

Investigation of salt marsh platform vegetation stress indicators to reveal potential marsh loss mechanisms



Elizabeth Watson
Ecology & Evolution
Stony Brook University, New York



Stony Brook
University

Shelter Island, NY

2023

Google Earth

Image © 2025 Airbus

200 m

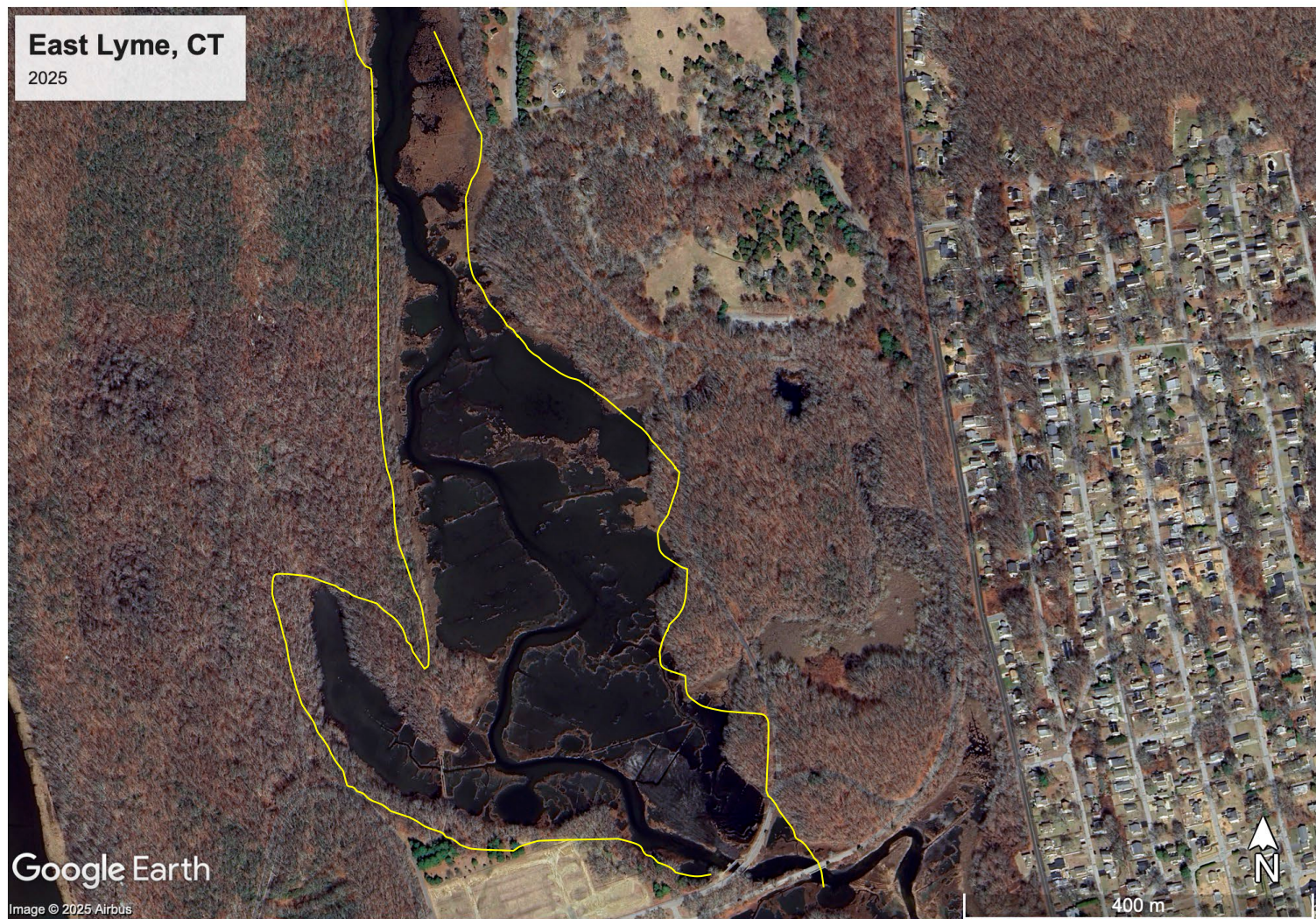


East Lyme, CT

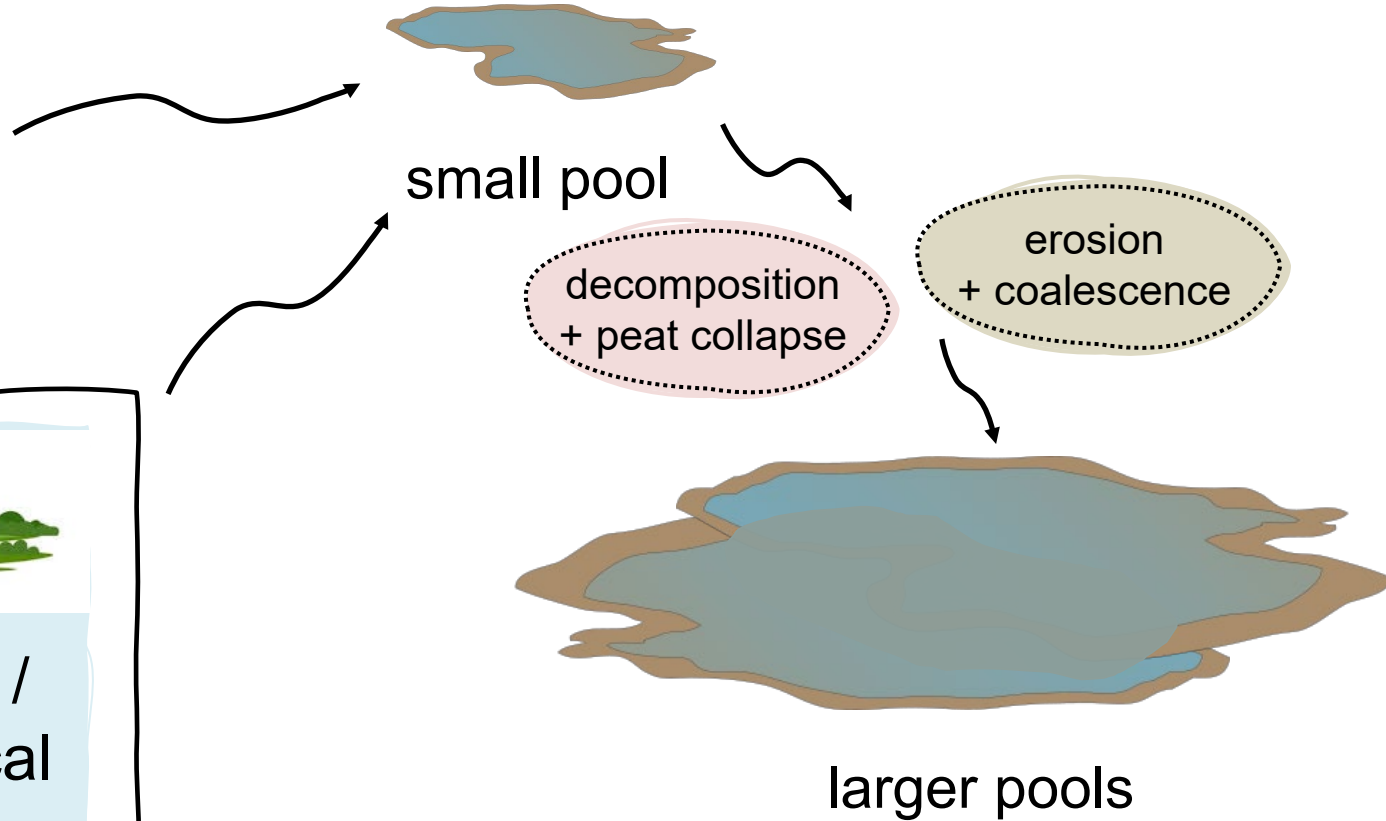
2025

Google Earth

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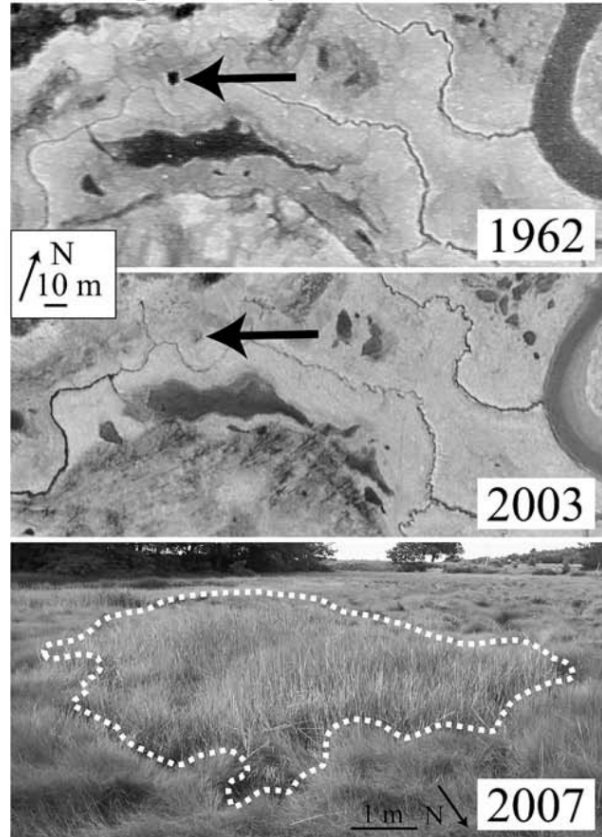


conceptual model of pool formation

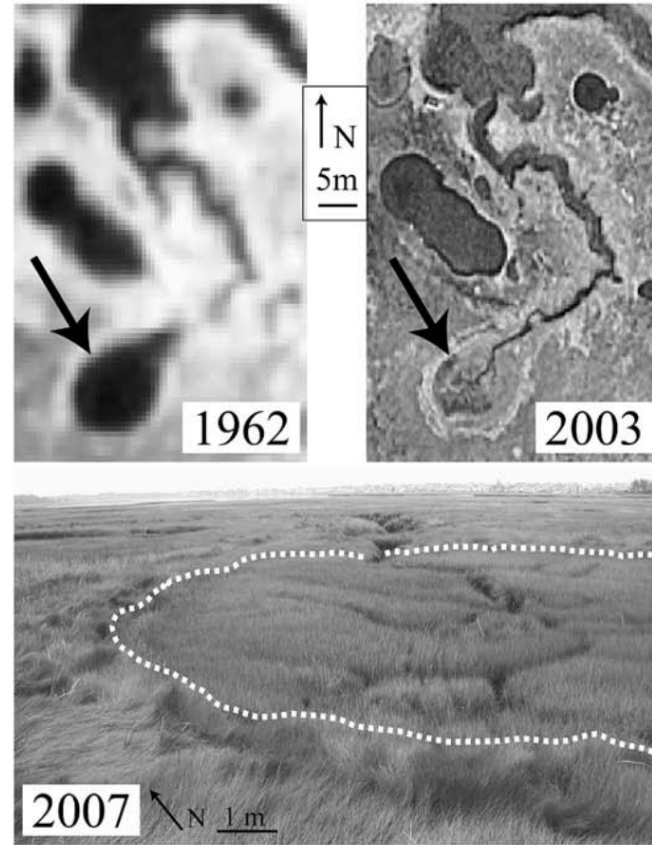


ponds are captured by tidal channel networks

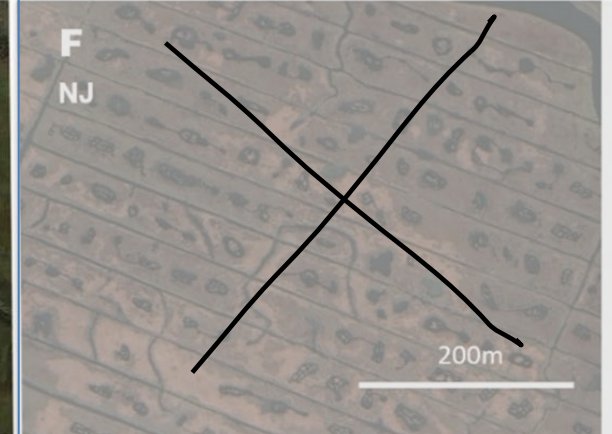
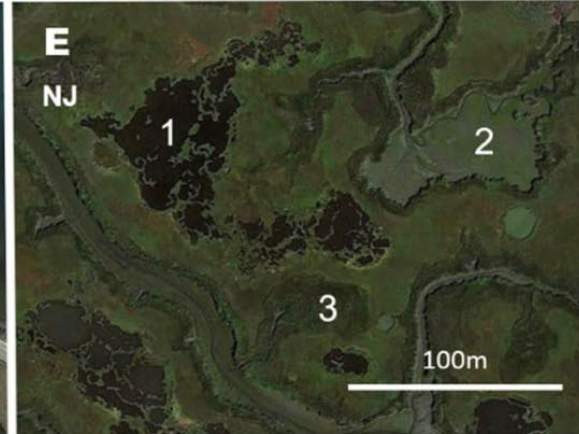
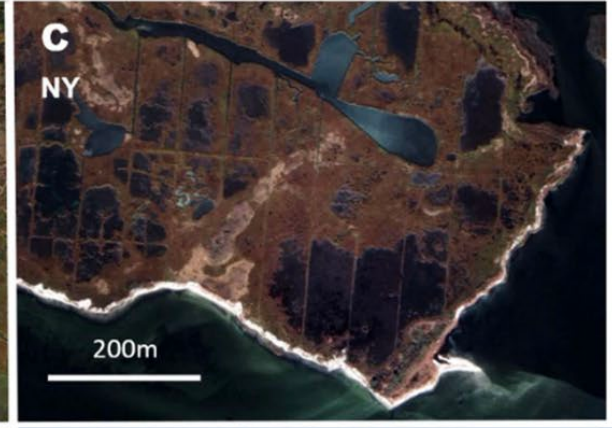
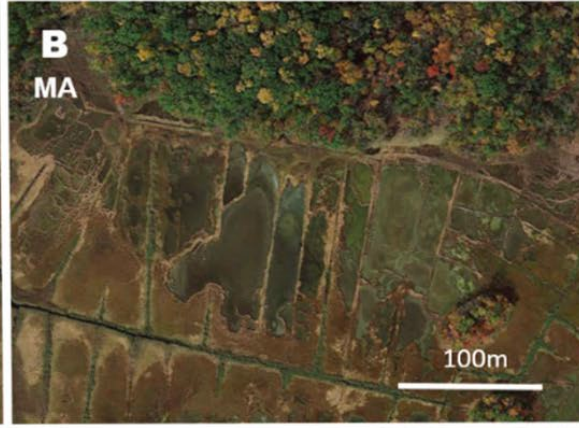
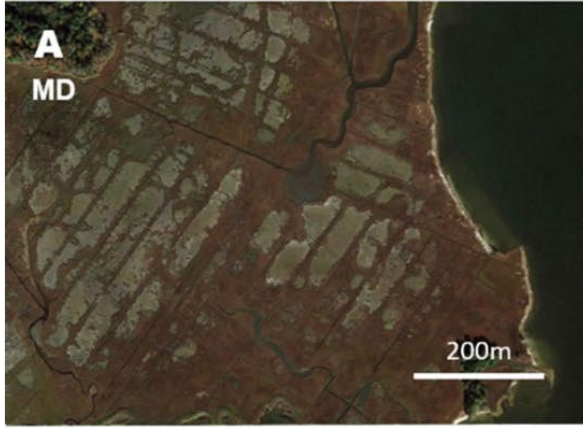
A. Maquoit Bay, Brunswick, ME



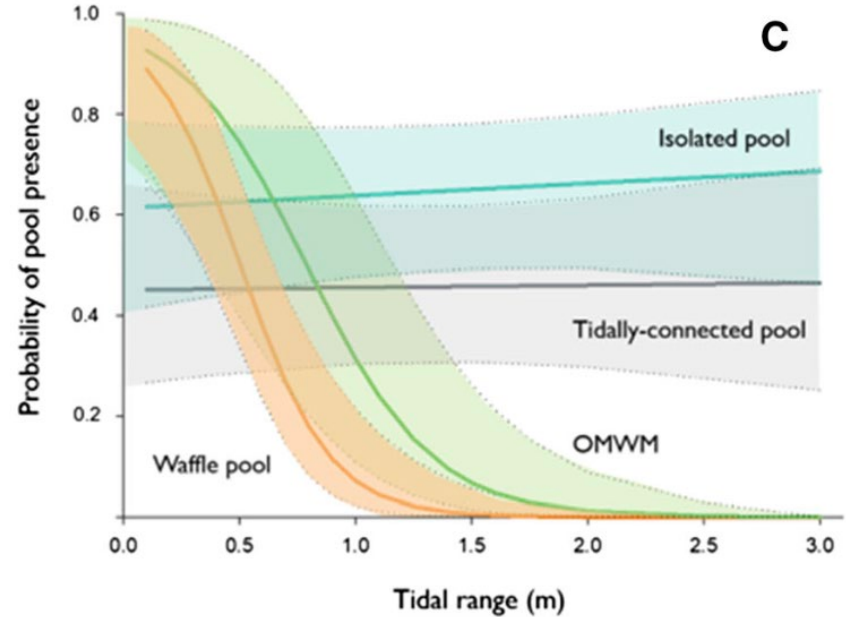
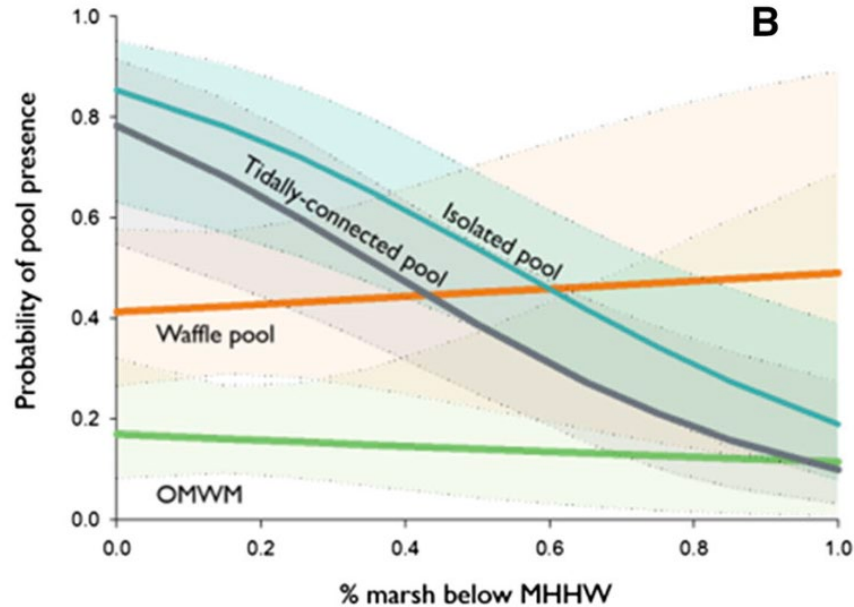
B. Webhannet, Wells, ME



3 types of pools: waffle marsh, natural pools, OMWM

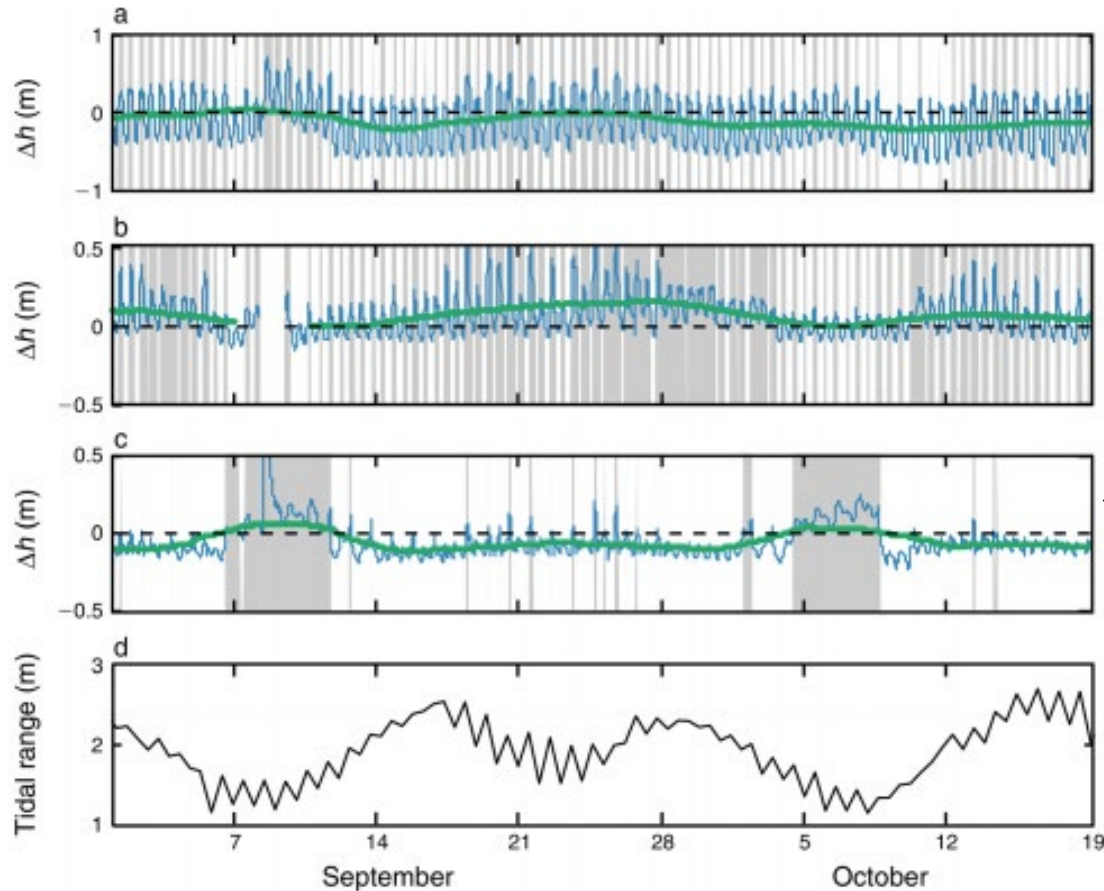


These 3 types of pools are found in different marshes



Smith et al., 2021, *Estuaries & Coasts*

the marsh interior is poorly flushed



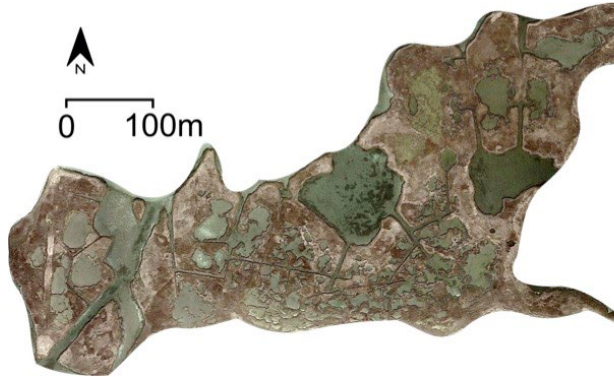
Wilson et al., *Ecology*, 2015

research objectives

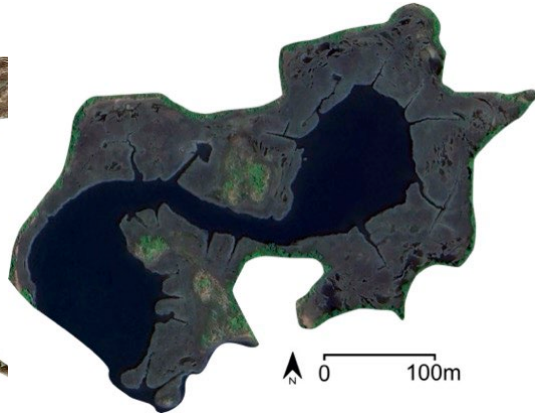
- To generate multidimensional measures of plant stress at pool margins for comparison with nearby better drained areas.
- To determine whether there are indicators of ecohydrologic stress adjacent to pools

Plants growing along pool margins are exposed to hydrologic stress

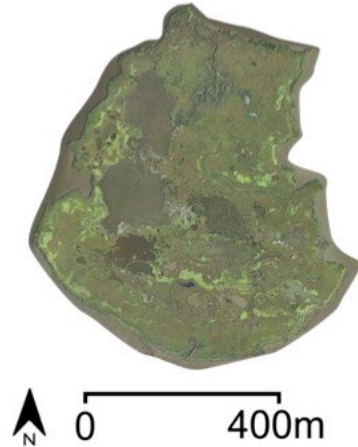
Hypothesis



Waquoit Bay, MA

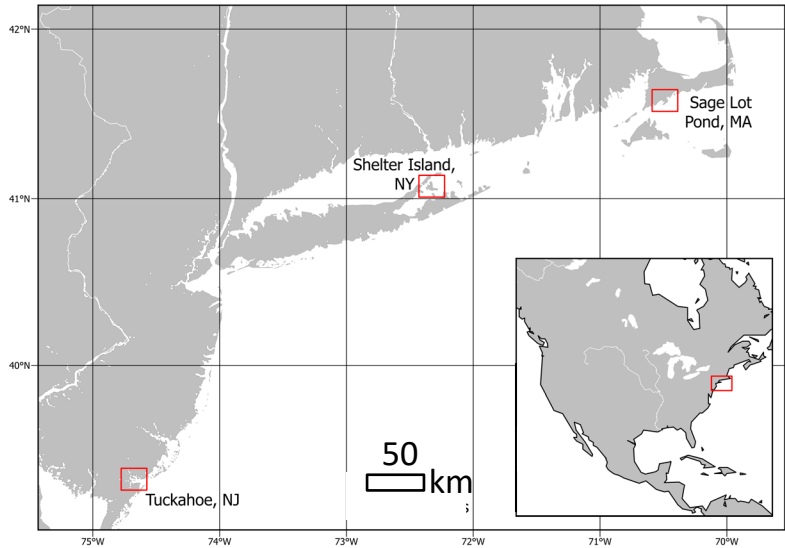


Mashomack, NY



Tuckahoe Island, NJ

Pine Barrens Ecoregion

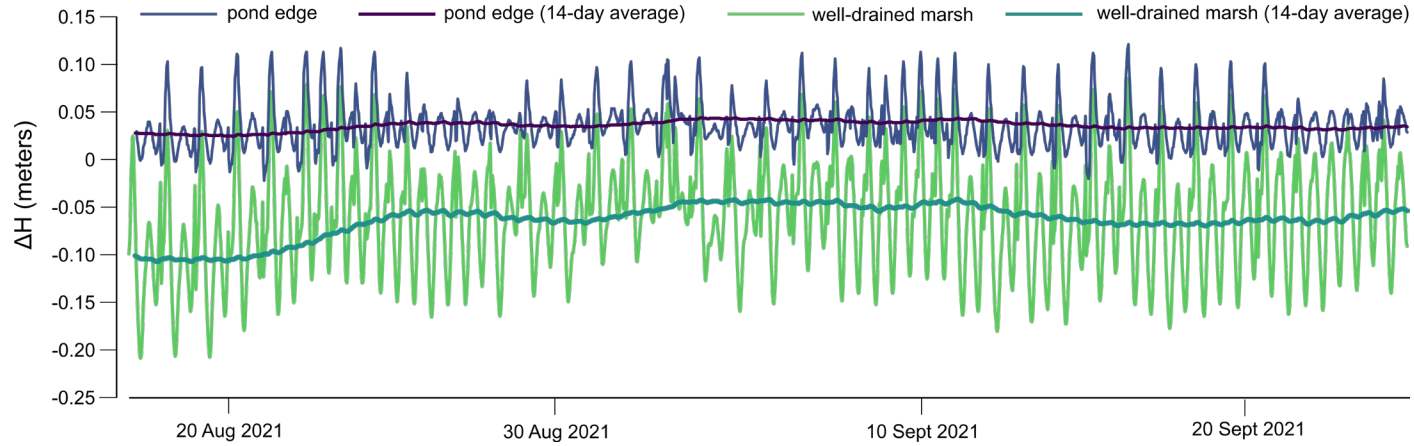


	Waquoit Bay	Mashomack	Tuckahoe River
tidal range	0.61 m	0.74 m	1.1 m
salinity	31.8 ‰	30.2 ‰	24.1 ‰
soil	very poorly drained		
elevation	0.19 m _{navd88} 0.01 m _{MHW}	0.27 m _{navd88} 0.02 m _{MHW}	0.78 m _{navd88} 0.25 m _{MHW}
vegetation	<i>Spartina alterniflora</i>		
geomorph	back barrier	back barrier	riverine
history	ditched, not grid-ditched		un-ditched
pools	natural, isolated pools		

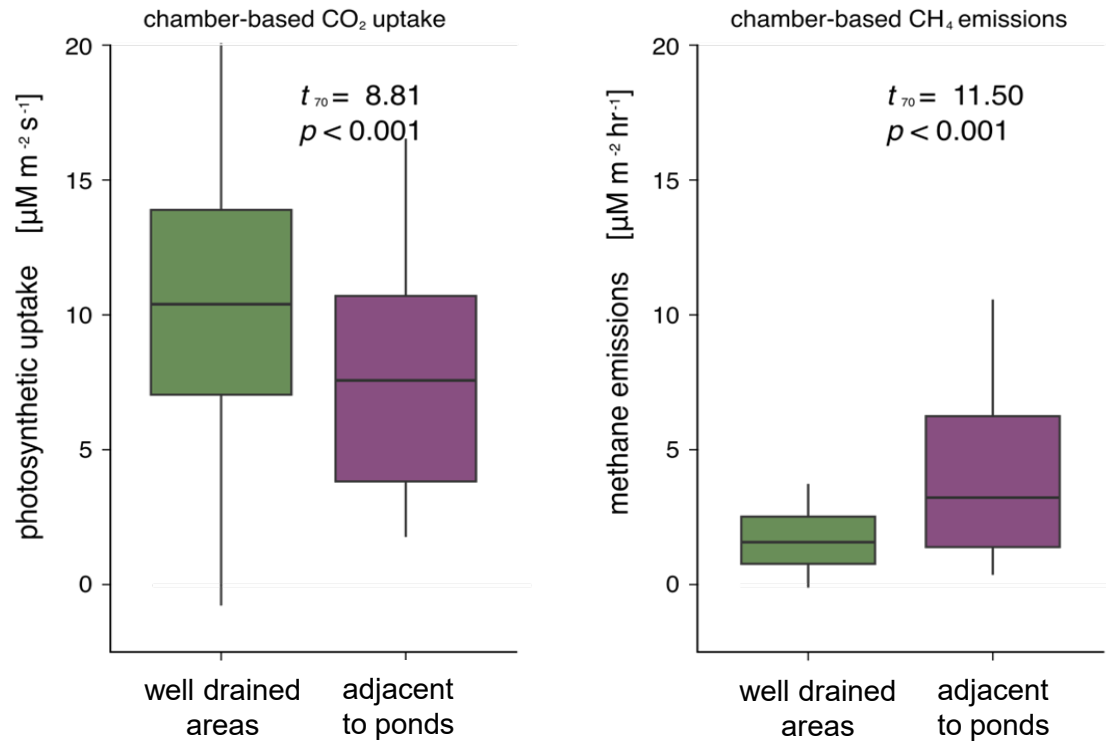


Upward flow is common along pool margins

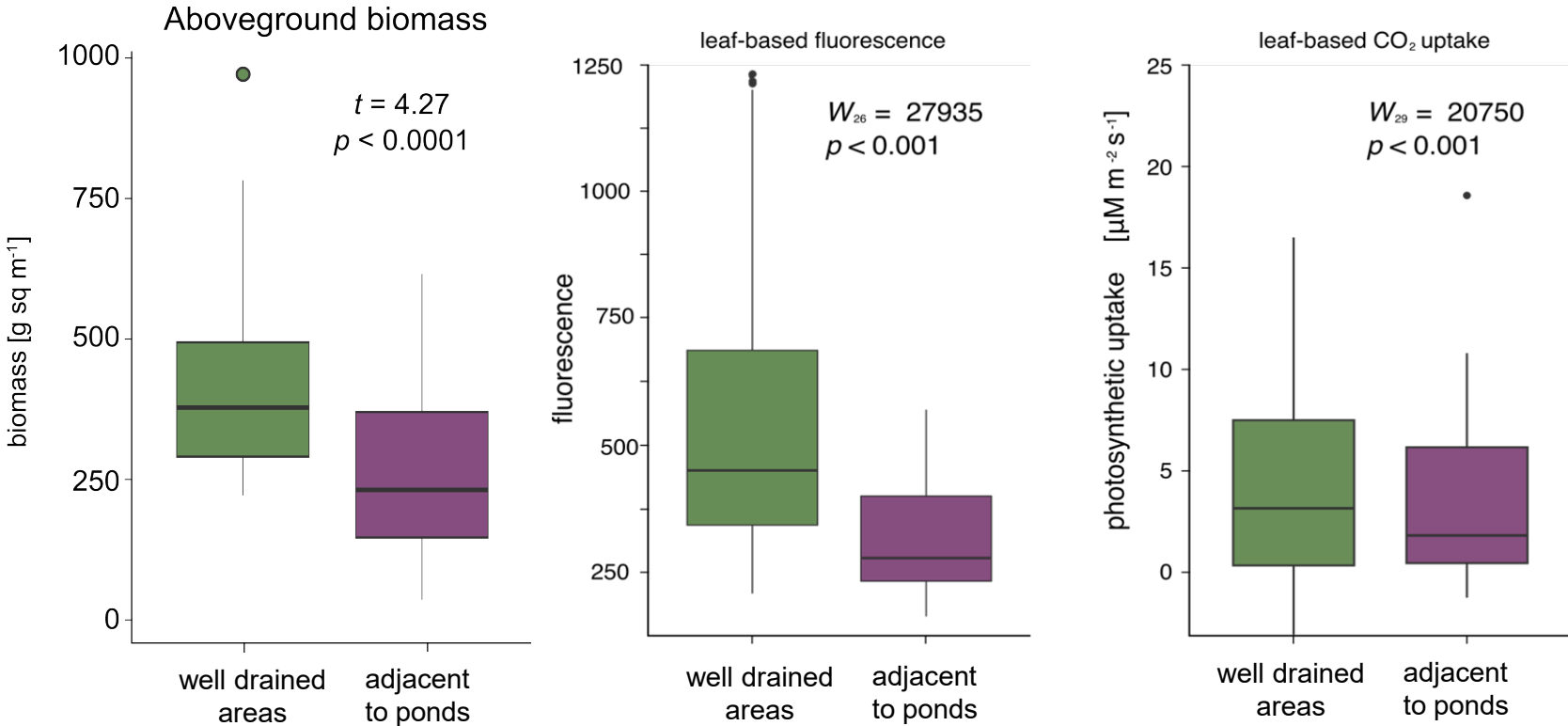
Waquoit Bay, MA



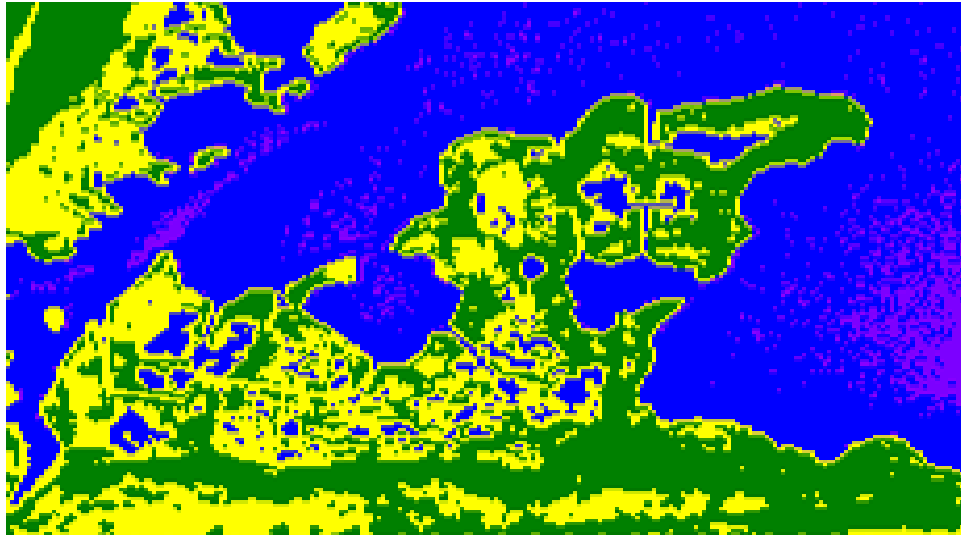
Chamber-based measures showed lower CO₂ uptake but enhanced methane emissions



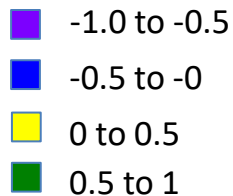
Lower CO₂ assimilation adjacent to ponds



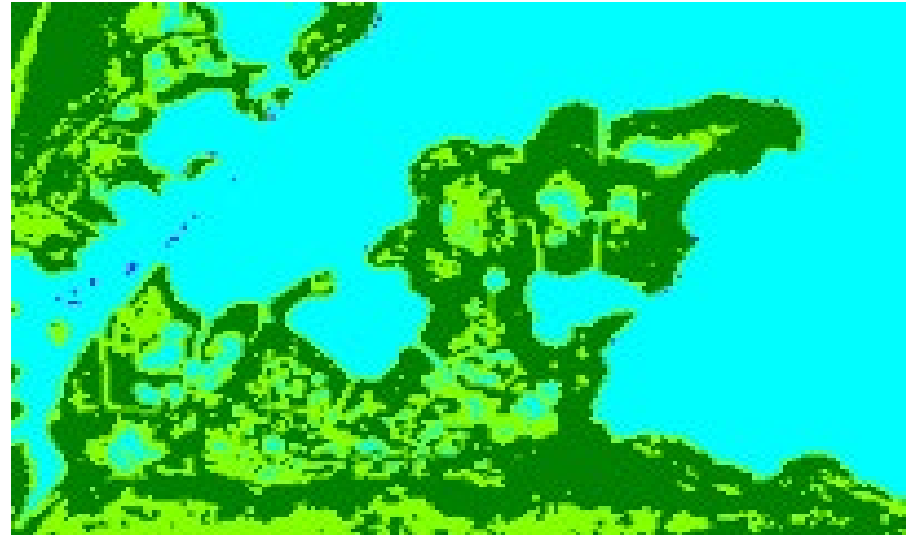
Waquoit Bay spectral indices show evidence of plant stress around ponds



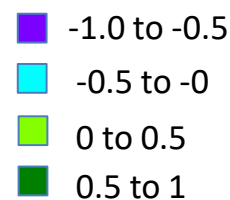
green-normalized difference vegetation index (GNDVI)



$$\text{GNDVI} = \frac{\text{NIR} - \text{green}}{\text{NIR} + \text{green}}$$

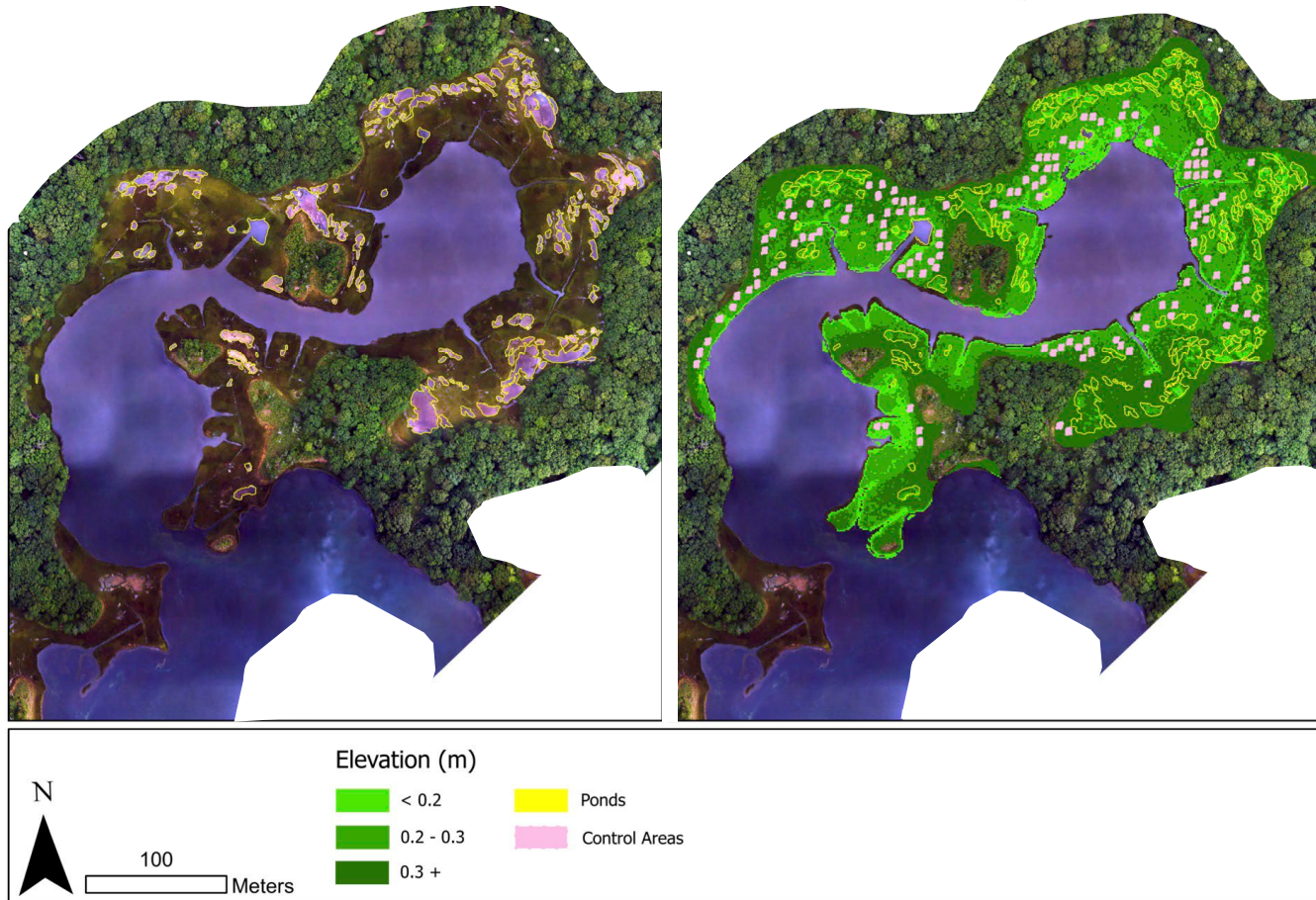


normalized difference vegetation index (NDVI)



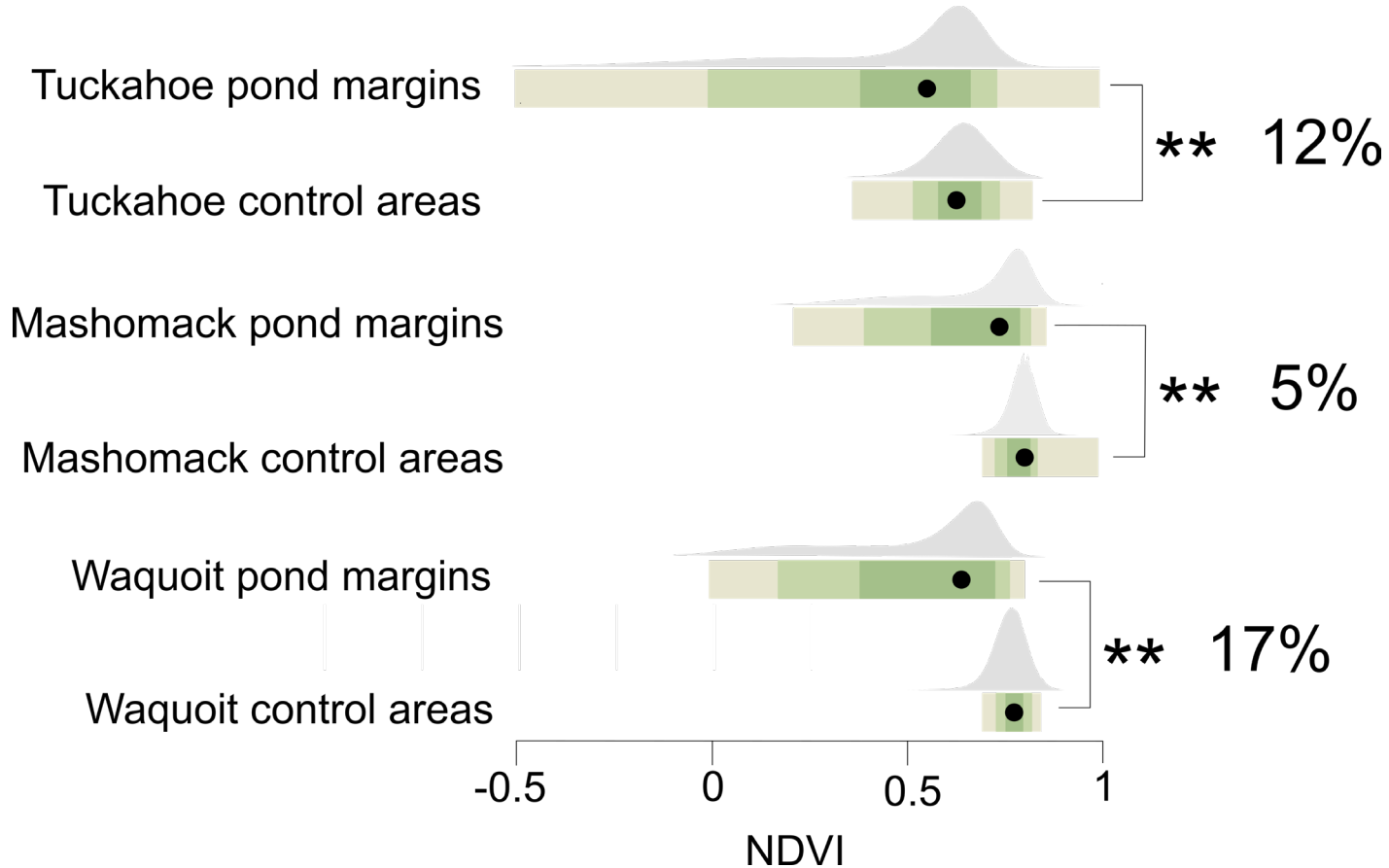
$$\text{NDVI} = \frac{\text{NIR} - \text{red}}{\text{NIR} + \text{red}}$$

Collected multispectral drone imagery

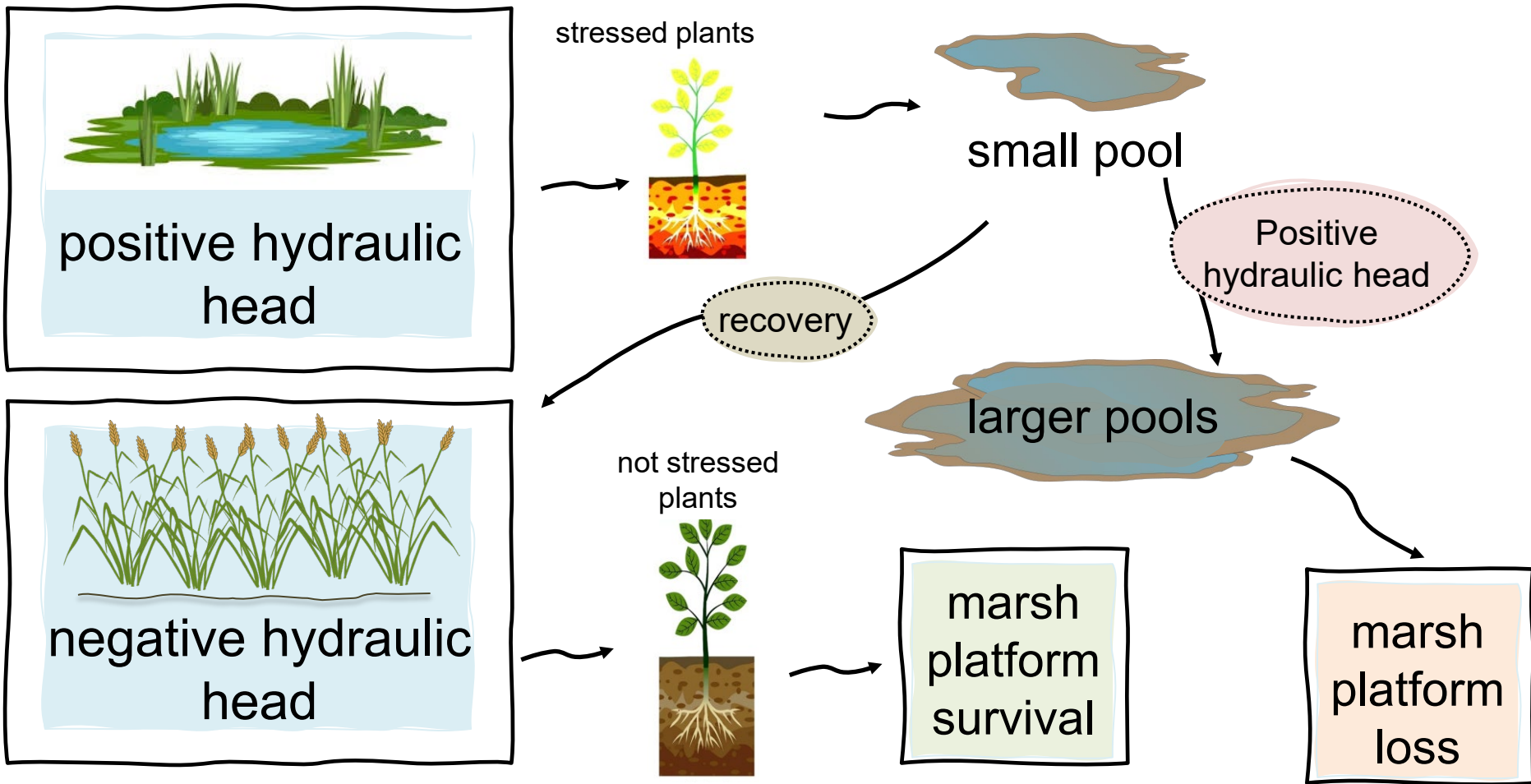


- 6 cm resolution
- segmented imagery to delineate ponds (GEE)
- Compared NDVI around ponds (1m) with that around “control” segments

Reduced NDVI along pond margins



conceptual model of marsh platform persistence



conclusions & future directions



- Significant rates of salt marsh loss are occurring in the Northeastern US, which are not well predicted or hindcast by models
- This study argues for a much stronger focus on how sediment biogeochemistry and groundwater levels shape plant stress, as well related environmental factors

acknowledgements



Antonio Zevola



Faith Echijiele



Rupert Ikeh

Indigenous groups

- Wampanoag (MA)
- Manhasset (NY)
- Lenni Lenape (NJ)



The Nature
Conservancy



WAQUOIT BAY
NATIONAL
ESTUARINE
RESEARCH
RESERVE



Questions?

elizabeth.b.watson@stonybrook.edu