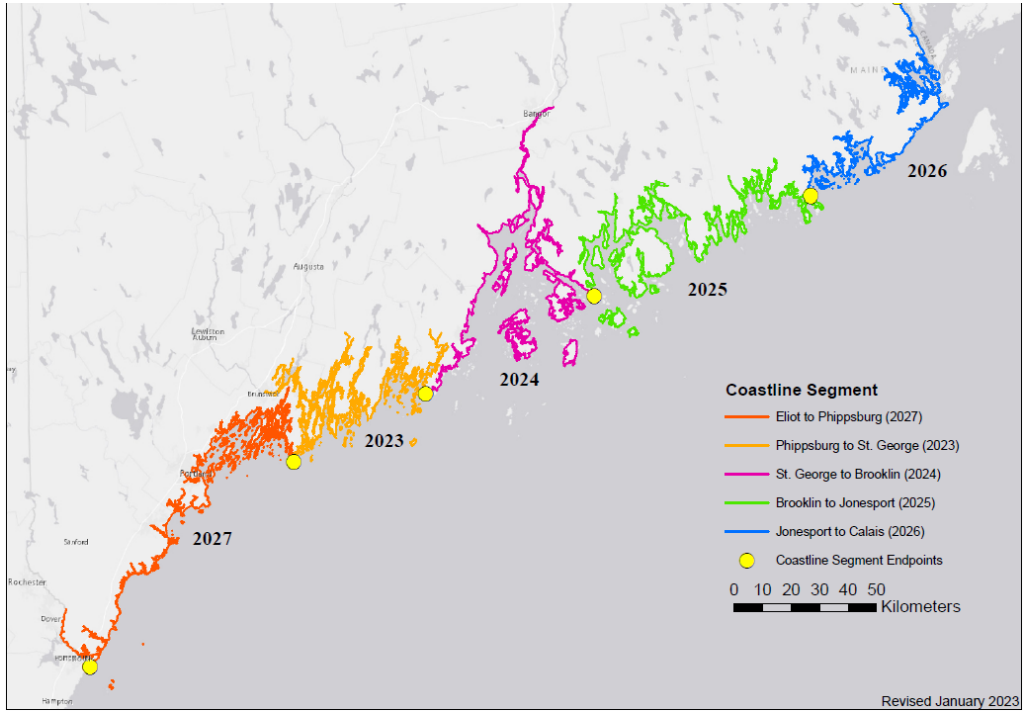
Marine Environmental Monitoring Program

- Contaminant sources
- Impacts on marine biota
- Assessment of habitat condition
- Mostly discrete data collection
- Collaboration with 1) Engineering Unit for continuous data collection, 2) Marine Unit's Marine Vegetation Mapping Program for seagrass & salt marsh mapping



Annual sampling design

- regional focus w/ anthropogenic system gradient
- May-Oct. mid-day sampling, every ~three weeks, alternating ebb and flood tides
- 3 systems, 3-6 sites per system along salinity gradient



Parameters

- profiles (temp., salinity, dissolved oxygen, pH, chlorophyll, turbidity, Colored Dissolved Organic Matter), irradiance
- surface grabs: NO_x, NH_3, TN, TP, chl *a* & phaeo., Total Suspended Solids (added pH and Total Alkalinity in 2024!)
- Secchi depth, weather observations

Class	Designated Uses	Dissolved Oxygen	Bacteria[1]	Aquatic Life
SA	Recreation in and on the water (Primary and Secondary Contact Recreation) Fishing Aquaculture (excludes finfish) Propagation and harvesting of shellfish Navigation Habitat for fish and estuarine and marine life	As naturally occurs	As naturally occurs but Enterococcus may not exceed geometric mean of 8 CFU or MPN/100 mL in any 90-day interval or 54 CFU or MPN /100 mL in more than 10% of samples in any 90-day interval	As naturally occurs
SB	Recreation in and on the water (Primary and Secondary Contact Recreation) Fishing Aquaculture Propagation and harvesting of shellfish Industrial process and cooling water supply Hydroelectric power generation Navigation Habitat for fish and estuarine and marine life	Not less than 85% of saturation	Enterococcus may not exceed geometric mean of 8 CFU or MPN /100 mL in any 90-day interval or 54 CFU or MPN /100 mL in more than 10% of samples (STV) in any 90-day interval from 4/15 to 10/31. Not to exceed criteria of National Shellfish Sanitation Program for shellfish harvesting	Support all indigenous estuarine and marine species Discharge not to cause closure of shellfish beds
SC	Recreation in and on the water (Primary and Secondary Contact Recreation) Fishing Aquaculture Propagation and restricted harvesting of shellfish Industrial process and cooling water supply Hydroelectric power generation Navigation Habitat for fish and estuarine and marine life	Not less than 70% of saturation	Enterococcus may not exceed geometric mean of 14 CFU or MPN /100 mL in any 90-day interval or 94 CFU or MPN /100 mL in more than 10% of samples (STV) in any 90-day interval from 4/15 to 10/31. Not to exceed criteria of National Shellfish Sanitation Program for restricted shellfish harvesting.	Maintain structure and function of the resident biological community Support all indigenous fish species

Seagrass functions and values:

- Food web support
- Nutrient uptake & storage
- Oxygen production, pH buffering
- Sediment stabilization ➔ water clarity
- Carbon sequestration (~10% globally)

New England stocks (Novak et al. (2020)) :

- aboveground biomass: 86 +/- 19 g C/m^2
- sediment: 2,832 +/- 416 g C/m^2

Zostera marina

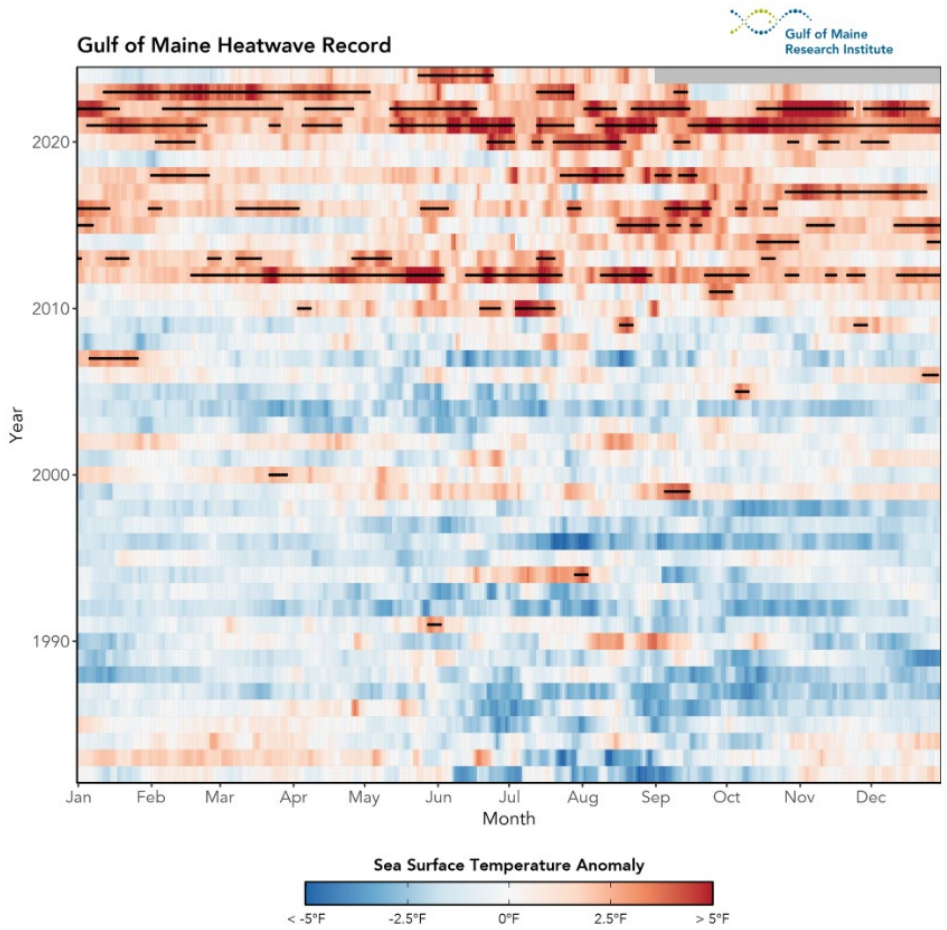
Photo credit: Stantec, August 2022

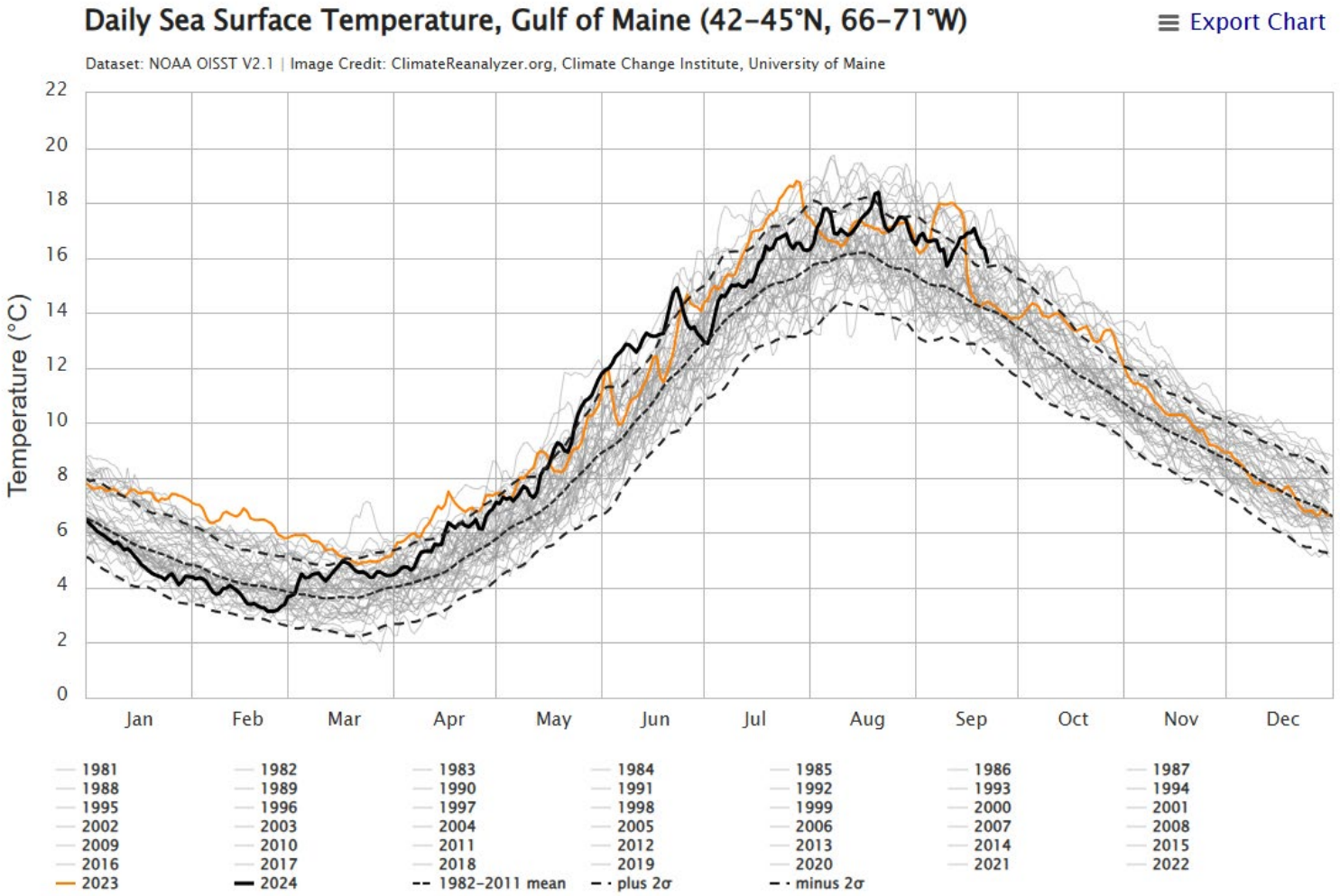
Stressors:

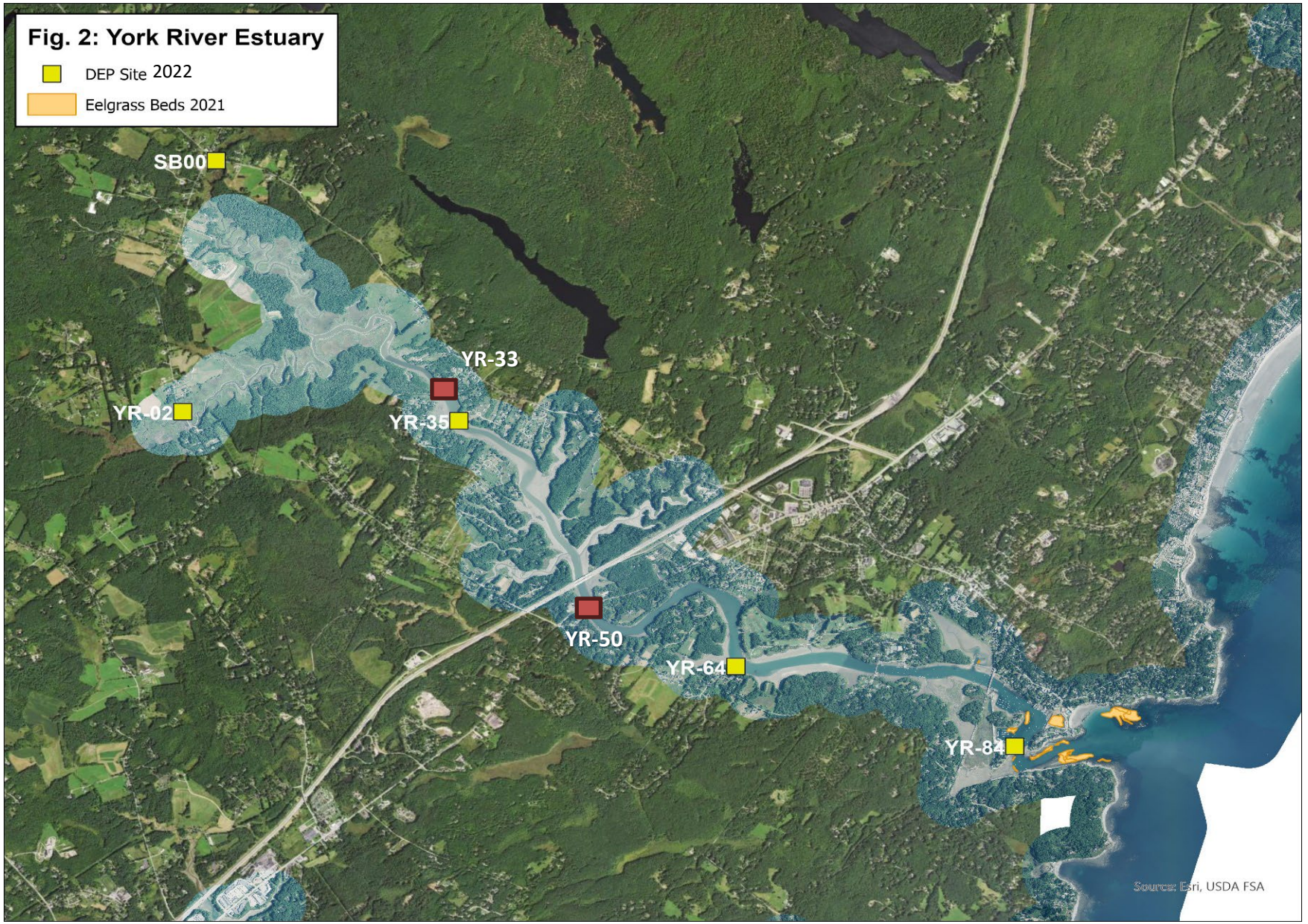
- Abrasion/scour
  - Moorings
- Sediment disturbance
- Low light/shading
  - Sea level rise
- Excess nutrients
- Invasive species
- Grazing
- Rising temperature

Scientists Are Freaking Out About Ocean Temperatures

"It's like an omen of the future."

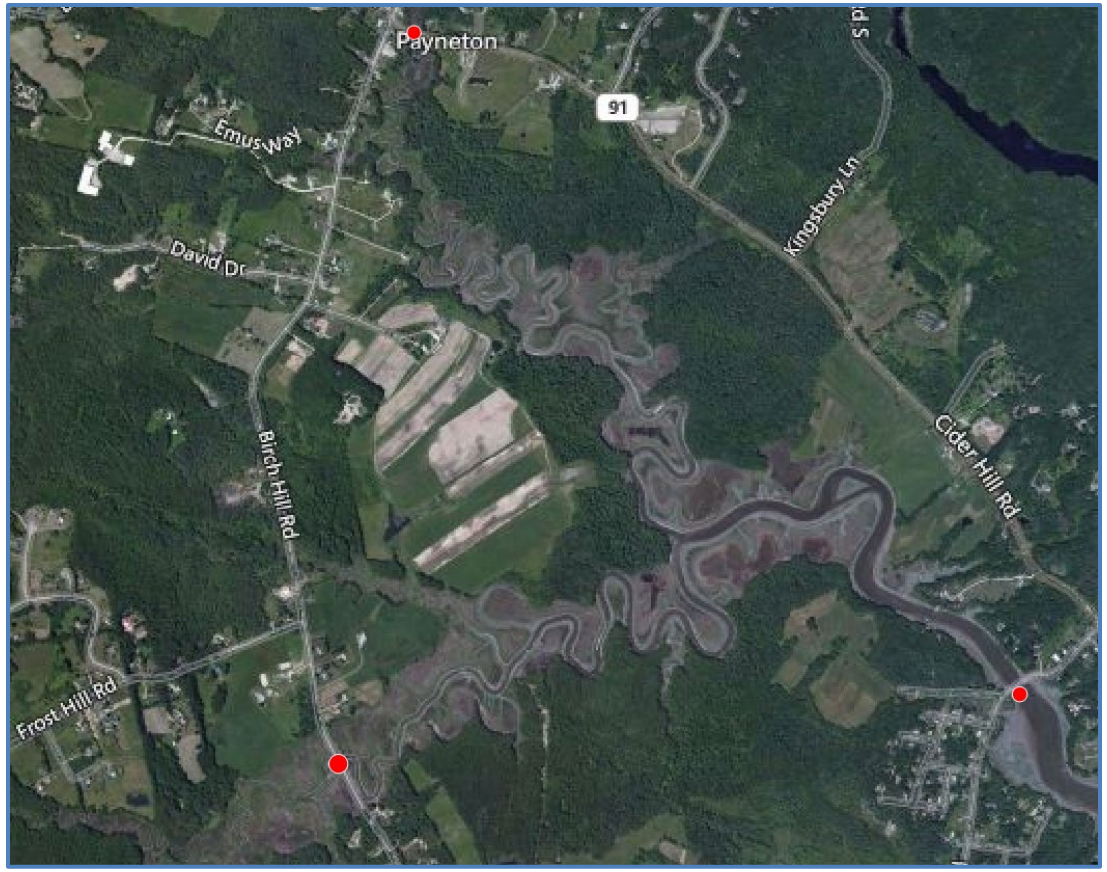




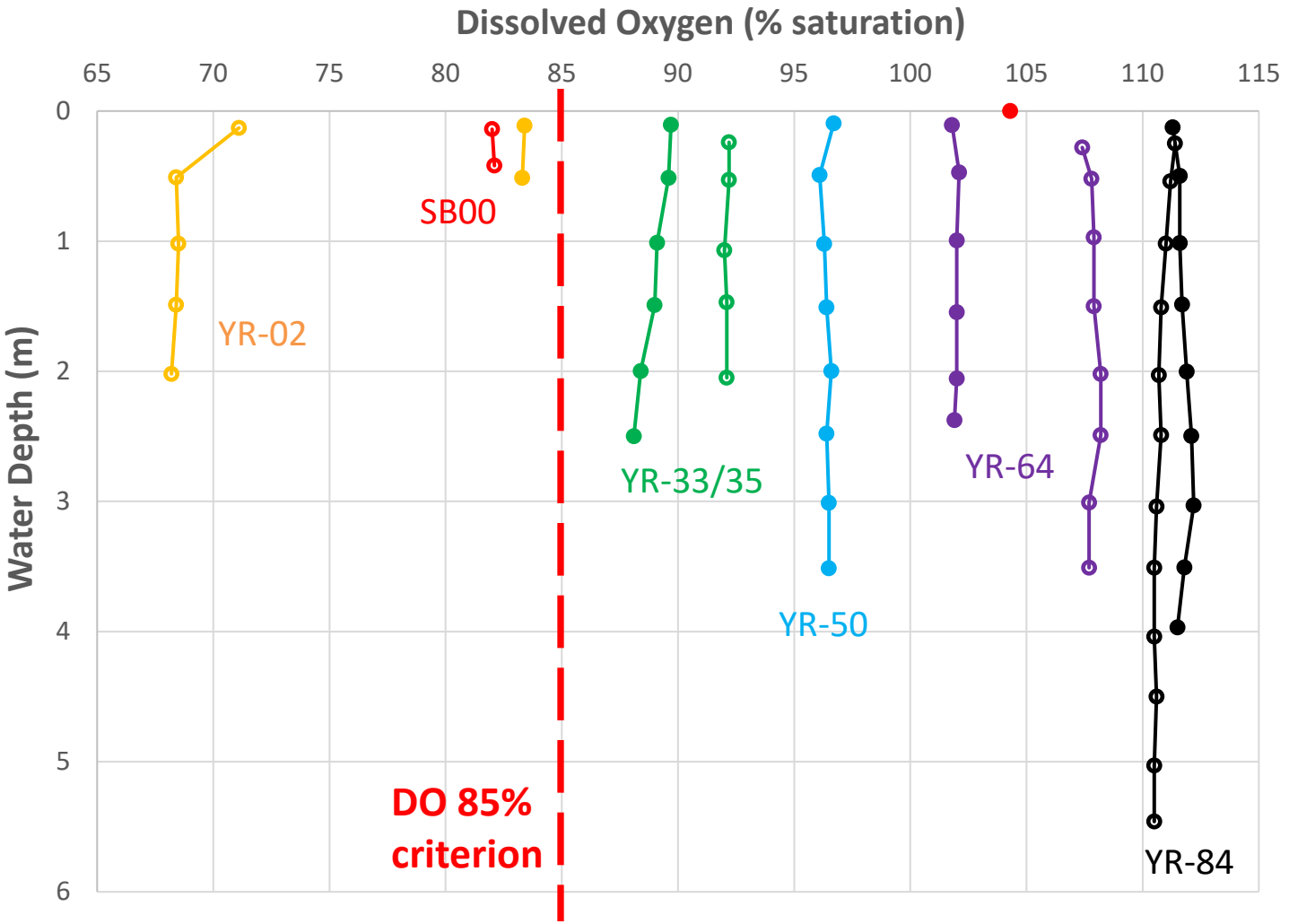


- 2022: sampled in channel, every three weeks from May-October, on alternating ebb and flood tides
- 2017: included YR-50, sampled June-September
- Unattended sonde locations characterize mixing (YR-35) and seawater (YR-64) zones (NOAA Coastal Assessment Framework)

- Extensive marsh near Head of Tide on York River & Smelt Brook, fringing marsh & intertidal flats throughout estuary
- Shallow, well-mixed estuary throughout summer—surface grabs representative of water column conditions
- Rapid flushing (12-13 ft tidal range on spring tides)
- Temperature peak mid-July to mid-Aug. (19-27°C max)—80°F at York River Head of Tide in 2022!
- Sites generally less dynamic with distance from Head of Tide
- Classic confined estuary

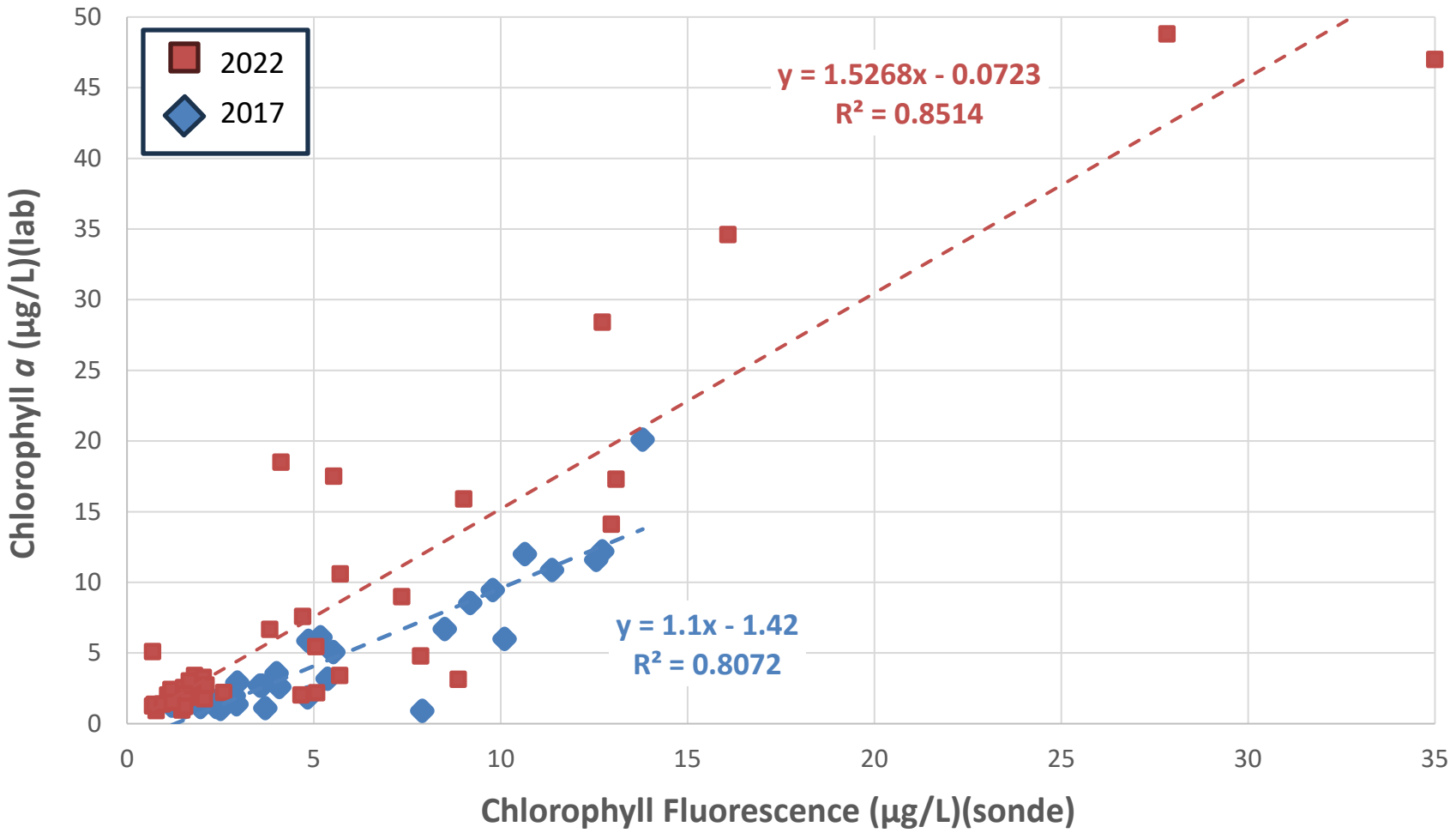


Data review: August ebb tide profiles



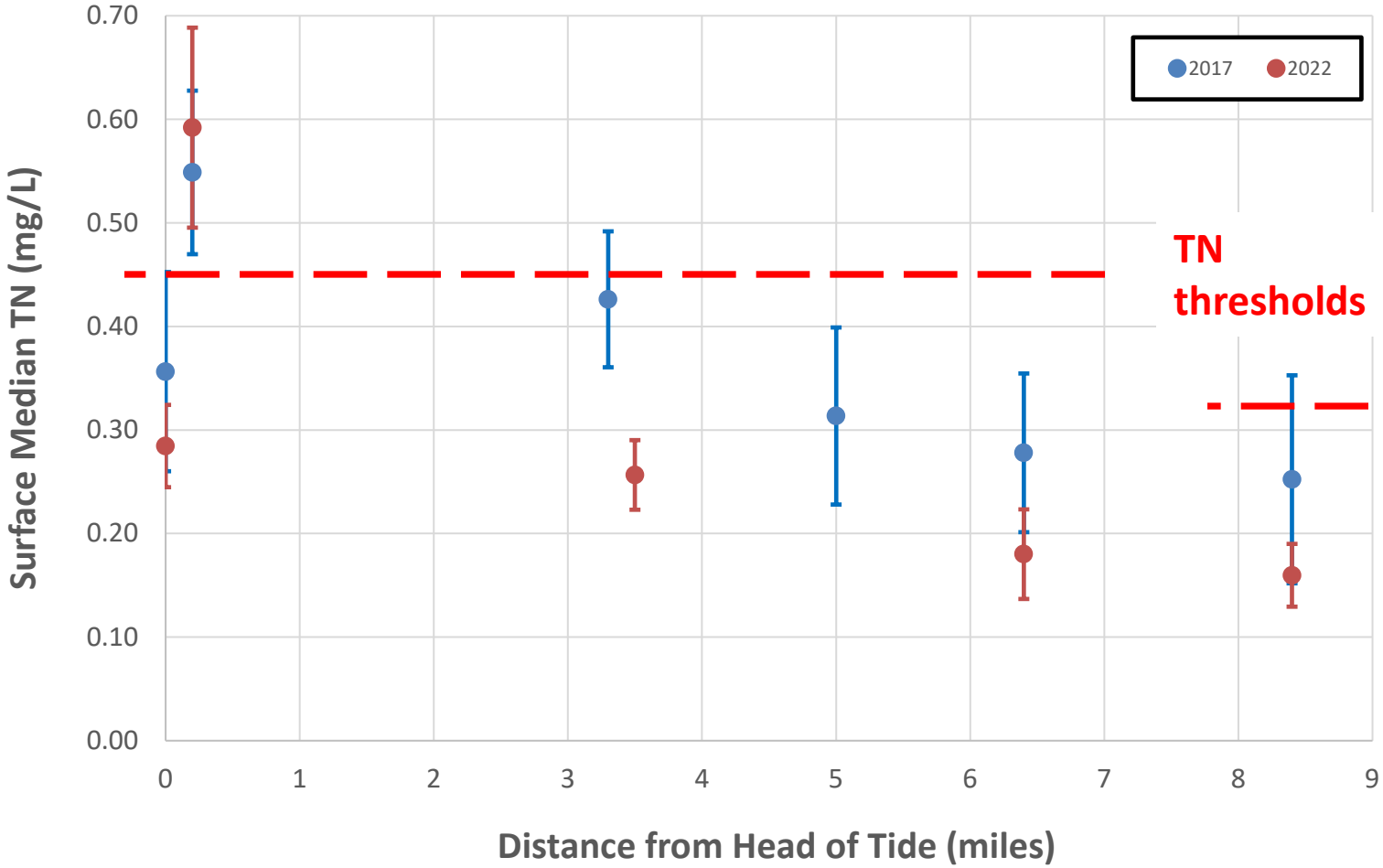
- DO: generally increasing saturation, less variability with distance from head of tide
- pH: generally increasing value, less variability with distance from head of tide
- turbidity: not clearly tied to algal production, more likely due to suspended sediments, especially at YR-02

Data review: chlorophyll relationships



- Chlorophyll sensor good predictor of water column phytoplankton biomass
- Gradient of high chlorophyll *a* (≤ 49 µg/L) near York Head of Tide to low (<5 µg/L) at lower estuary sites

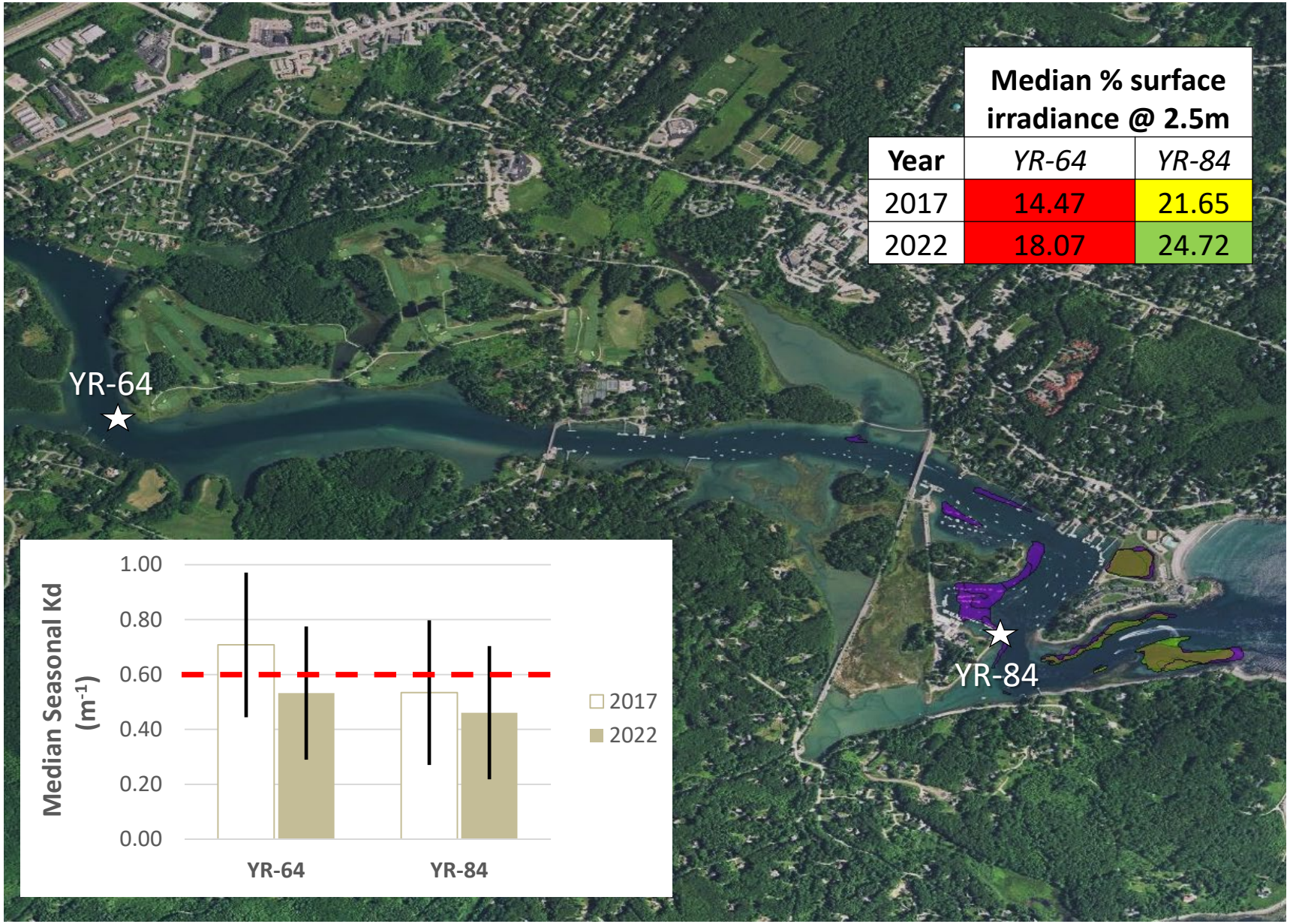
Data review: Total Nitrogen (TN) gradient



- Other than SB00, TN shows typical estuarine gradient
- Except for YR-02, all sites below DEP TN threshold in both years
- YR-02 data suggest organic nitrogen enrichment from upstream of site

Data review: Eelgrass & Light

- Eelgrass mapped in York River in 1995, 2010, 2021
- Irradiance and calculated light attenuation indicate survival possible at lowest estuary site, YR-84, borderline to unsuitable at YR-64



Data Conclusions

- A second season of monitoring helps to characterize sites with greater certainty
- Estuary demonstrates classic gradient with decreasing variability with increasing distance from Heads of Tide
- Upper York River and Smelt Brook water quality differs considerably
- Turbidity throughout estuary more influenced by suspended sediment than by active phytoplankton ➔ expect greater phytoplankton role if estuary not so well mixed
- Total Nitrogen values lower than or similar to comparable estuaries
- Eelgrass presence up estuary from York Harbor mouth likely light limited
- Tide stage not strongly influential on measured parameters in mid-, lower estuary

Recommendations for Future Work

1) Determine whether high organic nitrogen in upper York River estuary is mostly natural or considerably enhanced by human activity

2) Protect existing water quality, priority habitats, land & water connectivity by:
   a) Maintain vegetative buffers
   b) Minimize or eliminate fertilizer use
   c) Promote responsible use of estuary by boaters
   d) Provide migration space for coastal wetlands
   e) Avoid direct and indirect effects on eelgrass habitat

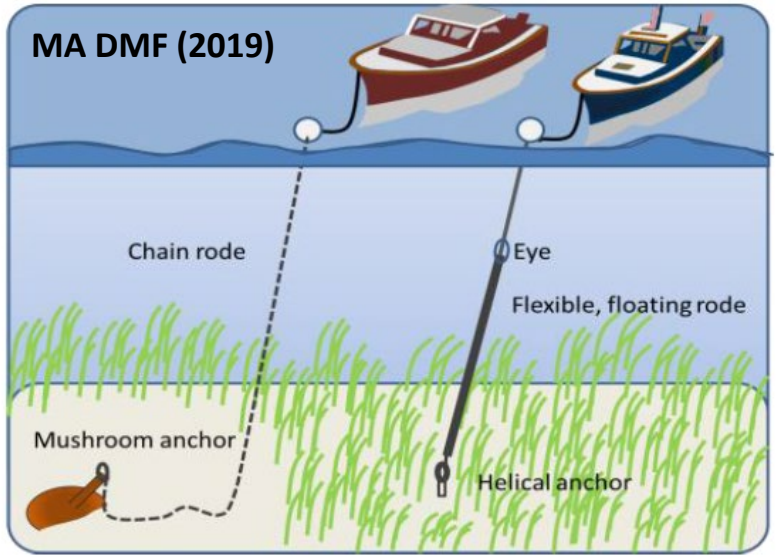


Figure 2. A conventional chain mooring showing a scar in eelgrass meadow (left), a floating conservation mooring (right).


Video Credit: Jon Betz @JonBetzFilms

Contact:

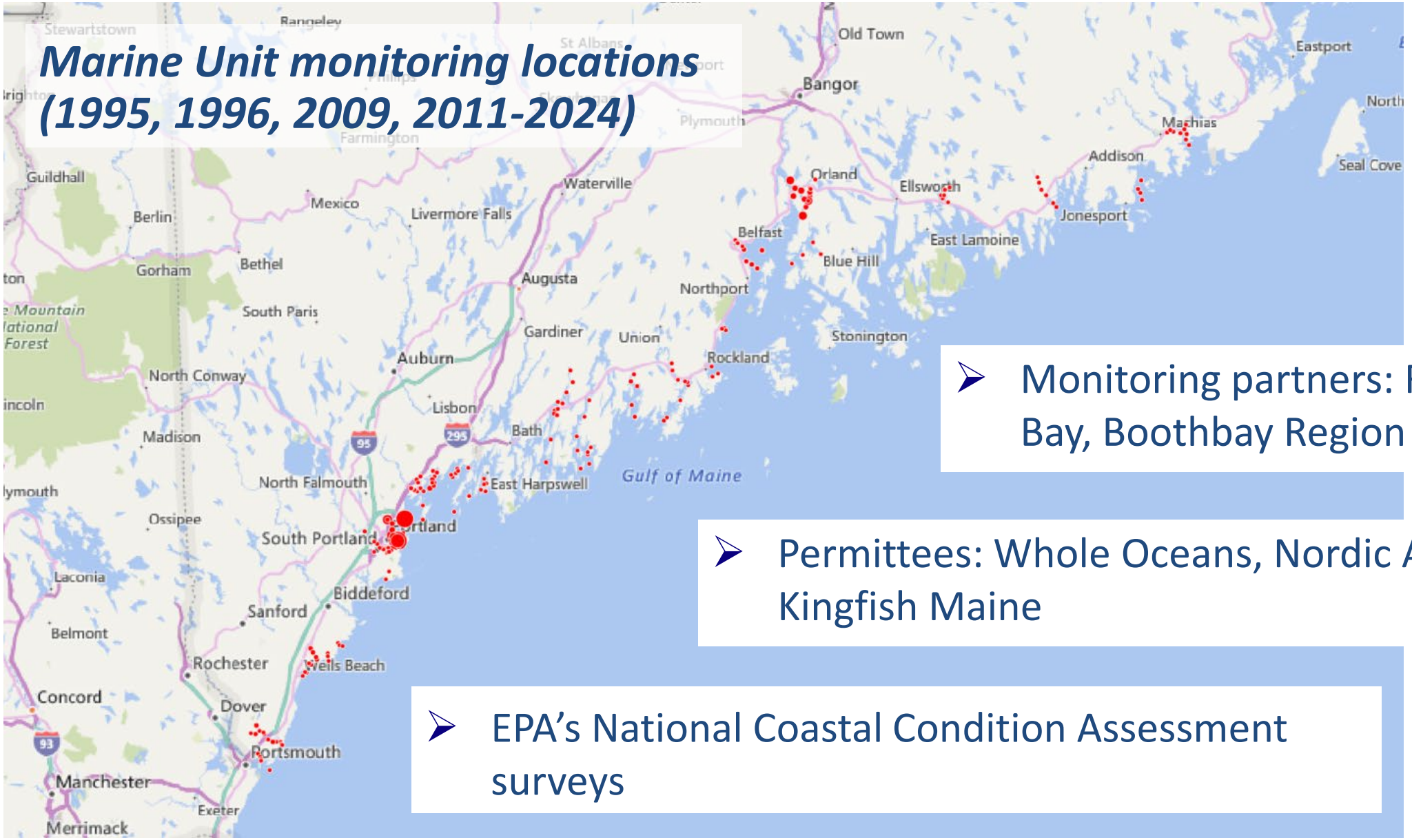
Angela Brewer, 207-592-2352

angela.d.brewer@maine.gov

https://www.maine.gov/dep/water/monitoring/coastal/index.html

www.maine.gov/dep

Marine Unit monitoring locations (1995, 1996, 2009, 2011-2024)



- Monitoring partners: Friends of Casco Bay, Boothbay Region Land Trust
- Permittees: Whole Oceans, Nordic Aquafarms, Kingfish Maine
- EPA's National Coastal Condition Assessment surveys