Experiments with thin layer sediment placement to enhance salt marsh resilience to climate change

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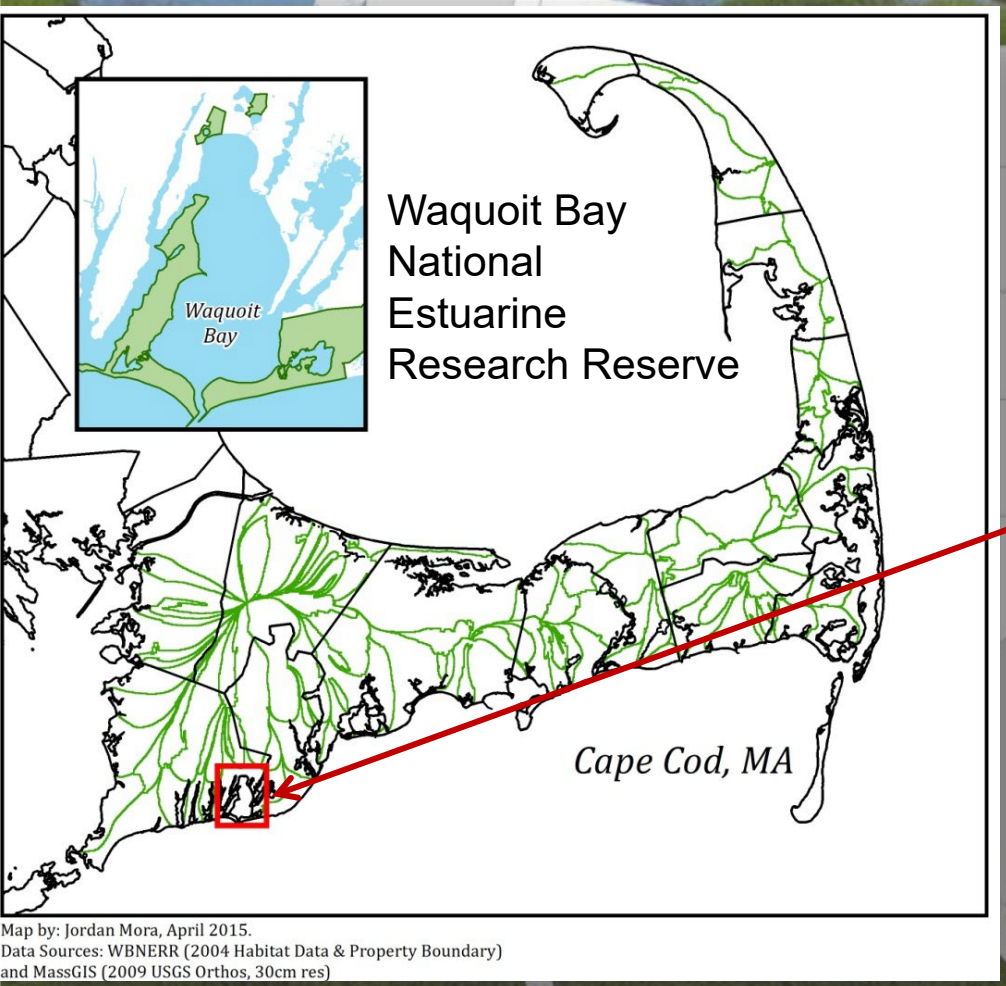
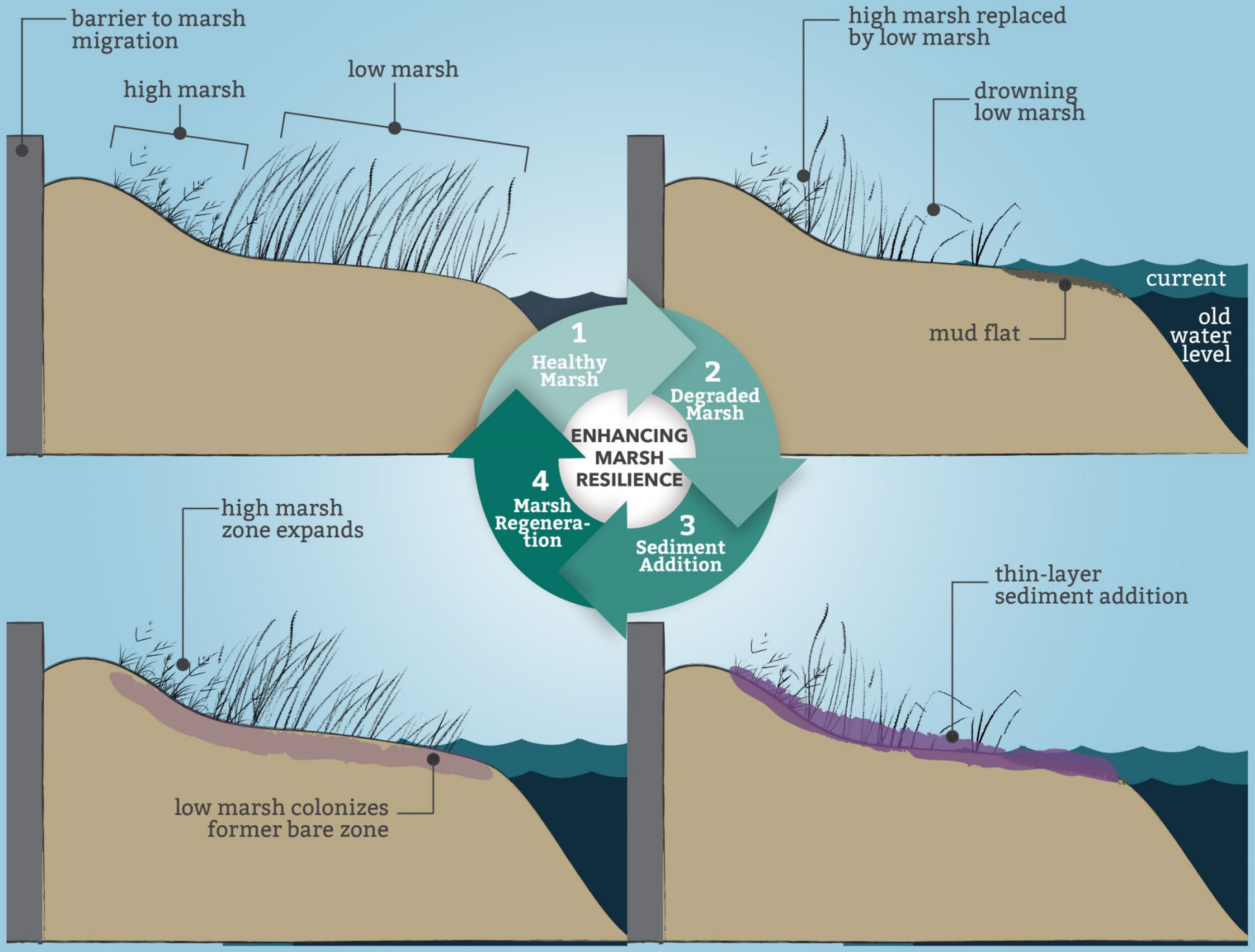
National Estuarine Research Reserve System



http://www.mass.gov/eea/images/dcr/passport/passportcoverpetecircle462x286.gif


barrier to marsh migration
high marsh
low marsh
high marsh replaced by low marsh
drowning low marsh
current
old water level
mud flat
1 Healthy Marsh
2 Degraded Marsh
3 Sediment Addition
4 Marsh Regenera-tion
ENHANCING MARSH RESILIENCE
high marsh zone expands
low marsh colonizes former bare zone
thin-layer sediment addition

Spraying dredged sediments on marsh in full scale restoration

Examples of sediment augmentation/TLP


Image credit: Bart Wilson, FWS

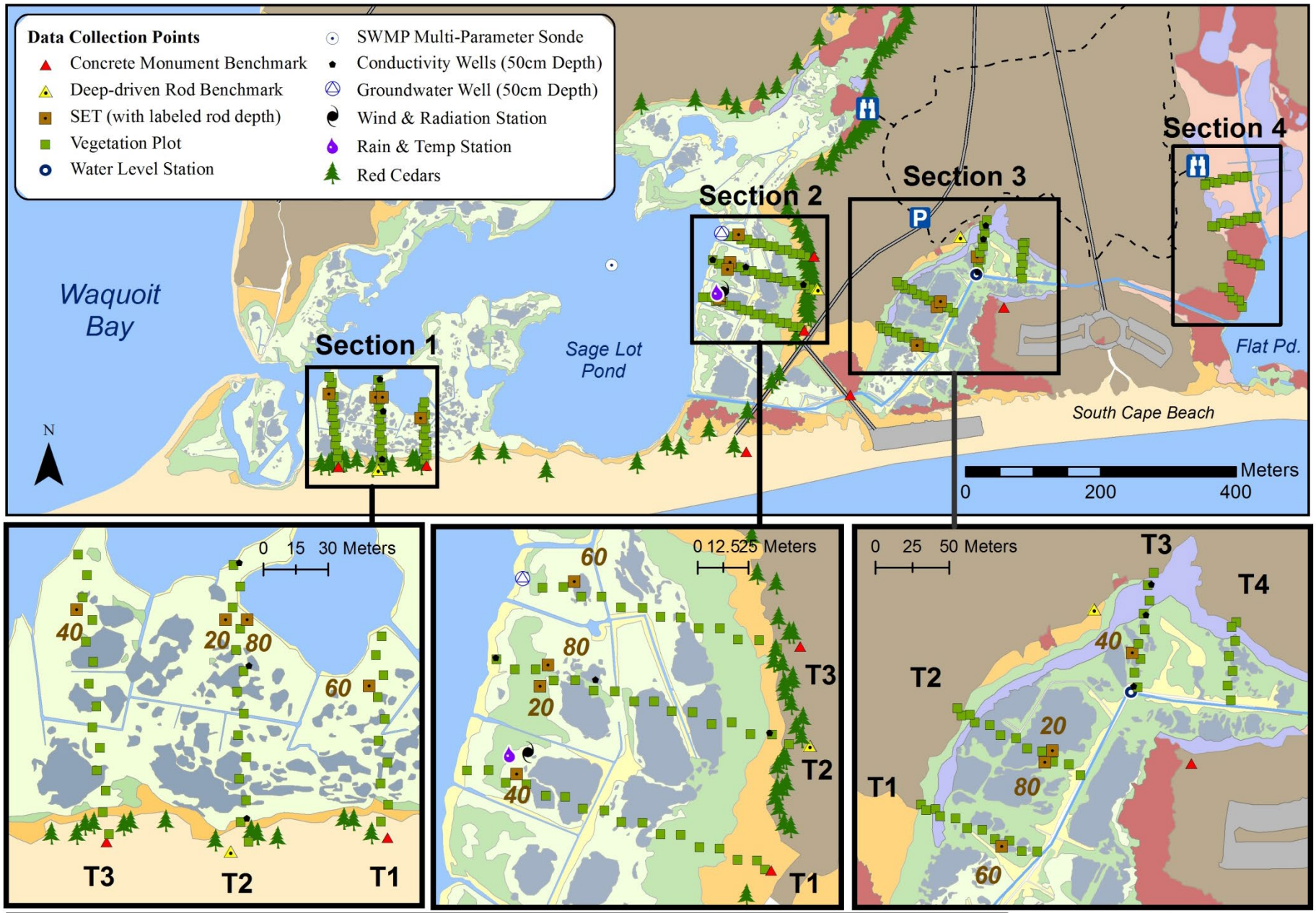
- RI- John H. Chafee NWR and Ninigret Pond (2016), Sachuest Point NWR (2015)

- NY- Big Egg (2003), Elders East (2006), Elders West (2010), Yellow Bar (2012), Black Wall & Rulers Bar (2013)

Thin-layer sediment placement:
EVALUATING AN ADAPTION STRATEGY TO ENHANCE COASTAL MARSH RESILIENCE

Funded by the National Estuarine Research Reserve Science Collaborative

Salt Marsh Wetlands and Water Levels program



Map by J. Mora ~ November 2013
Habitat Data: WBNERR 2004
Survey Points: WBNERR 2012 & 2013

Eight NERRs did same TLP experiment

PROJECT OBJECTIVES

Determine conditions where sediment addition is an effective strategy to enhance marsh resilience

- Consistent comparisons among 8 marshes
- Standardized mix of quarried sediment
- Compare effect in high vs. low marsh
- Compare thin (+7 cm) vs. thick (+14 cm) addition layer

LOW MARSH SITE SELECTION

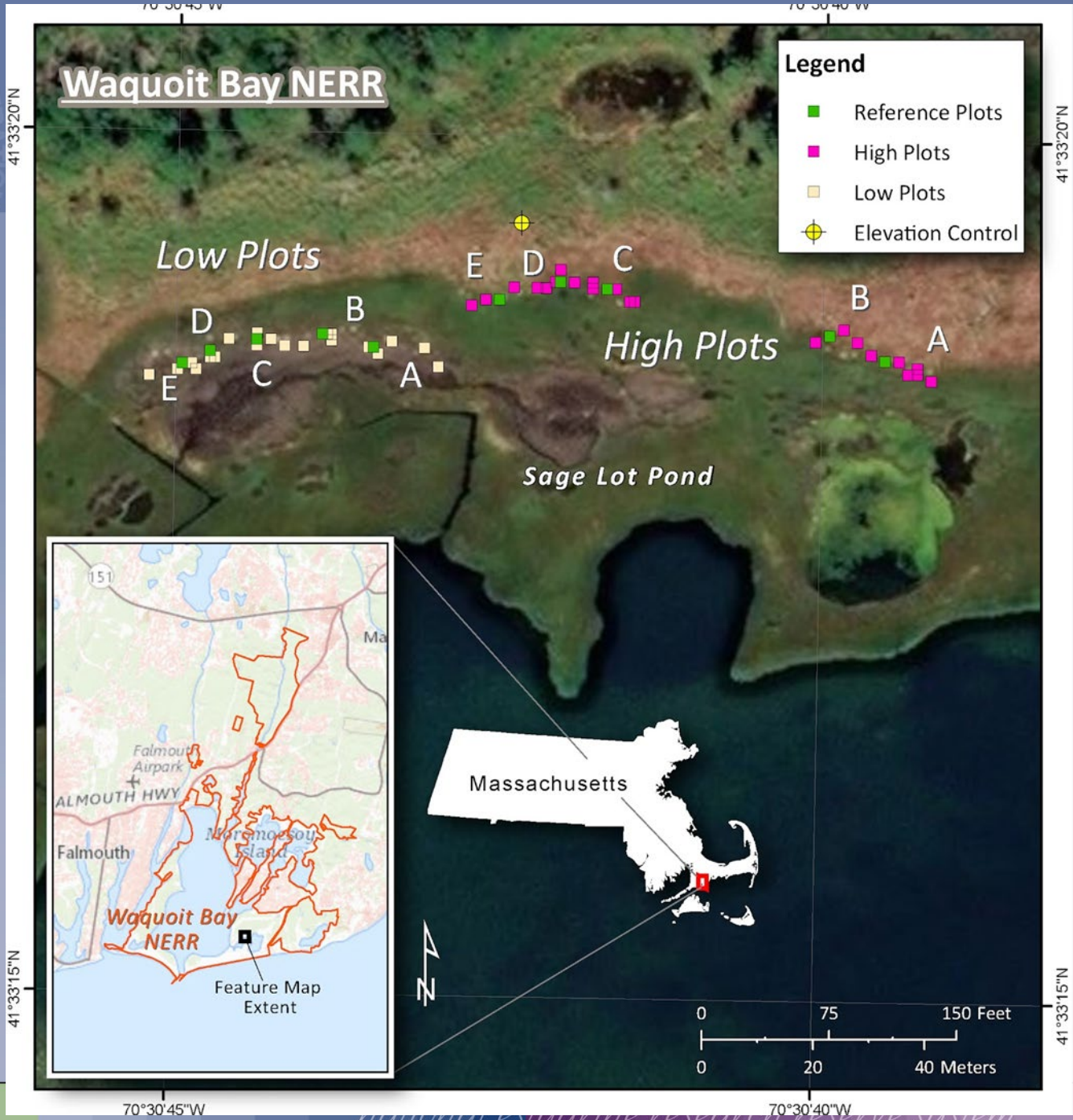
- Near lower tolerance limit of marsh vegetation at each site
- Areas with 0-50% cover, ideally with recent loss due to drowning
- Goal of TLP here is to increase cover by low marsh vegetation

Experimental plot before

Experimental plot after

Sage Lot Pond low marsh study site


Credit: Jeanna Mielcarek/UConn SHARP


Waquoit Bay NERR
Legend
Reference Plots
High Plots
Low Plots
Elevation Control
Low Plots
High Plots
Sage Lot Pond
Massachusetts
Falmouth
Waquoit Bay NERR
Feature Map Extent
41°33'20"N
41°33'15"N
70°30'45"W
70°30'40"W
0 75 150 Feet
0 20 40 Meters

HIGH MARSH SITE SELECTION

- Just below elevation where high marsh species dominate
- Areas that have converted from valued or rare high marsh communities to low marsh communities
- Goal of TLP here is to increase proportion of high vs. low marsh plant species

Experimental plot before

Experimental plot after

Sage Lot Pond high marsh study site

Built 40 frames

Some methods…..

10% local mud mixed in with quarried sediment

MA Dept of Environmental Protection Permit 043-2942

Thin Layer Placement- sediment addition for elevation boost

Before

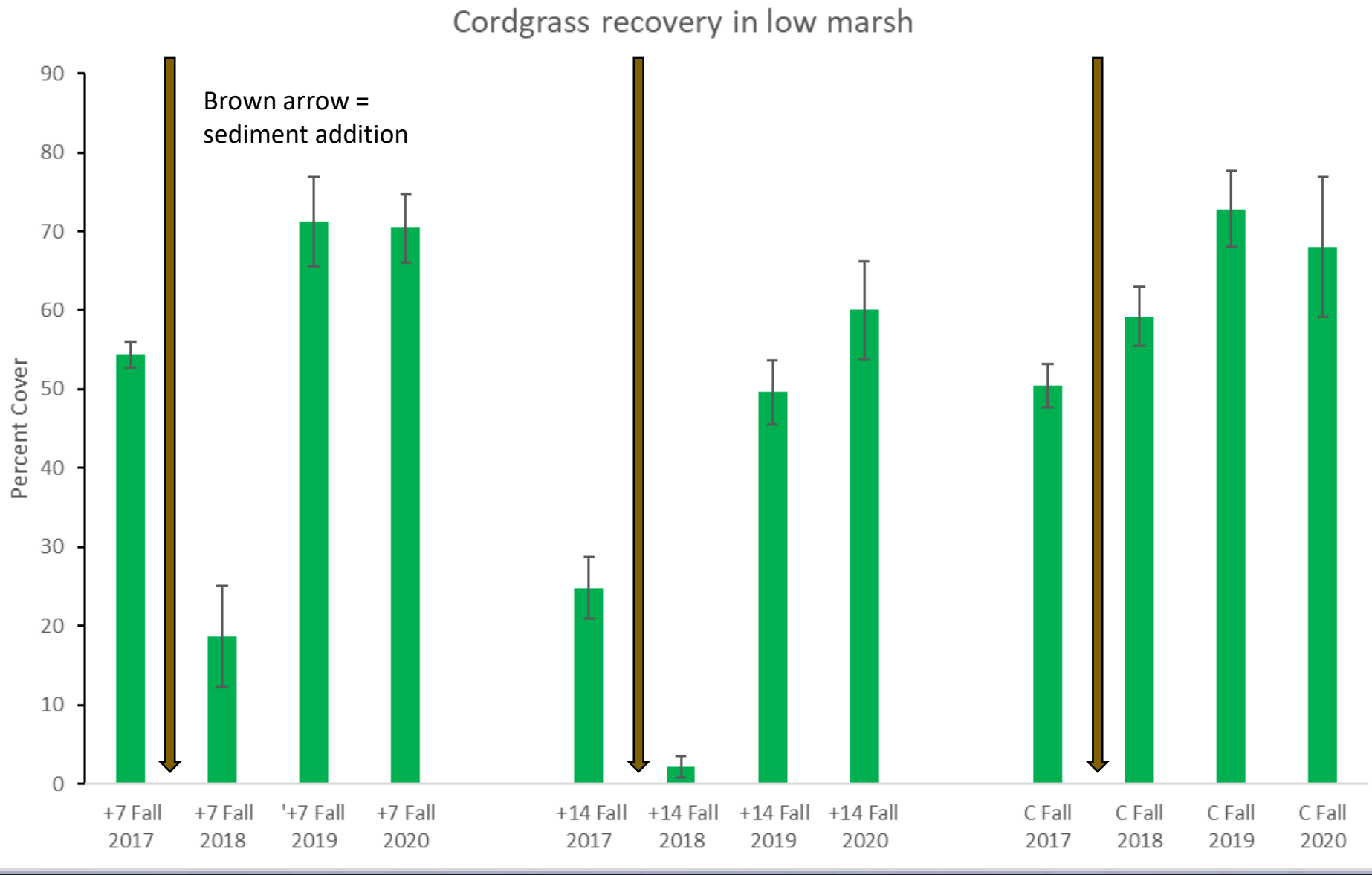
Immediately after

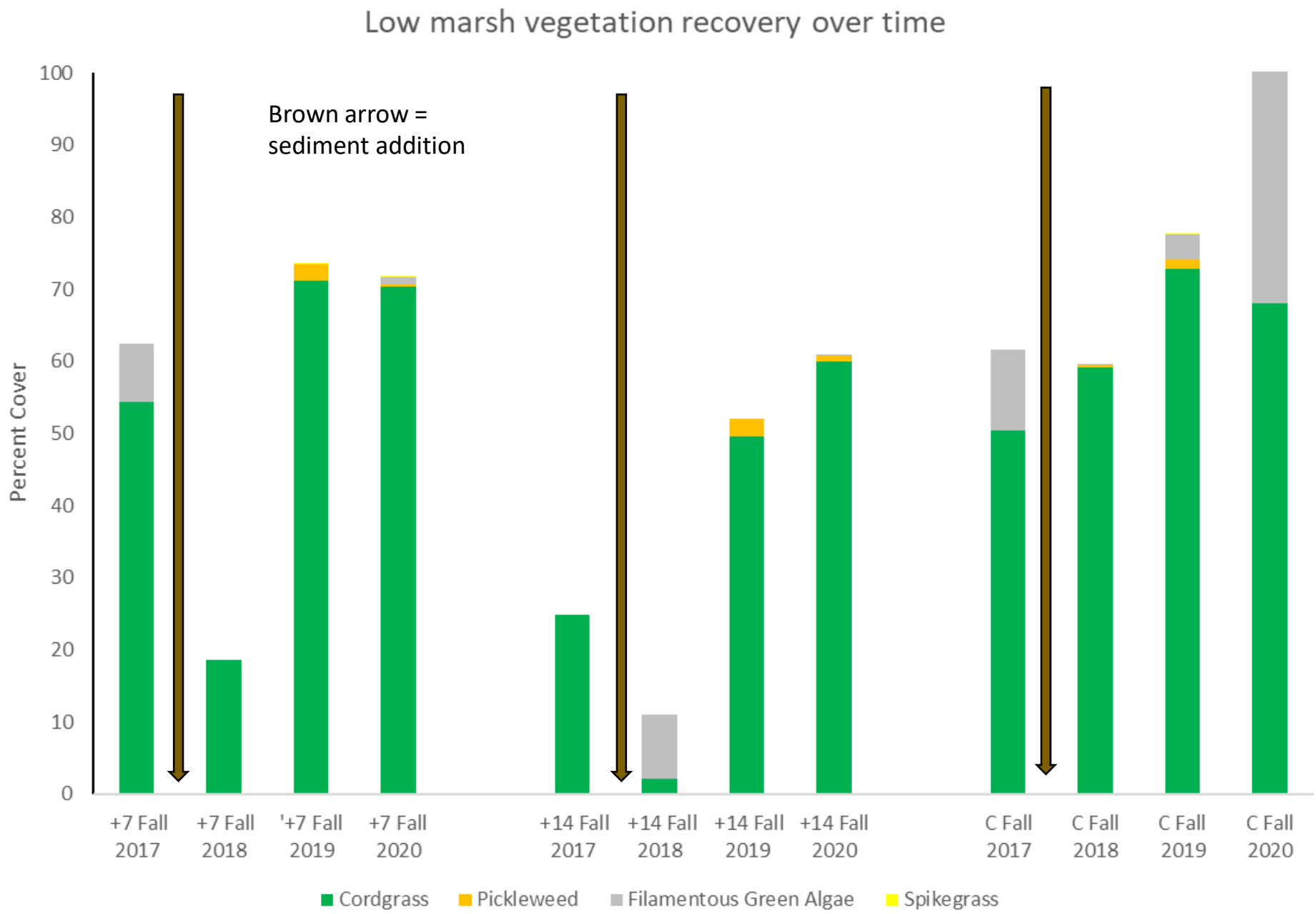
Five months after

One year

Two years later

Cordgrass recovery slower w. thick sediment addition




Low marsh vegetation recovery over time
Brown arrow = sediment addition
Percent Cover
100
90
80
70
60
50
40
30
20
10
0
+7 Fall 2017
+7 Fall 2018
'+7 Fall 2019
+7 Fall 2020
+14 Fall 2017
+14 Fall 2018
+14 Fall 2019
+14 Fall 2020
C Fall 2017
C Fall 2018
C Fall 2019
C Fall 2020
Cordgrass
Pickleweed
Filamentous Green Algae
Spikegrass

Flooding sensitive high marsh plants

Suaeda = annual sea blite

https://www.pinterest.com/pin/307089268319172591/

Iva = marsh elder, high tide bush

https://images.app.goo.gl/NJdN5WwM6e81UxEc8

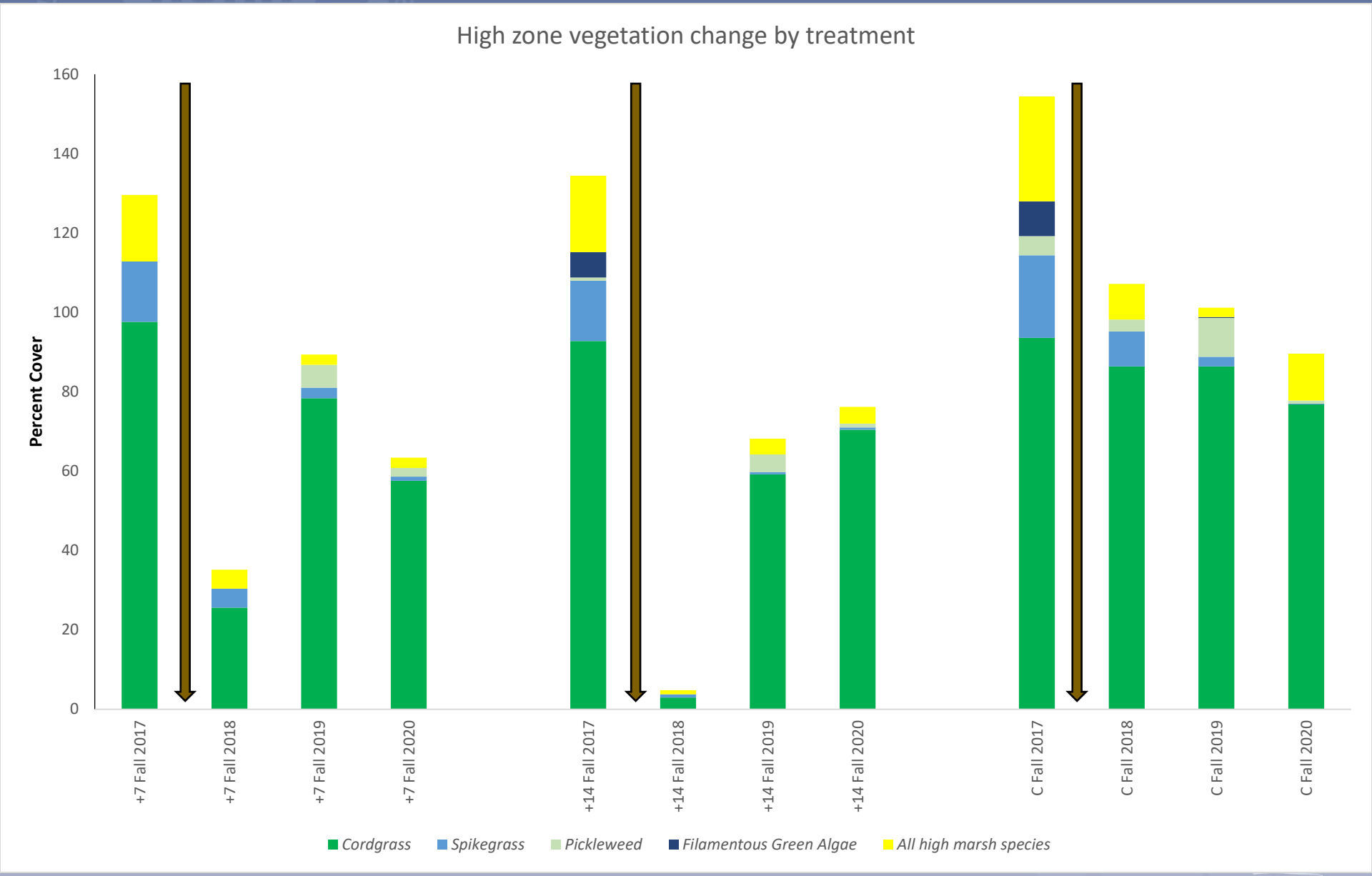
Seaside lavender

https://images.app.goo.gl/kn2druQWhKuqTgSS9

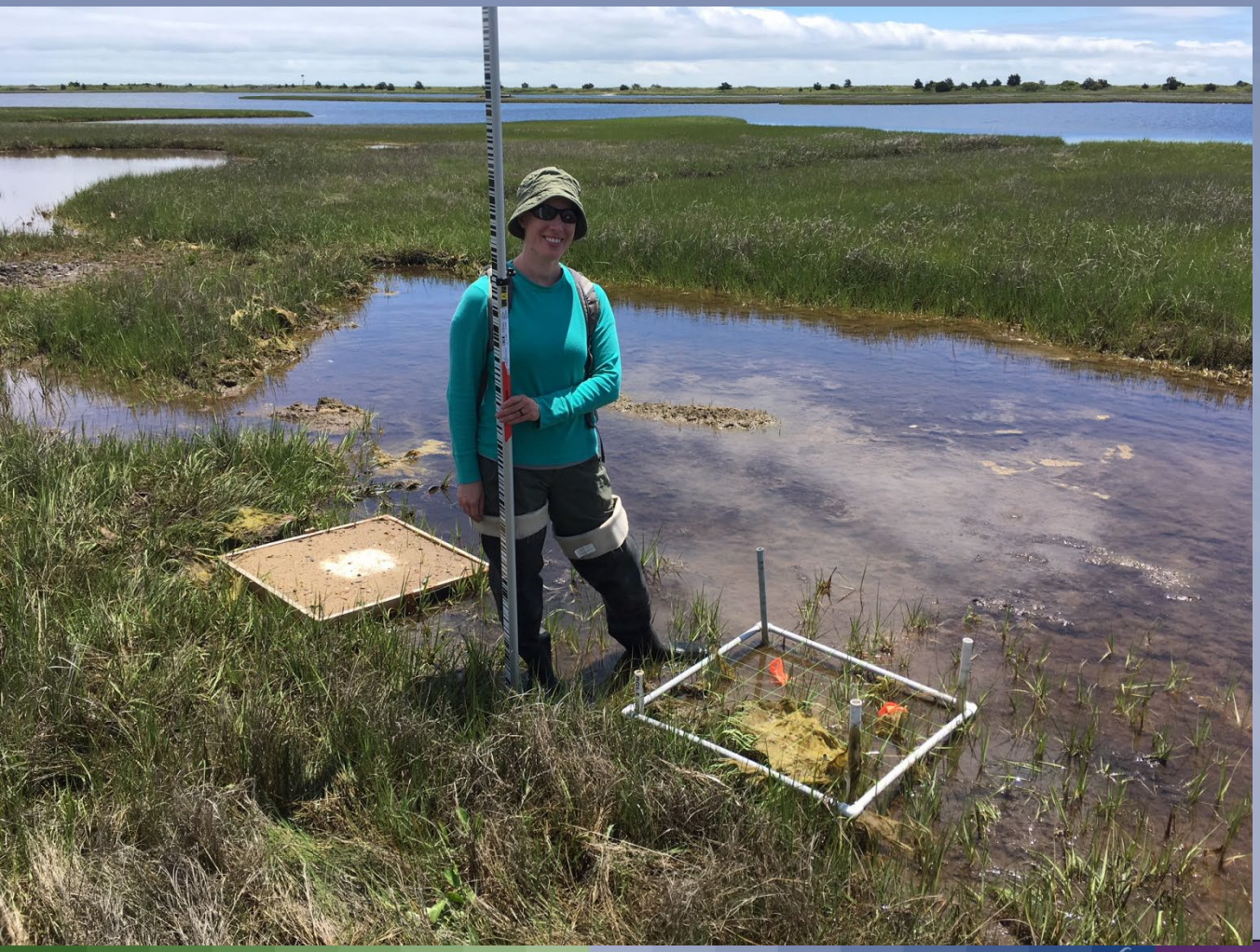
Salt marsh hay

https://dunescience.com/wp-content/uploads/2018/06/BJ5I5400.jpg

High marsh- all veg categories combined



Green Filamentous Algae

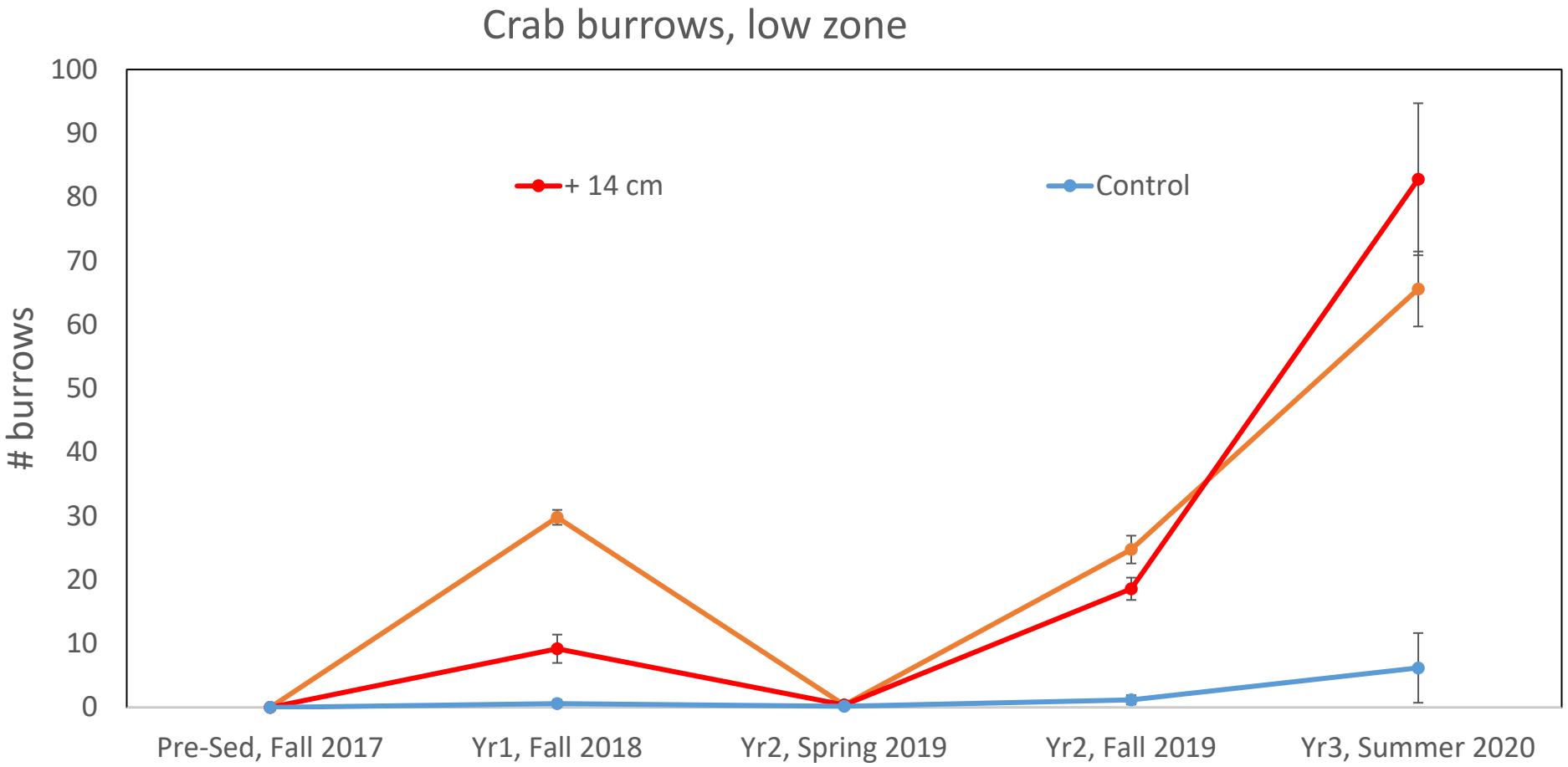


Mammal utilization of sediment frames

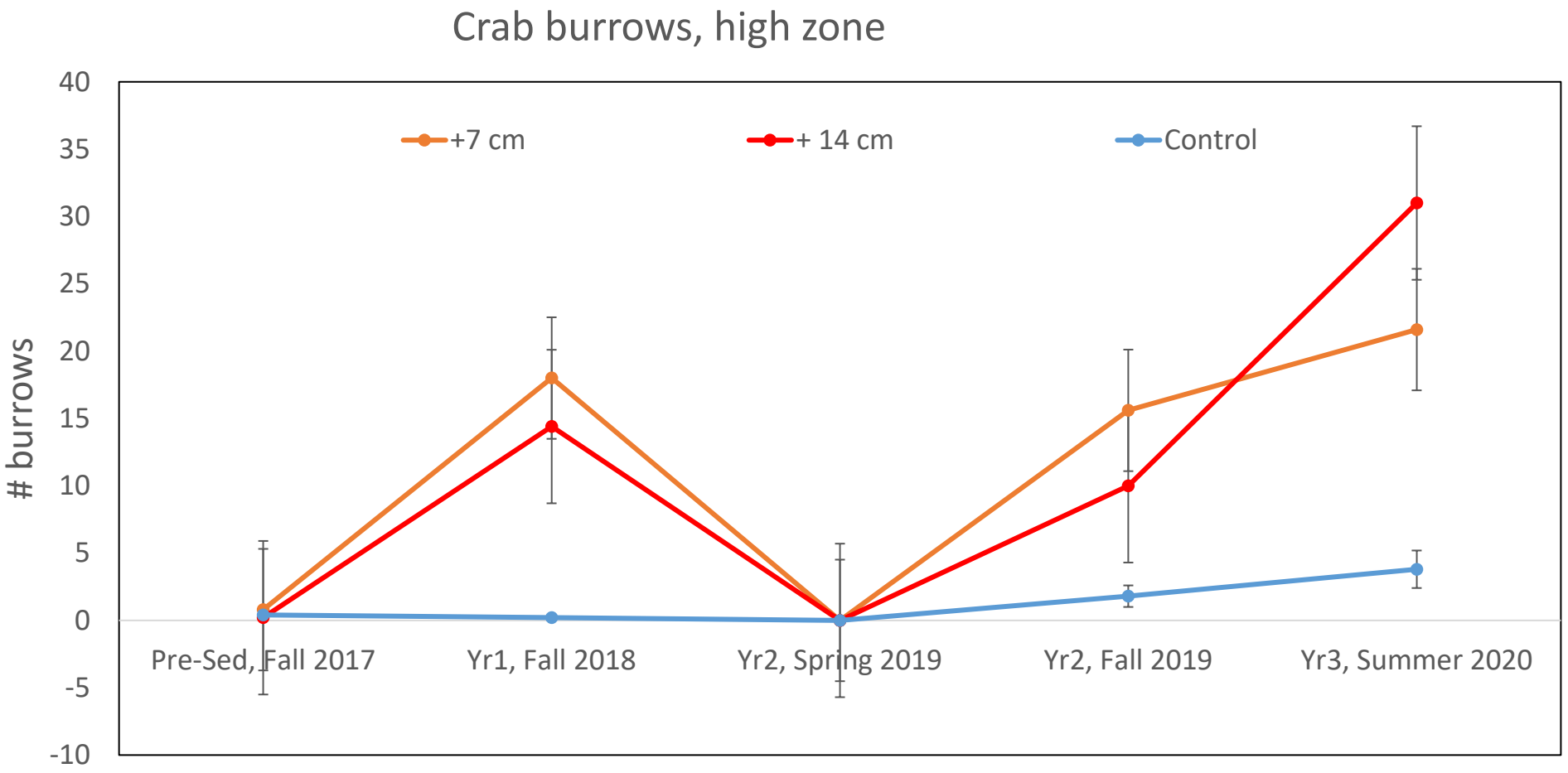
Did we create more opportunities for fiddler crab burrow construction?

Counted burrows before and after sediment additions

Sediment addition had more crab burrows



High zone lower burrow density but enhanced by sediment addition



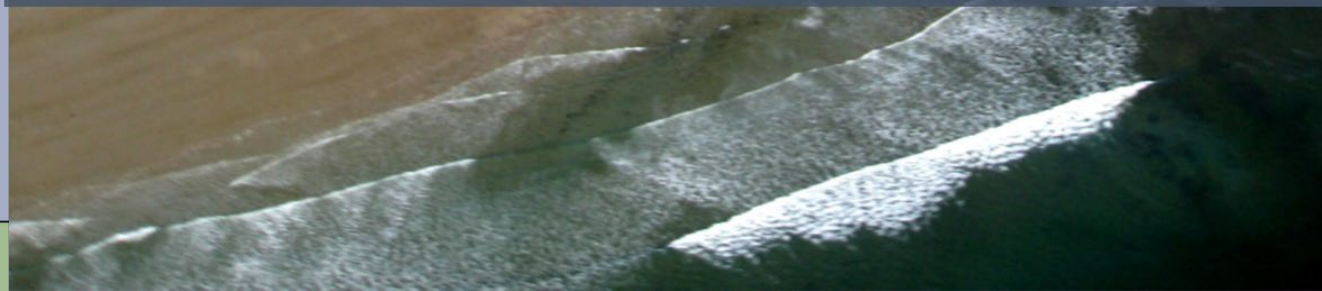
Take Home Points- 8 NERRs

- Vegetation colonization was generally rapid
- +7 cm recolonized faster than +14 cm sediment addition, but little difference after 3 years
- TLP works better to increase veg cover than to enhance flooding sensitive species
- Site matters!

https://nerrssciencecollaborative.org/resource/guidance-thin-layer-sediment-placement

GUIDANCE FOR THIN-LAYER SEDIMENT PLACEMENT AS A STRATEGY TO ENHANCE TIDAL MARSH RESILIENCE TO SEA-LEVEL RISE

RAPOSA, WASSON, NELSON, FOUNTAIN, WEST, ENDRIS, WOOLFOLK



Further considerations for sediment augmentation/ thin layer placement

- Use 1 thick rather than 2 thinner sediment applications
- Sediments compact over time, slightly overshoot desired elevation
- Monitor burrowing crab density- have a plan to mitigate if needed
- Plan to monitor for 3+ years to assess restoration efficacy
- If success = more plant cover, then project goal likely to be met. If success = more flooding sensitive species naturally recolonize, then goal less likely to be achieved

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