Evaluating Runnels Workshop

March 2, 2020

Welcome address will begin at 9 AM

<u>Please remember to:</u>

- Turn off your microphones
- Silence phones

Tweet us!
#Runnels2020

Twitter pages:
@WoodsHoleResCtr
@savebuzzardsbay
@SaveTheBayRI

Agenda:

8:00am: Arrive- light refreshments and coffee

9:00am Welcome and workshop logistics (Rachel Jakuba, BBC)

9:05am Workshop goals (Linda Deegan, WHRC)

9:20am Introduction/state of current practice (Sue Adamowicz, USFWS)

10:10am Overview of runnel projects in Rhode Island (Wenley Ferguson, STB)

10:50am Runnel case studies
- Diana Brennan, Bristol County Mosquito Control- 23 mins
- Dave Burdick, University of New Hampshire-23 mins
- Tom Iwanejko, Suffolk County Mosquito Control- 23 mins

12:00pm Lunch break (55 min)

12:55pm Panel of case study presenters. Questions by SNEP team and by audience. (30 min)

1:25pm SNEP project - Ideas to test potential sites (Alice Besterman, BBC/WHRC)

1:50pm Breakout Groups: Discussion of what makes a good runnel site and potential of proposed runnel test sites (60 min)

2:50pm Groups report out (40 min)

3:30pm Adjourn

Funding

SNEP
Southeast New England Program

NSF

Project Partners

buzzards BAY COALITION

Woods Hole Research Center

Buzzards Bay Project

SAVE THE BAY
NARRAGANSETT BAY
est. 1970

Bristol County Mosquito Control

USGS
science for a changing world

Evaluating Management Actions to Promote Salt Marsh Resilience

Monday March 2, 2020

Rachel Jakuba, Linda Deegan, Joe Costa,
Wenley Ferguson, Neil Ganju,
Diana Brennan, and Alice Besterman

SNEP
Southeast New England Program
NSF
buzzards BAY COALITION
WOODS HOLE RESEARCH CENTER
Buzzards Bay Project
SAVE THE BAY® NARRAGANSETT BAY est.1970
USGS science for a changing world
BRISTOL COUNTY MOSQUITO CONTROL

SNEP Project Major Tasks

SNEP Project Major Tasks

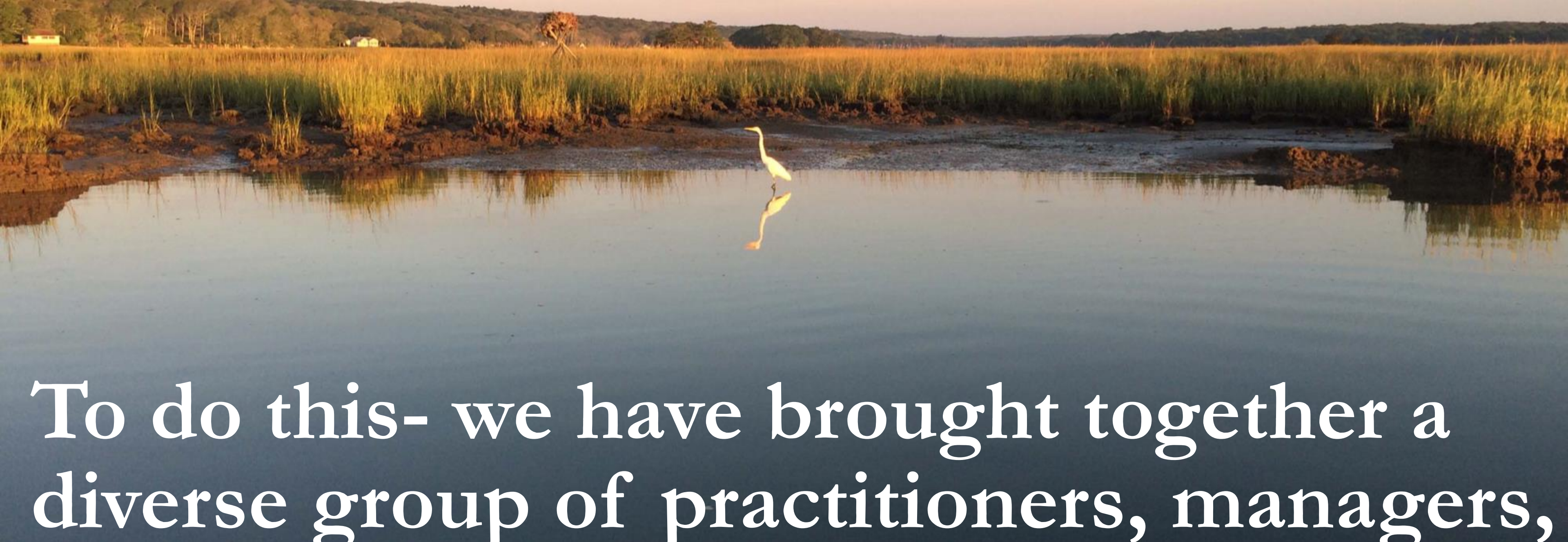
1. Evaluate current state of runnel practice & potential app to Buzzards Bay
2. Assess role of water quality and conservation strategies for marsh elevation and stability

Workshop Goals

Workshop Goals:

1. Discuss the state of the practice
2. Summarize outcomes from projects
3. Characteristics of "good" runnel sites

Southeast New England Program



To do this- we have brought together a diverse group of practitioners, managers, regulators, non-profits and academics.

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Runnels: An Introduction

Susan C. Adamowicz, Ph.D.,
Rachel Carson NWR
Geoff Wilson,
Bear Creek Sanctuary
David Burdick, Ph.D.
University of New Hampshire

Definition

runnel

[ˈrənl]

NOUN

a narrow channel in the ground for liquid to flow through.
"muddy lanes with runnels for effluent"

- a brook or rill.
- a small stream of a particular liquid.
  "a runnel of sweat"

Overview

- Motivation: Saltmarsh Sparrow
- What hope to accomplish
- Overall conditions -- megapools
- Stressors
  - Farmers in the marsh
  - Grid ditching
  - SLR
- 4 Tier Approach
  - When to use runnels
  - Runnel evolution

North Atlantic Appalachian Region At-Risk Species

Saltmarsh Sparrow Overview

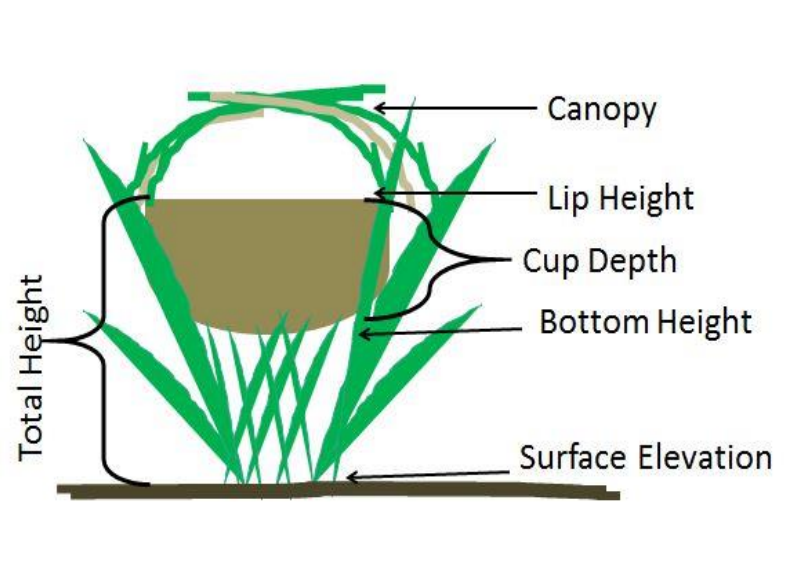
R. Longenecker

Abundance & Distribution

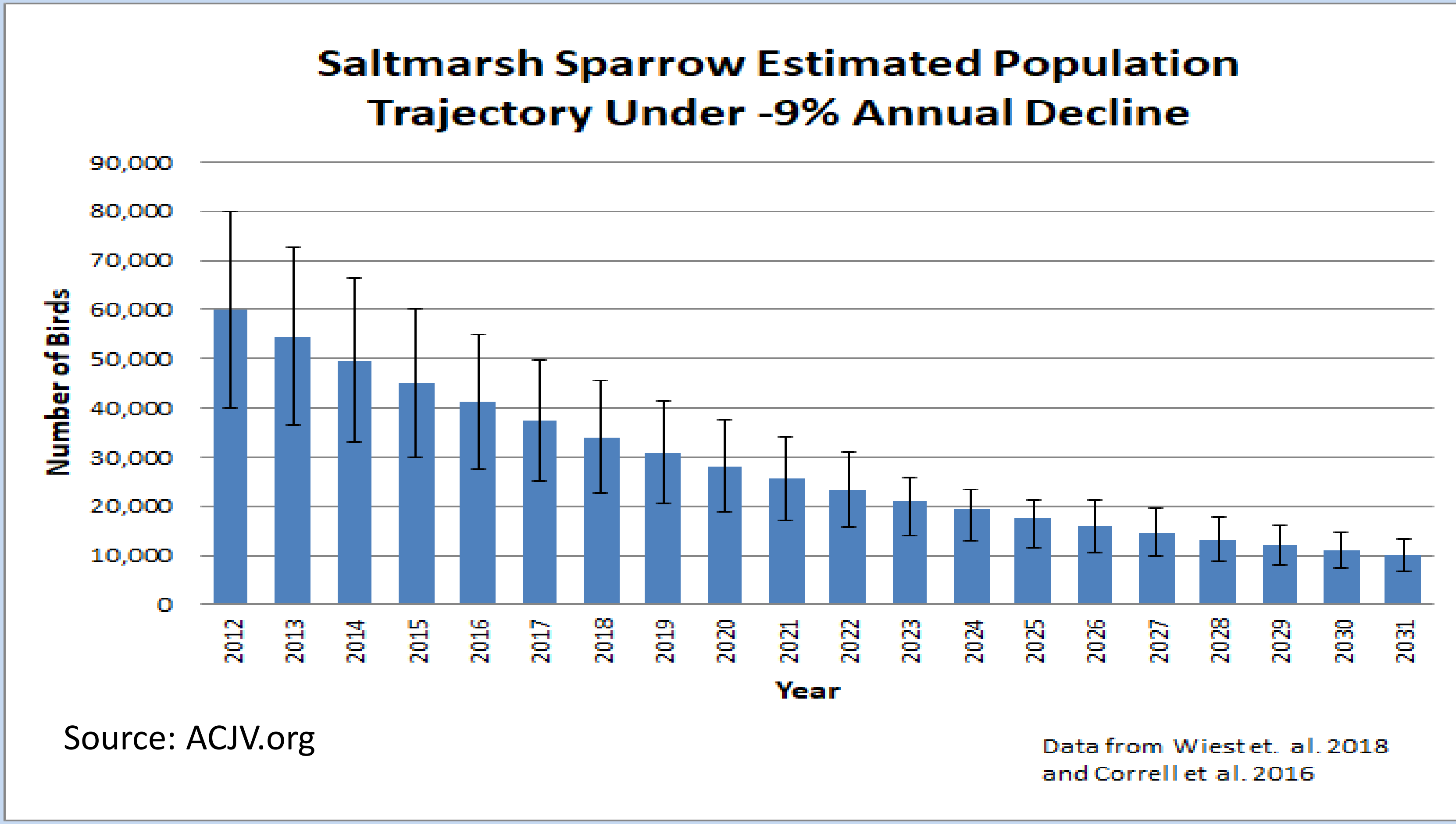
State	Population Estimate
Connecticut	1,600
Delaware	4,100
Maine	1,600
Maryland	15,100
Massachusetts	6,200
New Hampshire	1,100
New Jersey	19,900
New York	5,300
Rhode Island	900
Virginia	4,200
Total	**60,000***

Obligate salt marsh bird

Nests in *Spartina patens, Juncus*, etc, which are located in areas of marsh that flood the least frequently (should be once/month)



Population Trend



Source: ACJV.org

Documented 9% annual rate of decline range-wide (1998-2012)
Projecting that decline through 2018, we would estimate 84% population decline since 1998
Extinction predicted as early as 2032 and as late as 2064 based on population viability analyses

Causes of Decline

- Low reproductive success
- 57% of nests failed to produce a single fledgling from 2011-2015
- Reproductive failure is caused by:
  - Flooding of nests
  - Predation of nests (in the south)
  - Tidal restrictions associated with negative population growth rates

Jenna Mielcarek

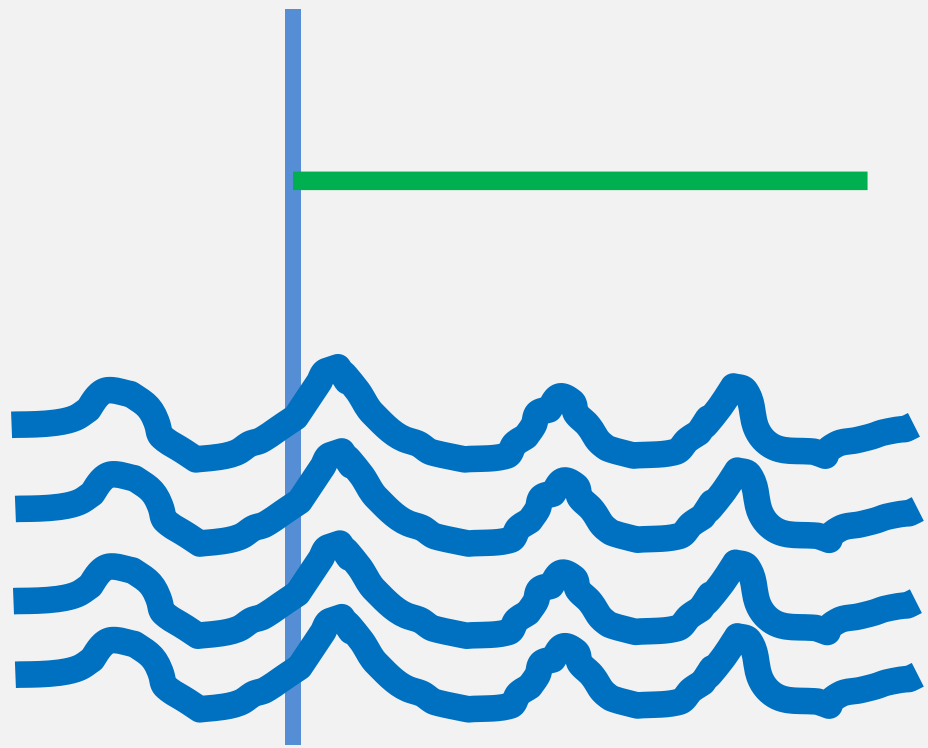
Mega-Pools: Waffle & Maple Syrup

Mega-Pools: Parker River NWR

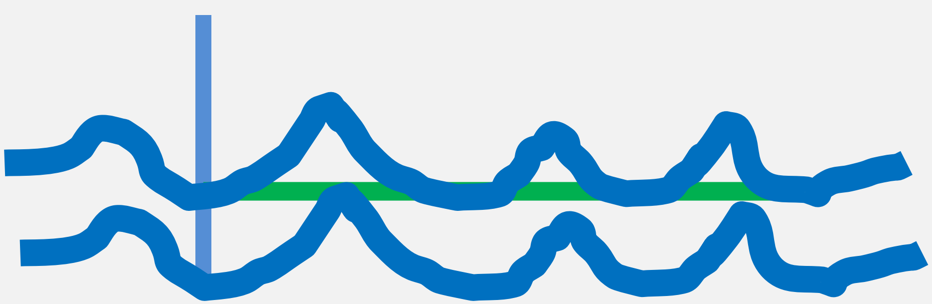
Mega-Pools: Jigsaw Puzzle Pools

Position in the Tidal Frame

Meso- Macro-tidal System
Marsh sits high in tidal frame



Micro-tidal System
Marsh sits low in tidal frame



Effect of Ditching

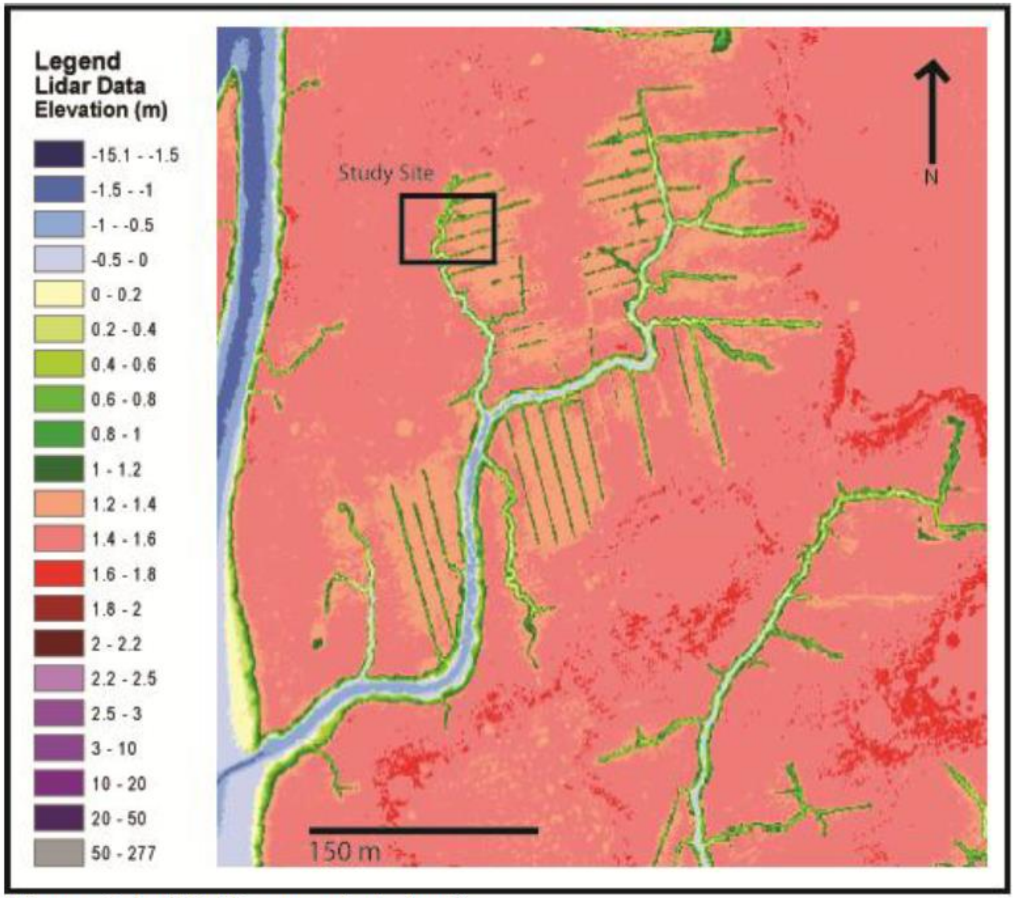
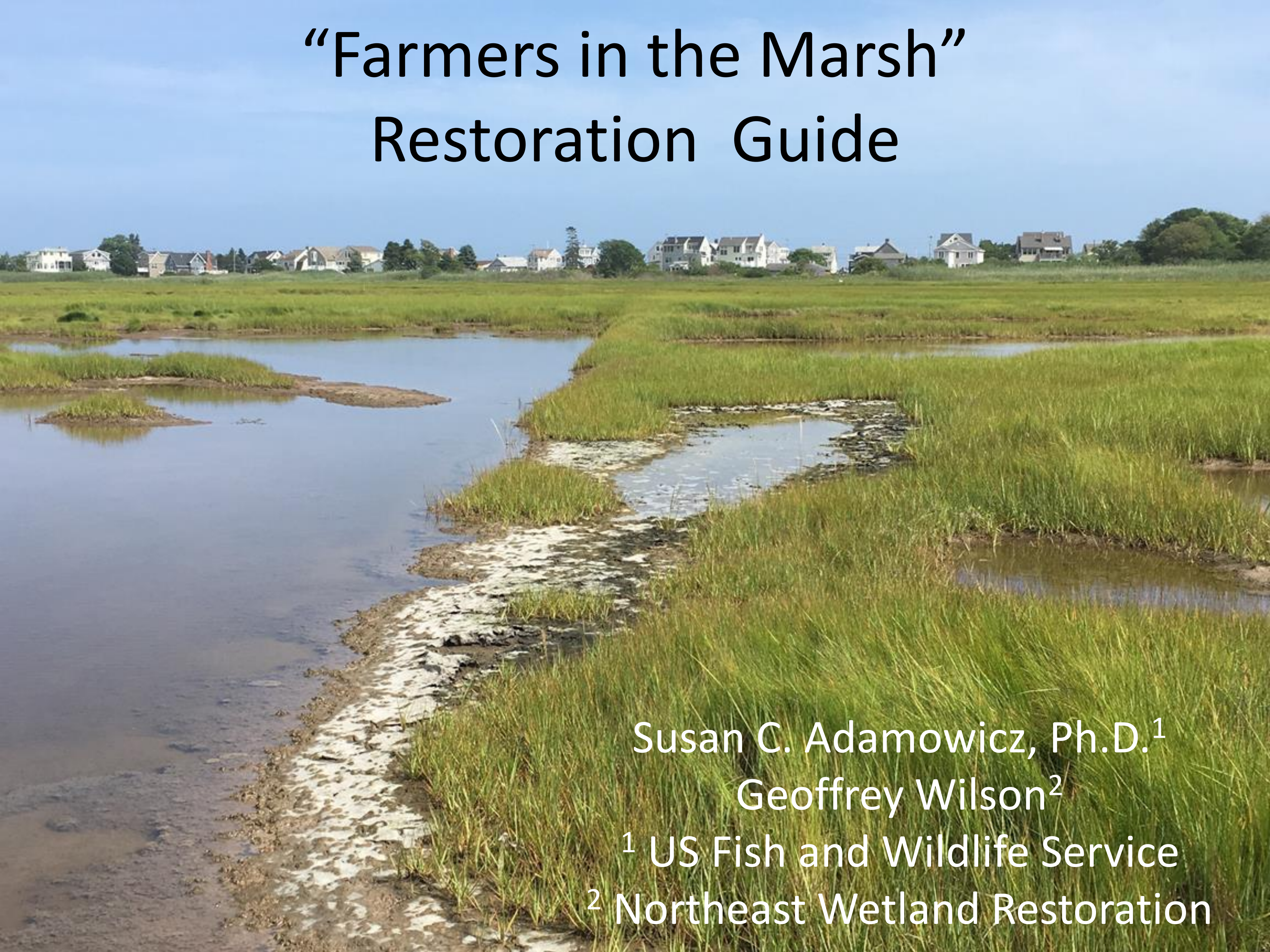


Figure 3.1. LIDAR map of study site

Samantha Wright
MS thesis 2012
Boston University

Slide by David Burdick

"Farmers in the Marsh" Restoration Guide



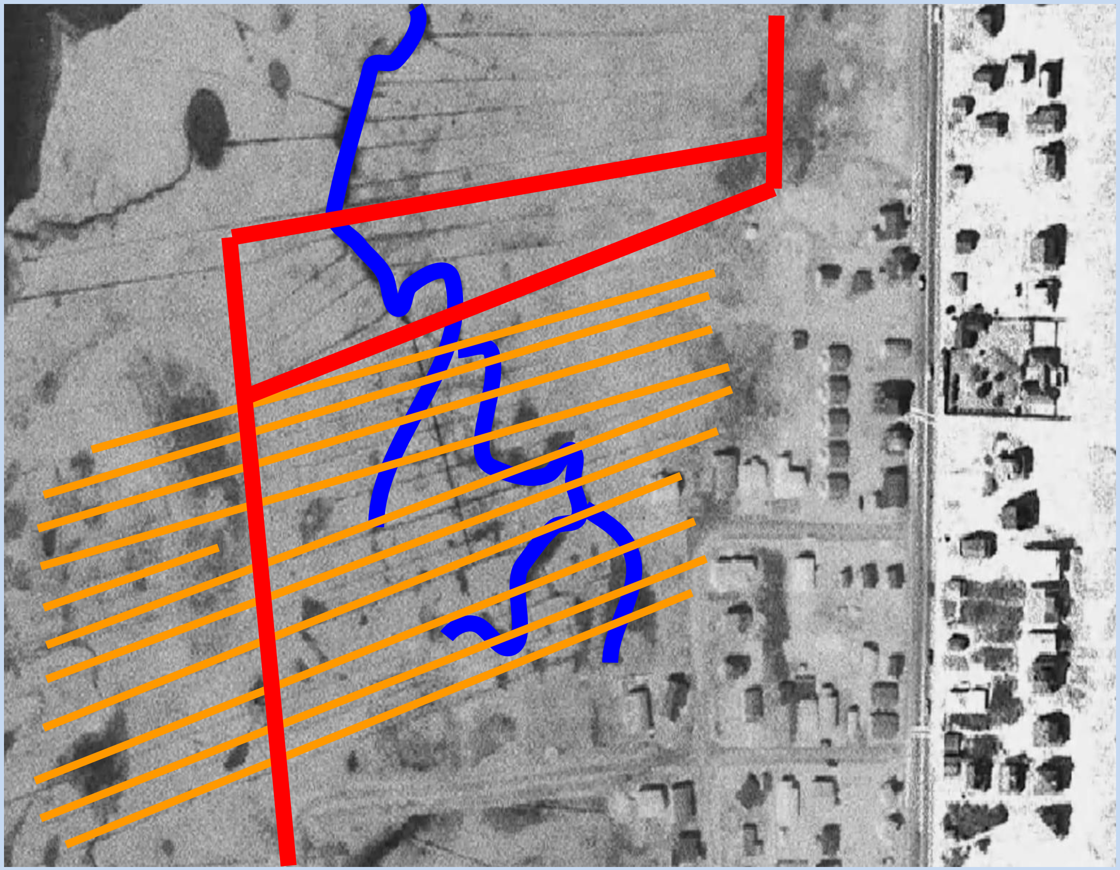
Susan C. Adamowicz, Ph.D.[1]
Geoffrey Wilson[2]
[1] US Fish and Wildlife Service
[2] Northeast Wetland Restoration

What we think about farming history

Martin Johnson Heade

What we think farmers left behind

Actual farming history



What farmers actually left behind

- Pre-colonial Tidesheds Based on Existing Creek Hydrology (Blue)

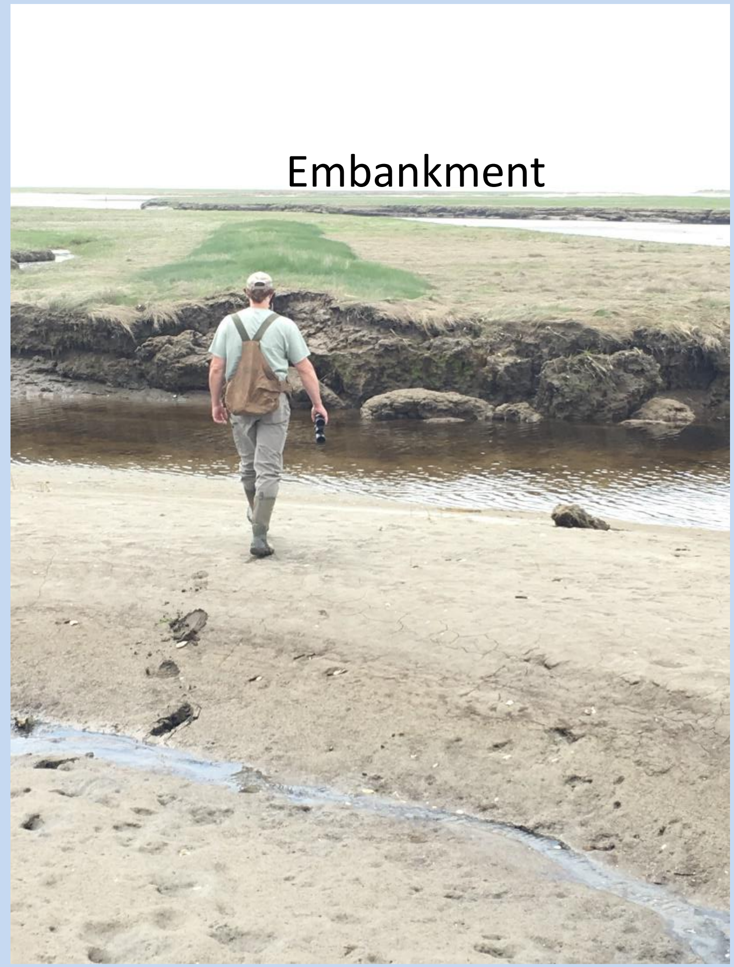
- Early Colonial (1600-1700) Farmers Fractured Tidesheds With Farmer's Ditch Network (Orange)

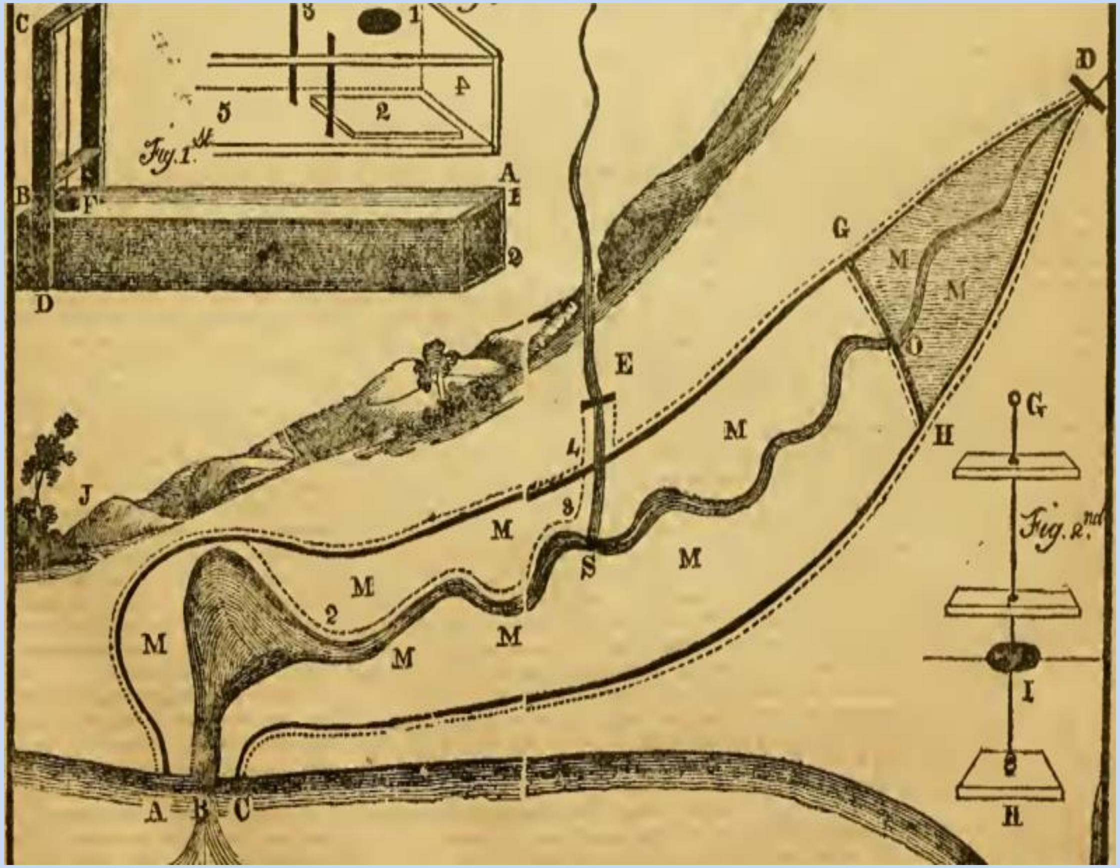
- Later Eras of Salt Marsh Farming (1800s) Further Isolated Areas With Agricultural Embankments (Red)

Three
Salt Marsh
Embankments

1800s Farming Footprint

Trunk





1800s
Salt Marsh
Management Era 3

- During the 1800s Salt Marsh Farmers Reclaimed Large Areas of Salt Marshes Into Upland Fields With the Use of Tightly Fitted Tide Gates Called Tide Trunks and Large Reclamation Embankments (Fessenden & Sheppard 1823; Clift 1862; Sebold 1966; Hawes 1986; Mora & Burdick 2013)
- American Farmer, Friday October 27, 1820. The Diagram Depicts Plans to Build a Simple Tidegate With Instructions on How to Isolate a Salt Marsh With Agricultural Embankments.

What farmers actually left behind (cont.)

- Mega-pool formation behind embankments and/or collapsed ditches
- (Waffle Maple Syrup model)
- Loss of elevation through root collapse and decomposition of saturated peat
- Decades delay for revegetation if possible at all given SLR
- Significant loss of vegetated "high marsh"

Mega-pool Trajectory

- Marsh surface unable to have proper ebb flow
- Peat becomes saturated
  - *S. patens* thins then is replaced by *S. alterniflora*
  - If trend continues, *S. alterniflora* is replaced by shallow standing water.
    - Mimics the string & flark morphology of patterned fens showing that peat is saturated and breaking down
    - In ditched marshes, ultimately results in "waffle-maple syrup" model where vegetation only grows along high banks of ditches and interior panel is unvegetated, shallow-standing water on top of marsh platform
  - Left alone, it will take up to 40 years for peat to break down and for a breach to intersect with a creek or ditch
  - Or we can manage with a light hand and restore tidal channel network, tidal hydrology, high marsh habitat and elevation.

1800s Salt Marsh Management Era 3

- A Properly ‘Banked Out’ Marsh was Estimated to Yield 4T/Ac Herd Grass (English Hay), 1600 Bu/Ac Mangel-wurzel (Fodder Beet), and a Wide Variety of Common Vegetables for Human Consumption (Fessenden & Sheppard 1823; Clift 1862)

Take Home Points

- The farming infrastructure is a system that can be recognized in salt marshes from Maine to Long Island and potentially further south as well
- The system is a combination of dikes/embankments, ditches and trunks (water control structures)
- The current hydrological failure (mega-pool trajectory) in marshes results from a collapse in the agricultural (and now, mosquito ditching) infrastructure
- **We can use this information to establish a high marsh restoration design and implementation process**

4 Tier Approach:
When it comes to sustaining your marshes, remember to keep it **HOTT**

- Halt subsidence
- Optimize Accretion
- Tune for Wildlife
- Tend to Your Marsh

Ramping up to multiple locations

- Tier 1:
  - Train local staff to ID ditch plugs/impediments
  - Work with local staff to develop plan for this stage
  - Design Review Team reviews plan
- Tier 2
  - Train local staff to ID embankment systems
  - Hold design charrettes with local staff
  - Design Review Team reviews plan
- Tier 3
  - Design Team uses staff input, expertise and local data to design more complex restoration that addresses long-term needs
- Tier 4
  - Design Team and local staff develop management plans based on site specific conditions and tide-shed management rotation in order to constantly provide saltmarsh sparrow habitat in some locations, while re-building marsh elevation in other locations.

Old Town Hill Base Map

Blue = ditch or channel
Red = embankment

OTH Tier 1: Rapid Corrections (**Halt** subsidence)

Red dot= “plug” removed
Bird= SALS island
Green = ditch remediation

Ditch Plug Breach
Tier 1 Level Project

- Goal: Use to restore tidal flow in marsh collapse areas associated with ditch plug removal projects
- Function: Use medium depth swale to restore tidal channel network and halt waterlogged subsidence trajectory
- Process: Breach ditch plug in existing channel and use peat soil materials and marsh sods to create Saltmarsh Sparrow breeding island.
- Watch for: Anoxic water remaining in channel above gradient of plug breach, and take care not to over drain the marsh area.

Saltmarsh Sparrow Nesting Island Form I

Tier 1 Level Projects

- Goal: Use peat soils and sods from ditch plug breach projects to create Saltmarsh Sparrow refugia
- Function: Carefully located, elevated areas within Saltmarsh Sparrow breeding areas offer nesting sites higher in the tidal frame to reduce nest failure rates due to tidal immersion.
- Process: Use peat soils and sods to create vegetated islands within and adjacent to Saltmarsh Sparrow breeding locations.
- Watch for: Carefully choose site locations to maintain moist organic soils for optimal primary production.

Ditch Remediation

Tier 1 Level Project

- Goal: Use natural processes to address auxiliary Ditches
- Function: Used to stabilize naturalized tidal channel network and halt oxidation subsidence trajectory
- Process: Salt hay in ditch filters sediments creating growing medium for S. alterniflora. Plant establishment develops natural peat floor and accretion process raises ditch floor elevation reducing drainage in surrounding soils.
- Watch for: Uneven sediment deposition that can create ponding in treatment ditch.

OTH Tier 2- Mid-term Restoration (**Optimize** Accretion)

Bright blue= runnel
Bird= nesting island

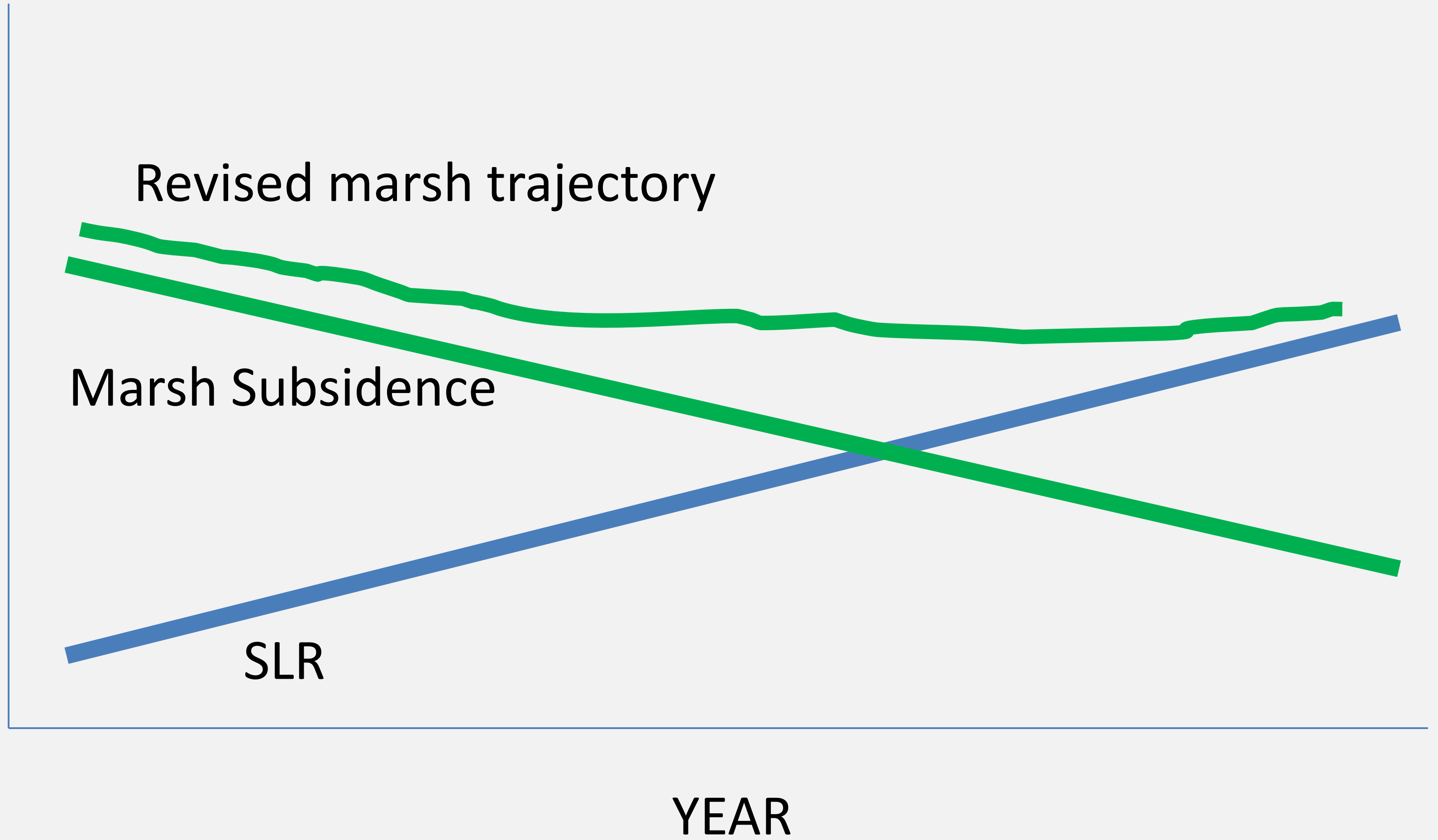
Salt Marsh Runnel
Tier 2 Level Project

- Goal: Use natural processes to advance Megapool stage of salt marsh secondary succession
- Function: Use a runnel at the anticipated creek incision location to stabilize marsh platform and advance revegetation stage.
- Process: Runnel accelerates creek incision process advancing Megapool stage of salt marsh secondary succession to revegetation stage
- Watch for: Open water remaining within the Megapool basin, manage for future pool habitats.

Saltmarsh Sparrow Nesting Island Form I
Tier 2 Level Projects

- Goal: Use peat soils and sods from runnel projects to create Saltmarsh Sparrow refugia
- Function: Carefully located, elevated areas within Saltmarsh Sparrow breeding areas offer nesting sites higher in the tidal frame to reduce nest failure rates due to tidal immersion.
- Process: Use peat soils and sods to create vegetated islands within and adjacent to Saltmarsh Sparrow breeding locations.
- Watch for: Carefully choose site locations to maintain moist organic soils for optimal primary production.

Changing Trajectories



OTH Tier 3 (**Tune** for Wildlife)

Salt Marsh Runnel Form II

Tier 3 Level Project

- Goal: Use natural process **to accelerate salt marsh accretion** <u>within embankment enclosures</u>
- Function: Use micro runnels to improve growing condition of *S. alterniflora*
- Process: Micro runnel slightly improves growing conditions for *S. alterniflora*. Improved growing conditions increases *S. alterniflora* productivity accelerating accretion rates.
- Watch for: To avoid managing for low diversity, manage adjacent embankment enclosures through a restoring rotation process to maintain a mosaic of habitats across the salt marsh system.

Tidal Channel Headward Extension
Tier 3 Level Project

- Goal: Use natural processes to manage marsh migration and increase salt marsh resilience during sea level rise
- Function: Managed tidal channel expansion into reclamation embankments to reduce erosion, avoid invasive species encroachment, and improve wildlife values.
- Process: Lower embankment segments at key locations to facilitate tidal channel network incision.
- Watch for: Unintended increase in invasive species.

OTH Tier 4 (**Tend** to Your Marsh)

Accelerated Accretion Cycle Rotation

Tier 4 Level Projects

- Goal: Use Ditch Remediation and Salt Marsh Runnel techniques together to rotate adjacent areas in a mosaic of marsh platform vegetation suitable for SALS nesting or elevation accretion.
- Function: Carefully shift and balance wildlife values and surface elevation accretion cycles over large portions of the marsh.
- Watch for: Manage areas to avoid diversity loss by maintaining 3-4 rotation phases.

OTH – 4 Tier All Together

Mid-Summary

- The era of massive salt marsh digging is gone
- In areas where not too much elevation is lost, there will be no need to resort to use of dredged sediments (TLD) which is costly and at this time is fraught with difficulties (up to 20 yrs for proper vegetation, compaction of peat below TLD, etc.)
- This process will restore high marsh vegetation using low impact (and lower cost) techniques
- This approach addresses long-term needs

Runnel Workshop

- Introduction to SMART (SMART 101) March 2, 2020
- Design Charrette (SMART 102)
- Project Implementation (SMART 103)
- Adaptive Management (SMART 104)
- SMART 101-102 also offered at
  Eagle Hill July 12-17,2020

Salt Marsh Adaptation & Resiliency Team (SMARTeam)

- Mission: **Working with partners** to
  - **Restore** existing northeast salt marshes and **prepare** them for SLR and marsh migration, **for the joint purposes of ecosystem and At-Risk Species preservation**.
  - **Preserve** as much existing acreage and nesting habitat as possible by
    - **Halting subsidence** trajectories
    - Using innovative and standard restoration techniques in a 4-Tiered Approach to **build marsh elevation**
    - Restoring conditions for "**high marsh**" **vegetation community**
    - Continually improving **nest site availability** for At-Risk Species such as Saltmarsh Sparrow
  - Prepare sites for **marsh migration** where surrounding lands permit

Salt Marsh Adaptation & Resiliency Team (SMARTeam) Chart

SMART Review Team
Adamowicz/ G. Wilson (ME)
D. Burdick (NH)
MA Sean Reilly ? (MA DCR)
W. Ferguson/ C. Chafee (RI)
R. Wolfe (CT)
N. Maher (NY)
J. Smith? (NJ)
SALS "Whisperer" Tom French ?
(MA Wildlife, Ret)

SMART Technical Support Group
Estuarine Tidal Hydrologist
Agricultural/Coastal Hist'ry Tech
GIS Specialist
Database Manager
Decision/Stats Analyst
Marine (Salt Marsh) Geologist

SMART Education, Outreach, Training Group
Adamowicz, Wilson, Burdick
Web Site Master (± social media)
Trustees (MA) (Russ H.)
MA Wildlife (Pat H)

Other Support Group?
NE Marsh Czar
State Marsh Czars

SMART Field Teams
See next slide for state and site
Specific project teams

ACJV
FWS Migratory Birds
FWS DNRCP I/M
FWS Refuges

SMARTeam Partnership Umbrella

USFWS
SMART
SHARP
SALSRI
NRCS
UNH
RI CRMC
CT Deep
NH Coastal Program
ME Coastwise
Save The Bay (RI)
MA Wildlife
RI Audubon
Mass Audubon
MA Bays
MA DCR
Pew Charitable Trust
NOAA

<u>Additional Partners</u>

NE Marsh Cza
State Marsh Czarr

FWS Migratory Birds
FWS DNRCP I/M
FWS Refuges
FWS Partners for Wildlife
FWS NEFO
FWS Gulf of Maine Program

<u>UNH</u>
Burdick

Field Teams: Local level project teams

__Field Teams__

Parker River NWR
Great Marsh Coalition
Trustees (MA)
Bear Creek Sanctuary
Friends of Belle Isle Marsh
Saugus River Watershed Council
Brookline Birding Club
Mass Audubon (David Moon)
SALS RI

__Other Potentials__

State Audubon Societies
Essex Ornithological Society
MA Greenbelt
Municipalities
Land Trusts
Conservation Commissions
State WMA
State Parks
National Seashores, NERRS,
Any organization that owns marshes

__State Contacts__

NRCS
CZM
ACOE
EPA (Ed Reiner is on board)

10-Year Time Line: Yrs 1-3

Effect

Stop subsidence trajectory
Establish tide-sheds
Tidal flow removes metabolites, brings in sediments
Increase nesting areas w/ short & long-term strategies

Re-establish primary channel hydrology;
Continue increase nesting areas

Begin building suitability for S. patens by:
......restoring appropriate tidal flow
......building marsh elevation via S.alterniflora
Increase nest site availability
Expand work zone up-slope and up-estuary;
Expand work on NWRs and "beyond the boundaries"

1 **2** **3**

Actions

Remove select ditch plugs
Build nesting areas in high plane
Begin Tier 2,3 AR diagnoses & designs
4 Tier Training in all years

Ditch remediation in remaining DP sites
Begin T2-3 permitting
Complete T1 in remaining NWRs

Continue use DR & Runnels;
Breach embankments in design locations;
Build additional nest site availability using AR methods;
Begin T4 design process

Scale

FWS NWRs: 50% in T1 **100% T1** **50% in T2,T3**

Non-FWS marshes **50% T1**

10-Year Time Line: Yrs 4-6

Effect

Continue building suitability for S. patens by:
......restoring appropriate tidal flow
......building marsh elevation via S. alterniflora.;
Increase "naturalized" nest site availability
Expand work zone upslope and up estuary
Complete T2,3 on NWRs
Expand work to more locations "beyond the boundaries"

4 | **5** | **6**

Actions

Year 4:
Increase FWS sites in T2,3
Complete plug removal in non-FWS

Year 5:
Increase number of sites in T2,3

Year 6:
Increase number of sites in T2,3;
Tier 4 permitting (if needed)

Scale

Year 4:
FWS NWRs: 65% T2,3
Non-FWS marshes 100% T 1

Year 5:
80% in T2,T3
50% T2,3

Year 6:
95-100 % in T2,T3
60-65% T2,3

10-Year Time Line: Yrs 7-10

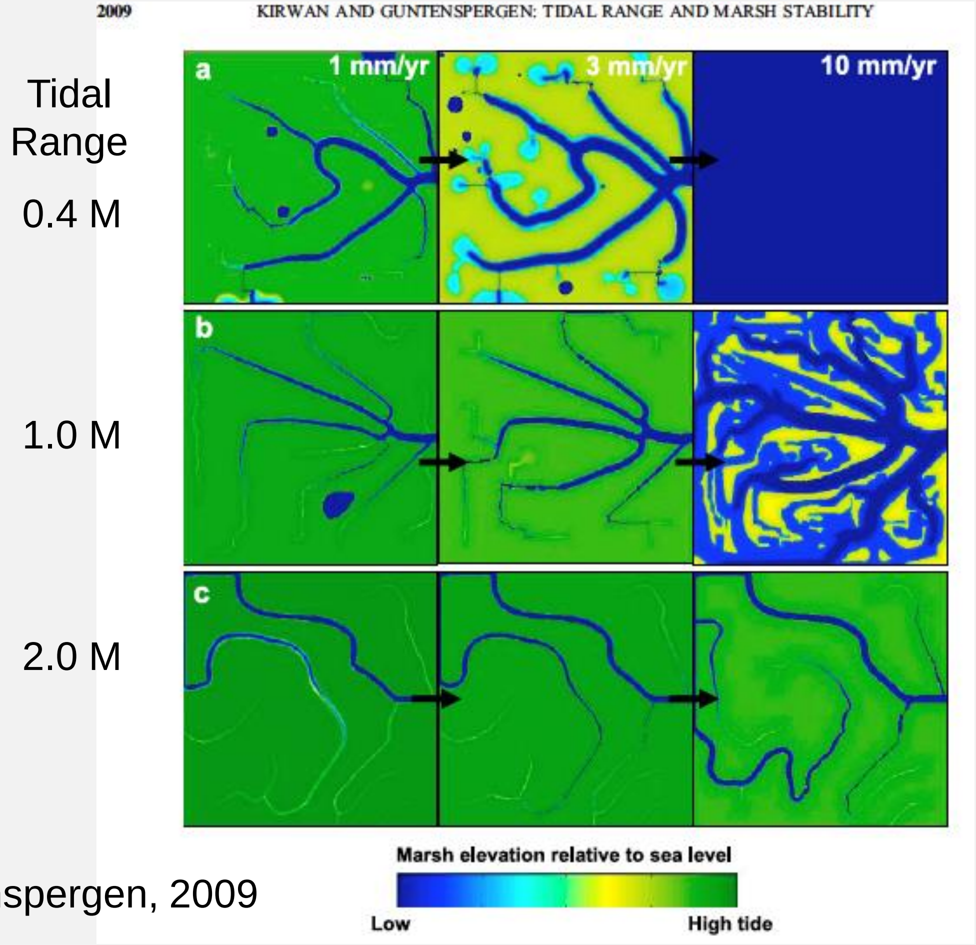
	7	8	9-10
Effect	Begin T4 on NWRs= …..long-term system-wide management rotations across tide-sheds and hay beds…elevation building then S. patens & sparrow nesting	T4 expands across NWRs; Complete T2, T3 in non-FWS sites	Tier 4 projects complete; Marshes respond with accretion rather than subsidence; All project sites in rotational sequence; All project marshes always have suitable array of nesting habitat
Actions	Begin T4 in FWS sites Expand T2,3 in non-FWS sites	Increase number of FWS sites in T4 Complete non-FWS sites in T2,3	Increase nest site availability at higher plane; Site adaptation measures in all projects
Scale	**FWS NWRs: 25% T4** **Non-FWS marshes: 75% in T2,3**	**50% in T4** **100% in T2,3**	**100 % in T4** **100% in T4**

Thank you


U.S. FISH & WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR
BEARCREEK
WILDLIFE SANCTUARY
NH
University of New Hampshire
U.S. DEPARTMENT OF THE INTERIOR
NATIONAL WILDLIFE REFUGE SYSTEM
trustees

Marsh Responses to three SLR rates under three Tidal Ranges

Tidal restrictions put our high tidal range marshes at risk
e.g. Philbricks Pond



Matt Kirwan and Glen Guntenspergen, 2009

Slide by David Burdick

Marsh response to shallow runnels

Wenley Ferguson, Save The Bay

Buzzards Bay Coalition's Runnel Workshop

March 2, 2020

SAVE THE BAY®
NARRAGANSETT BAY

Outline

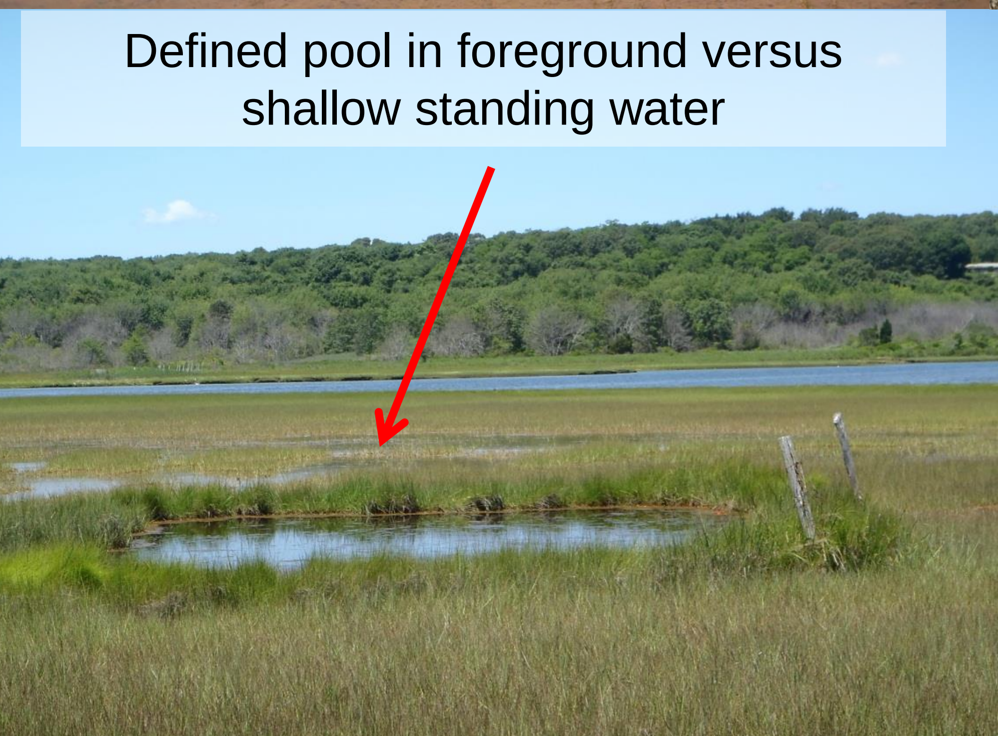
- Assessment of marsh condition in Narragansett Bay and RI coastal waters
- Review physical characteristics of runnels
- Overview of 7 sites where runnels have been used, monitoring results of 3 of those sites and lessons learned
- Wrap up of lessons learned

Region-wide assessment of Narragansett Bay and South Shore salt marshes: 2012-2014

- Monitored vegetation every 10 meters and width of plant communities
- Measured bearing capacity
- Additional data: salinity, mosquito density, fish presence


Shallow impounded water


Barren peat


Defined pool in foreground versus
shallow standing water


Mosquito breeding habitat

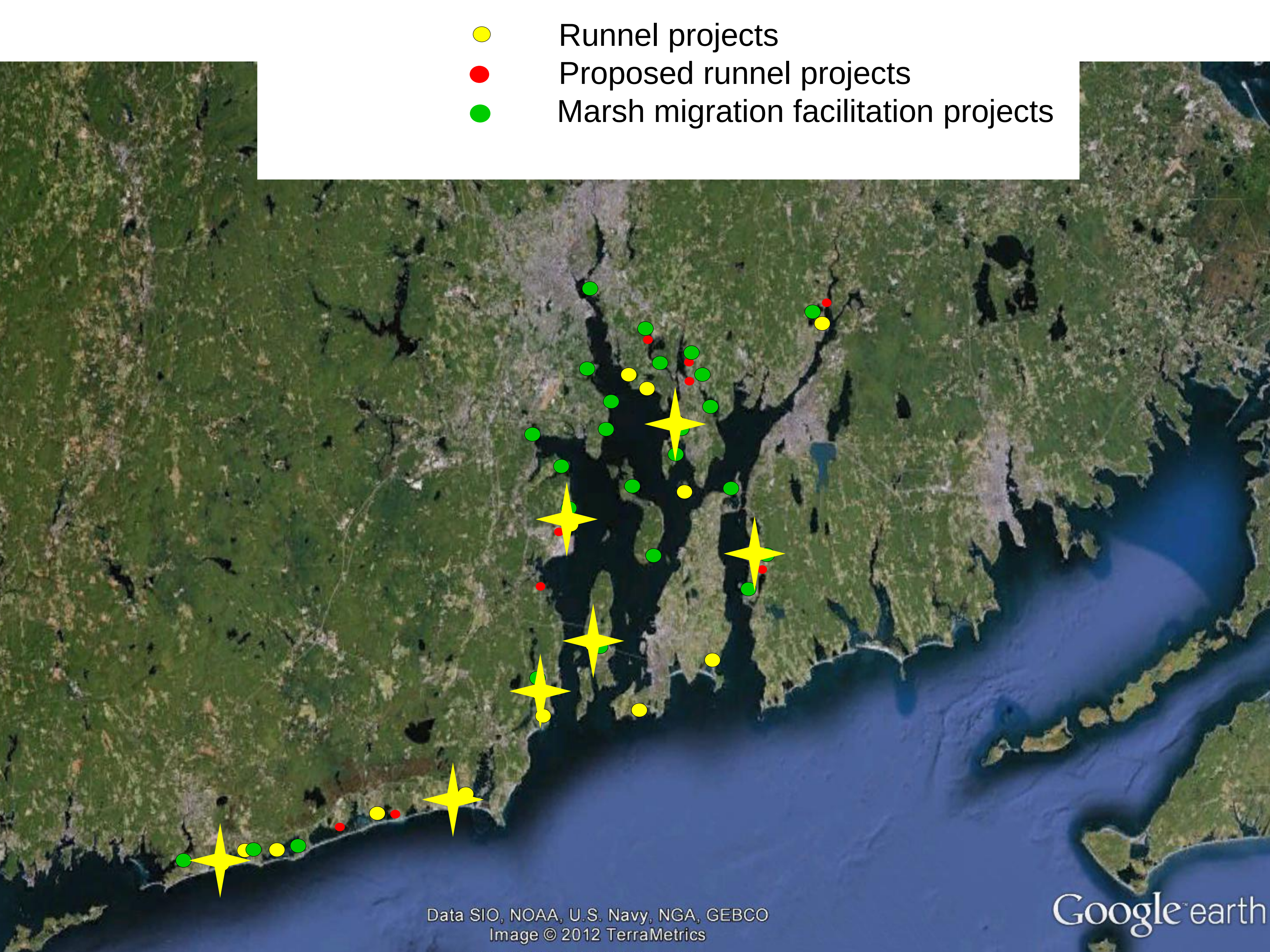
Marsh Adaptation Strategies

In Marsh

- Drainage enhancement of expanding impounded water areas through excavation of shallow creeks or runnels
- Sediment placement

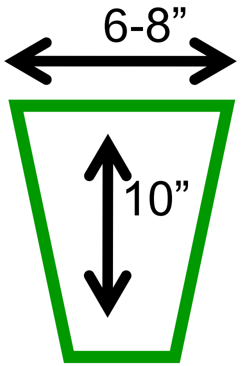
Marsh Migration area

- Remove of physical barriers to marsh migration i.e. walls/dams/roads
- Land conservation

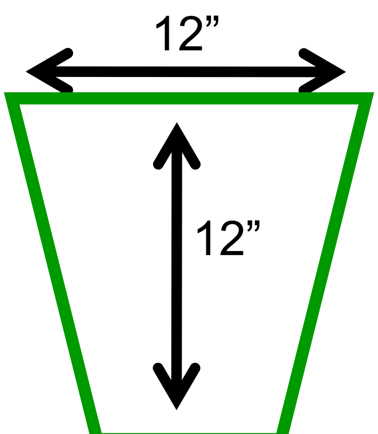

Runnel projects
Proposed runnel projects
Marsh migration facilitation projects
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2012 TerraMetrics
Google earth

Runnel range of profiles

small runnels



large runnels

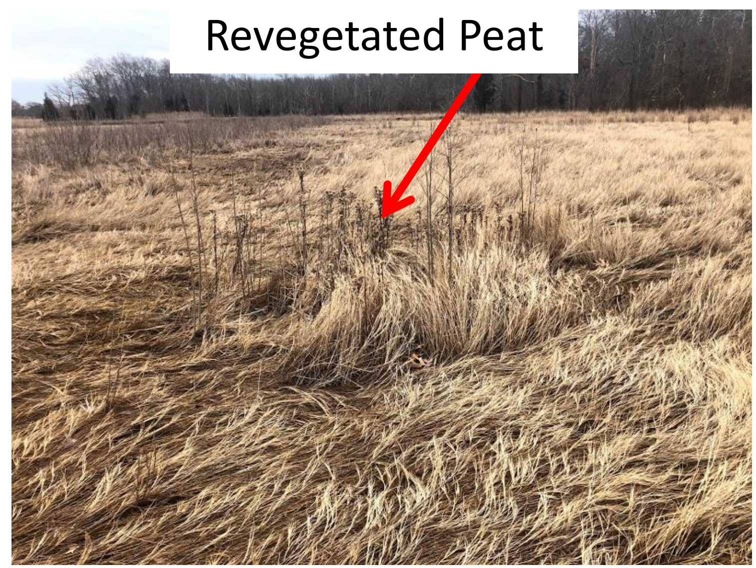


Ditch blockage opened by hand

Peat placement

Lesson learned: don't track the peat in; place in small islands to create higher elevation areas for recolonization

Peat placement



Hand dug runnels

Winnapaug Marsh: Westerly

- Runnel excavation through ditch spoils in grid ditched marsh

Runnels dug through ditch spoils: 2013

Lesson learned: *If marsh elevation is too low, marsh unlikely to revegetate and scouring of runnels could result due to the volume of water flooding and draining during a tidal cycle*

2011


2018


2011

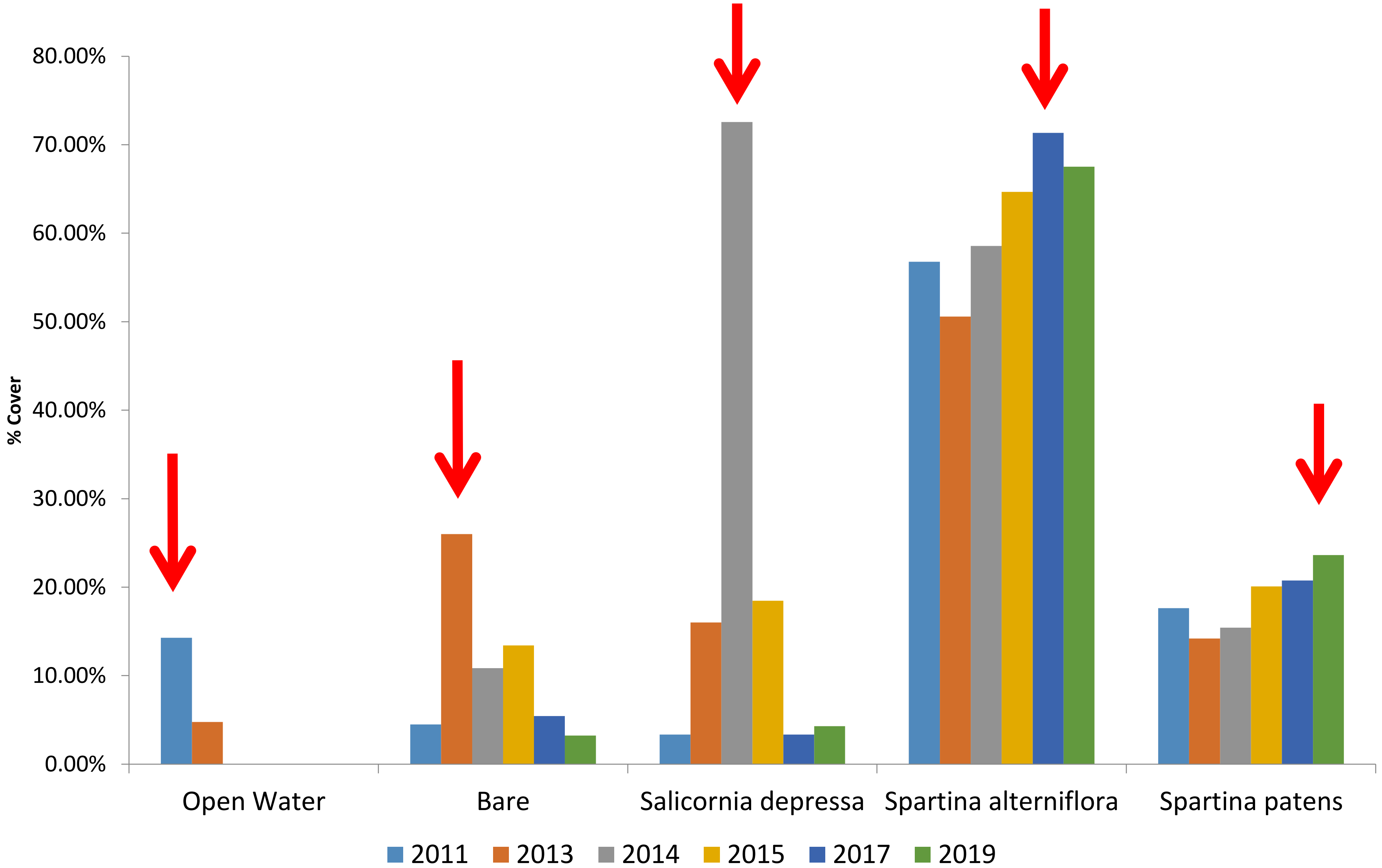

2019


2017

Winnapaug Marsh migration corridor

- Lesson learned: *Runnels in marsh migration corridor had greatest recolonization*

Winnapaug Marsh Vegetation Percent Cover

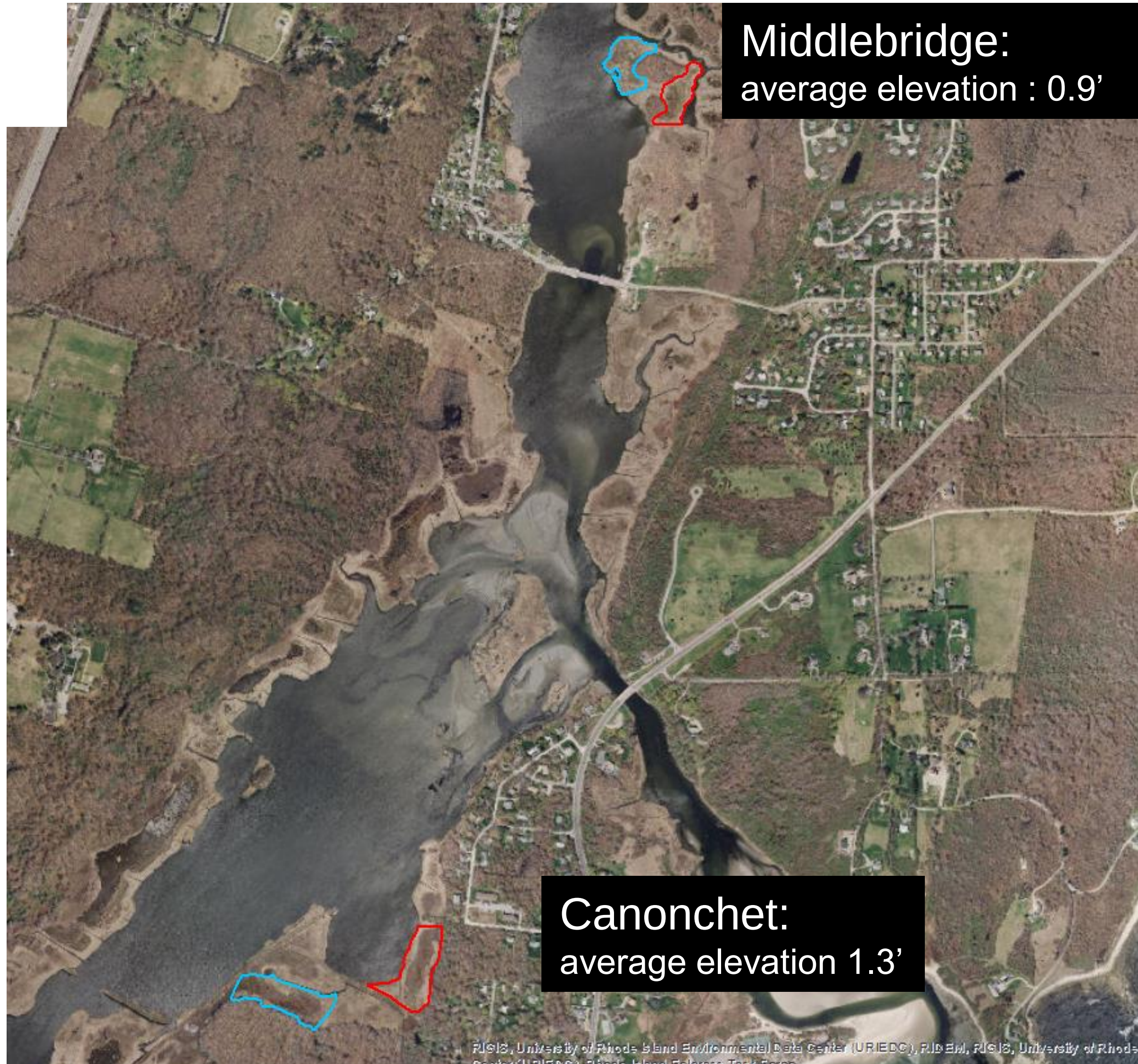


Runnels installed spring 2013

Narrow River Salt Marsh Adaptation Monitoring 2014-2019

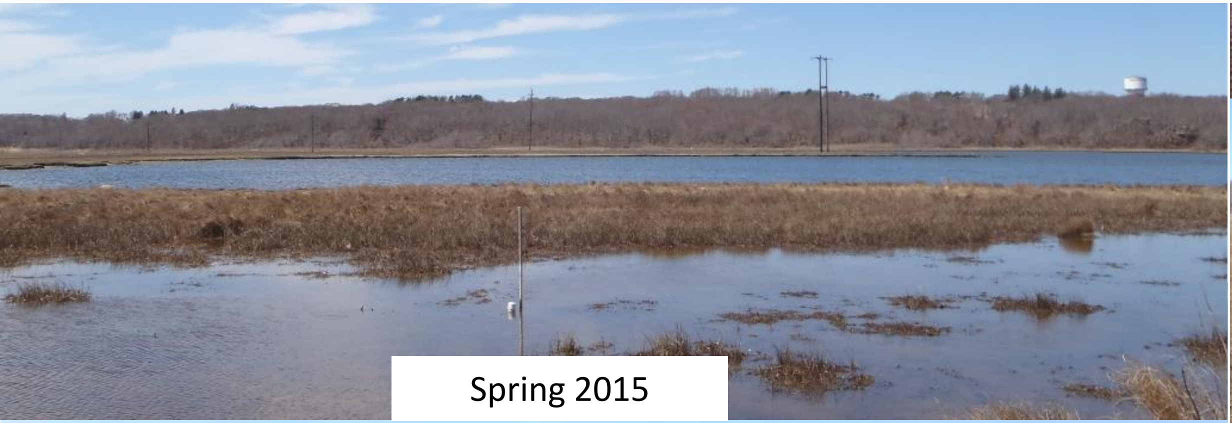
Goal to assess effects of runnels on marsh function

- Parameters include vegetation (point intercept method)
- Pore water salinity
- Water level



Narrow River runnels:

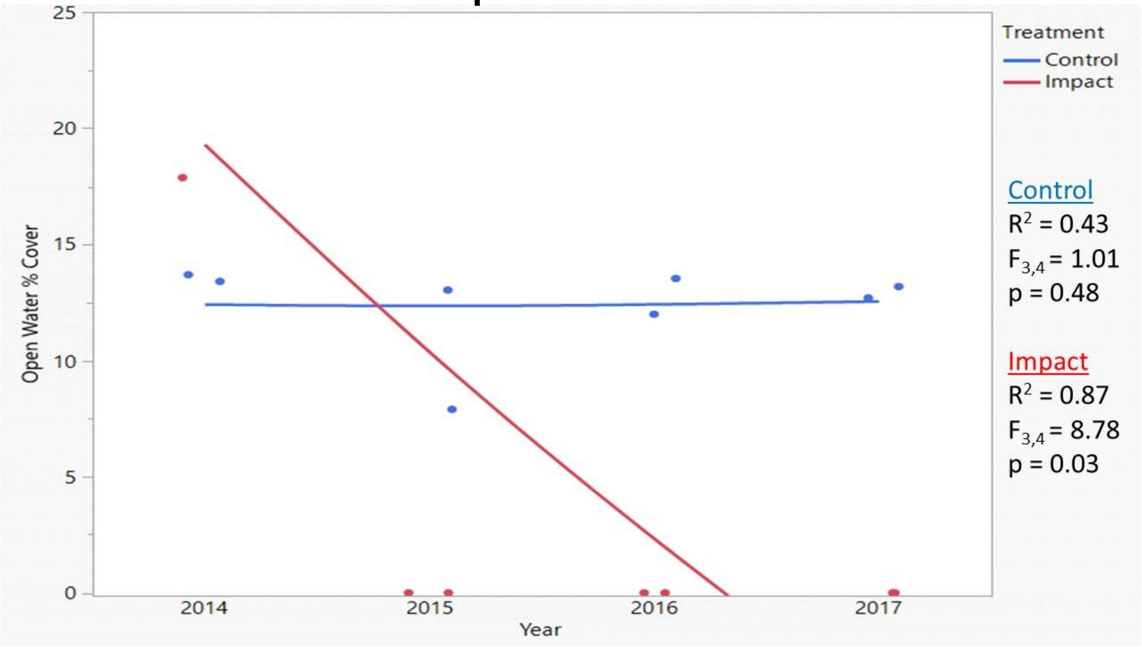
- *Lesson learned: conduct project in phases and maintain sills at the mouth of runnels to allow unconsolidated sediment to stabilize and recolonize with vegetation; shallow runnels reduce loss of marsh elevation*



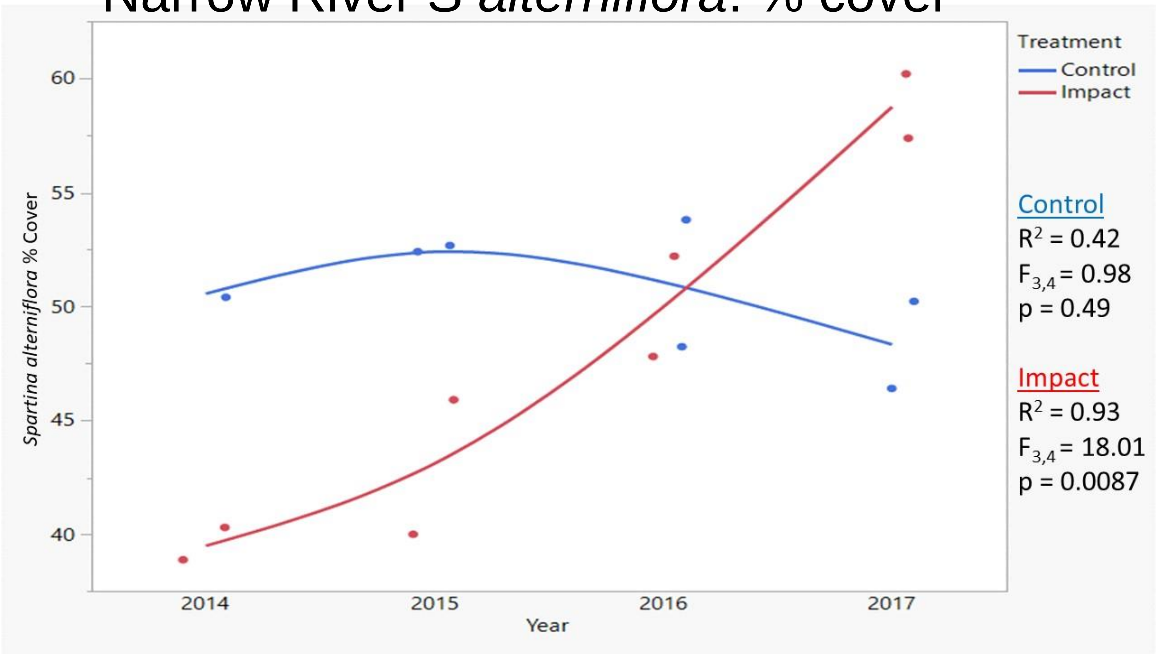
Spring 2015

Fall 2019

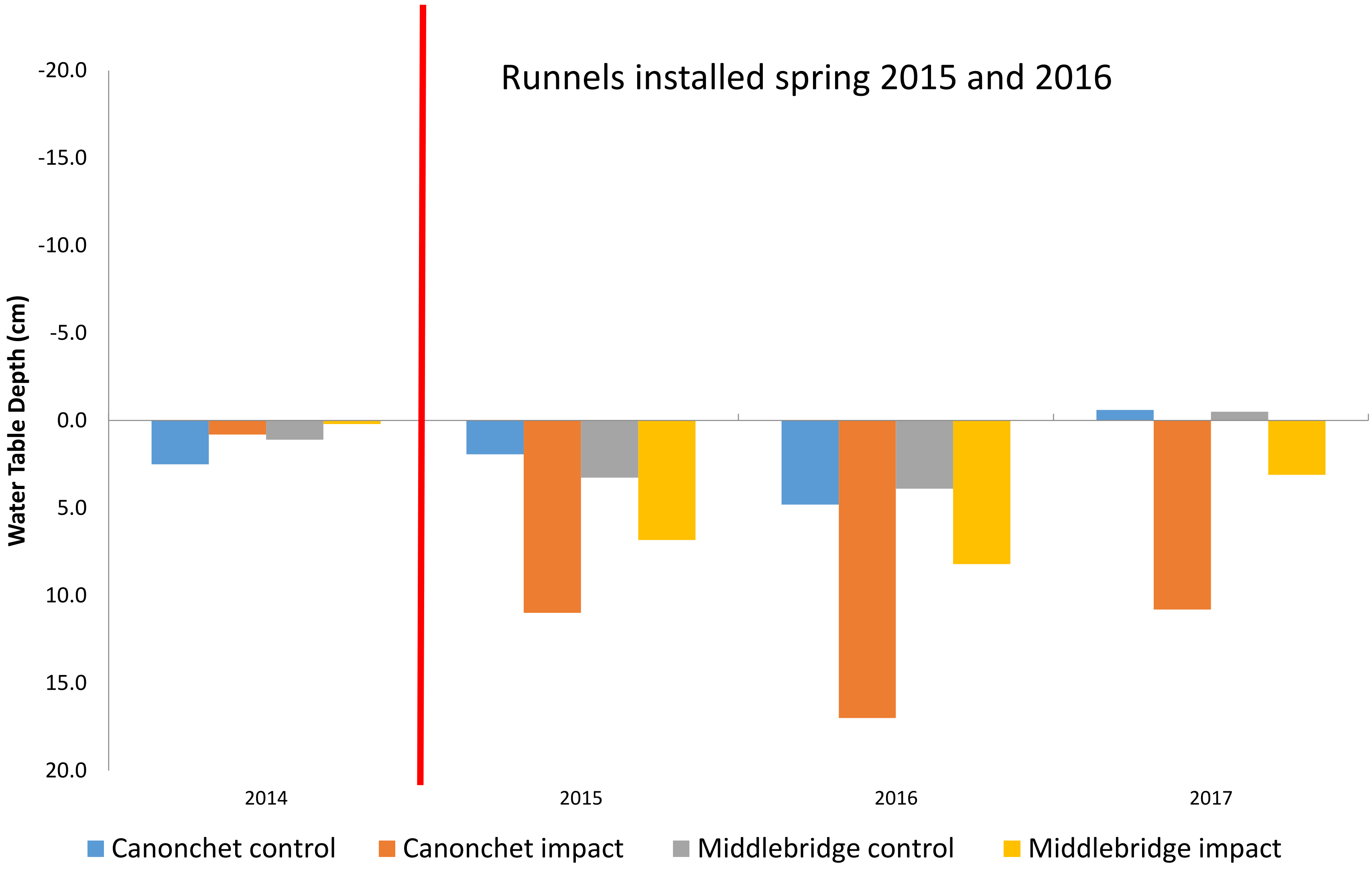
Narrow River Open Water: % cover

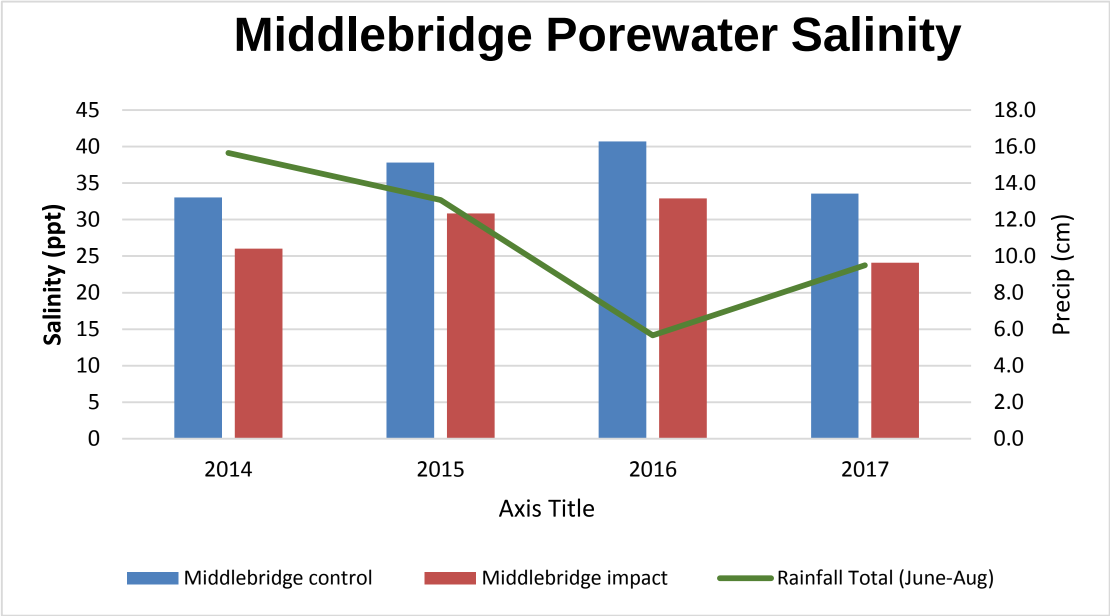


Narrow River *S alterniflora*: % cover

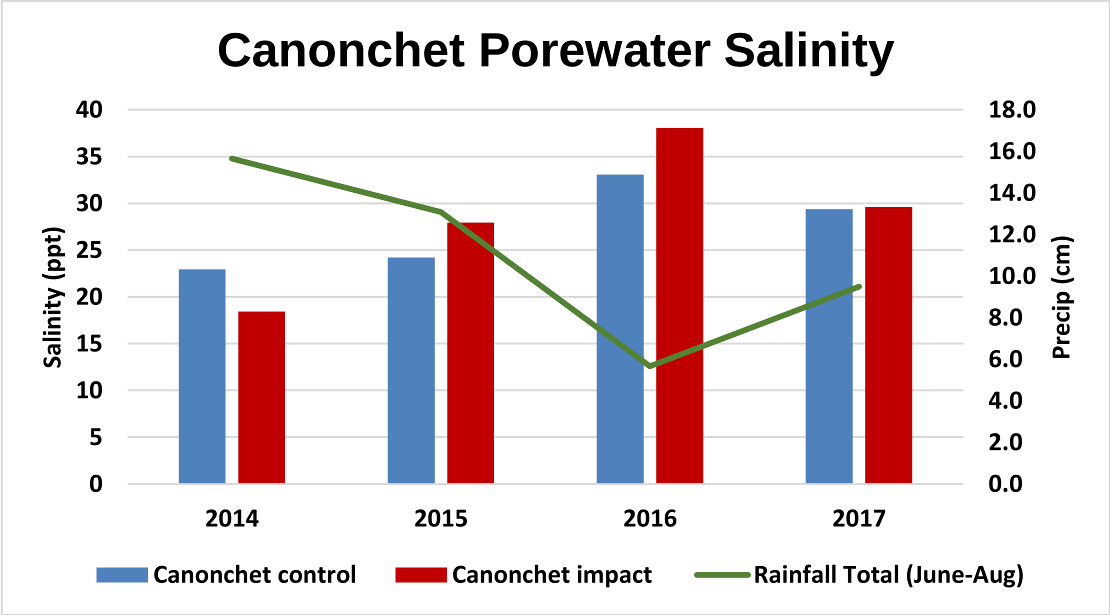


Narrow River Water Table Depth





Middlebridge Porewater Salinity
45
40
35
30
25
20
15
10
5
0
Salinity (ppt)
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Precip (cm)
2014
2015
2016
2017
Axis Title
Middlebridge control
Middlebridge impact
Rainfall Total (June-Aug)



Canonchet Porewater Salinity
40
35
30
25
20
15
10
5
0
Salinity (ppt)
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Precip (cm)
2014
2015
2016
2017
Canonchet control
Canonchet impact
Rainfall Total (June-Aug)

Round Marsh, Jamestown

- *Lesson learned: Use runnels to reduce height and vigor of Phragmites; recolonize shallow impounded water*

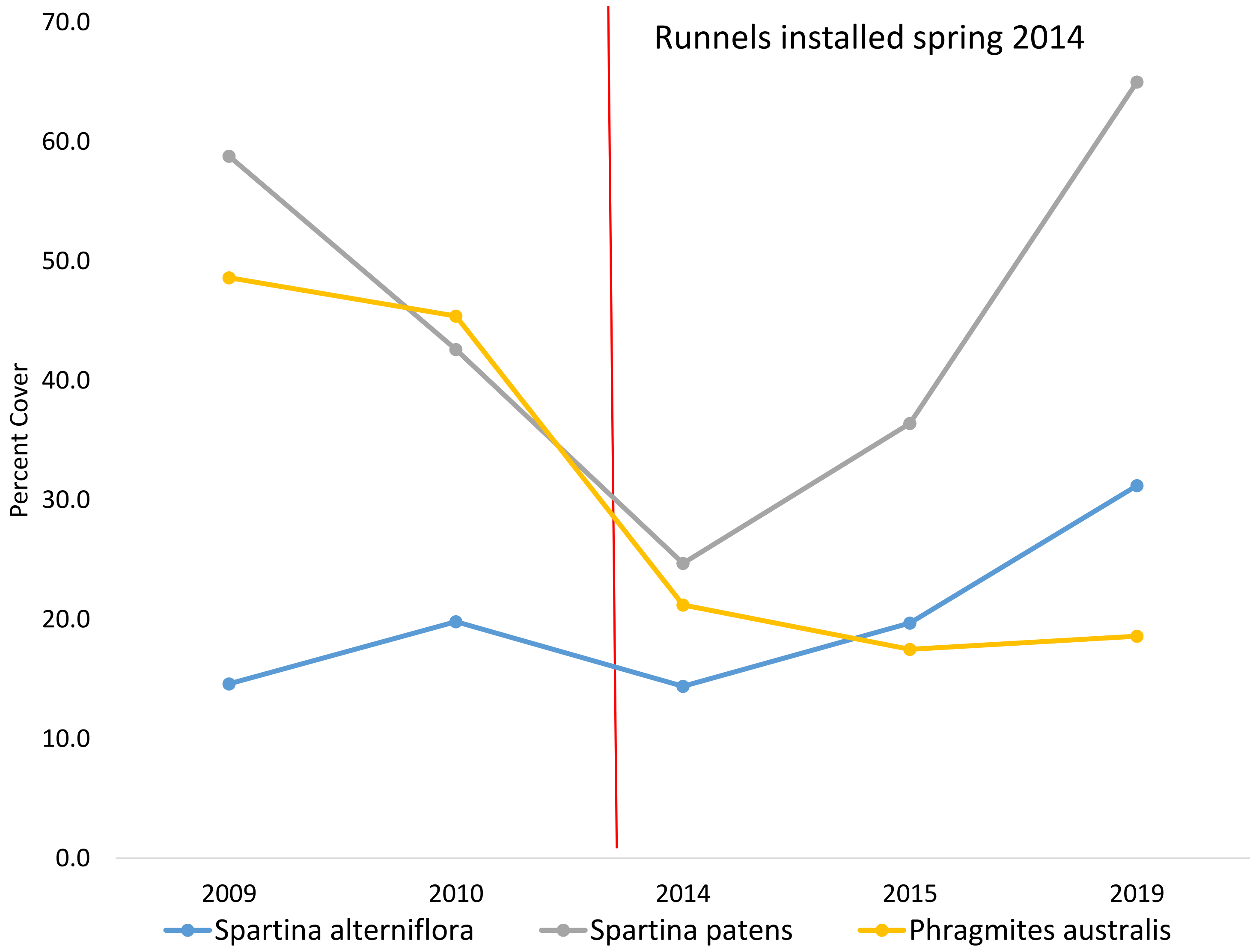

Conanicus

Lesson Learned: *Runnels provide fish access to marsh platform*

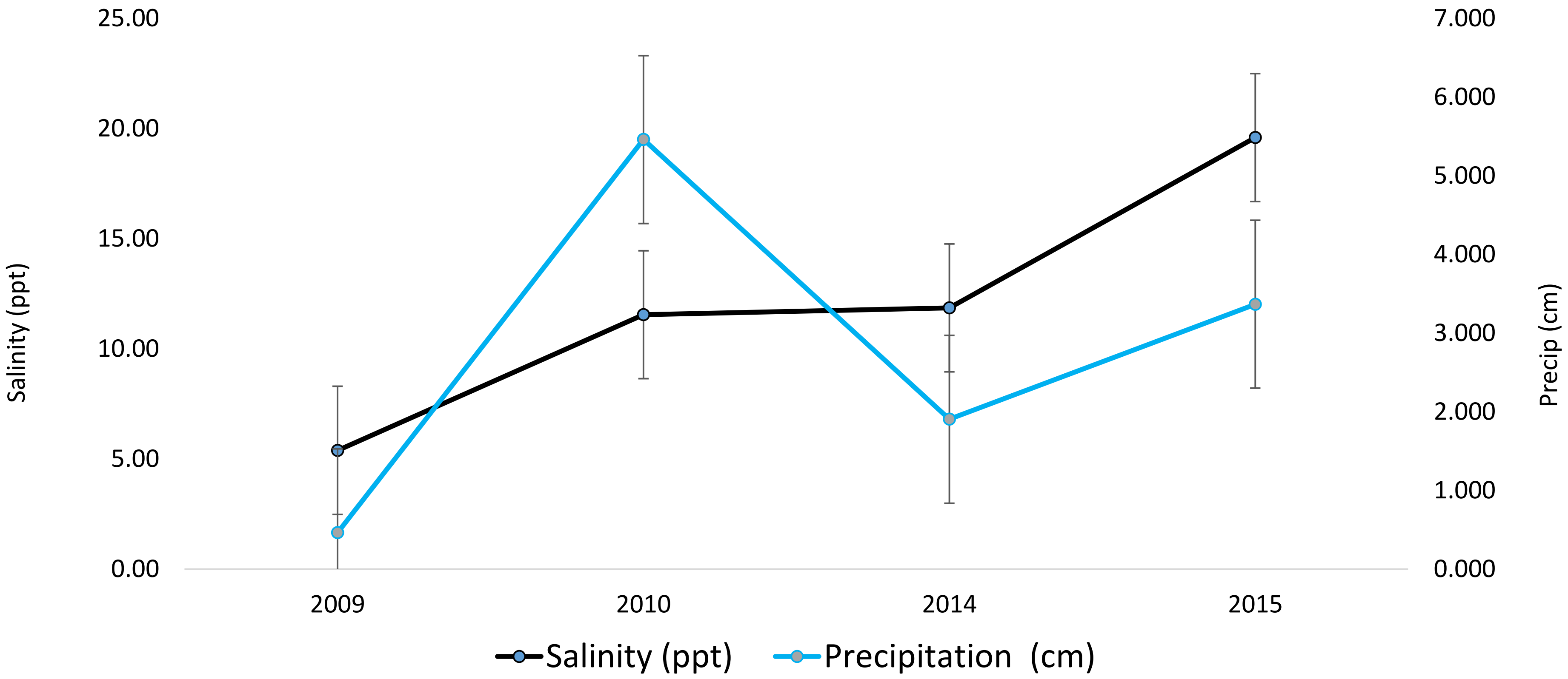
2014

2020

Round Marsh Vegetation percent cover



Round Marsh porewater salinity

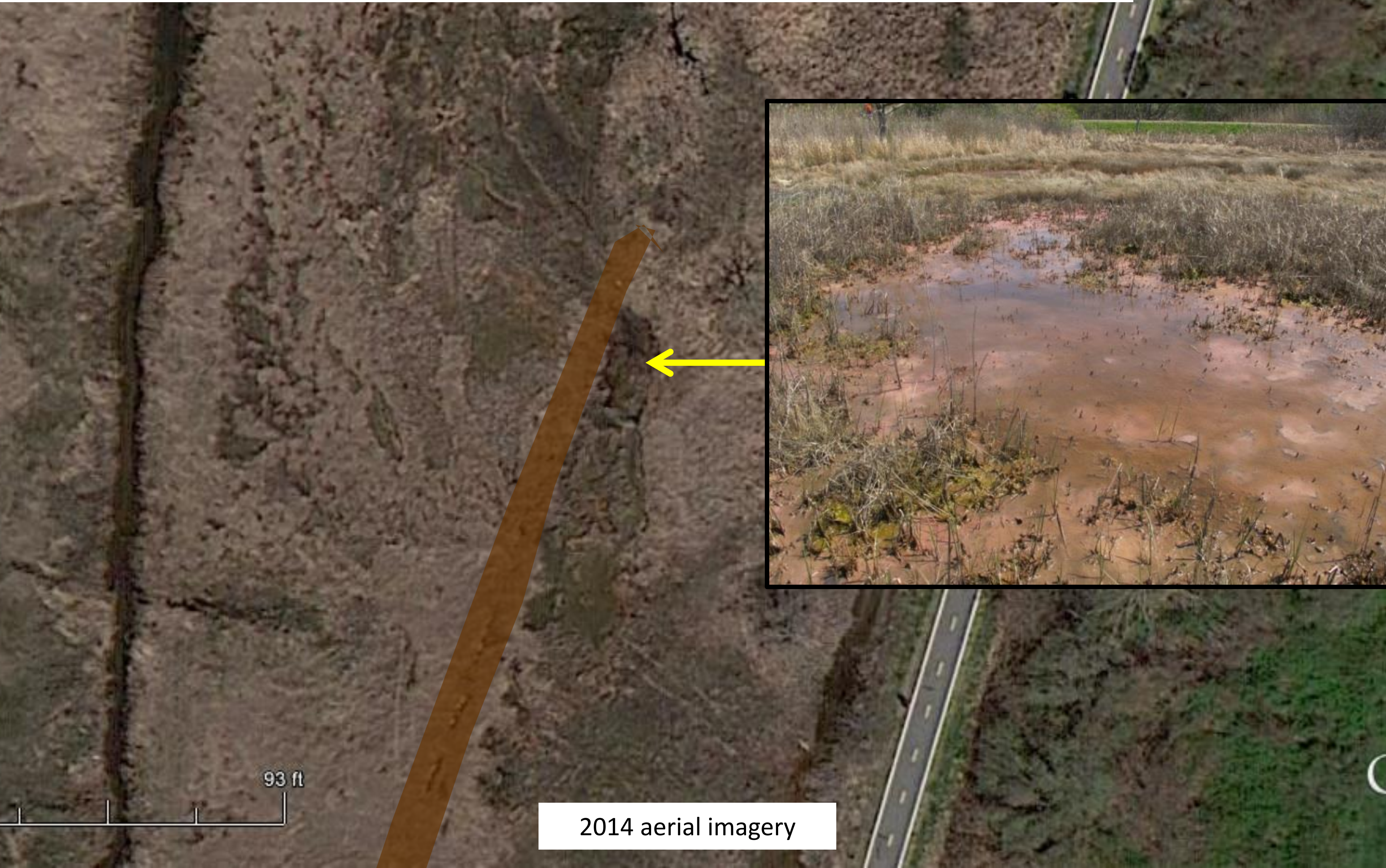


Jacobs Point Salt marsh restoration, Warren

- Tidal restoration conducted 2010 to address *Phragmites* and impounded water

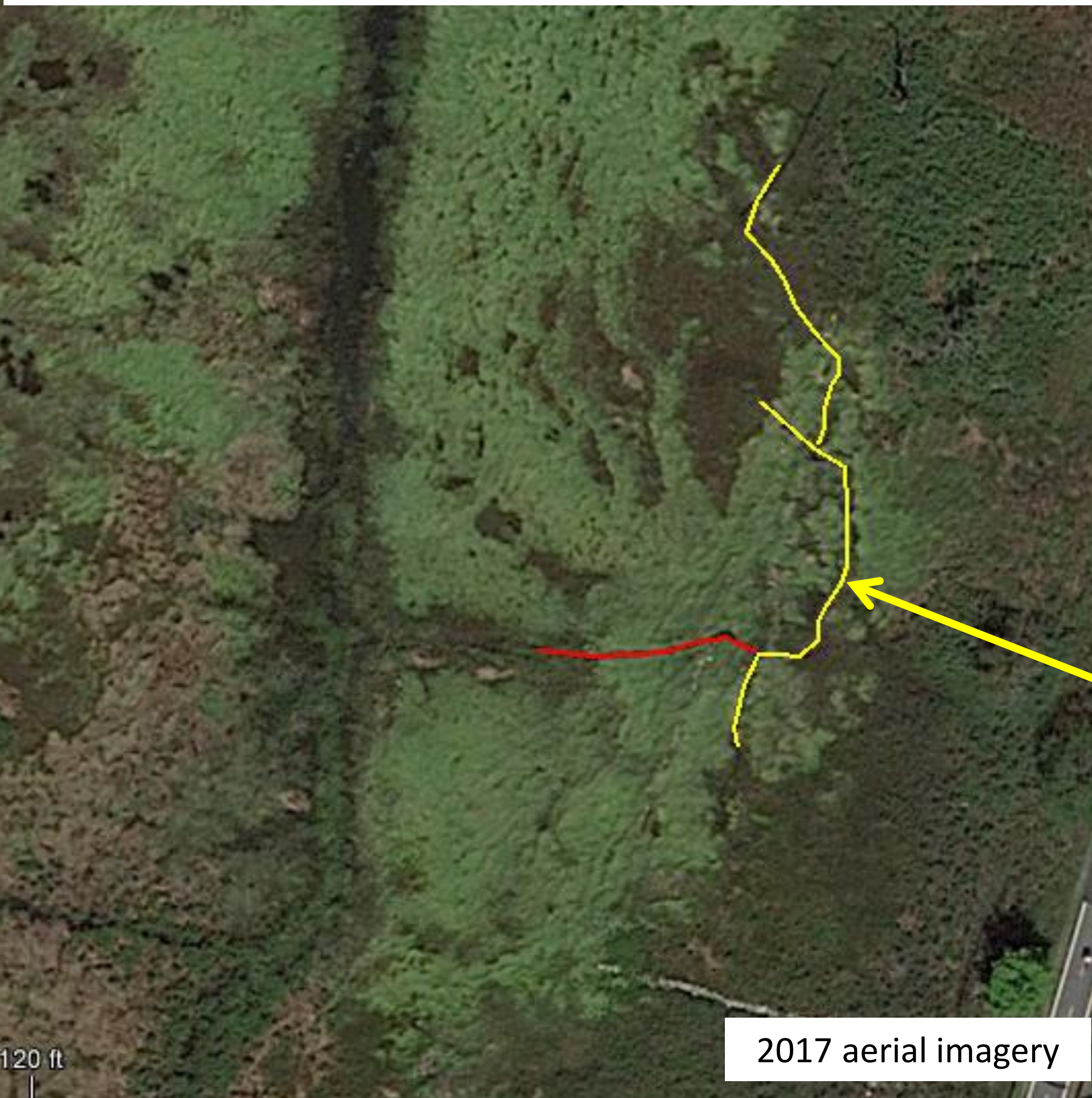
Jacobs Point runnel project

- Recent vegetation die-off/impounded water due to embankment/stone wall



Jacobs Point adaptation post runnel excavation

- Lesson learned: *Installing runnels at early stages of impounded water, recolonization of high marsh vegetation*



2017 aerial imagery

Runnels dug in 2015 and 2016 allowed for revegetation

Calf Pasture Point Adaptation, North Kingstown

- Runnels installed in high marsh and migration corridor
- Lesson learned: *Plan for erosion*

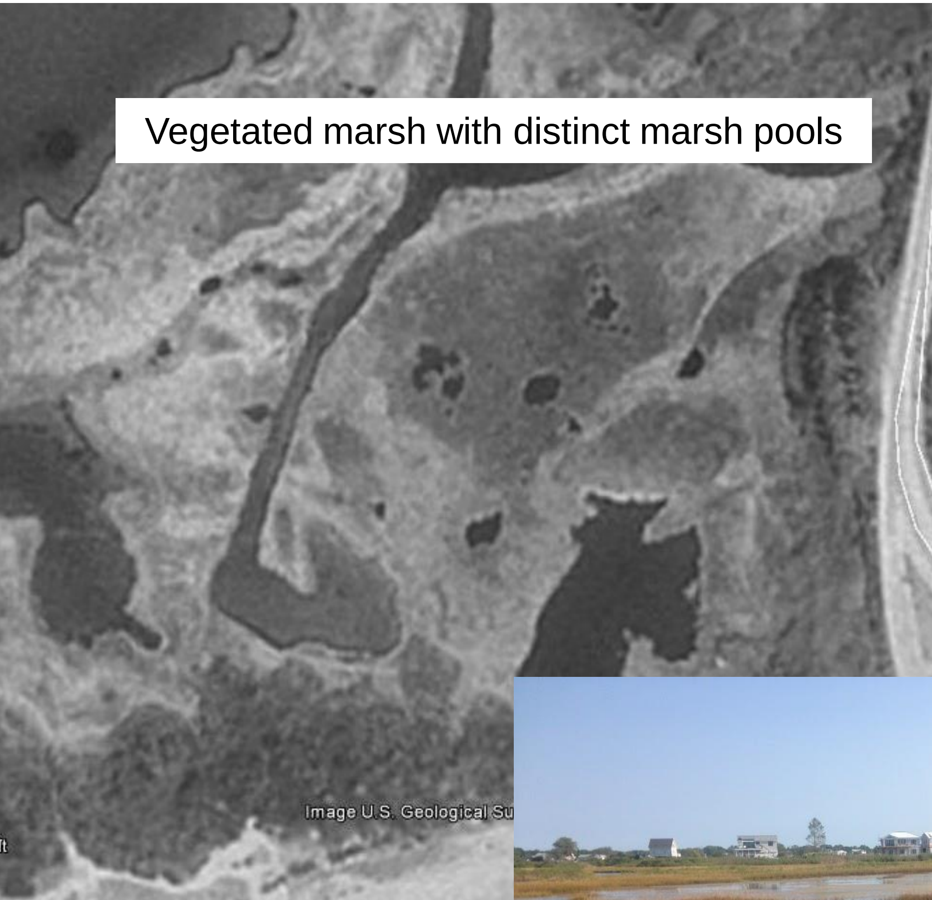

2016 Before


2016 After

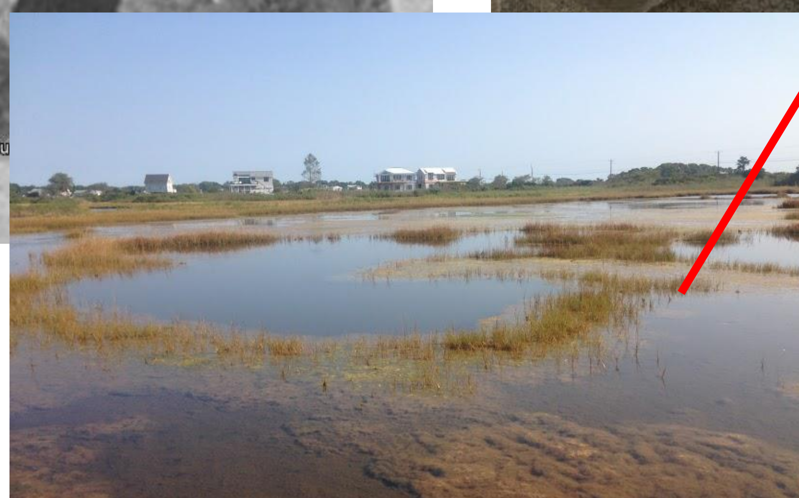

2017

Potters Pond salt marsh, South Kingstown

2001



2018



Shallow impounded water on the marsh surface surrounding an original marsh pool

Potters Pond, South Kingstown

- Lesson learned: *Maintain a sill along the edge of marsh to prevent excessive drainage and lose unconsolidated sediments*

Runnel excavation by hand in summer of 2018

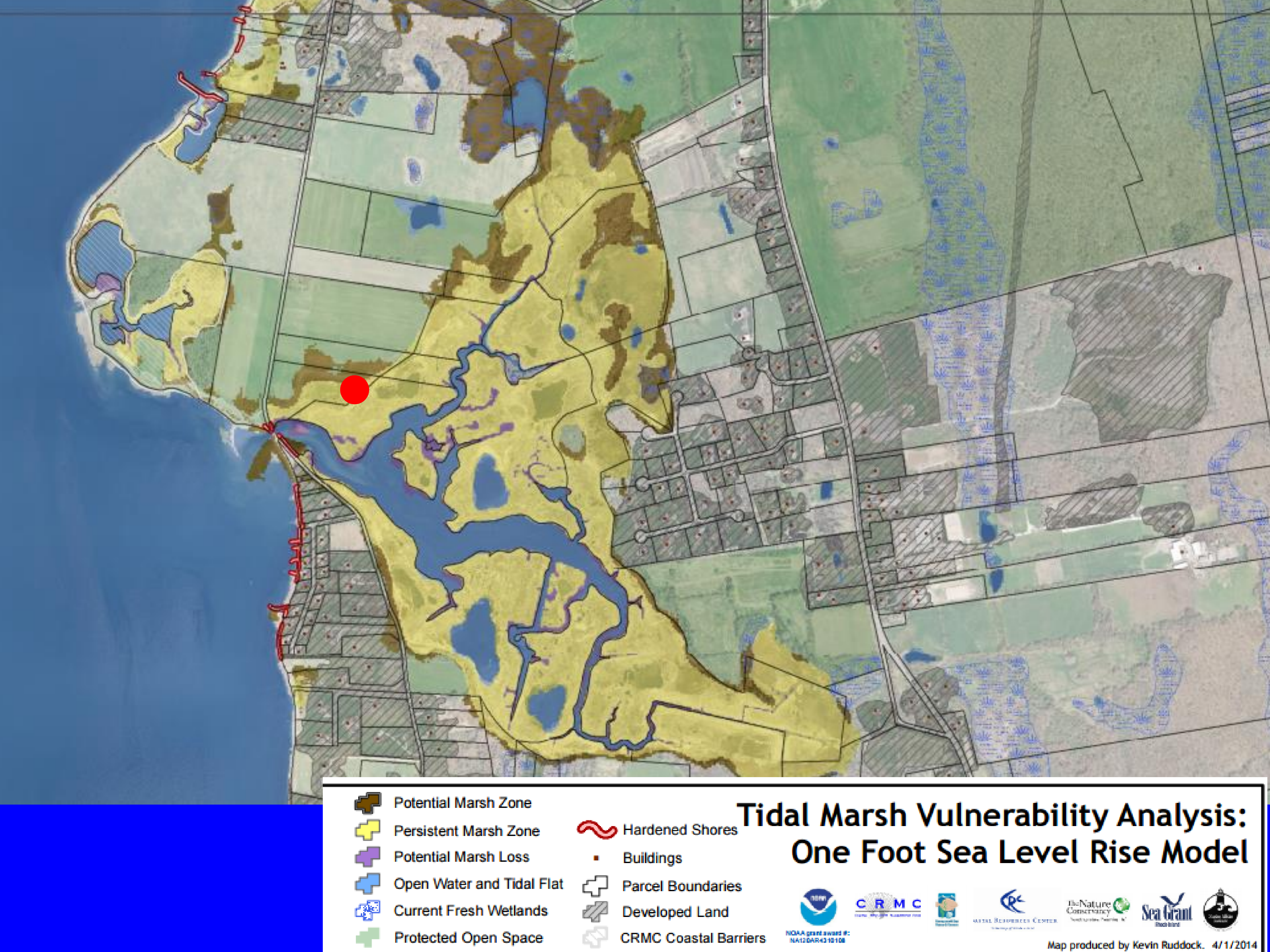
Creek excavation in fall of 2018 with low ground pressure excavator

Sapowet Marsh, Tiverton: marsh migration facilitation

- Lesson learned: *Connect runnels to low lying upland areas and remove barriers to migration*

Impounded water in field

Removal of stone berm

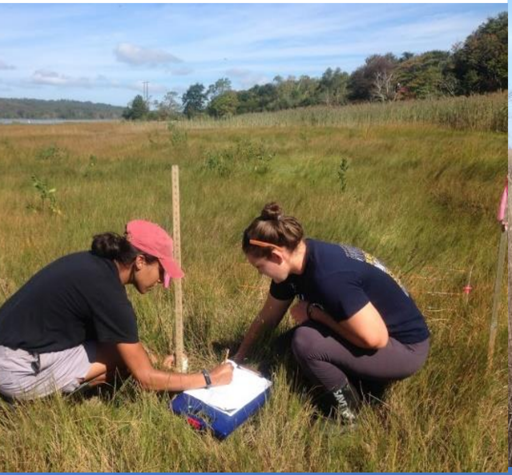


Tidal Marsh Vulnerability Analysis:
One Foot Sea Level Rise Model
Potential Marsh Zone
Persistent Marsh Zone
Potential Marsh Loss
Open Water and Tidal Flat
Current Fresh Wetlands
Protected Open Space
Hardened Shores
Buildings
Parcel Boundaries
Developed Land
CRMC Coastal Barriers
Map produced by Kevin Ruddock. 4/1/2014

Lessons Learned:

- **Sills to prevent excessive drainage and reduce fiddler crab expansion into marsh platform**
- **Possibly dig wider not deeper runnels to prevent them from clogging with veg**
- **Maintain runnels through hand digging; secure a 10 year maintenance permit**
- Shallow drainage can reduce loss of elevation from subsidence or loss of sediment
- Peat is gold! Use it to create microtopograhpy
- If marsh elevation is too low, marsh unlikely to revegetate and scouring of runnels could result
- Runnels in upper marsh and in marsh migration corridor greatest recolonization
- Conduct project in phases to allow marsh to revegetate and stabilize unconsolidated sediments

Thank You



Eager & brilliant INTERNS!

CRMC Coastal Resources Management Council

DEM Rhode Island

U.S. Fish & Wildlife Service

National Oceanic and Atmospheric Administration NOAA US Department of Commerce

NRCS Natural Resources Conservation Service


2013


2018
208 ft
© 2020 Google

MASSACHUSETTS SALT MARSH RUNNEL CASE STUDIES

EVALUATING RUNNELS FOR SALT MARSH ADAPTATION
March 2, 2020

Diana Brennan, Wetlands Coordinator
Bristol County Mosquito Control Project

MOSQUITO CONTROL BACKSTORY

- Maintain historic ditches
  - Clogged ditches breed mosquitos
- Create new ditches (a.k.a. runnels…?)
  - Manage surface water
    - Surface water breeds mosquitos
    - Drain surface water / provide fish access
  - *Phragmites* control
    - *Phragmites* breeds mosquitos
    - Get salt water into stands of *Phragmites*

MASSACHUSETTS RUNNEL SITES

- Broad Cove (2017)
  - First “official” runnel project in Massachusetts
  - Along the Taunton River in Dighton
  - Partners: Save the Bay, Town of Dighton

- Cow Yard (2018)
  - At the mouth of the Little River in Dartmouth
  - Partner: Dartmouth Natural Resources Trust (DNRT)

BROAD COVE
2017 PROJECT

Planning takes time!

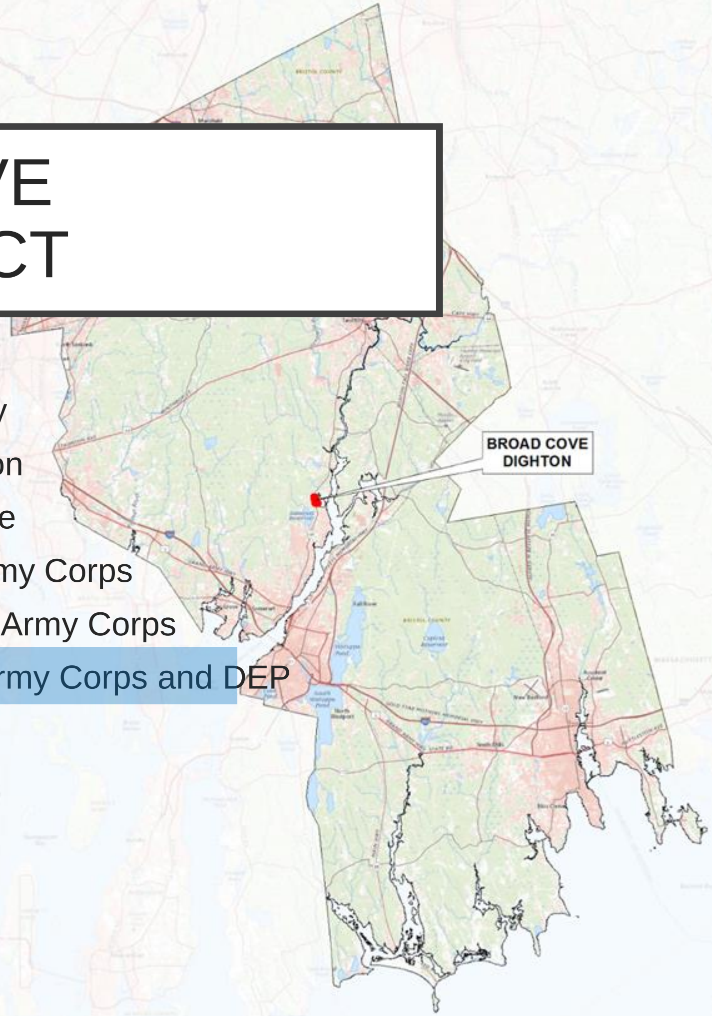
- 2015 – BCMCP first approached by Save the Bay
- 2015/2016 – Initial project planning and discussion
- March 2017 – Steve Burns passes the reins to me
- June 2017 – Pre-application site meeting with Army Corps
- September 2017 – Draft application submitted to Army Corps

Mosquito Control Exemptions

- October 2017 – Final applications submitted to Army Corps and DEP
- November 2017 – Site meeting with DEP

Weather Delays

- December 2017 – Permits in hand, work begins
- February 2018 – Work completed



BROAD COVE

- Along the Taunton River in Dighton
- Used for agriculture (hay) historically, until the 1990s
- Areas of subsidence averaging 7-9” deep and varying in width
- Clogged ditches and impoundments

Typical View of Marsh Subsidance Area to be Filled

DI 17-011 - BROAD COVE SALT MARSH RESTORATION - PHASE I

- Selective about which ditches cleaned and how deep
- Spoil placed in depressions
- Flexible permitting allowed us to adjust runnel locations

BROAD COVE – RUNNEL EXCAVATION

Low-ground pressure excavator with 12” wide bucket

BROAD COVE – RUNNEL EXAMPLE 1

- Cluster of depressions
- Runnel planned in this area
- Several depressions filled with spoil
- Runnel location and size tweaked based on site conditions

BROAD COVE – RUNNEL EXAMPLE 1

Cluster of depressions

Spoil placed in depressions, surface water remaining on marsh

Runnel created to facilitate surface water drainage

BROAD COVE – RUNNEL EXAMPLE 1

August 2018 (first growing season post-construction)

May 2019 (second growing season post-construction)

Nesting in former depression

BROAD COVE – RUNNEL EXAMPLE 2

- Known area with depressions
- Less concentrated depressions
- No runnel planned
- Not enough nearby ditch spoil available to fill depressions
- Runnel added to enhance surface water drainage

BROAD COVE – RUNNEL EXAMPLE 2

Pre-construction view west of mosquito breeding in depression

Post-construction view east of runnel from main ditch

BROAD COVE – RUNNEL EXAMPLE 2

May 2019 - View west of drained depression and runnel

February 2020 - View west of drained depression and runnel

BROAD COVE – RUNNEL EXAMPLE 3

- Subsidence area found while work already in progress
- Historic "runnel" had become clogged
- Surface water ponding
- Depressions beginning to form
- Historic runnel re-excavated

BROAD COVE – RUNNEL EXAMPLE 3

Existing shallow runnel re-excavated / cleaned

Post-construction

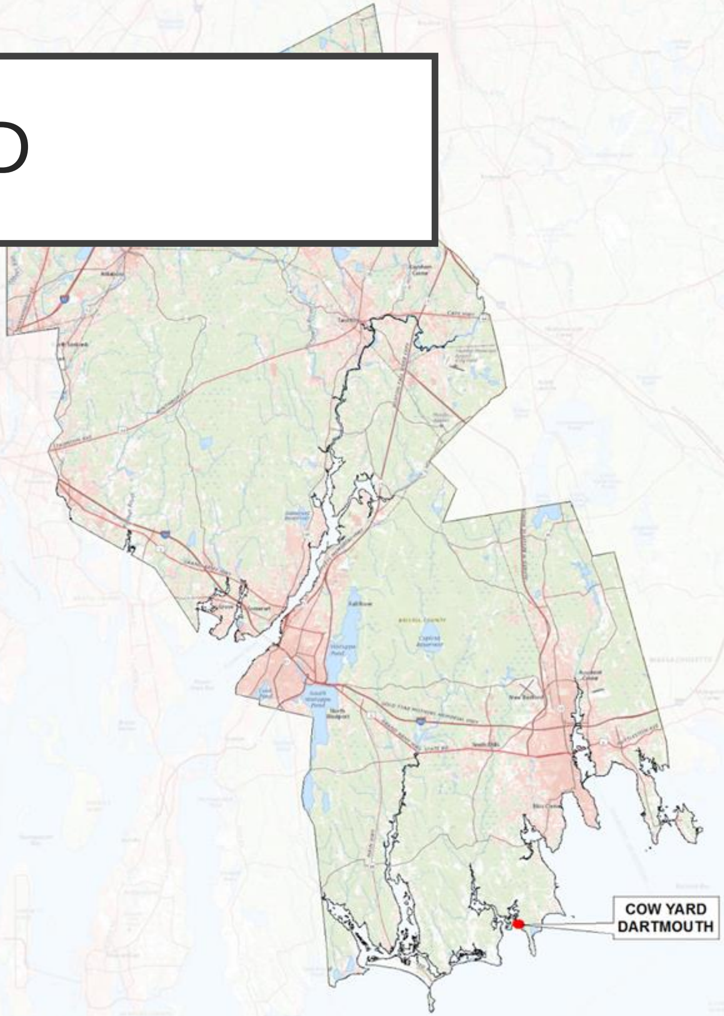
BROAD COVE – RUNNEL EXAMPLE 3

February 2020 (2 years post-construction)

Drainage appears improved – runnels will require maintenance

COW YARD

- Mosquito Control History
- 2018 Project



COW YARD – HISTORY

BCMCP work:

- 1988
- 1994
- 2005
- 2006
- 2007
- 2013

COW YARD RUNNELS – HISTORY

2005 – Spoil placed/runnels maintained west of Cow Yard Lane

2017

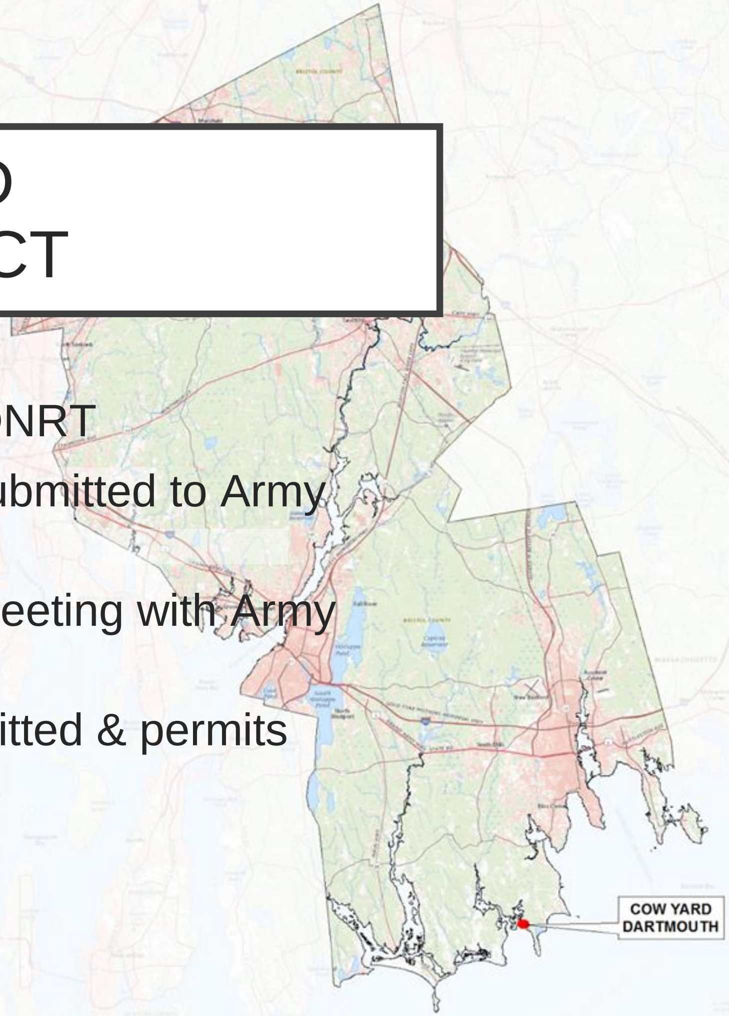
COW YARD RUNNELS – HISTORY

2007 – Runnels east of Cow Yard Lane maintained by BCMCP

2017

COW YARD
2018 PROJECT

- 2017 – Initial project planning with DNRT
- February 2018 – Draft application submitted to Army Corps
- March 2018 – Pre-application site meeting with Army Corps and DEP
- May 2018 – Final applications submitted & permits received
- June 2018 – Work begins
- July 2018 – Work completed



COW YARD

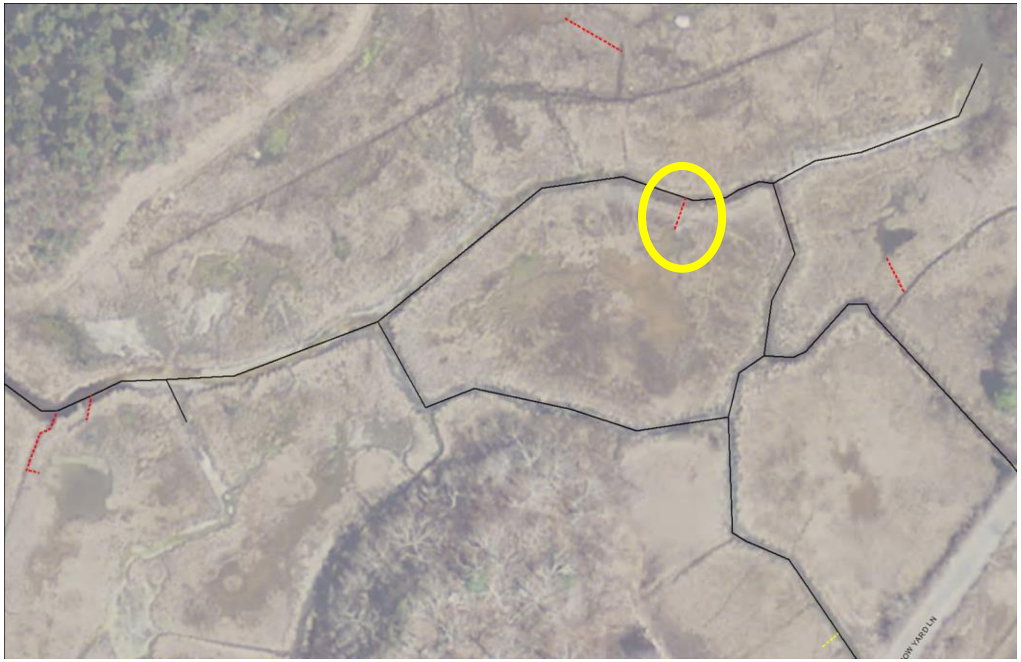
- At the mouth of the Little River in Dartmouth
- More degraded / softer marsh
- Areas of subsidence are shallower, broader, and generally less distinct than Broad Cove
- Main ditches clogged with sand which enters system through downstream culvert
- Ditch spoil placed in depressions when possible
- Flexible permitting allowed us to adjust runnel locations
- Corrective actions taken

COW YARD – RUNNEL EXCAVATION

Swamp mats needed due to very soft marsh conditions

Bucket teeth used to create new / clean out existing runnels

COW YARD – NEW RUNNEL EXAMPLE

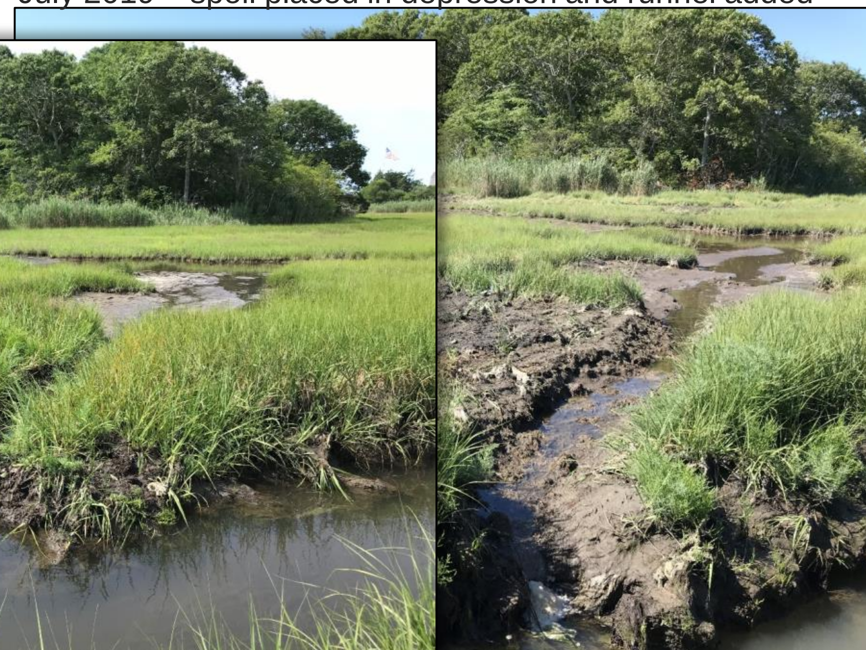


- Planned runnel
- Largest area of surface water for this project
- Combination of spoil placement and runnel creation

COW YARD – NEW RUNNEL EXAMPLE

June 2018 – Pre-construction

July 2019 – spoil placed in depression and runnel added



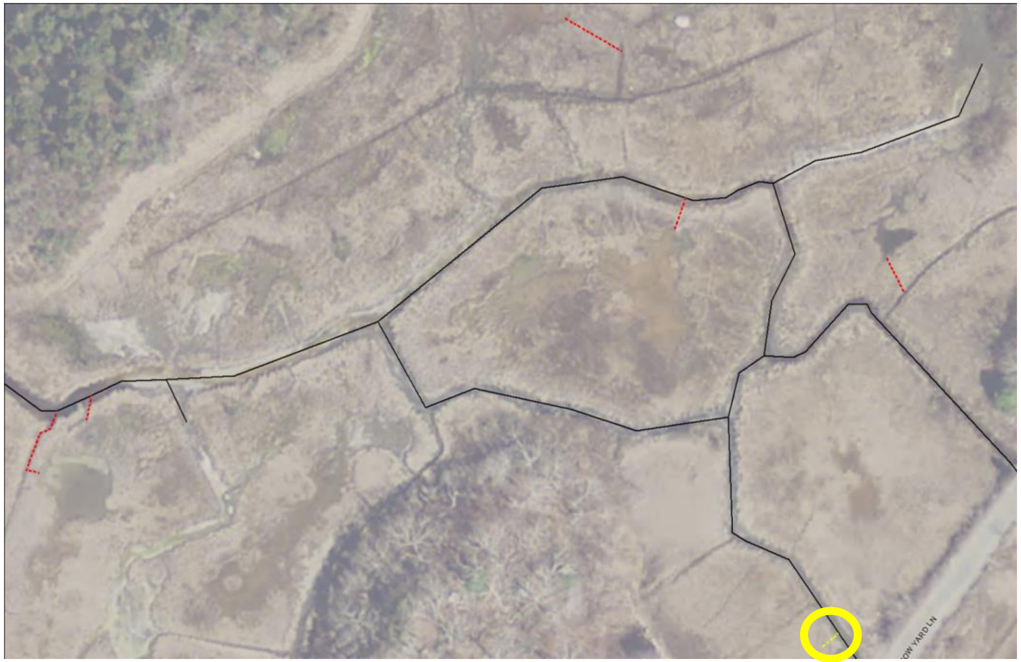
July 2019 - one year post-construction

COW YARD – NEW RUNNEL EXAMPLE

December 2017 – Pre-construction

August 2018 – 1 month post-construction

COW YARD – CORRECTIVE RUNNEL



- Lower elevation with freshwater inputs
- Frequently traveled
- Spoil placement as “thin veneer”
- Vegetation did not recover as expected
- Corrective runnel hand-dug

COW YARD – CORRECTIVE RUNNEL

August 2018 – 1 month post-construction, "thin veneer" of spoil

Photo credit DNRT

July 2019 – 1 year post-construction

COW YARD – CORRECTIVE RUNNEL

August 2019 – Hand-dug corrective runnel

February 2020

LESSONS LEARNED

- Runnels appear to have improved surface water drainage where they directly intersect depressions / areas of marsh subsidence
- To a lesser degree, runnels appear to have improved drainage in nearby depressions / areas of marsh subsidence
- In areas were surface water remains, runnels may reduce “pool creep” and / or provide fish access
- Spoil placement in conjunction with runnels may be a good strategy – be aware of how and where spoil is placed
- Flexibility in runnel placement is key
- Narrow runnels may be prone to blockages and may require maintenance
- Runnels may not work in all situations

THANK YOU

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MassDEP

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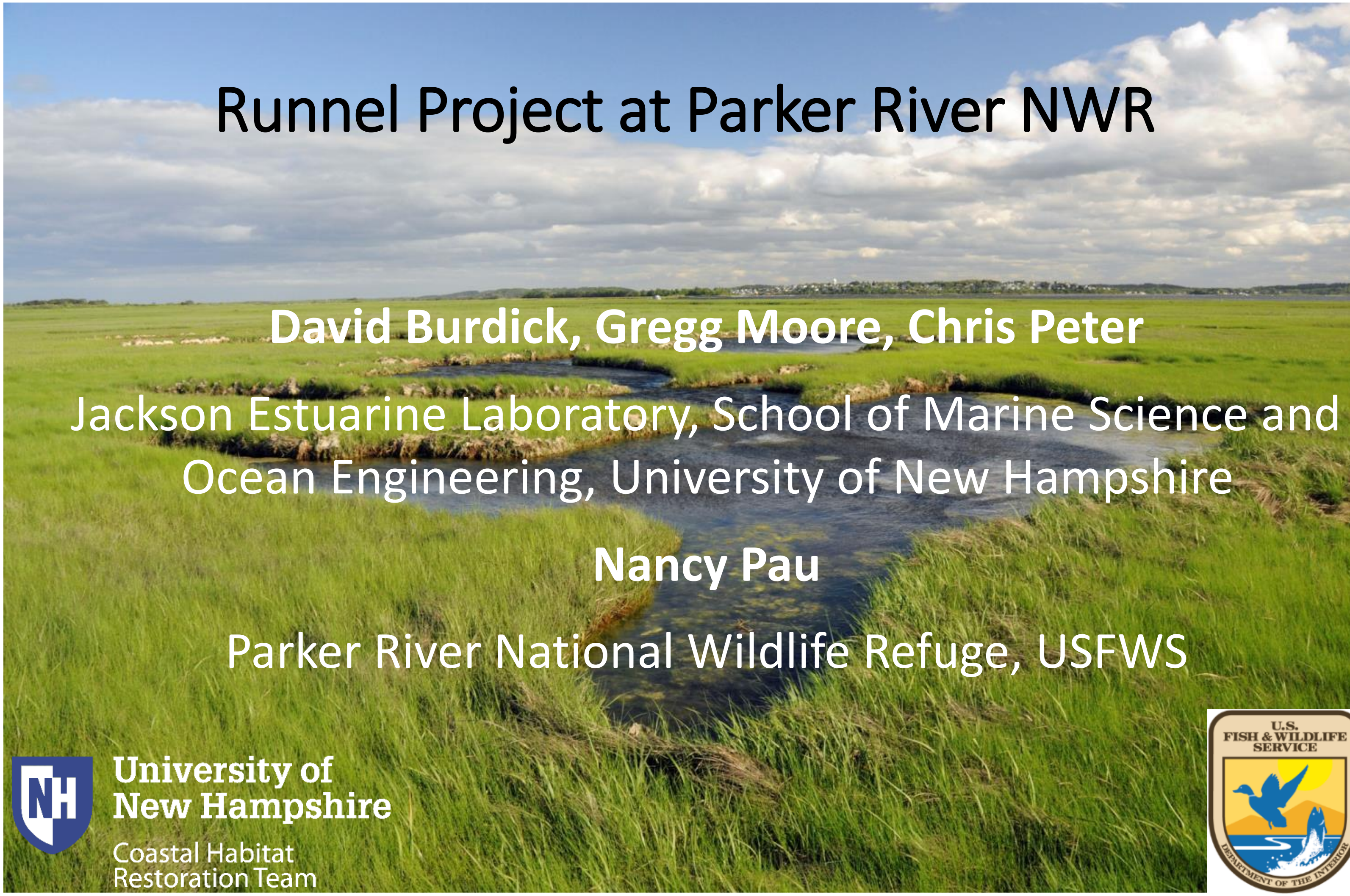
Bristol County Mosquito Control Project
38R Forest Street
Attleboro, MA 02703

508-823-5253

Diana.Brennan@mass.gov

www.mass.gov\eea\bristolcountymosquitocontrol



Runnel Project at Parker River NWR

David Burdick, Gregg Moore, Chris Peter

Jackson Estuarine Laboratory, School of Marine Science and Ocean Engineering, University of New Hampshire

Nancy Pau

Parker River National Wildlife Refuge, USFWS

University of New Hampshire
Coastal Habitat Restoration Team

U.S. Fish & Wildlife Service
Department of the Interior

Contact: david.burdick@unh.edu

Ditch spoil and levees impact tidal hydrology

Impaired drainage leads to:

- Vegetation die-back in ‘panels’ between ditches
- Loss of elevation and stored carbon
- Loss of resilience to sea level rise

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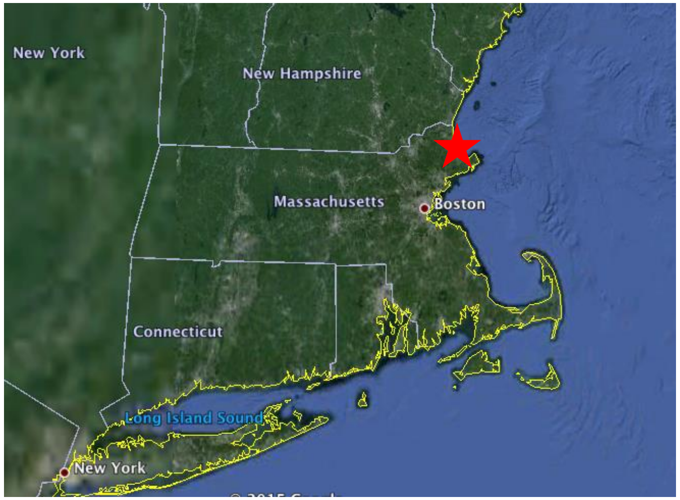
Coastal Habitat Restoration Team

Study Site: The Great Marsh, Parker River NWR



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Hydrology Impacts . . . + Pool Expansion Cycle:

- edges killed by algae blown by wind
- edge erosion and collapse
- N release, fueling more algae blooms
- new edges killed by algae

Stop-Gap Solution: Runnels

Small linear depressions

(30 cm wide, 15 cm deep)

Connecting pools to adjacent creeks or ditches

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Coastal Habitat Restoration Team

Project Goals:

- Establish a flow path that will allow better drainage from expansive pools
- Stop expansion cycle
- Test *S. alterniflora* transplant plots

Monitoring:

- Tidal hydrology
- Paired vegetation plots
  - in pool + marsh edge
- Survival and % cover of transplants

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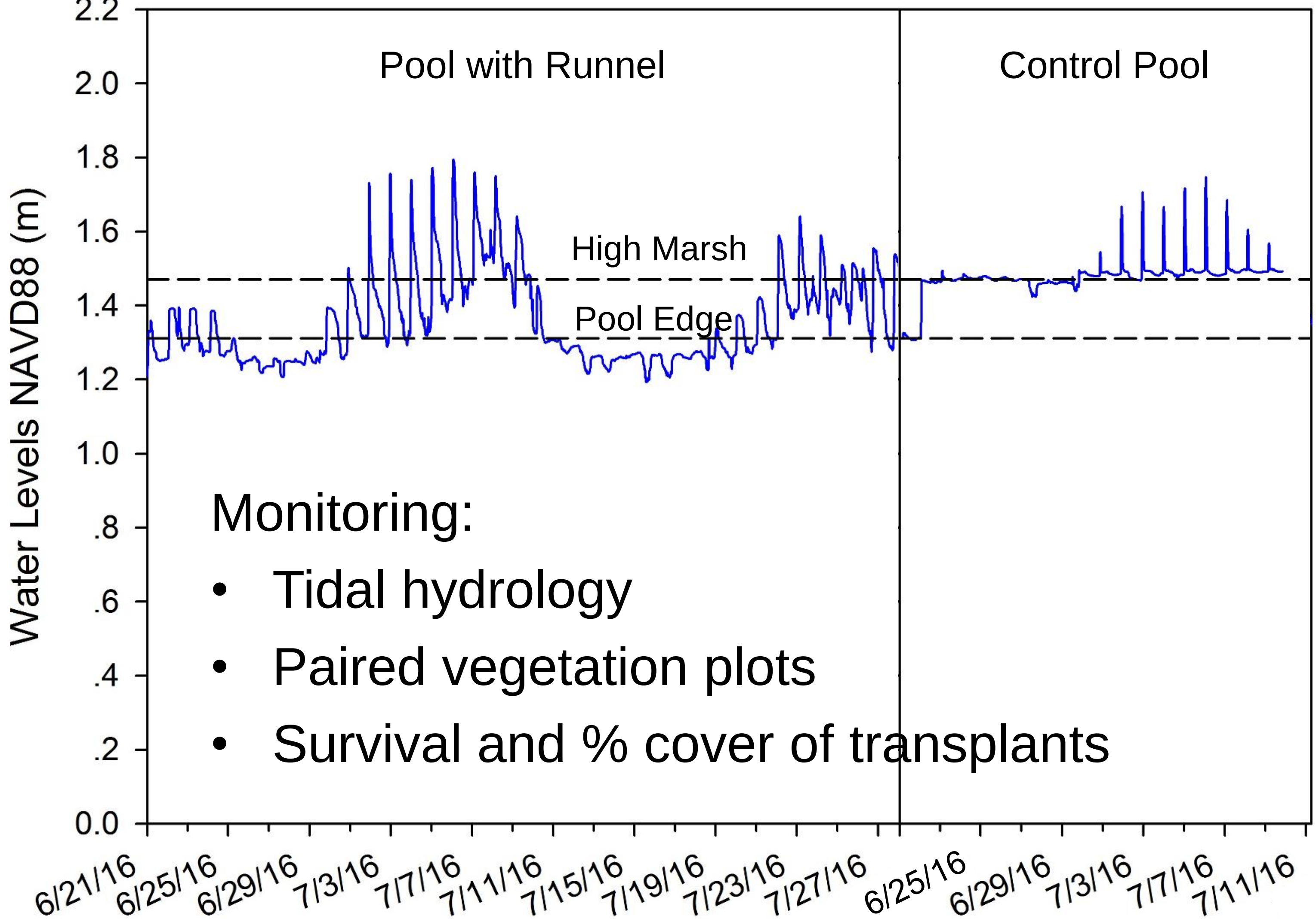
New Tidal Hydrology



Monitoring:

- Tidal hydrology
- Paired vegetation plots
- Survival and % cover of transplants

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Runnels partially drain pools

Spartina alterniflora
colonizes edges
20 paired plots/pool

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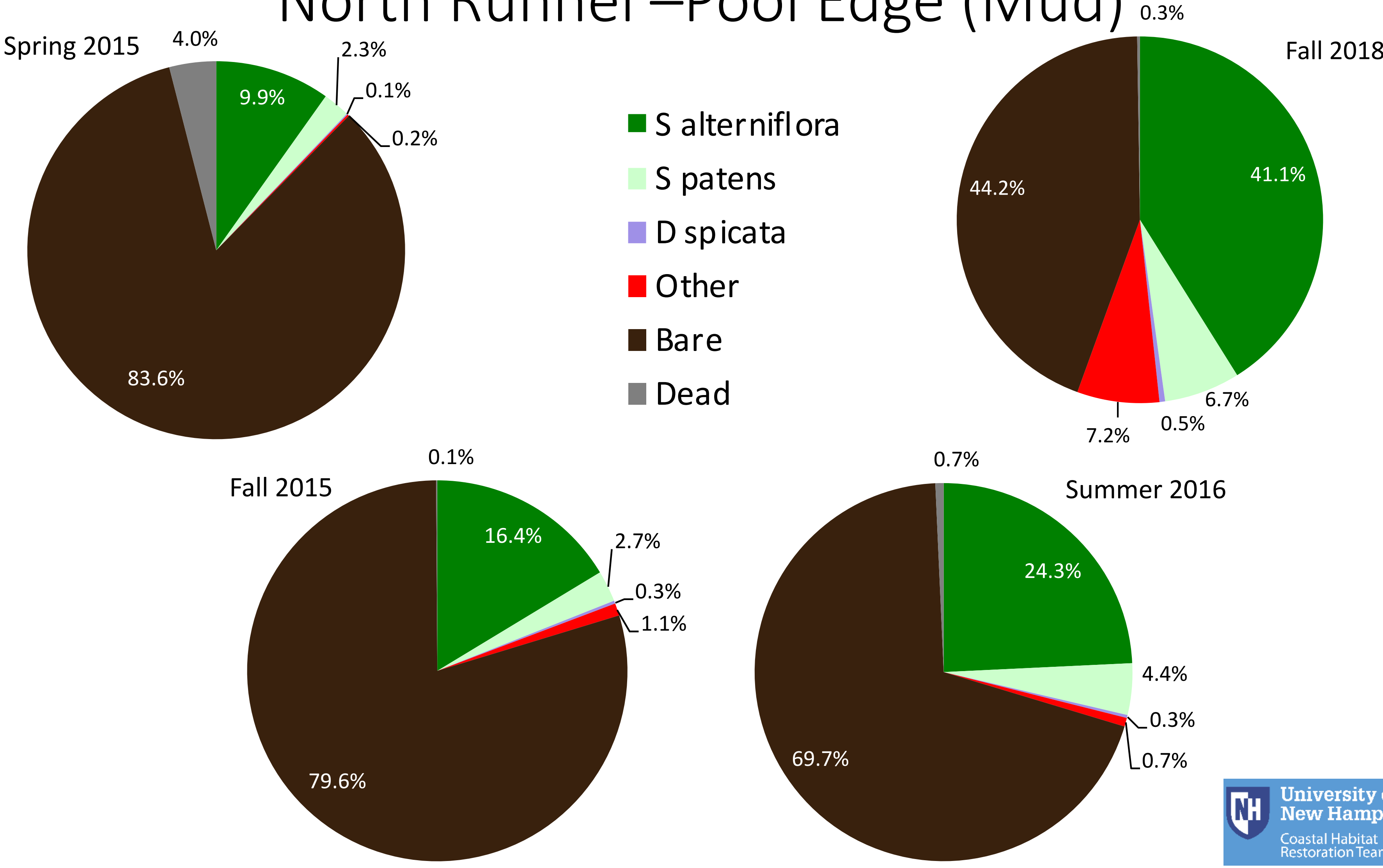
North Runnel –Pool Edge (Mud)



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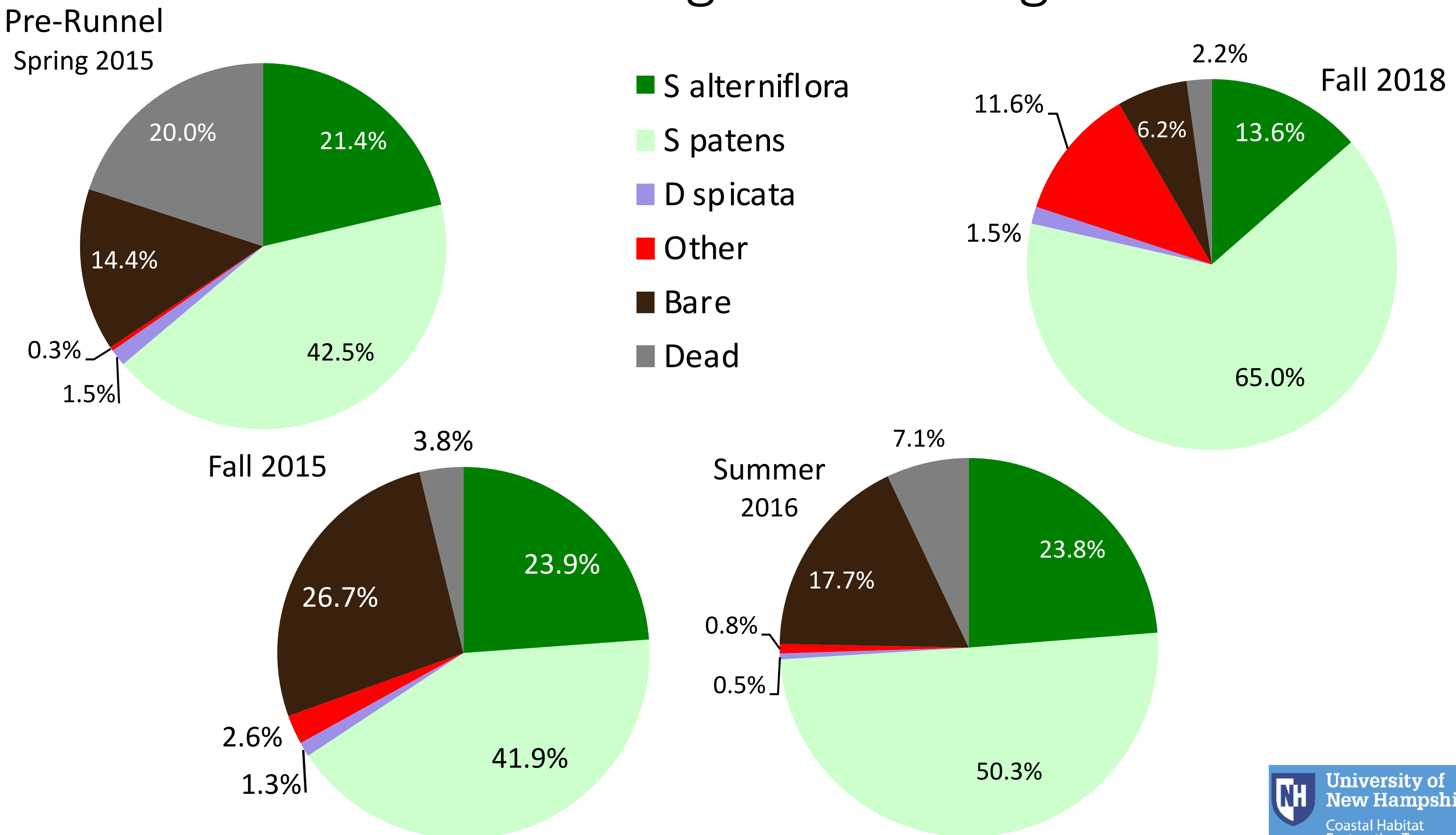
North Runnel – High Marsh Edge of Pool



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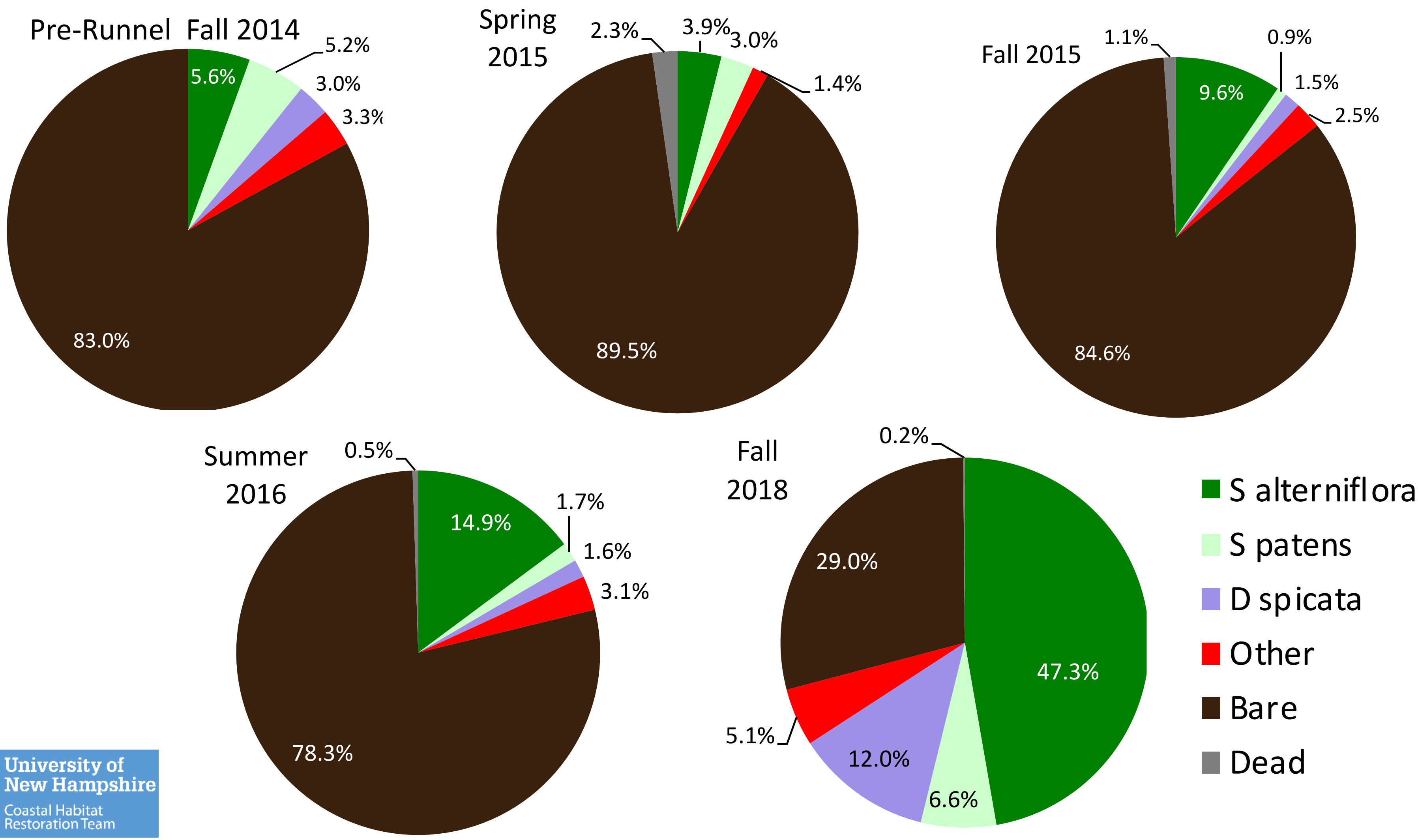
South Runnel –Pool Edge (Mud)



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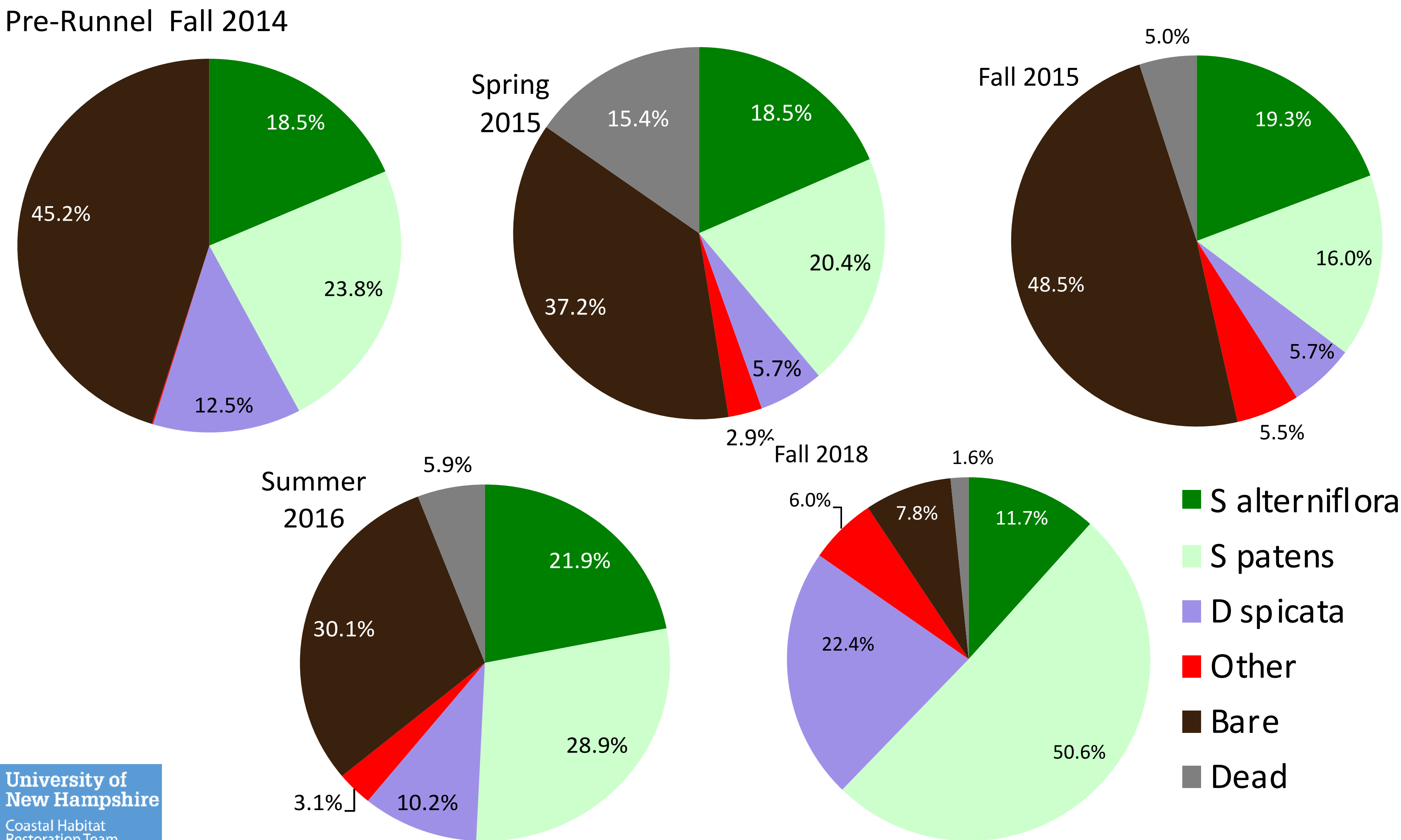
South Runnel –High Marsh Edge of Pool



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Runnels partially drain pools

Spartina can also be planted:
4 plots of 25 plants/pool
(but some killed by algae)

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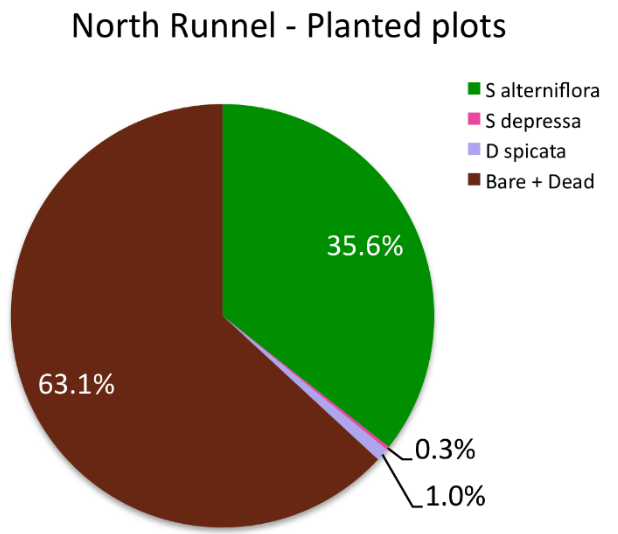

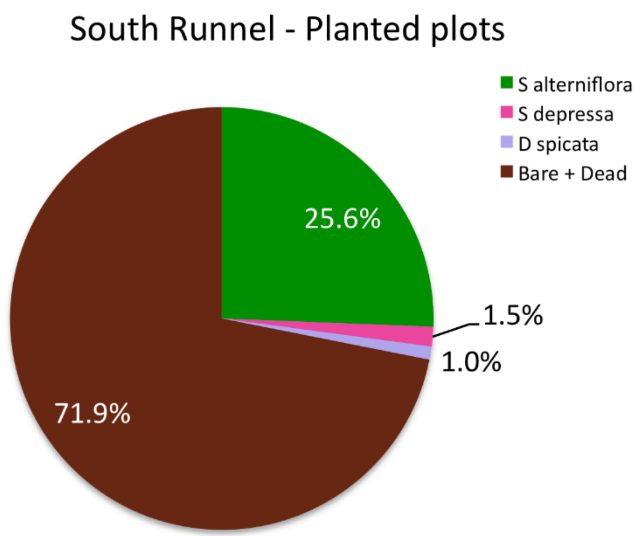

Planted plots

- 4 Plots per Pool
- 25 culms in 0.5 m^2

Second growing season 28-37% cover

South Runnel – more plant losses due to algal smothering

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Cordgrass growing within and beyond plots in second year

Runnels partially drain pools

Shorebirds benefit too

Taller grasses may provide nesting habitat

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Fall
2014

Google Earth

Spring
2018

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Coastal Habitat Restoration Team

Announcing Financial Support to Attend a Special Training Session: Gaining Carbon Credits for Wetland Restoration - in Quebec City, June 6-7, 2020

A 2-day Special Training Session "Gaining Carbon Credits for Wetland Restoration" held prior to the Québec Re3 Conference in Québec City. This training is open to all interested participants and will focus on the science and methodologies required to put a wetland restoration project on the carbon market – see details of the session below. The conference that follows is a joint meeting of in the Society of Wetlands Scientists International (SWS), Society of Ecological Restoration (SER) and others.

Through a Gulf of Maine (GoM) Collaborative Action Grant, funds are available to subsidize attendance of members of the GoM community at this training session. A minimum subsidy of CA$540 (the cost of session registration) is available to those who practice within the GoM, particularly policy-makers, NGO members, and research scientists involved in salt marsh restoration within the Gulf of Maine. Recipients will be selected to encourage attendance by practitioners representative of different sectors involved in salt marsh restoration who will be in the position to help stimulate funding of salt marsh restoration in the Gulf of Maine. (Unfortunately, subsidies are not available to students or consultants.)

To apply for a subsidy email your application by March 4, 2020 to gail.chmura@mcgill.ca.

Put "GoM carbon credits" in the subject line and in your message include.

Name	Position
Institution/Organization	`Do you plan to attend the Quebec RE^3 conference?

A brief description of your interest in salt marsh restoration and means to fund it.

*Applicants will be notified by March 10 if they have received a subsidy. The registration deadline for the training session is March 15, 2020. The subsidy will be provided as a reimbursement after proof of training session registration has been received.

See training session notice on the conference website: http://www.re3-quebec2020.org/training-courses

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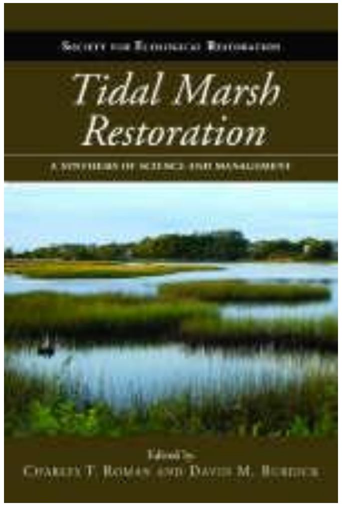
Thank you



David Burdick
david.burdick@unh.edu
Jackson Estuarine Laboratory
Dep't of Natural Resources & the Environment
School of Marine Science and Ocean Engineering
University of New Hampshire, Durham, USA

Thanks to:

Susan Adamowicz, Rachel Carson and PR NWR, USF&WS
Geoff Wilson, Northeast Wetland Restoration
Town of Newbury and Geoff Walker

U.S. FISH & WILDLIFE SERVICE
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Funding from US FWS,
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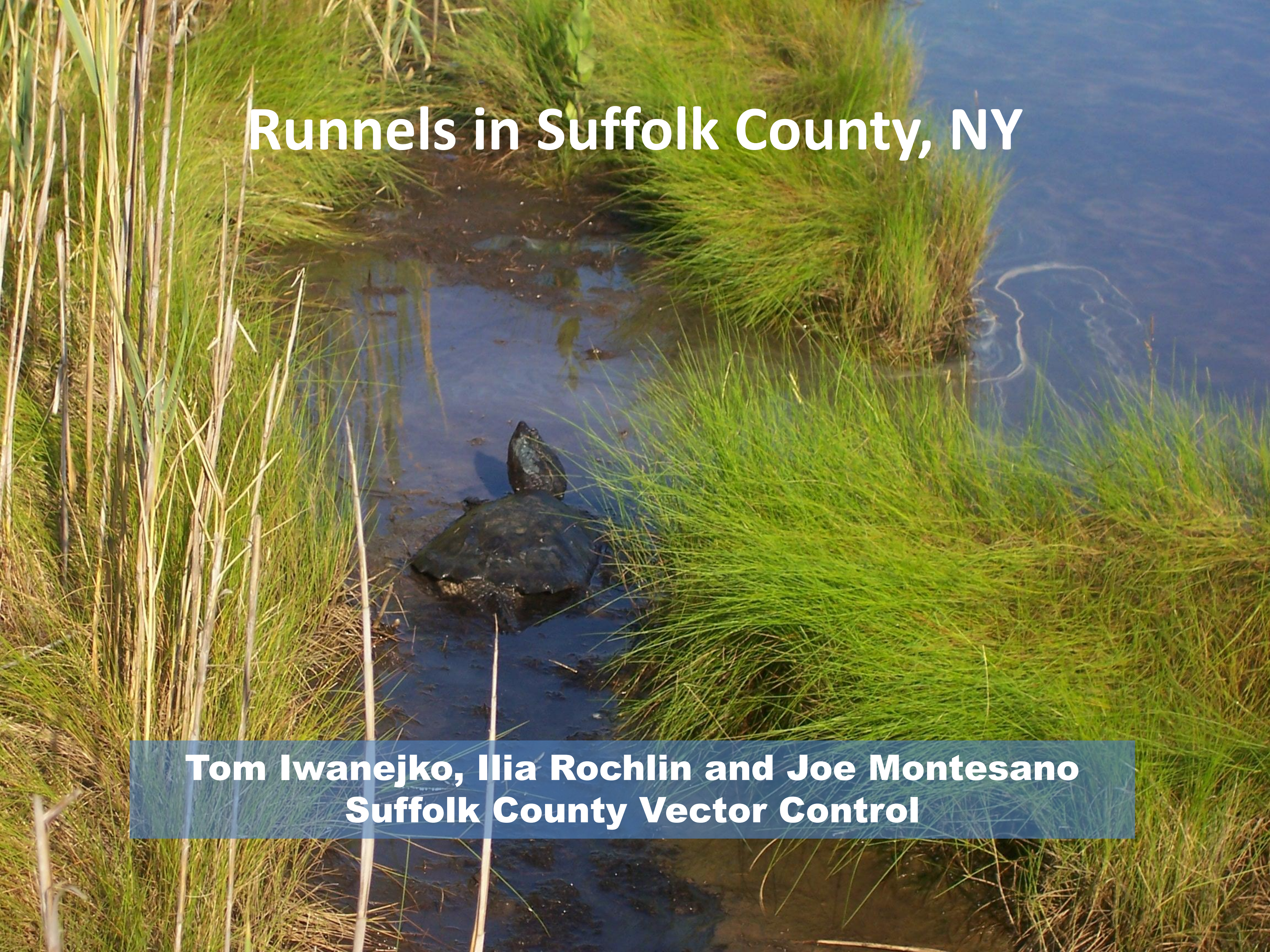
University of New Hampshire
School of Marine Science and Ocean Engineering



Runnels in Suffolk County, NY

Tom Iwanejko, Ilia Rochlin and Joe Montesano
Suffolk County Vector Control

Panne Formation in Suffolk & Use of Runnels

- Up until late 1990 to 2000 marshes were typically lawn like in appearance and thought to be too dry between tidal events for species diversity – push to retain more tidal water on marsh through ditch plugs and OMWM and to stop mosquito ditch maintenance - seen as drying out the marsh

- Beginning around 2000-2005 first signs of large scale panne formation noticed in otherwise healthy ditched marshes

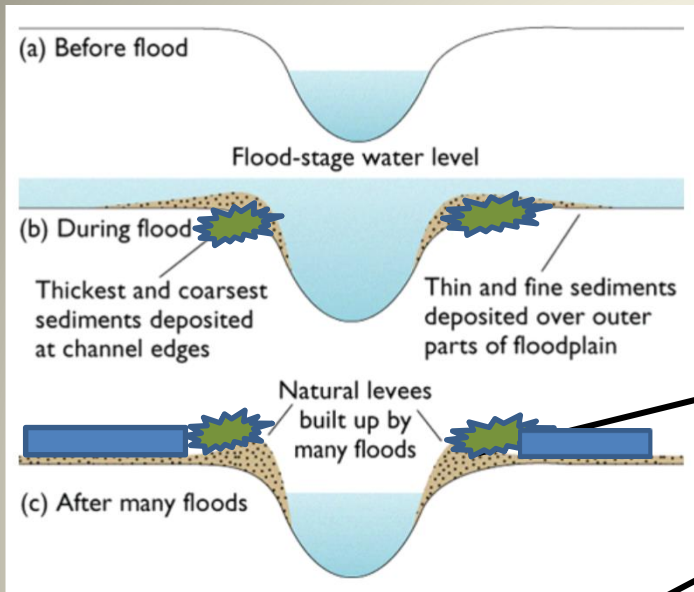
- Panne size and number grew quickly in the microtidal Great South Bay (tide range 1’ - 30cm), pannes less developed in Long Island Sound and Peconic Bay marshes where we have greater tidal amplitude (2’ to 6’+).

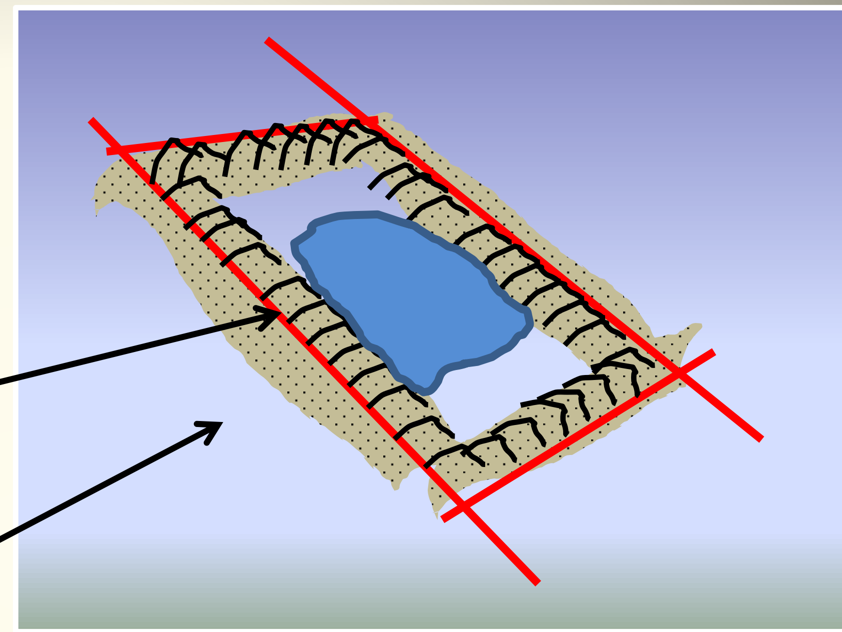
- Losses continue to increase today with threat of near complete wetland loss at some locations – runnels seen as potential mitigation measure to remove standing water from marsh surface

Salt Marsh Panne/Ponding

Pannes/Ponds continue to increase in size and number

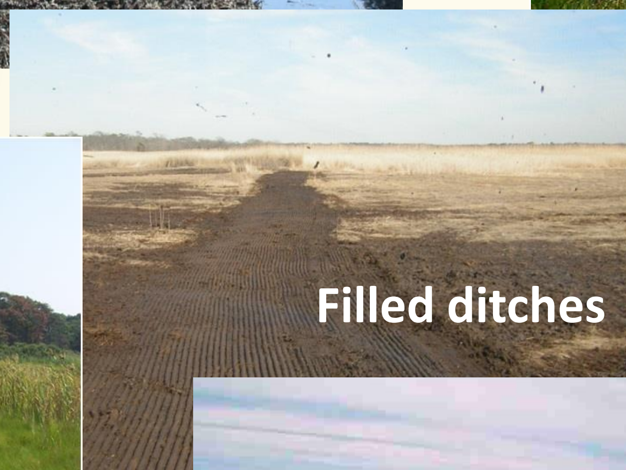
Ditched Marsh Panne Formation

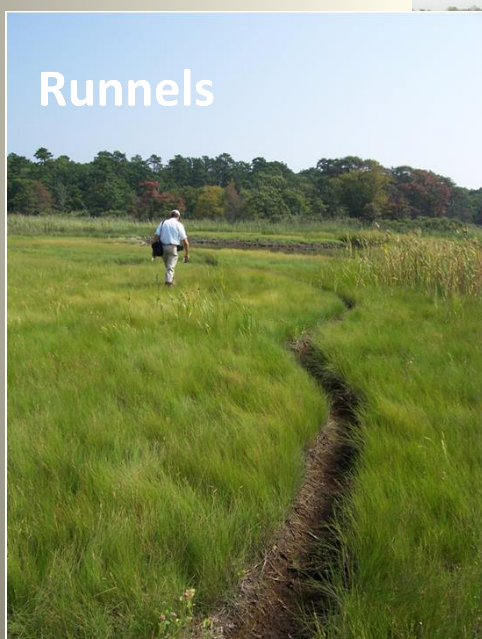




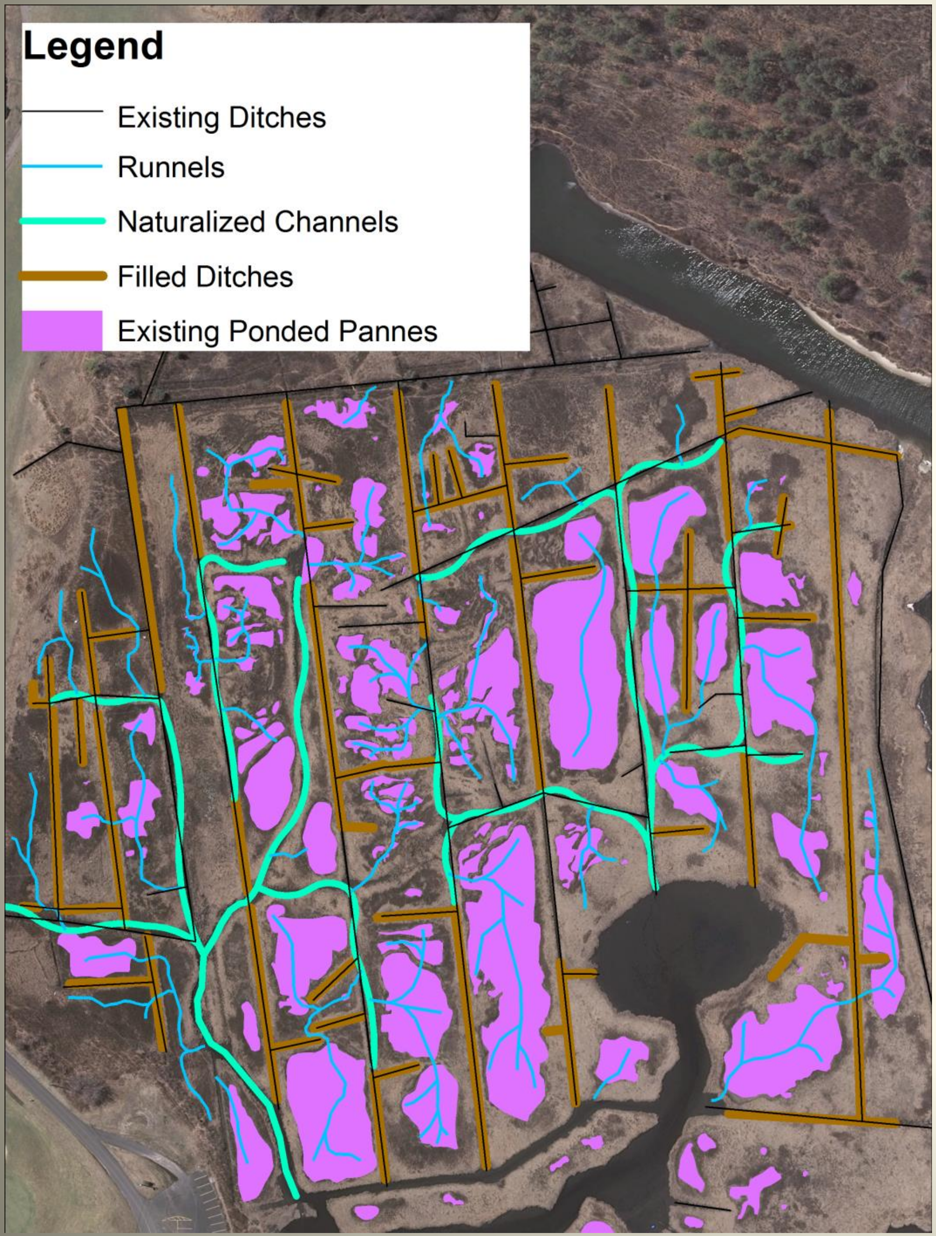
Problem – Marshes have mosquito ditches that are linear and often grid ditched, no meanders; SLR and sediment issues allow pannes Marsh turns into a 'waffle'

Our Wetland Restoration Toolbox





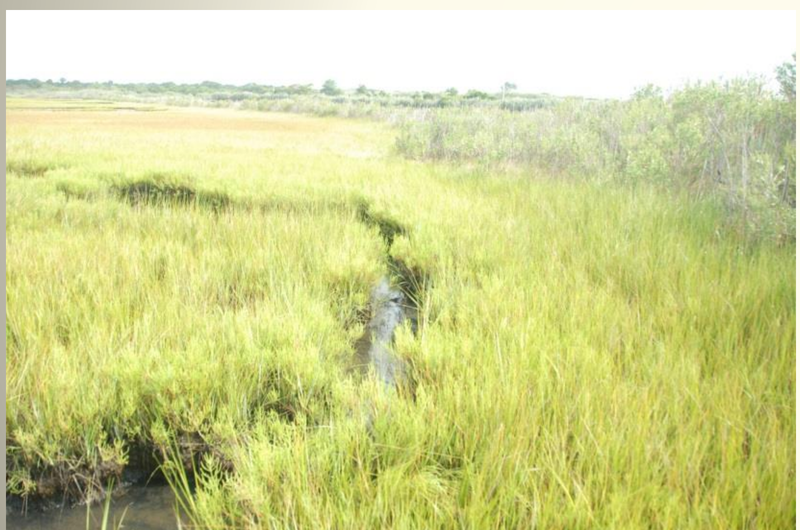
Solutions for Ponding?



- **Runnels**
- **Meandering channels**
- **Thin layer deposition**
- **Remove linear ditches**

Runnels for Biological Mosquito Control

Runnels into mosquito breeding habitat

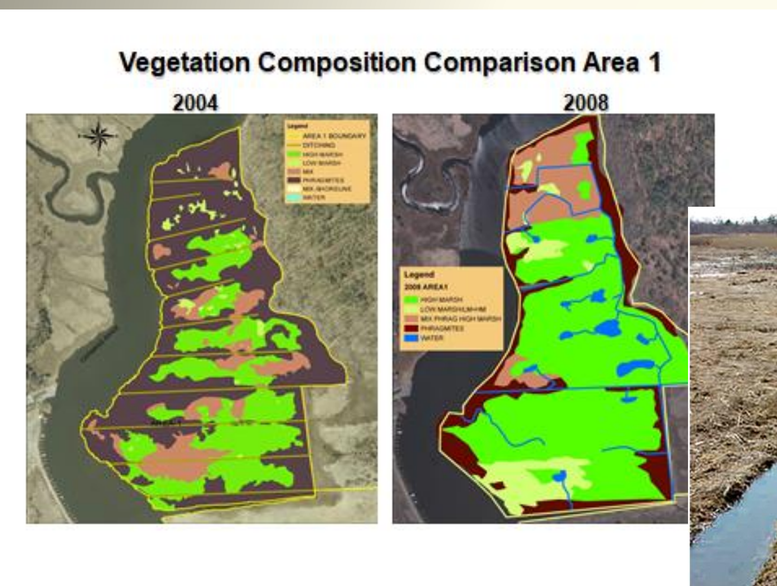


Natural or created micro-pools for increased killifish habitat/refuge from predators - about 10’ by 5’

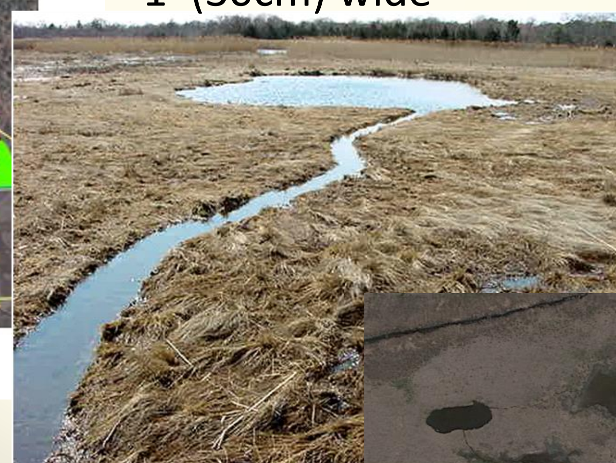
Benefit of reduce mosquitoes, less pesticide spraying and cost savings while restoring marsh hydrology and environmental ecosystem flora/fauna

Use of Runnels in Suffolk

Runnels are not new, hand crews dug them to mosquito breeding areas since the ditches were first installed 1930’s.
Wertheim NWR: Wetland restoration project 2005-2006
Runnels used as connectors between ponds and later added to areas of ponded water to allow for drainage of trapped water from surface



Depth 6-8” (15-20cm) x 1’ (30cm) wide



In 2020 the runnels at Wertheim are still working as designed, with minimal need for follow-up repair

Runnel Installation

Five Methods Of Runnel Installation

-Excavator Blade

-Pisten Bully Ditcher

-Excavator with 1 foot bucket

-Excavator with 2 foot bucket rotated 45 degrees

-Shovel

Methods Rated by:

-Quality of the Runnel

-Impact to the Marsh

-Ease of method

-Varying secondary and tertiary considerations

Pisten Bully Ditcher

Pisten Bully Ditcher

Pisten Bully Ditcher

Pisten Bully Ditcher

Pisten Bully Ditcher

+When functioning creates good runnels

+Sediment is dispersed over marsh

+Minimal Marsh Impact

+Somewhat angled sides

-Must start off a lip

-Limited turning

-Can become mis-aligned during cut, requiring restart

-Requires extensive hand work afterwards

Pisten Bully Ditcher

Pisten Bully Ditcher

Excavator Twisted Bucket

Excavator Twisted Bucket

Excavator Twisted Bucket

+Custom runnels in the proper shape

+Sediment can be repurposed easily

+Runnels have angled sides

-Runnel quality varies greatly

-Difficult for machine operator

-Requires lots of fine maneuvers

-Requires manual clean up work

The old fashioned way

The old fashioned way

The old fashioned way

+Runnels exactly how you want

+Minimal marsh impact

-By far the slowest method

-Sediment comes out in chunks that are time consuming to repurpose

-Areas underwater cannot be done by hand

One Foot Bucket

One Foot Bucket

One Foot Bucket

One Foot Bucket

+High quality runnels quickly

+With proper planning requires minimal movement

+Sediment can be easily repurposed

+Runnels requires little work to clean up

-Runnels have sharp edges that go straight down

-Turns can be tricky, leading to excessive movement

One Foot Bucket

Excavator Blade

Excavator Blade

Excavator Blade

Excavator Blade

Excavator Blade

Excavator Blade

- +Creates natural looking runnels with sloped sides
- +Minimal impact
- +Easily repurposed sediment
- +Quick
- +Turns are very easy to do

- -Runnels can require some manual clean up work
- -Depth can be hard to gauge for operator

Excavator Blade

Pre-restoration

Post-restoration

Thank you for listening!

At Lunch
Evaluating Runnels workshop will resume at 12:55

Agenda:

8:00am: Arrive- light refreshments and coffee

9:00am Welcome and workshop logistics (Rachel Jakuba, BBC)

9:05am Workshop goals (Linda Deegan, WHRC)

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1:50pm Breakout Groups: Discussion of what makes a good runnel site and potential of proposed runnel test sites (60 min)

2:50pm Groups report out (40 min)

3:30pm Adjourn

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@SaveTheBayRI

Panel Discussion

Moderator: Joe Costa

Panelists: Wenley Ferguson, Sue Adamowicz, Diana Brennan, Dave Burdick, Tom Iwanejko

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Testing Runnels: Background Information for Breakout Groups

Alice Besterman

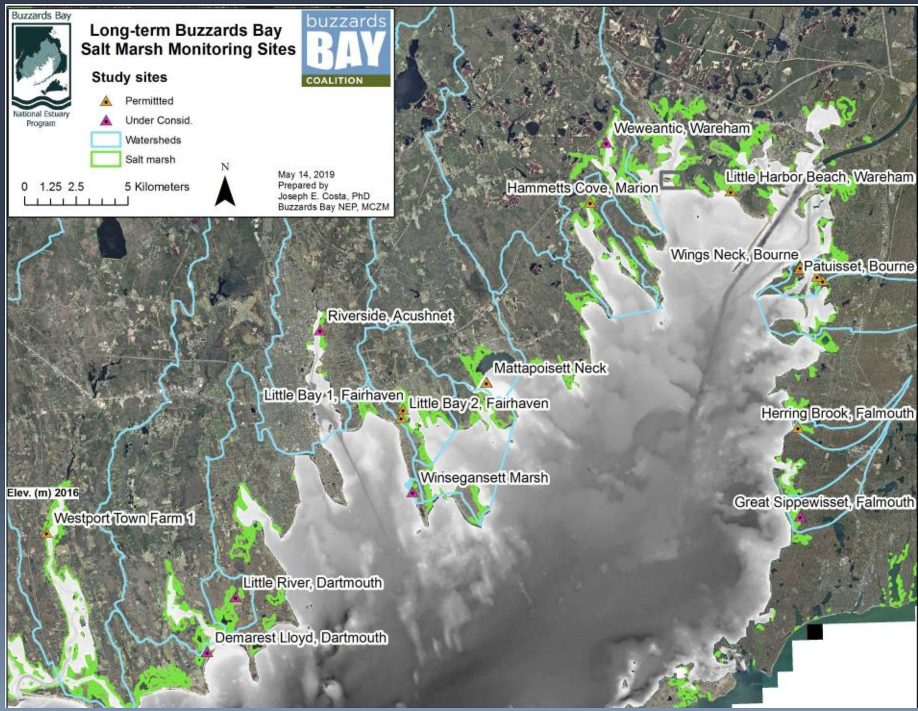
Thanks to:

Marc Carullo

Alfedo Aretxabaleta

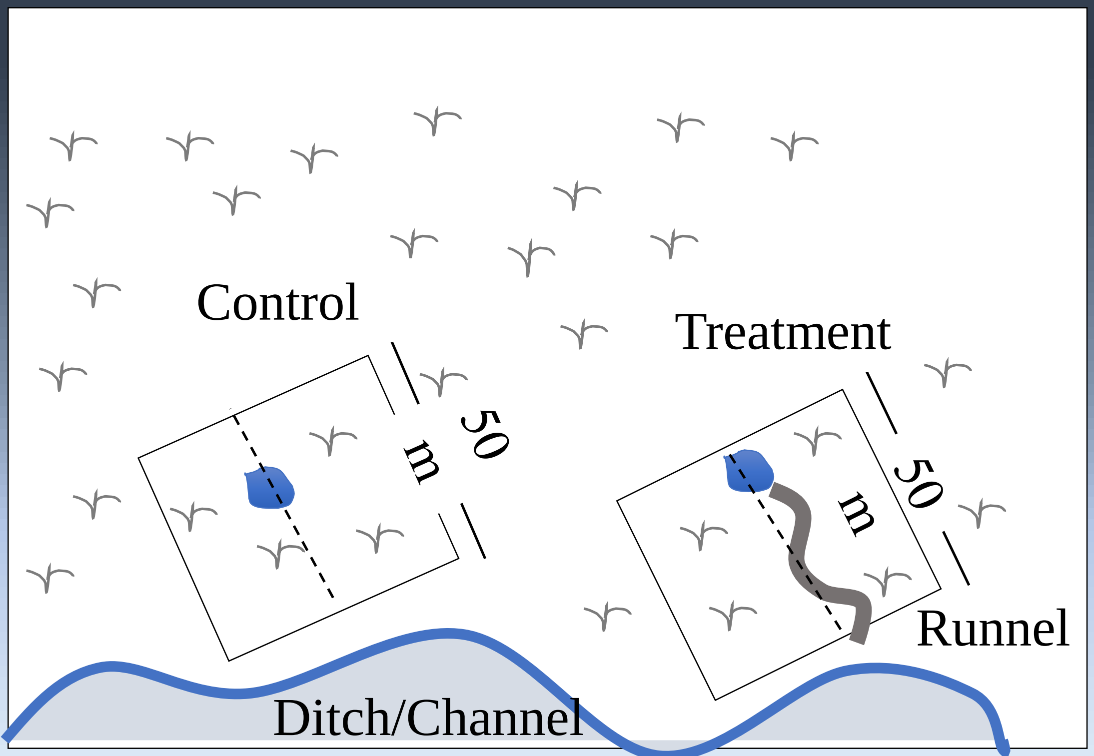
Breakout Groups: Background

- Runnel projects with before/after monitoring have not been attempted in Buzzards Bay
- Runnels are not going to work everywhere, in every situation
- Need to identify appropriate sites
- Need to determine where runnels are a potential solution



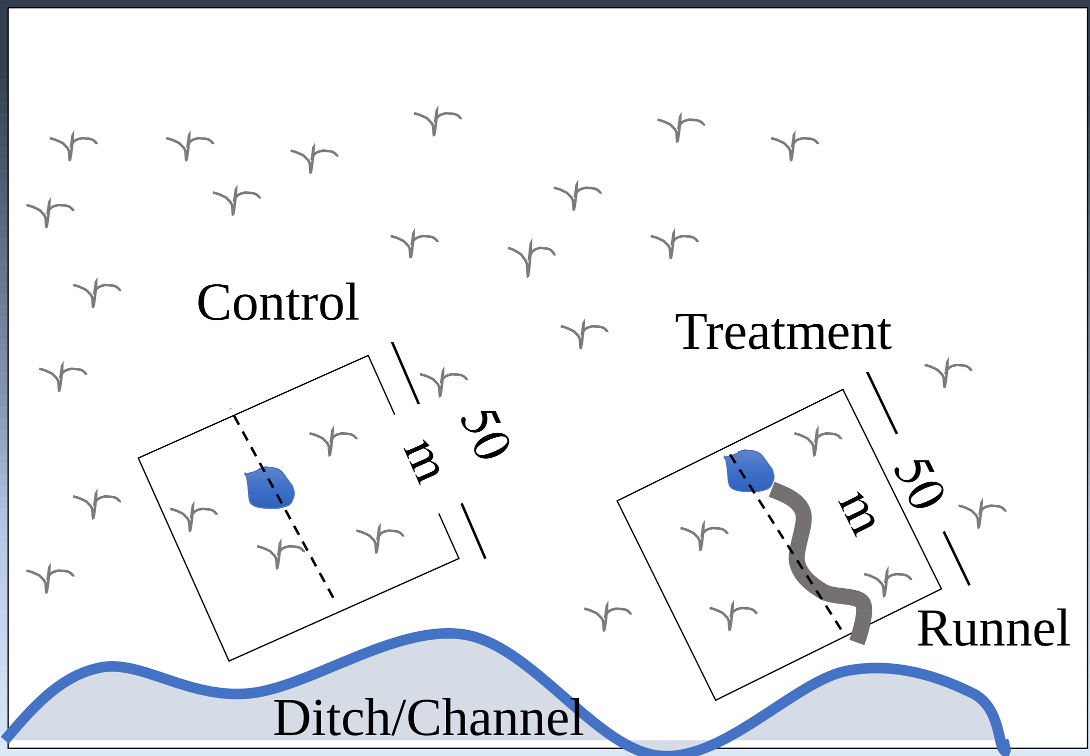
Breakout Groups: Background

- BACI-design experiment
- 3 Treatment Sites (dig runnels)
- 9 Control Sites (die-back/impoundment– no runnel)



Breakout Groups: Background

- Test limit of runnels- how far is too far gone?
- Need to control for other important factors



Breakout Groups: Background

- Sites need not (and cannot be identical)

- BUT want to avoid testing runnels in sites with obvious confounding variables

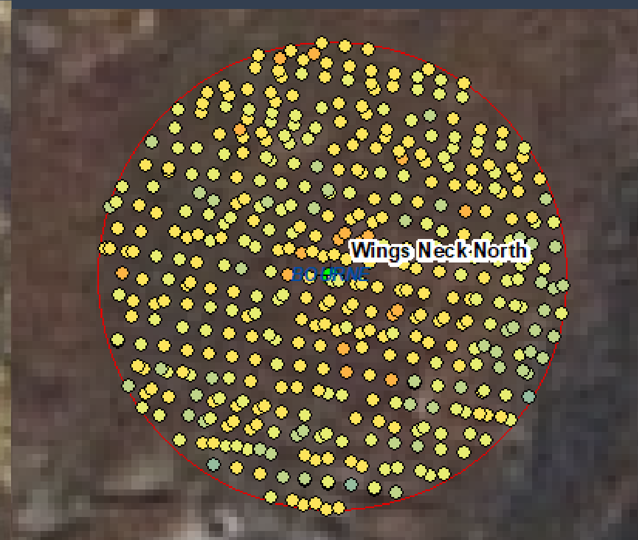
Breakout Groups: Objectives

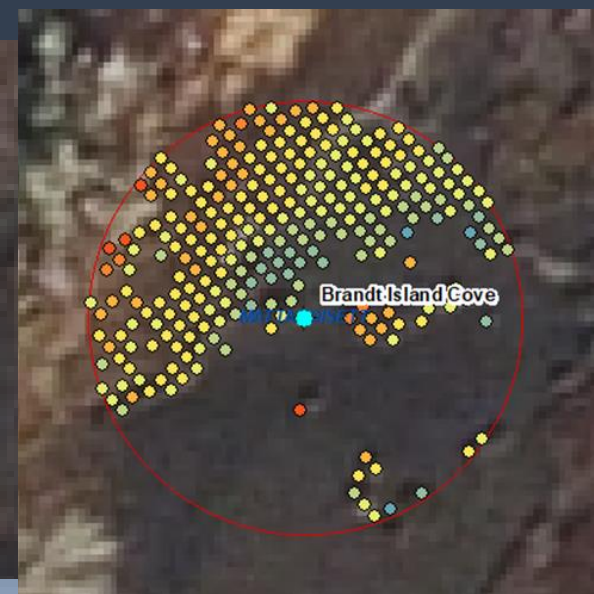
- Identify characteristics of sites where runnels will likely improve marsh adaptation to sea level rise
- Identify characteristics of sites where runnels will NOT successfully improve marsh adaptation

Breakout Groups: Packets

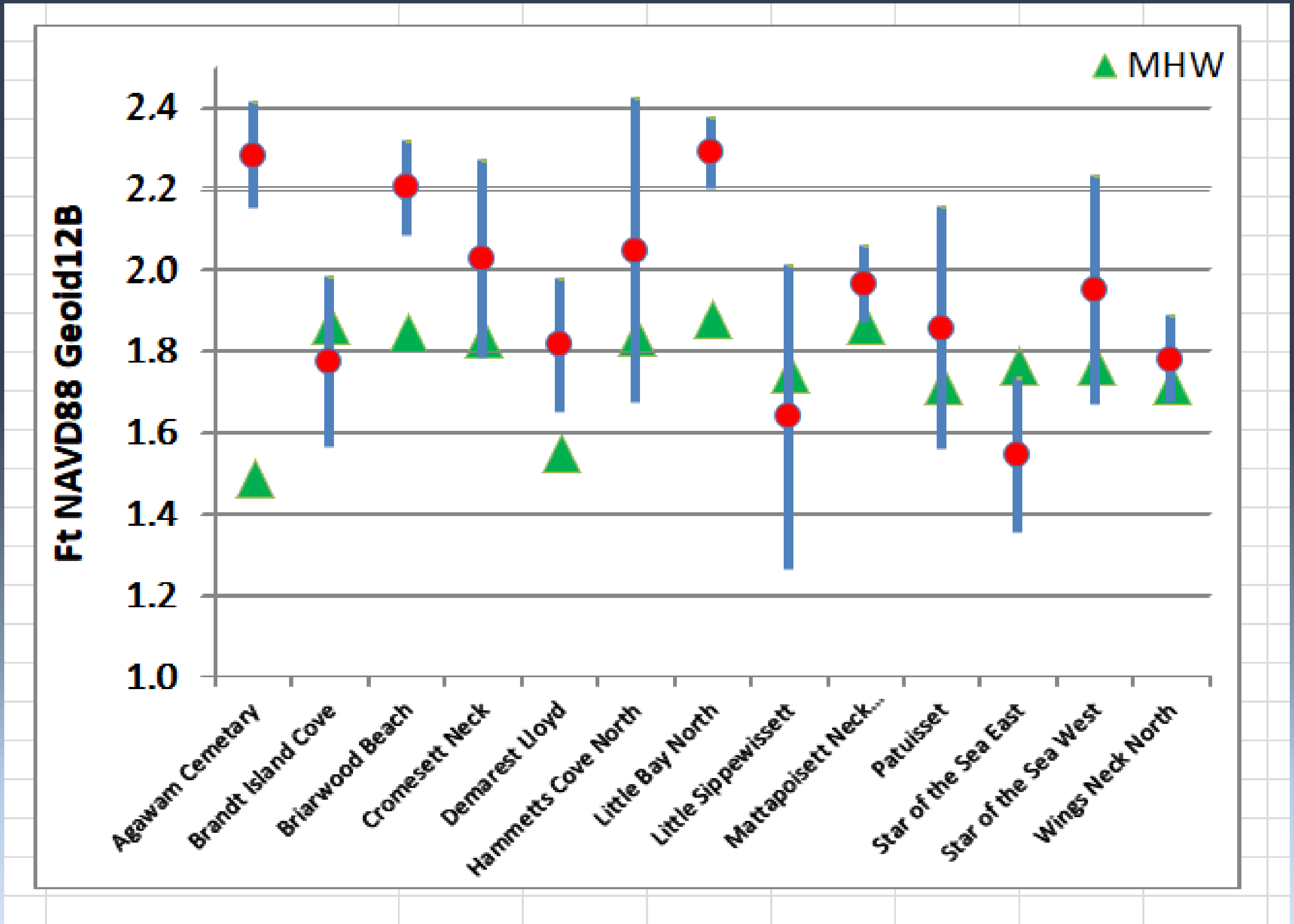
- 10 sites
- Overview of characteristics that could affect success of a runnel

Elevation



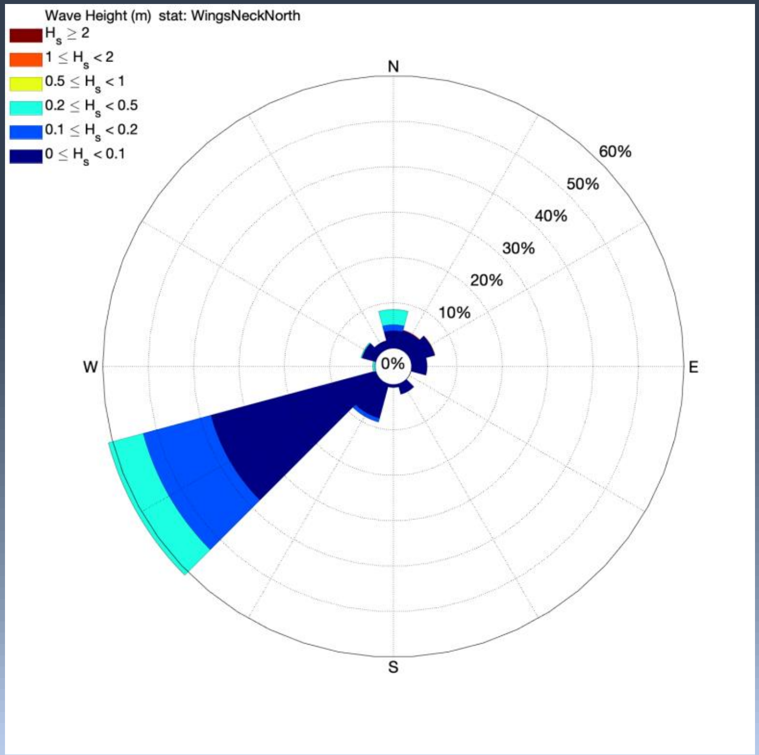


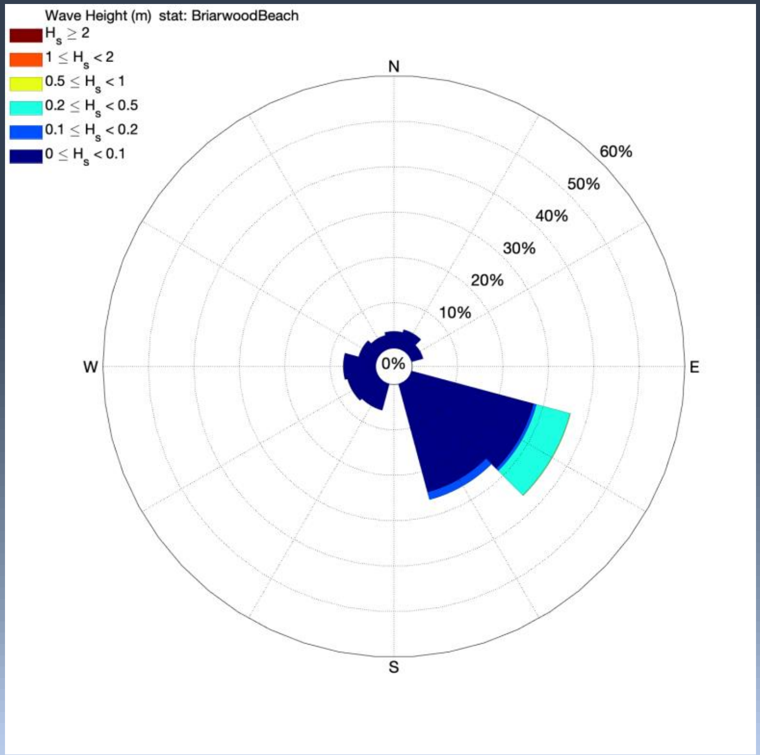
Elevation



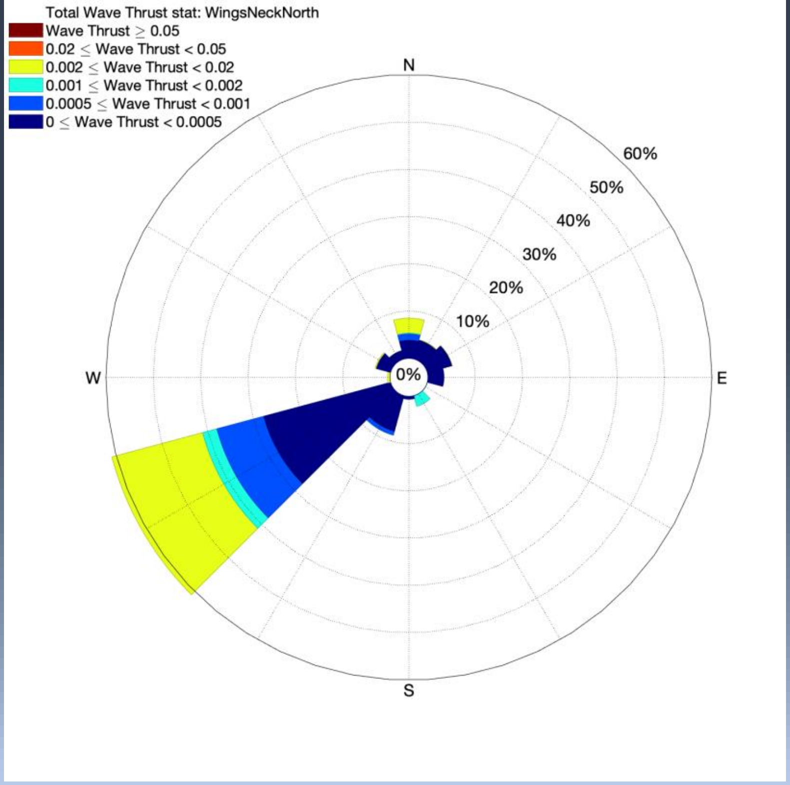
MHW
Ft NAVD88 Geoid12B
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
Agawam Cemetary
Brandt Island Cove
Briarwood Beach
Cromesett Neck
Demarest Lloyd
Hammetts Cove North
Little Bay North
Little Sippewissett
Mattapoisett Neck...
Patuisset
Star of the Sea East
Star of the Sea West
Wings Neck North

Significant Wave Height

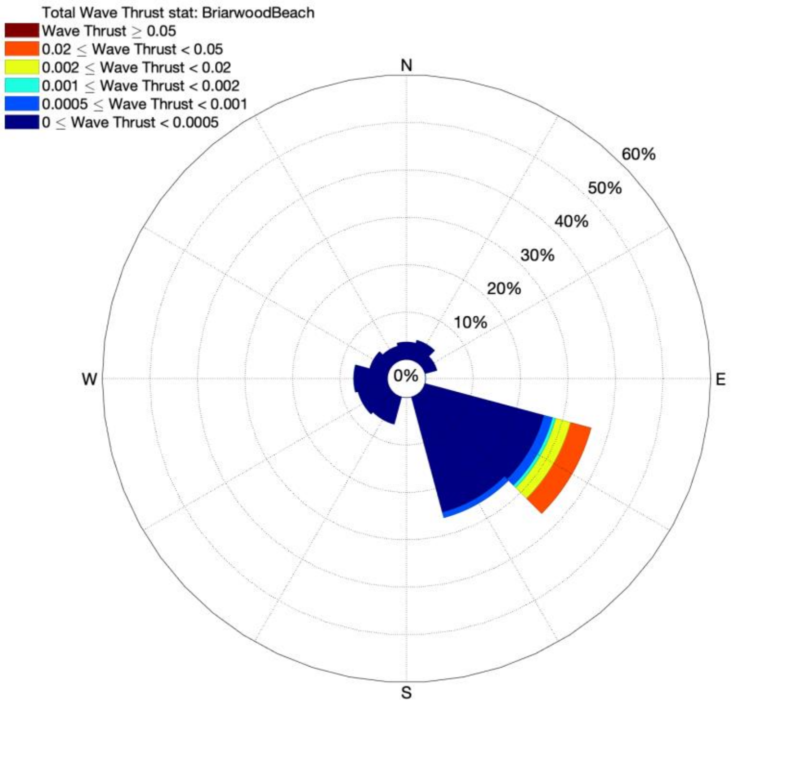




Wave Thrust



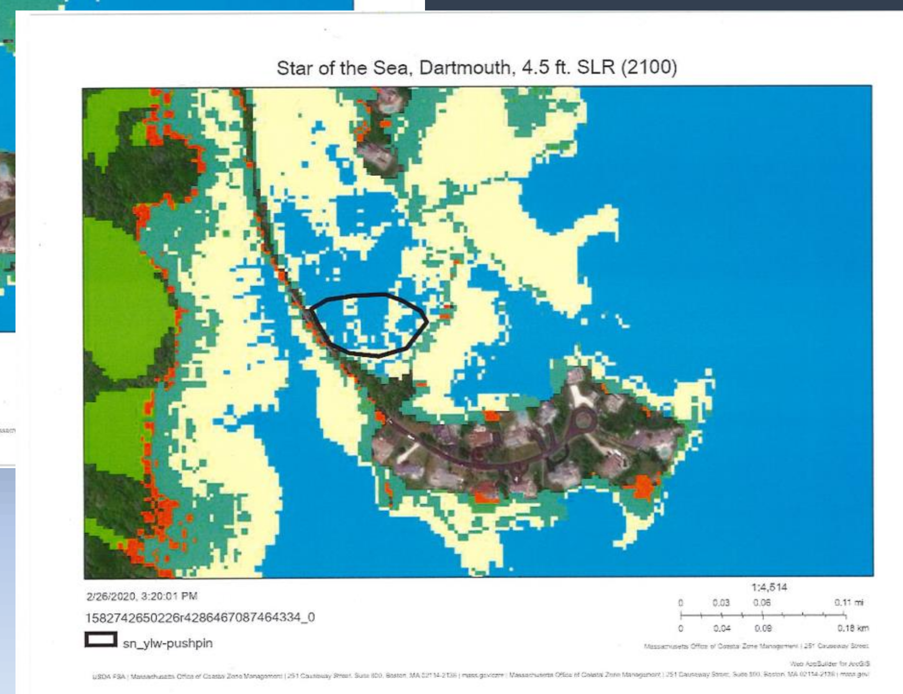
Total Wave Thrust stat: WingsNeckNorth
Wave Thrust ≥ 0.05
0.02 ≤ Wave Thrust < 0.05
0.002 ≤ Wave Thrust < 0.02
0.001 ≤ Wave Thrust < 0.002
0.0005 ≤ Wave Thrust < 0.001
0 ≤ Wave Thrust < 0.0005
N
E
S
W
0%
10%
20%
30%
40%
50%
60%



Total Wave Thrust stat: BriarwoodBeach
Wave Thrust ≥ 0.05
0.02 ≤ Wave Thrust < 0.05
0.002 ≤ Wave Thrust < 0.02
0.001 ≤ Wave Thrust < 0.002
0.0005 ≤ Wave Thrust < 0.001
0 ≤ Wave Thrust < 0.0005
N
E
S
W
0%
10%
20%
30%
40%
50%
60%

Existing Drainage Considerations

Marsh Migration



Breakout Groups: Packets

Wing's Neck Runnel Site

Table of Contents

Breakout Groups: Packets

Breakout Groups: Packets

- ➢ Do you have any thoughts on how a runnel at this site should be dug (by hand, low-pressure excavator), and/or whether a deeper-narrower, or shallower-wider runnel would be more suitable here? Should a sill be left?

  ____

  ____

  ____

- ➢ Additional comments:

  ____

  ____

- ➢ **Suitability Ranking (1-5)** ______________

Breakout Groups 1:50 – 2:50

- Divide into groups (number on your name tag)
- Online you are Group 6!
- 3-4 sites each group
- Aim for about 15 minutes of discussion (or less) per site

Group 1

Little Bay, Demarest Lloyd, Star of the Sea

Leaders: Dave/Diana
Location: Auditorium

Group 2

Little Bay, Demarest Lloyd, Star of the Sea

Leaders: Wenley/Neil
Location: Carriage House

Group 3

Brandt Island Cove, Field Family Farm, Hammett's Cove

Leaders: Rachel
Location: Commons

Group 4

Brandt Island Cove, Field Family Farm, Hammett's Cove

Leaders: Alice/Sue
Location: Commons

Group 5

Briarwood Beach, Cromesett Neck, Patuisset Marsh, Wing's Neck

Leaders: Joe/Megan
Location: Library

Group 6

Briarwood Beach, Cromesett Neck, Patuisset Marsh, Wing's Neck

Leaders: Linda
Location: Online Zoom Call

In break out sessions
Groups will return to report out at 2:50

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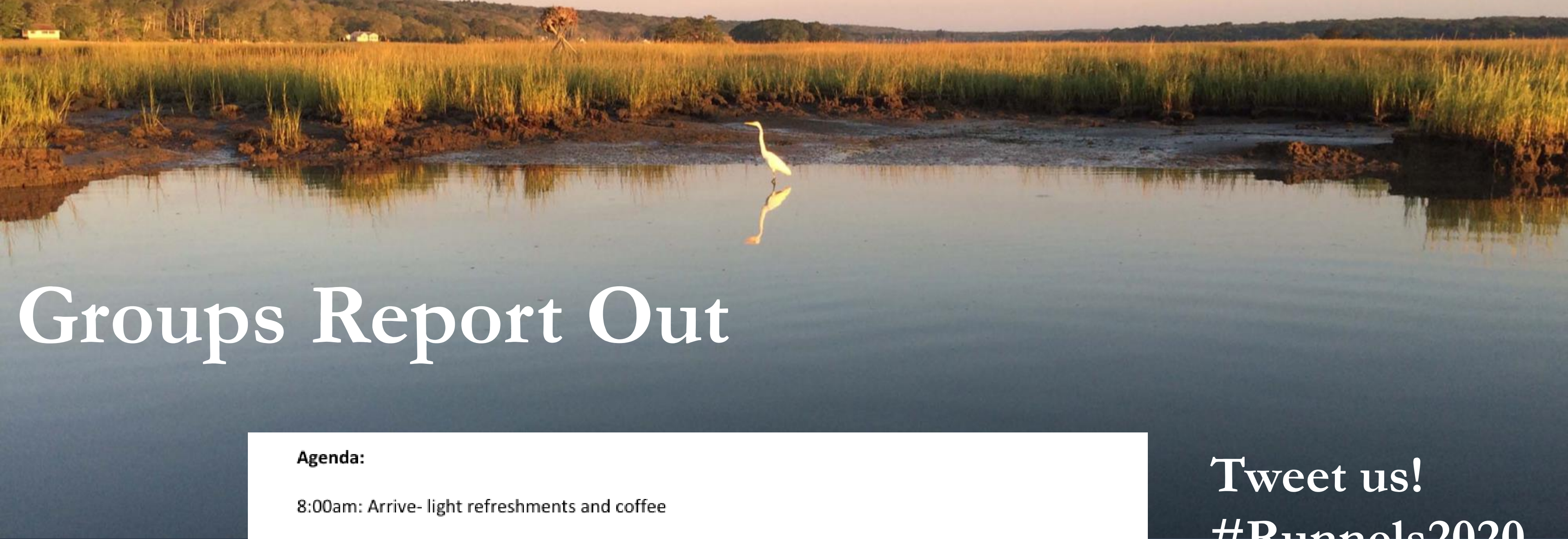

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THANK YOU!

Slides, packets, video from today, and a summary of the day will be posted on the Buzzards Bay Coalition website

Links to come!

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