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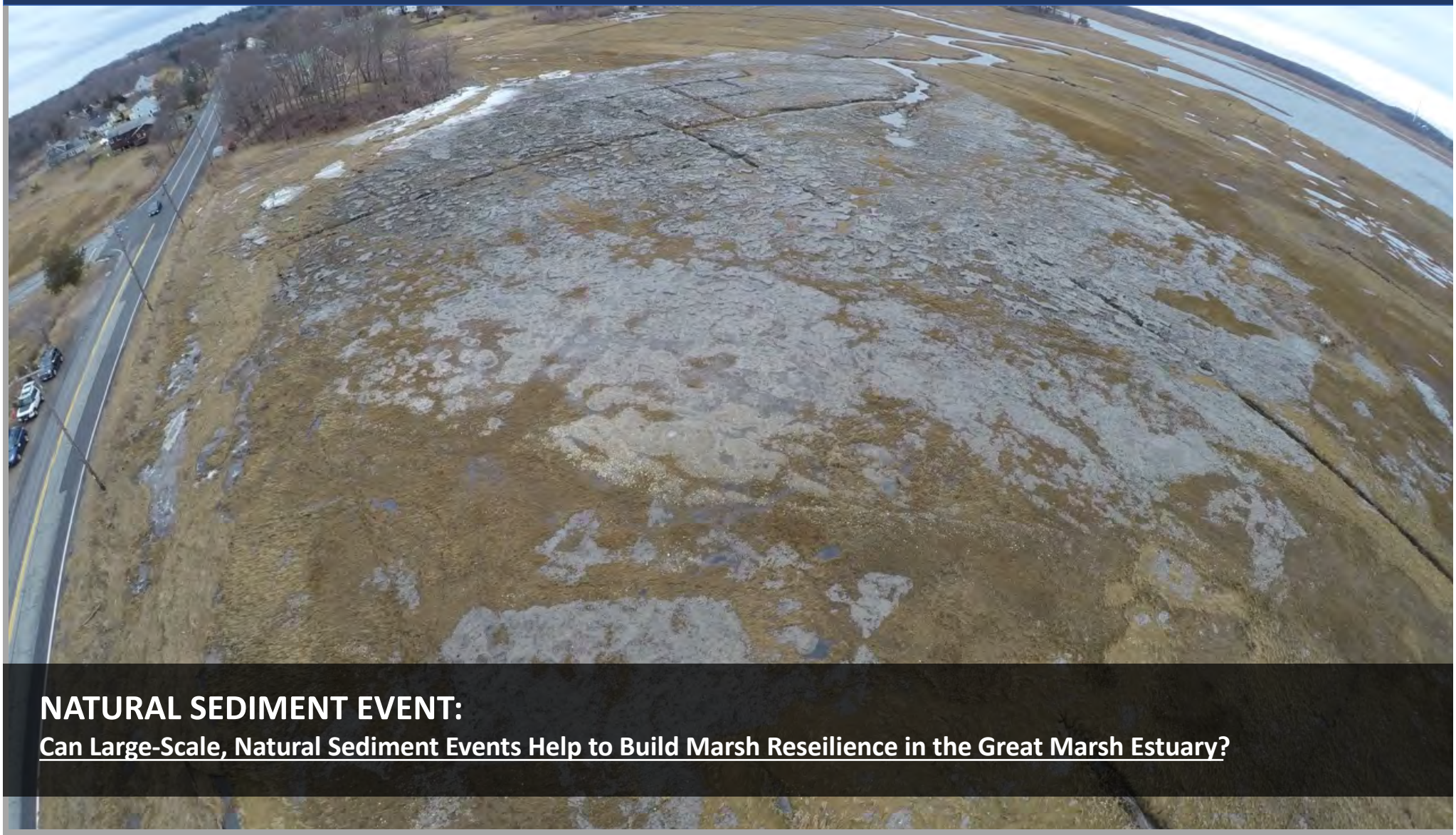

NATURAL SEDIMENT EVENT:

Can Large-Scale, Natural Sediment Events Help to Build Marsh Reseilience in the Great Marsh Estuary?

Gregg E. Moore

Jackson Estuarine Laboratory, University of New Hampshire

INTRODUCTION

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Project Overview

- Major Sediment Deposition Event, Jan 2018

- A “Perfect Storm” of sorts?

- Driven by:
- Extended period of extreme cold
- Astronomic high tides
- Strong Nor’Easter

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Project Overview

- Sediment resulted from freezing and rafting of material from exposed flats
- Observations in MA, NH and So. ME
- Significant scale, from >1 acre (Wolf Trap, Manchester), to 60+ acres (Great Marsh, Newbury)

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Rafting Event Date: ~Jan 1-7 2018

Photo Date: 5 Feb 2018

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Project Overview

- Sediment types failry uniform throughout sites = fine silt/sand
- One exception (Jeffreys Neck) contained many shells and cobble!
- Sediment thickness highly variable, within and across sites
- Ranging from 1mm (min) – 92mm (max),
- Avg. ~31.5mm

David Burdick, NREN

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Significance

- Unprecedented scale for our geography
- Getting lots of Regulatory attention (Impossible to permit in MA*)
- Wetlands Protection Act prohibits cut/fill in tidal marshes (limits ability to experiment or test sediment placement)
- *Opportunity* to evaluate TLP in MA over multiple sites at landscape scale
- *Opportunity* to align with my ongoing NERRS Science Collaborative TLP project in Great Bay (at JEL)

METHODOLOGY

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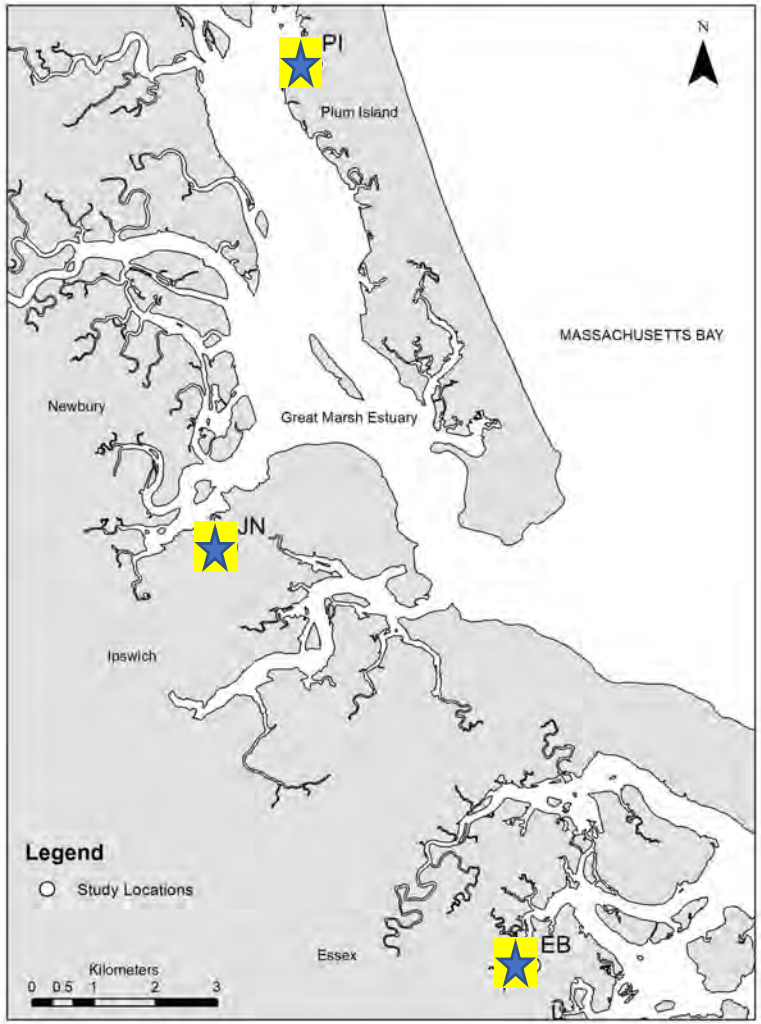
Study Area

- Mass Bay
- Refuge, Plum Is.
- Jeffrey's Neck, Ipswich Bay
- Lowe Is., Essex Bay
- Other sites…



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Objectives/Approaches

1) Scale: Document scale of event

2) Biological Effects: Determine effects on plant community structure

3) Assessment: Determine impact/benefits to marsh resiliency

4) Context: Provide recommendations to resource managers re: potential beneficial use of sediment

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Objectives/Approaches

Scale:

- Understand sediment redistribution patterns using repeated UAV-based surveys and direct field measures
- Map and quantify in GIS

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Application-Specific UAV Modifications

- Modified consumer grade UAV platform (3DR Solo)
- Two specialized self-geotagging 4K multispectral cameras;
- Imports directly to GIS to quantify areas, identify water stress, etc.

Visible light

NDVI

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Objectives/Approaches

Sediment Effects on Plants:

- Document sediment types and thickness/depth ranges
- Track plant community response in high and low marsh, grouped by depth/thickness ranges

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Objectives/Approaches

Assessment and Context:

- Compare results to controlled NERRS Science Collaborative Study that uses smaller experimental units ($0.5m^2$)
- Share results with regulators, managers, scientists to inform policy

[*Note: this is the first large-scale study of TLP in MA*]

Adrienne Pappal & Bob Boeri (EEA), Peter Phippen (MVPC), Alyssa Novak (BU), Mike Stroman (MADEP)

RESULTS: Essex Bay (EB)

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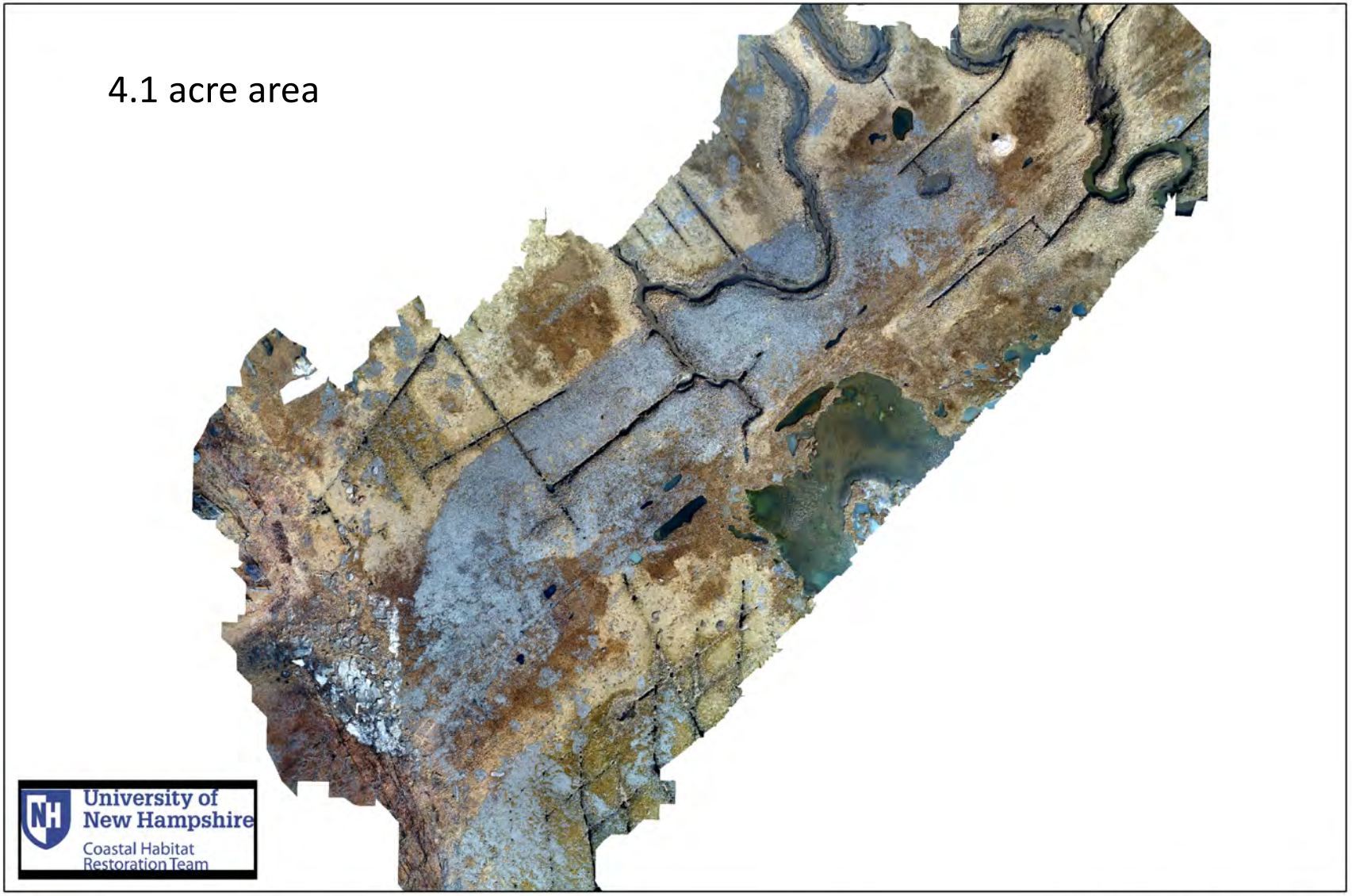

RESULTS : Essex Bay (EB)

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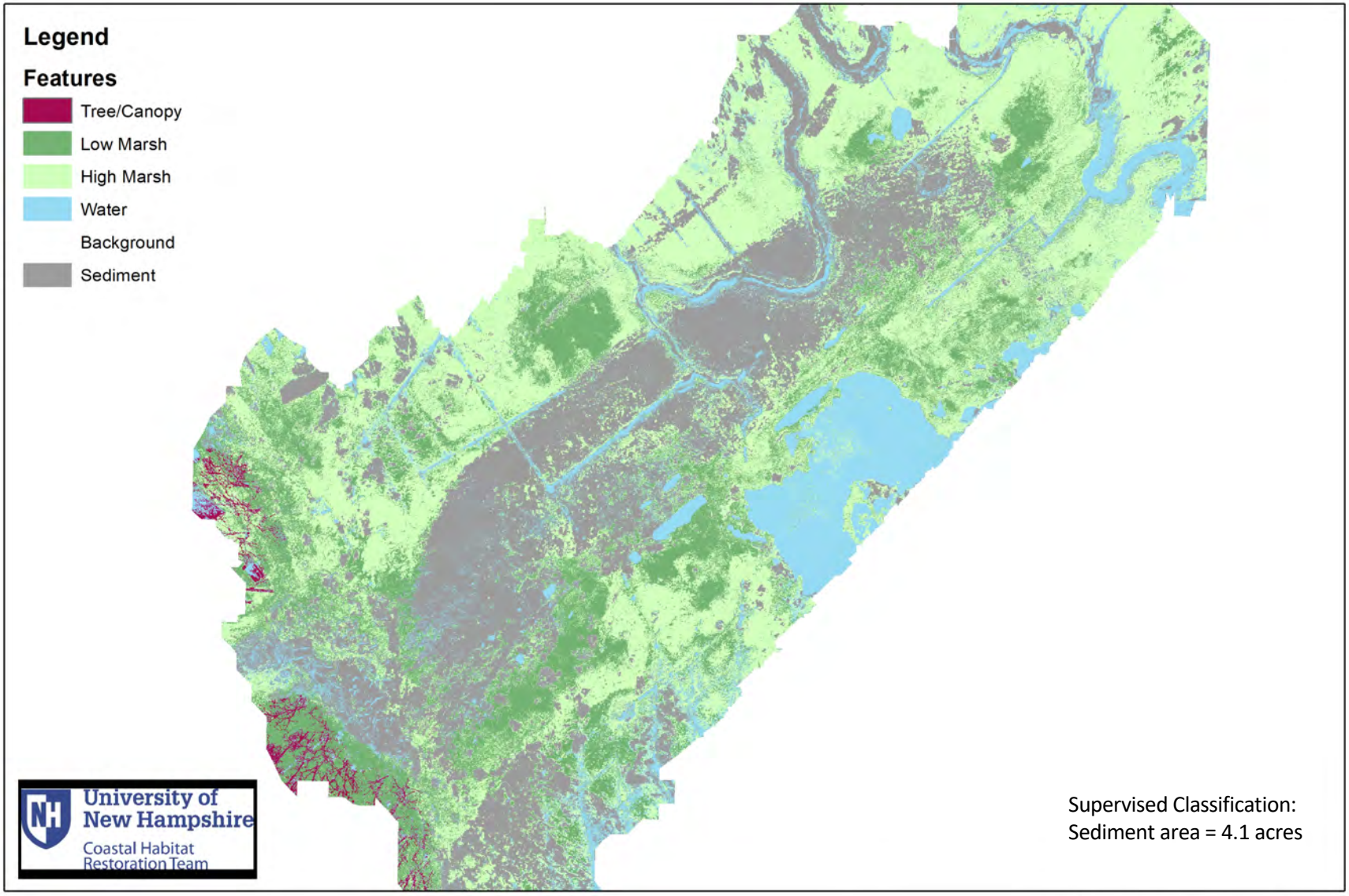

RESULTS: Jeffreys Neck (JN)

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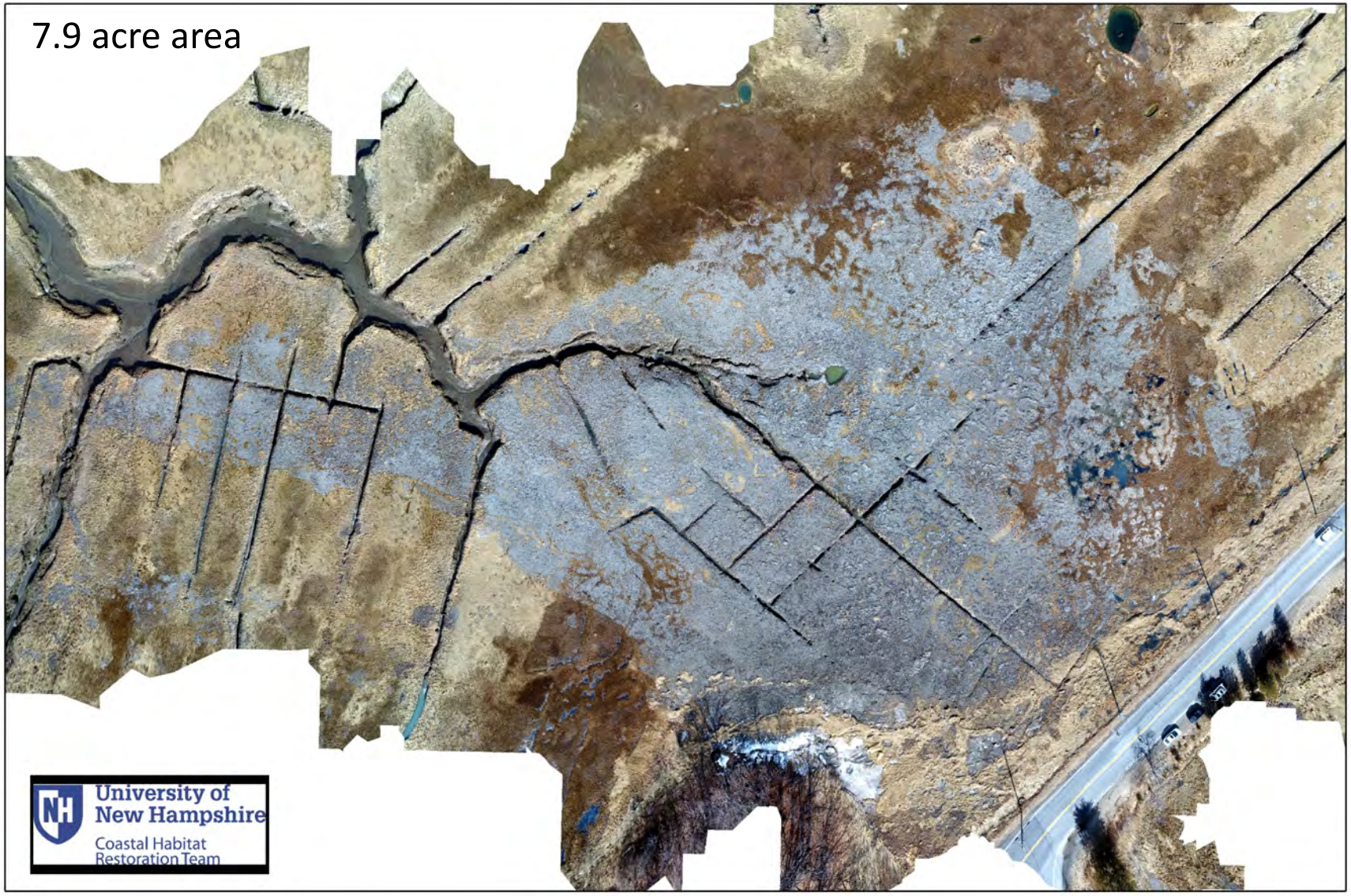

RESULTS: Jeffreys Neck (JN)

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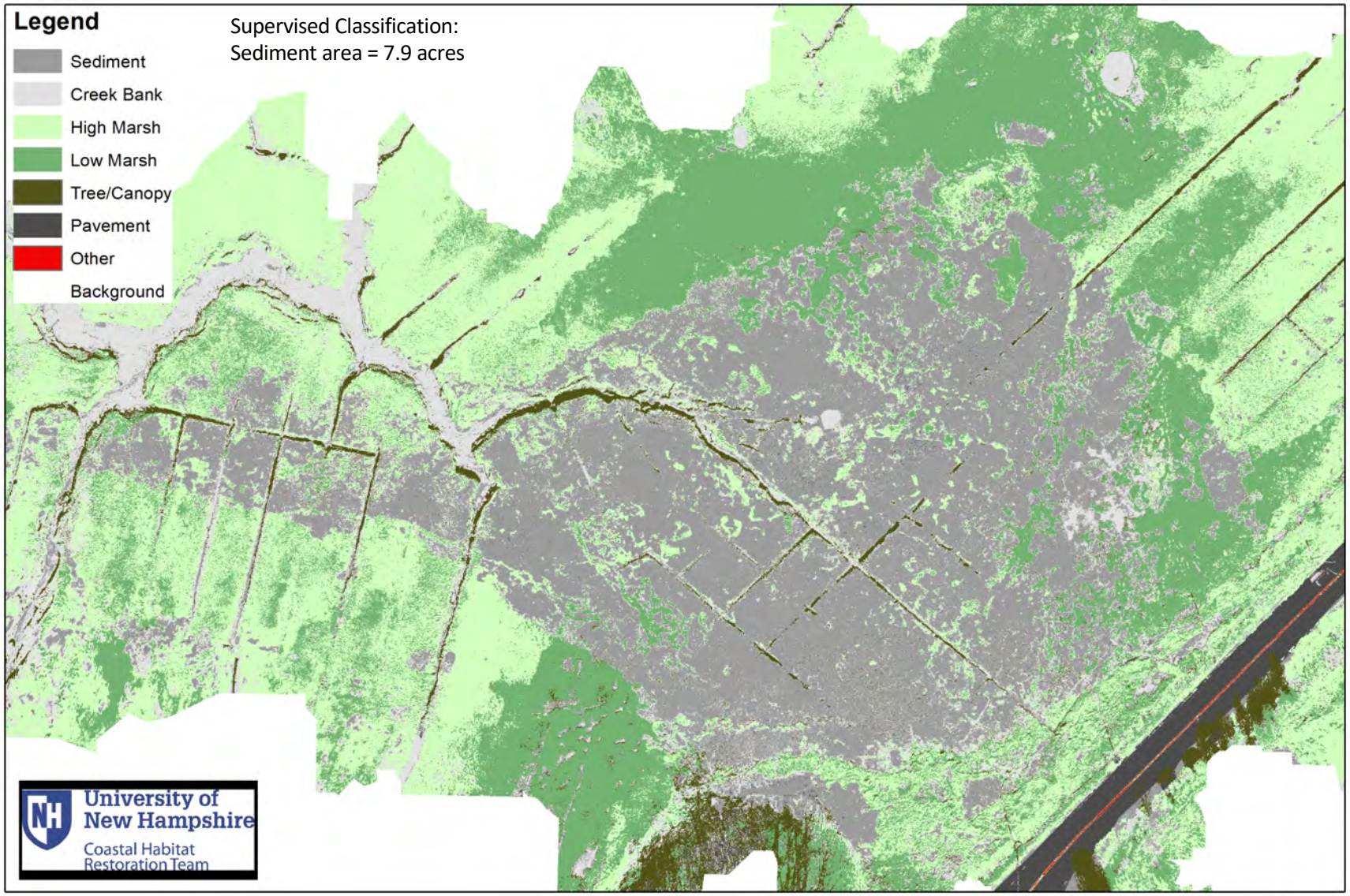

RESULTS : Plum Island (PI)

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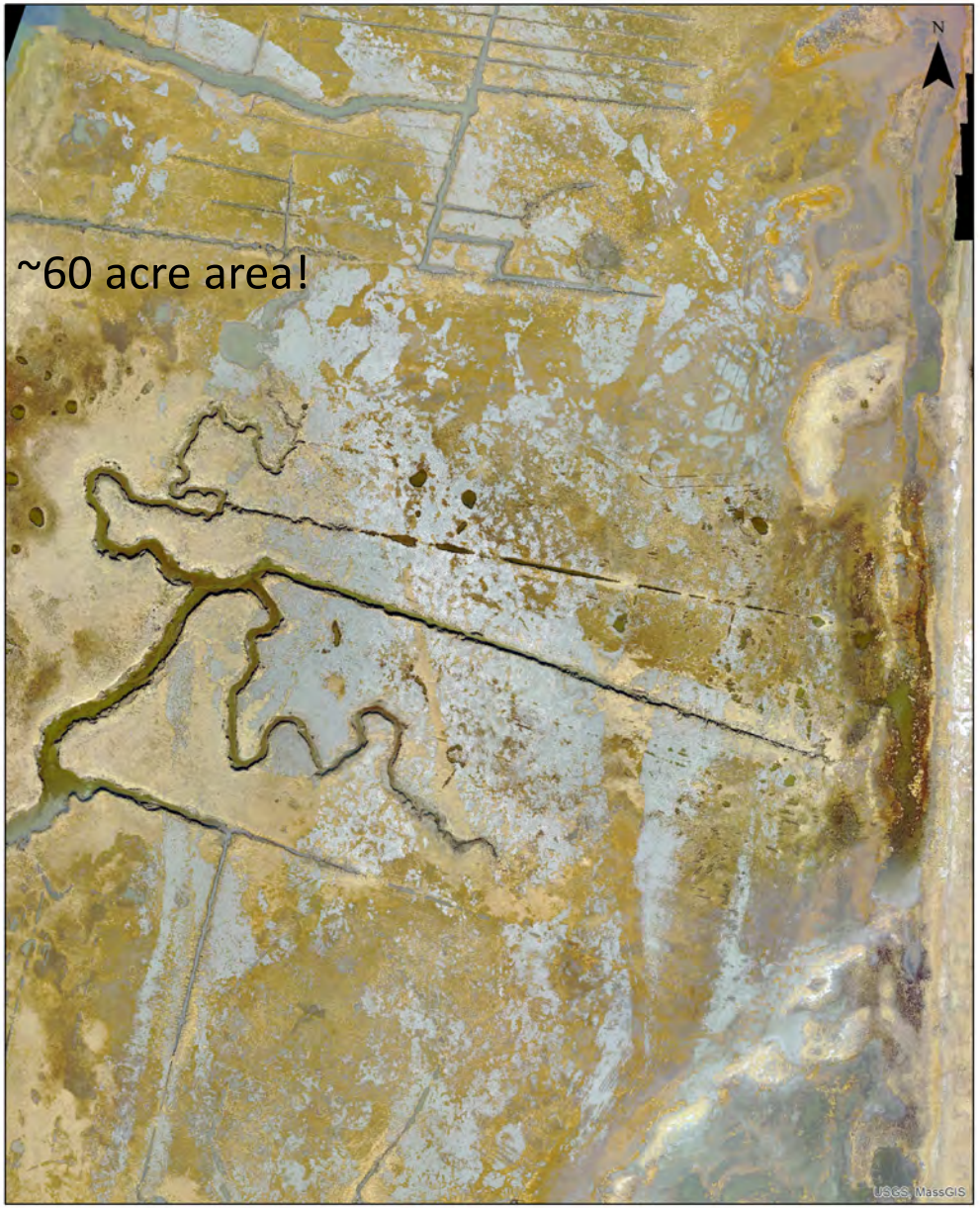

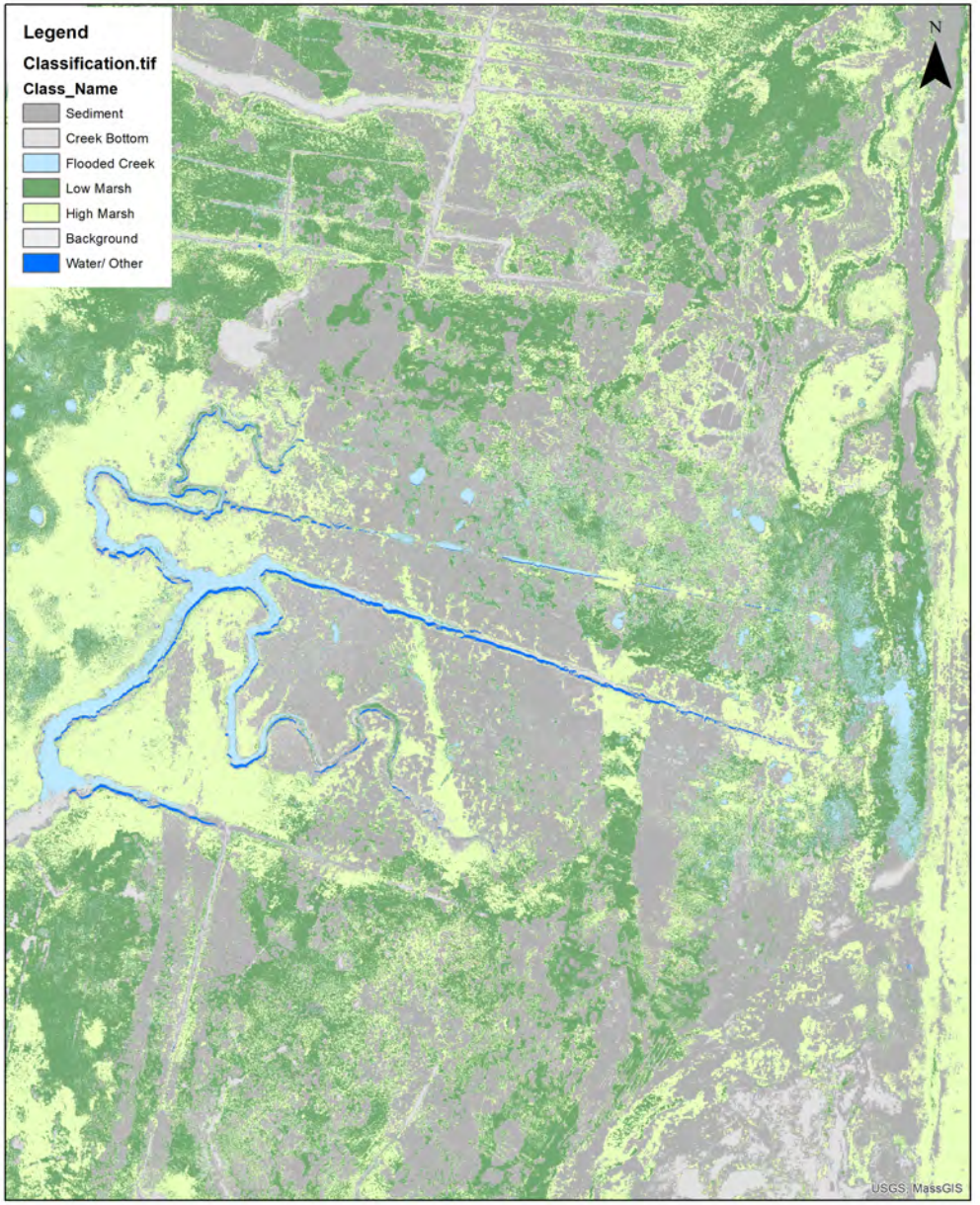

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0 12.5 25 50 75 100 Meters

UAV/Sensor: 3DR Solo/Mapir Survey3W
Flight Elevation/Area surveyed: 60m/55acres
Flight Dates: March 22 and 29, 2018
Prepared by: Gregg E. Moore

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0 12.5 25 50 75 100 Meters

UAV/Sensor: 3DR Solo/Mapir Survey3W
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RESULTS : Plum Island (PI)

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RESULTS

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Sediment Thickness

- Some variability, within ideal ranges from pub and unpub work (2-10cm);
- Winter to summer thickness measures confirm sediment staying in place, not migrating;
- Net positive accretion event.

** - Slight increase over time not significant, but worth considering...*

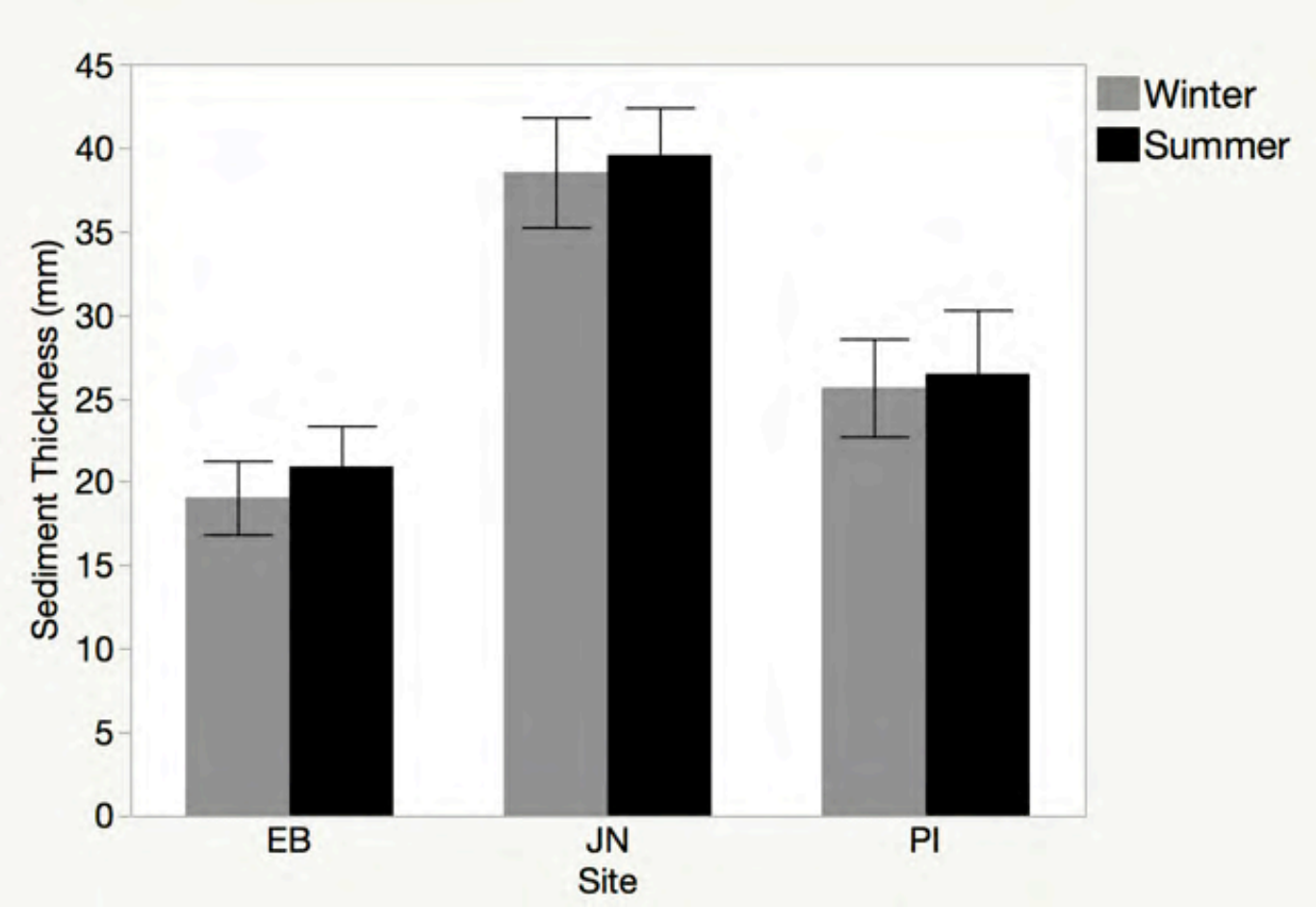

Figure 1. Sediment thickness (mm) of samples collected from three sites. JN received significantly more sediment than EB or PI. Measures from winter and summer show material staying in place.

Note: EB = Lowes Island, Essex Bay; JN = Jeffrey's Neck, Ipswich Bay; PR = Parker River "Refuge", Newbury.

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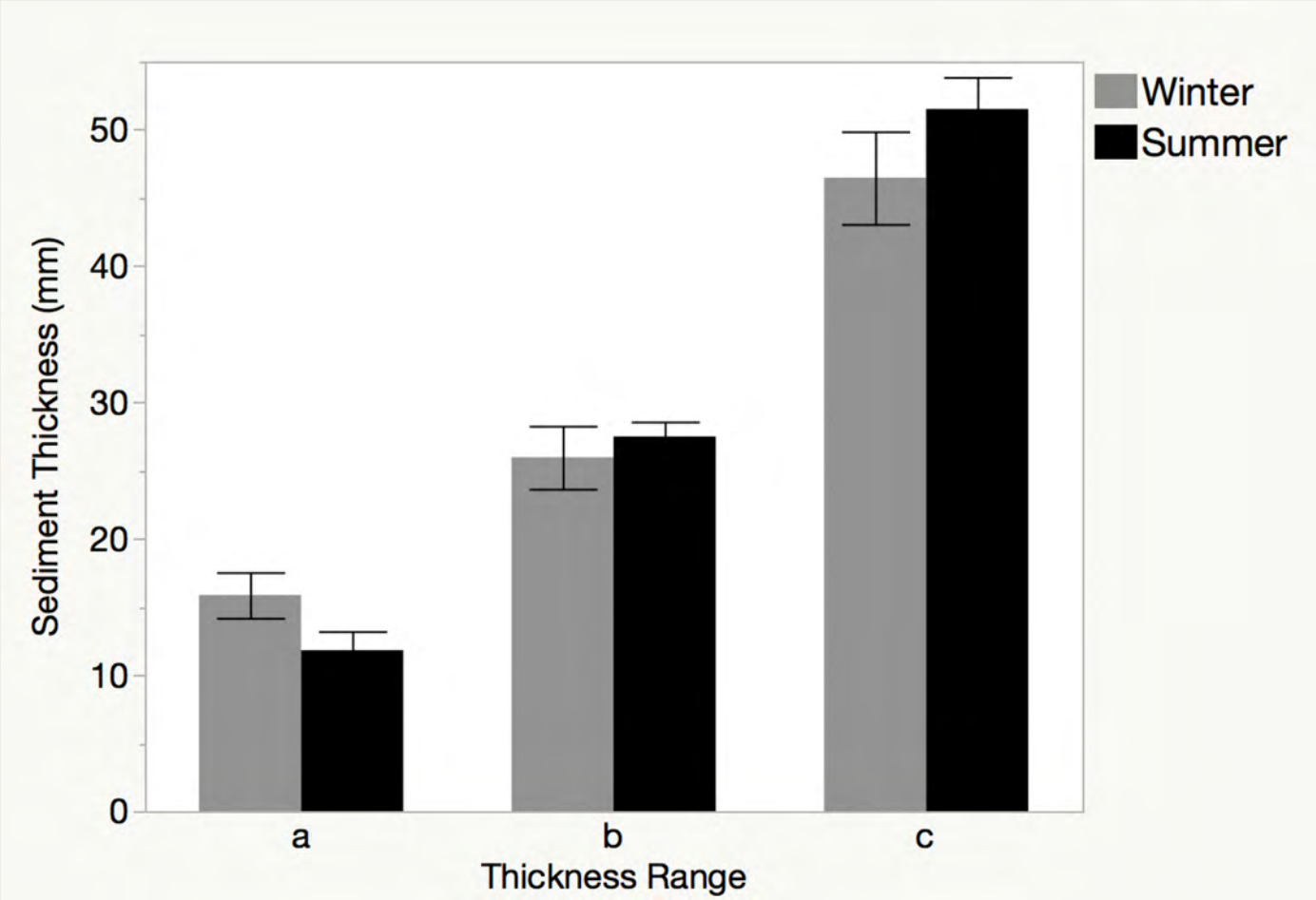
Sediment Thickness

- Due to the variability, created thickness ranges to explore further
- Ranges:
  - Control (0)
  - a (1-20mm)
  - b (20-40mm)
  - c (40-90mm)
- Winter to Summer pattern generally holds



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Sediment Response

- Little change over time
- Sediment doesn't appear to be 'moving'
- Non-significant, but interesting trend of sediment thickness *increase?*
- ***Causes?? Explanations??***

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RESULTS (when it works…)

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RESULTS (when it struggles…)

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RESULTS

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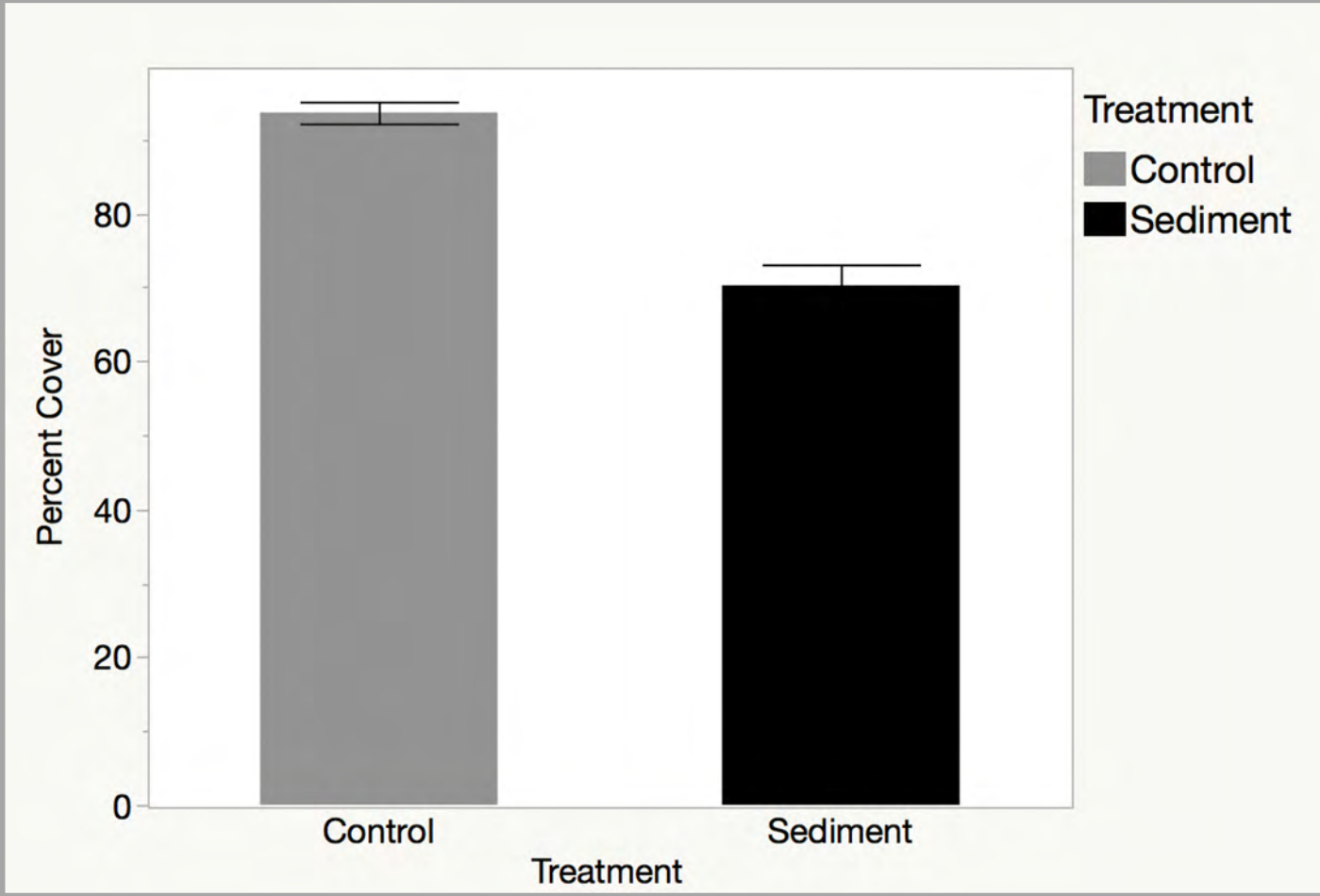
Vegetation Response

- Control (no sediment) plots had significantly greater vegetation cover
- Sediment addition plots had less plant cover, but still had ~75% cover
- Results suggest sediment addition not *that* negative to marsh vegetation in first year
- ***Is Trend true for all sites??***



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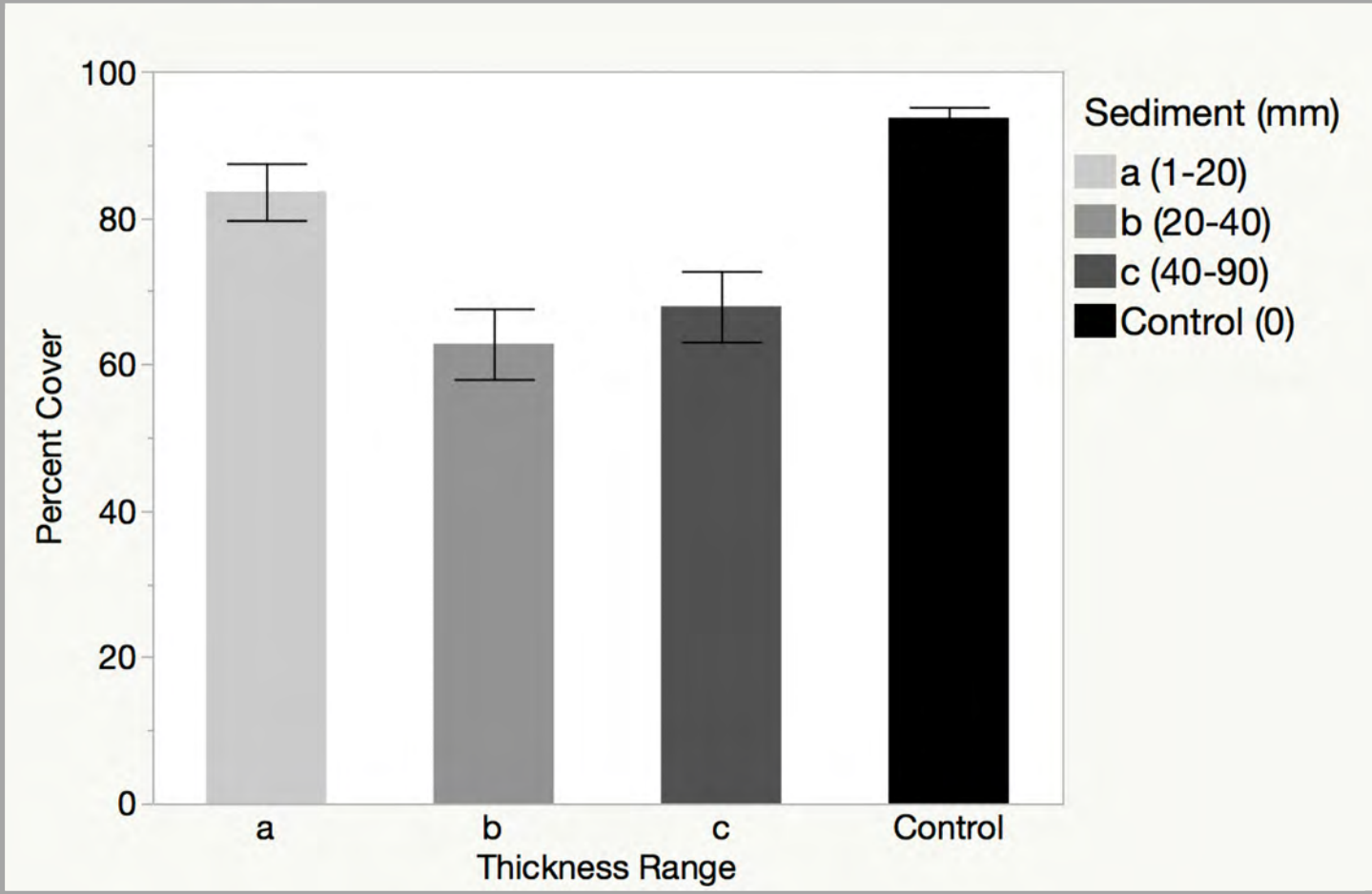
Vegetation Response

- Trend holds. Percent cover of vegetation in Control plots significantly higher across all three sites;
- Also true by thickness ranges!
- Not particularly surprising, but very valuable data for resource managers



RESULTS

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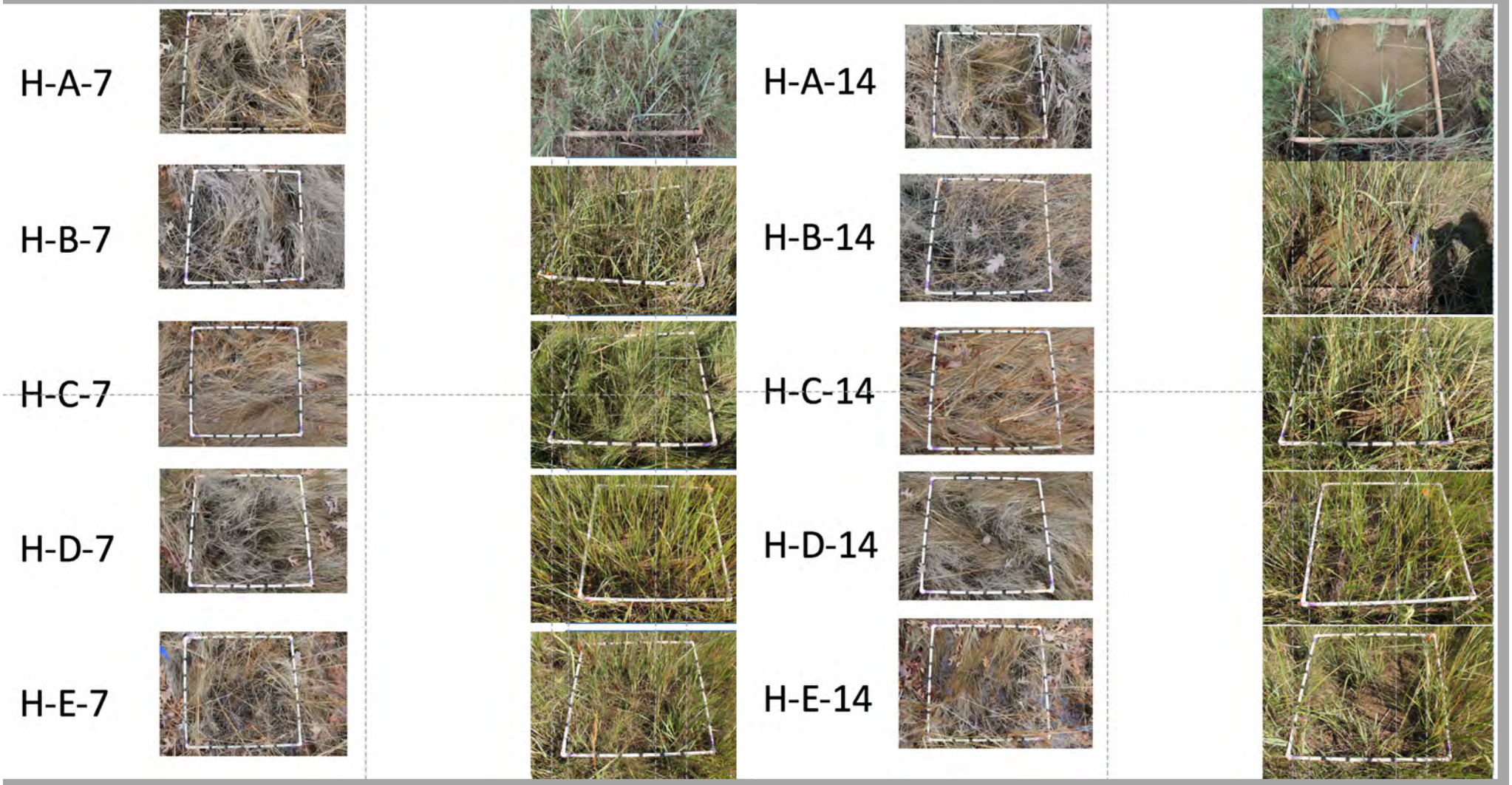
Vegetation Response Compared to National Study Fixed Experimental Plots

HIGH MARSH



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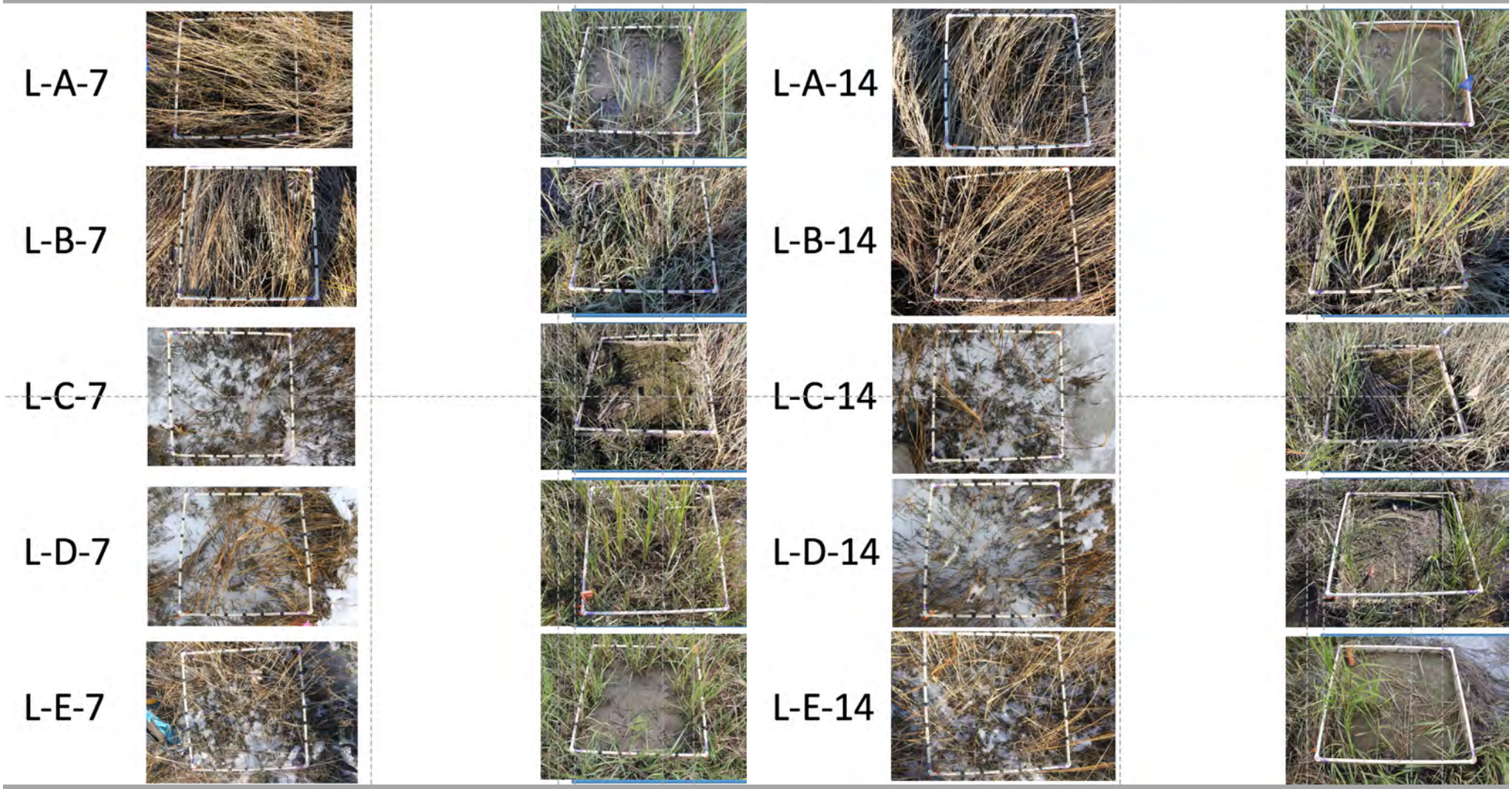
Vegetation Response Compared to National Study Fixed Experimental Plots

LOW MARSH



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Other Parameters Measured?

- Pore water chemistry (salinity, pH, redox, sulfides); *no significant differences between sediment and control*
- Sediment type and composition (sand silt clay, etc.); *no significant differences between sites despite slight differences at Jeffreys Neck*
- Bulk density and Percent organic matter; *no trends yet (but very interested in year assessment as roots proliferate*


Brian Davis, MEFB

DISCUSSION

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Next Steps (for proposed Year 2 study)

- Repeat UAV mapping and compare sediment footprint
- Re-measure sediment depths along fixed points on monitoring transects
- Further evaluate plant response between experimental (sediment) plots vs controls (no sediment addition) after second grow season

Additional Research Opportunities

→ *Above/Below-ground Biomass??*

→ *Effects on marsh invertebrates??*

→ *Effects on Avian species*

Jacob Moore and Robert Lafreniere, MEFB

Nancy Pau, USFWS

DISCUSSION

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Summary and Lessons Learned

- Significant Ecological Event
- This is the FIRST time such an event has been studied in our geography
- Based on measures and drone mapping, ~8,000m^3 of material.
- That's ~750 dump trailer payloads! $$ Real Costs/Values (from other sediment reuse applications…)
- Aligning w annual accretion rate of 2mm/yr, the average of 31.5mm represents ~15yrs worth of sediment in one single event!
- Manuscript to be submitted this month!

DISCUSSION

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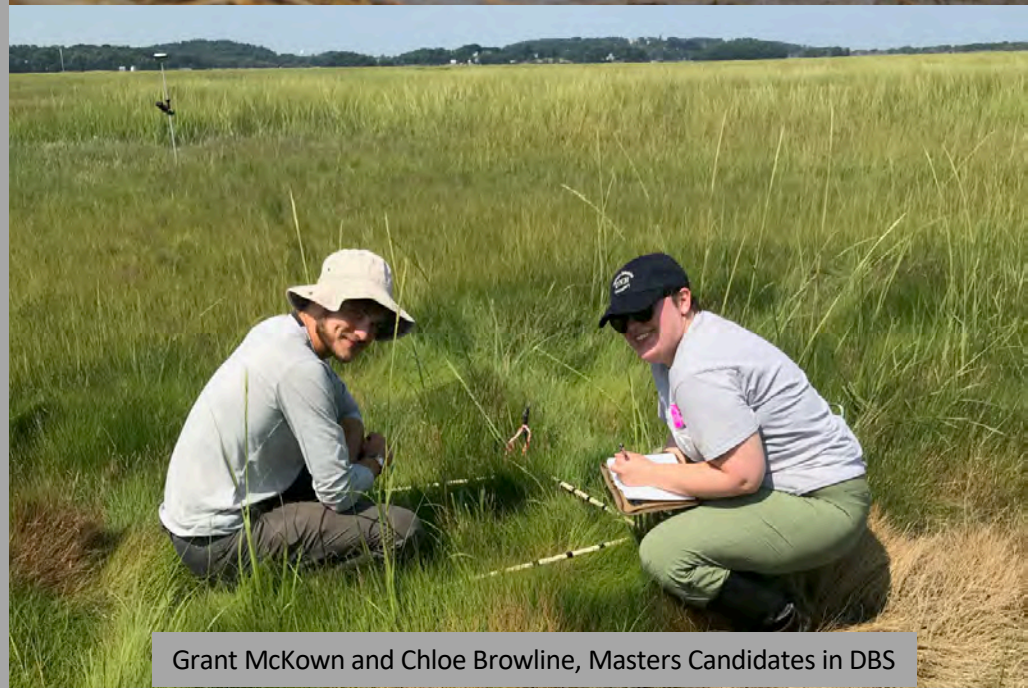
Summary and Lessons Learned

- Sediment Stable - staying in place, not migrating much, if at all
- Minor Reduction in Plant Cover - After ONE growing season, negative impacts fairly limited (~20% reduction in plant cover)
- Building Marsh Capital – Net increase in elevation, plus increased root biomass (work in progress)

***SO*, in this case, extreme weather and storm surge *HELPED* build marsh capital, and benefitted resilience!**

…*AND*, suggests that TLP, in moderation, may help resource managers too!



Grant McKown and Chloe Browline, Masters Candidates in DBS

SUPPORTED BY:

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Executive Office of Energy and Environmental Affairs

Municipal Vulnerability Preparedness (MVP) program

U.S. FISH & WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR