Saltmarsh Habitat & Avian Research Program

SHARP

Maureen Correll and Britt Cline

Hurricane Sandy Tidal Marsh Resiliency Workshop

U.S. Fish & Wildlife Regional Office, Hadley, MA
10 Dec 2015

Co-PIs:
Tom Hodgman
Brian Olsen
Greg Shriver
Adrienne Kovach
Jonathan Cohen

Humans have been changing tidal marshes for centuries.

ditching

agriculture

tidal restriction

sea level rise

extreme storm events

Tidal marsh specialist birds

Rallidae

1. Clapper Rail (*Rallus crepitans*)

Scolopacidae

2. Willet (*Tringa semipalmata*)

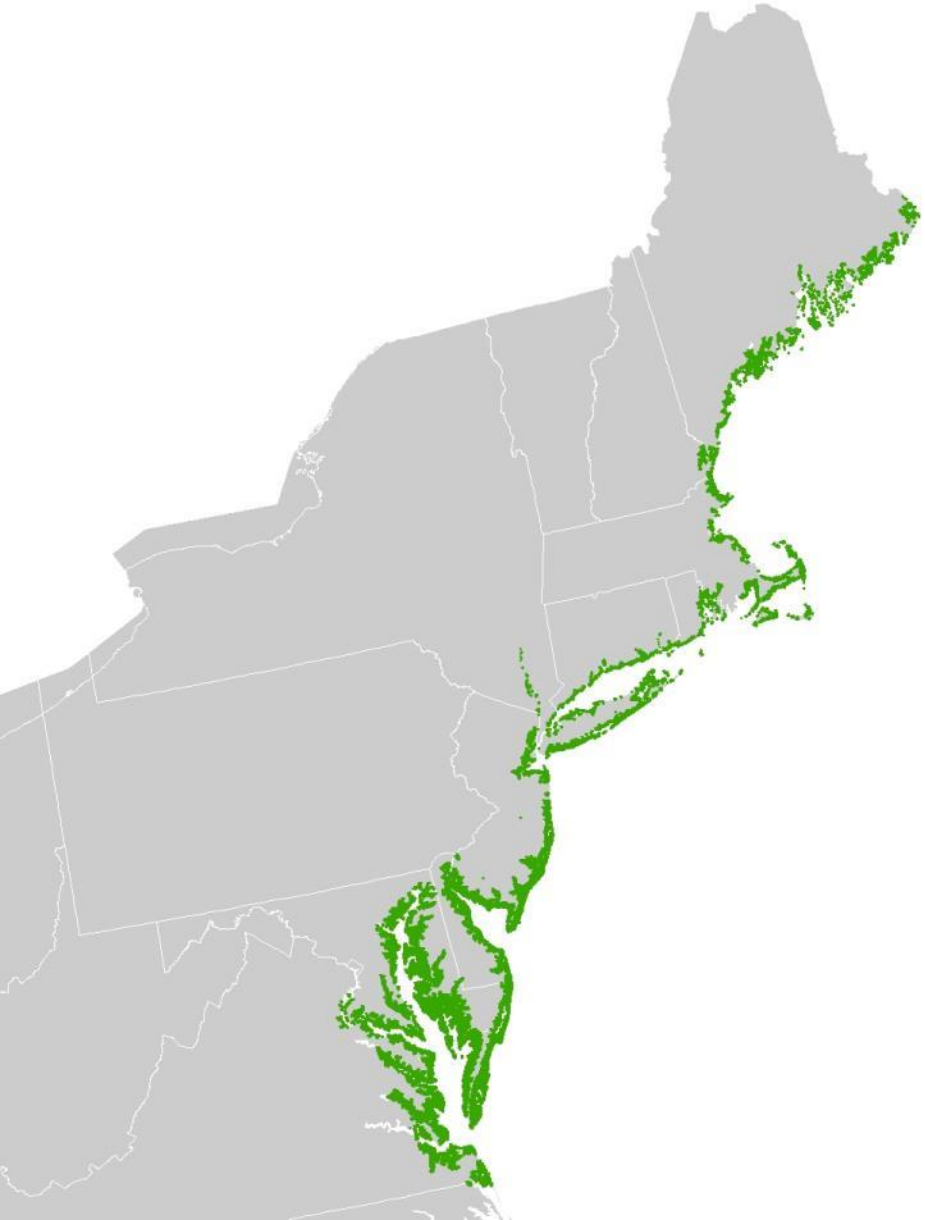
Emberizidae

3. Nelson's Sparrow (*Ammodramus nelsoni*)

4. Saltmarsh Sparrow (*A. caudacutus*)

5. Seaside Sparrow (*A. maritimus*)

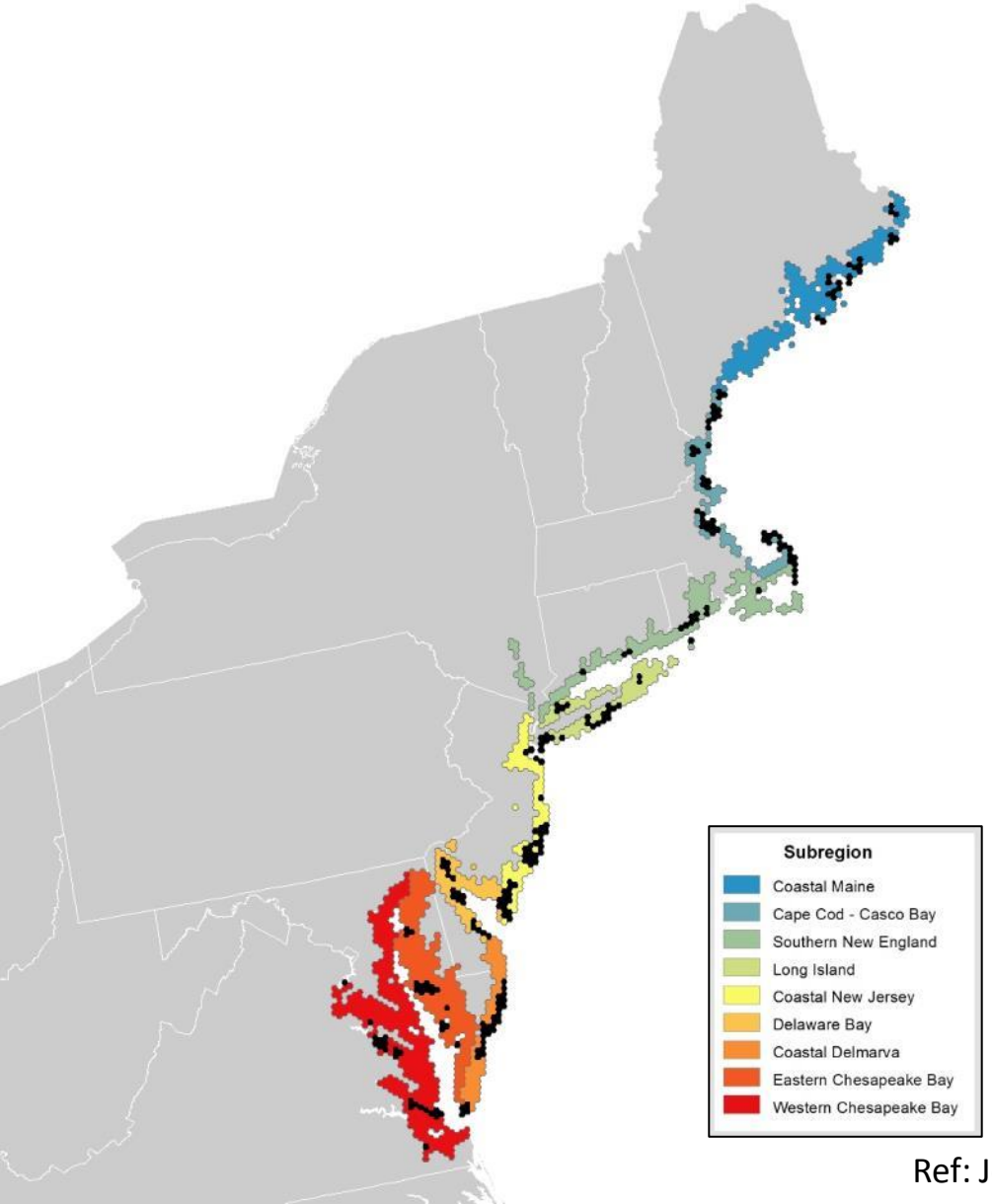
Study area: Region-wide point count surveys 2011-14



Bird Conservation Region 30+
USFWS Region 5

National Wetlands Inventory
estuarine intertidal emergent wetland (E2EM)

Sampling design: Region-wide point count surveys 2011-14



SHARP Sampling Universe

40 km^2 hexagons with
estuarine intertidal emergent wetland

Two-stage Cluster Sample

- Primary sampling units - hexagons
- Secondary sampling units - survey points

Generalized Random Tessellation Stratified (GRTS)

- Probabilistic sample
- Spatially balanced
- Flexible
- Program R - spsurvey

Hexagon Selection

1. Random draw by subregion
2. Random draw by state lands
3. Forced inclusion of federal lands (USFWS/NPS)

Ref: Johnson et al. 2009, Kincaid and Olsen 2012, Thompson 2012

Hurricane Sandy : 22-31 October 2012

washingtonexaminer.com

The Examiner WASHINGTON

WEDNESDAY, OCTOBER 31, 2012

'My Fair Lady' hits D.C.
Musical at Arena Stage P. 17

Wizards fall to Cavs
Open season with loss P. 32

Calm after the storm
56° 41°
DETAILS P. 4

LOCAL
Allen pushes jobs
Va. Senate candidate must close gap. P. 9

POLITICS
Disappointed in Iowa
White voters say Obama has failed to deliver. P. 11

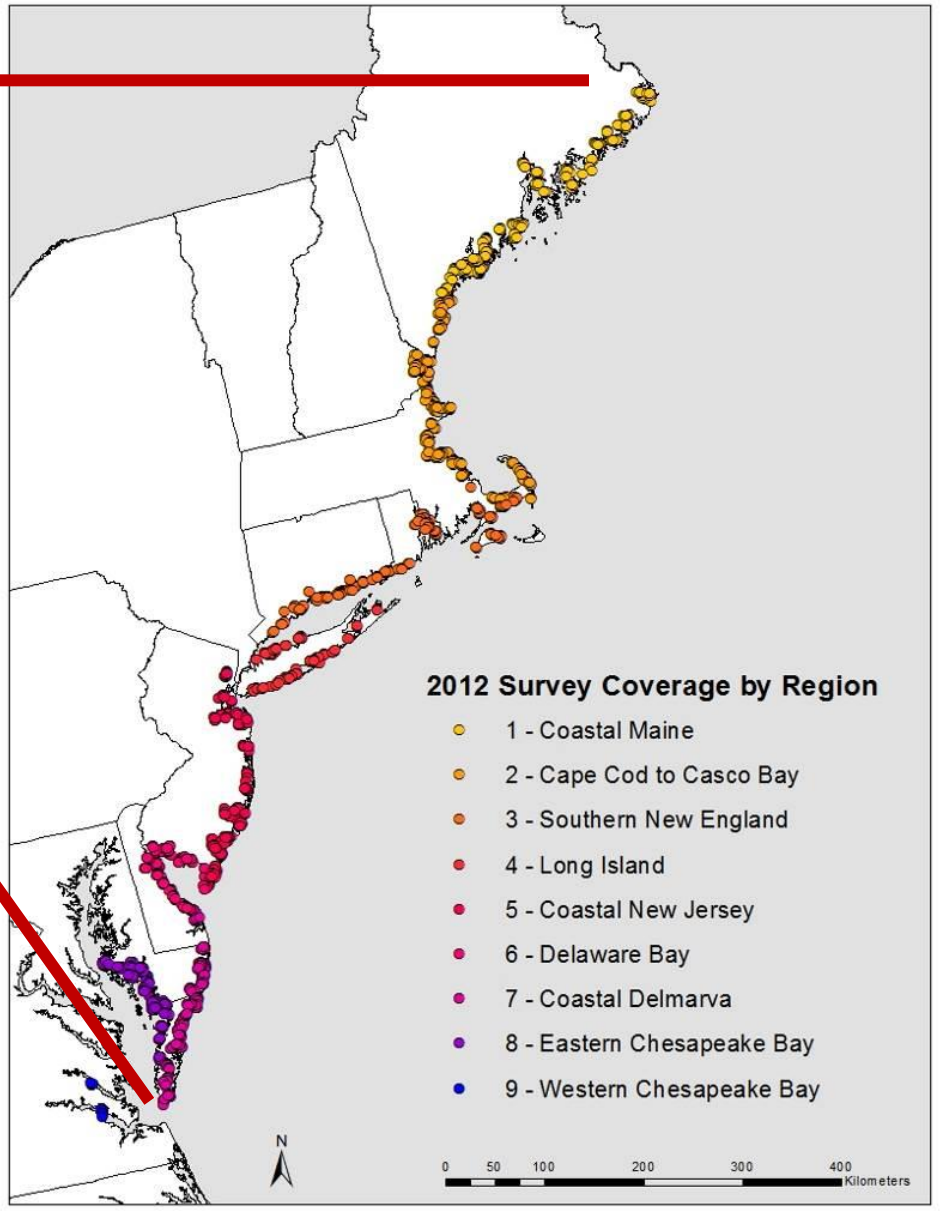
EDITORIAL
Halloween politics
Obama's 5 scariest domestic policies. P. 22

MICHAEL BARONE
Republican offensive
Romney pressures Obama with multi-front attack. P. 11

Disaster Zone
Sandy leaves 50 dead, $50b mess

Storm Sandy path

Our study area

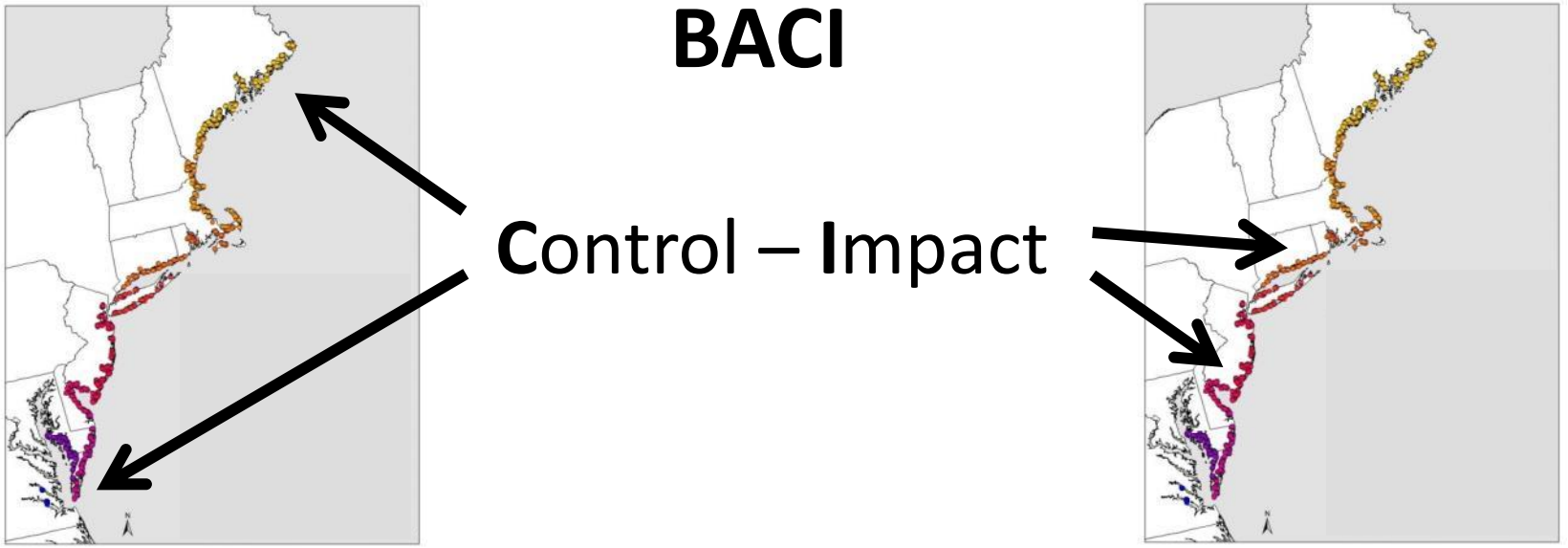


Hurricane Sandy : 22-31 October 2012

Before

After

BACI



2011-2012

2013-2014

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

NSF

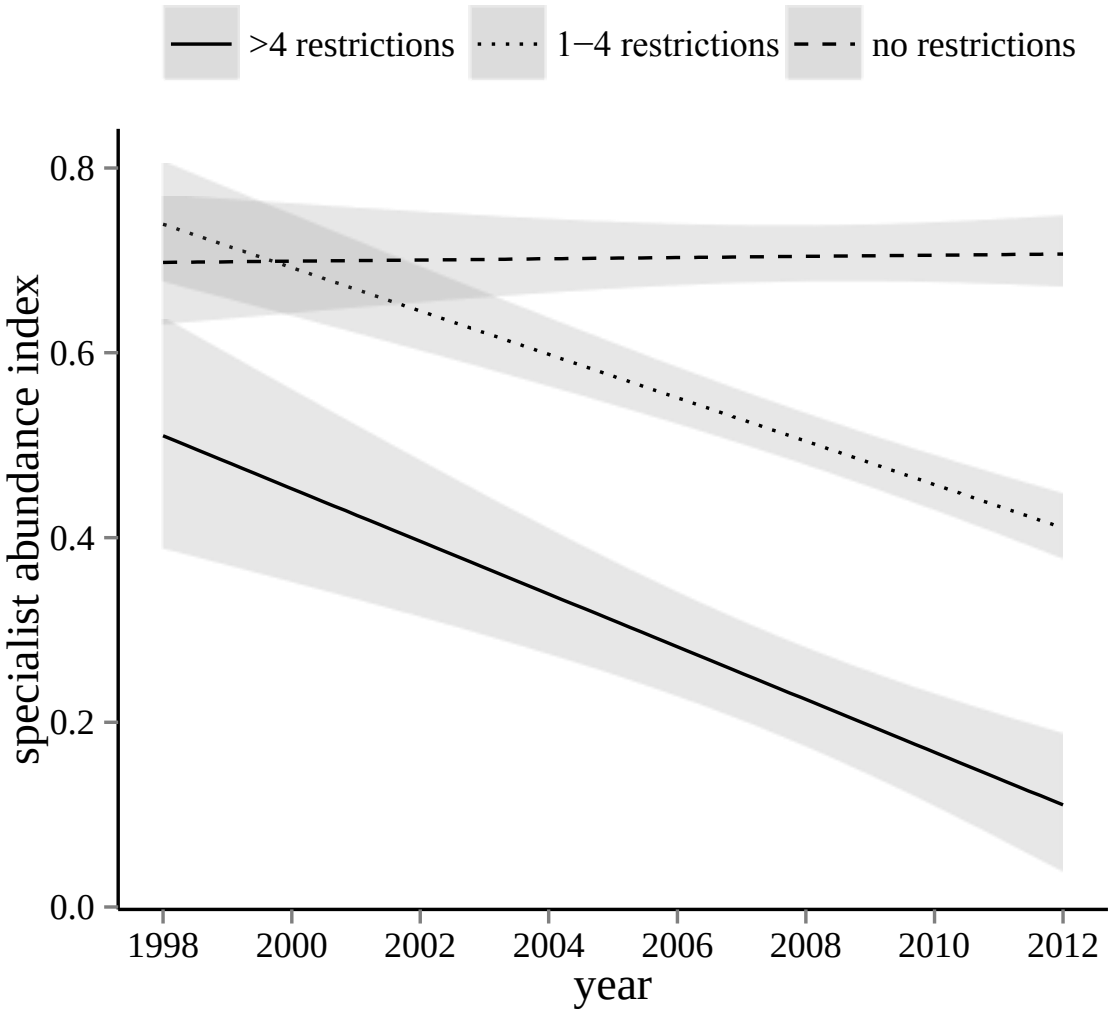
North Atlantic LCC
North Atlantic Landscape Conservation Cooperative

Hurricane Sandy : 22-31 October 2012

Birds were not affected by size of storm surge at the species or community level.

Tidal marsh bird communities & tidal restrictions

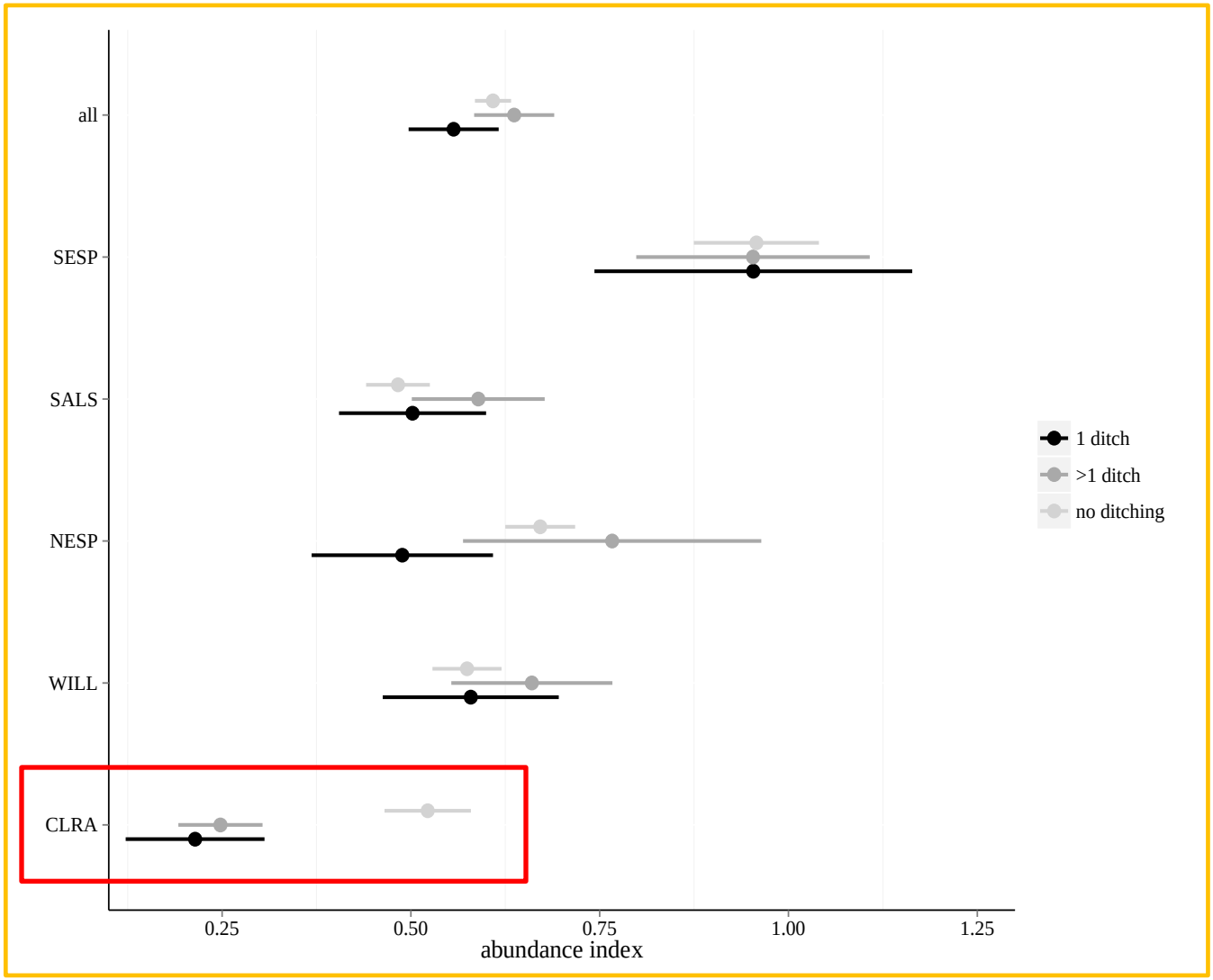
However, local marsh management can affect TM bird communities



Correll et al in review

Marsh modification affects tidal marsh bird abundance

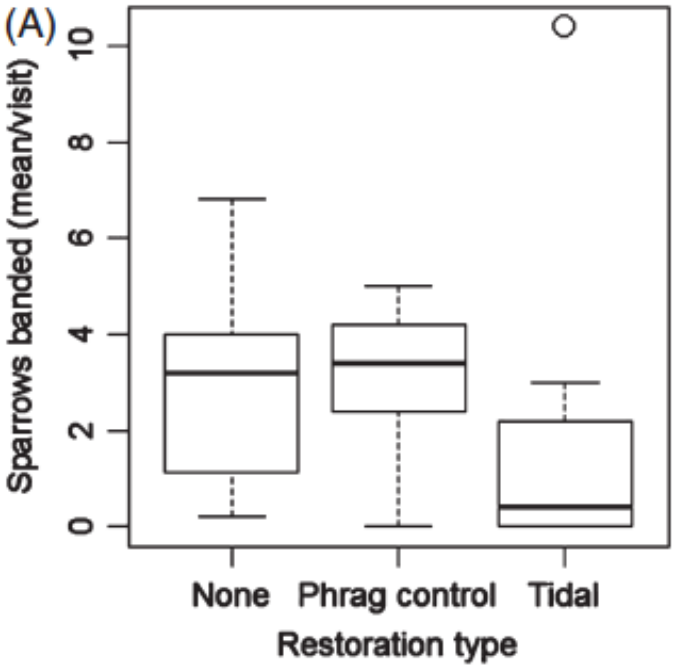
Tidal ditching (alone) may decrease abundance for some TMO species

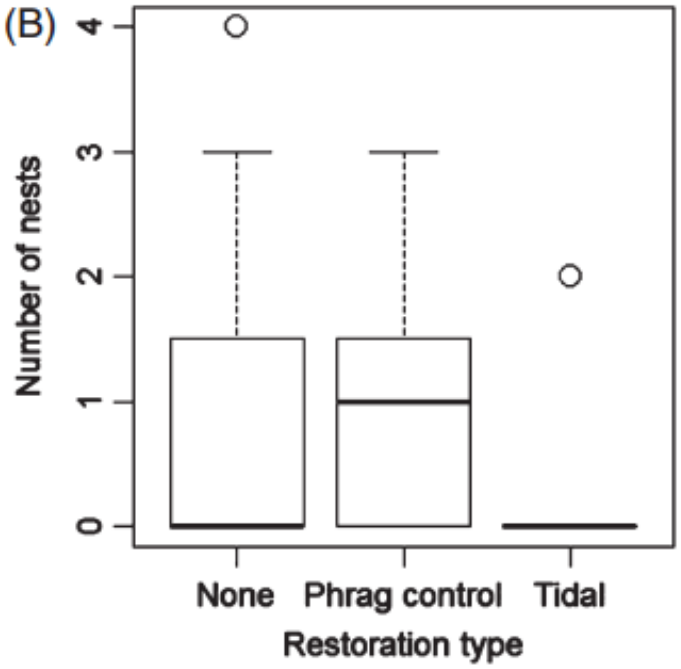


SHARP State Wildlife Grant (SWG) report; to be released

Bird responses to marsh restoration may be complex, however

Tidal-flow restoration may restore native saltmarsh vegetation… but conditions may be less suitable for nesting SGCNs.





For Saltmarsh Sparrows, focus management on sites where higher-elevation marsh can be restored or created

Elphick et al. 2015, Restoration Ecology

Monitoring marsh condition: Ecological surrogates?

We can monitor different tidal marsh characteristics to get at marsh condition.

birds: species, communities (distribution & abundance)

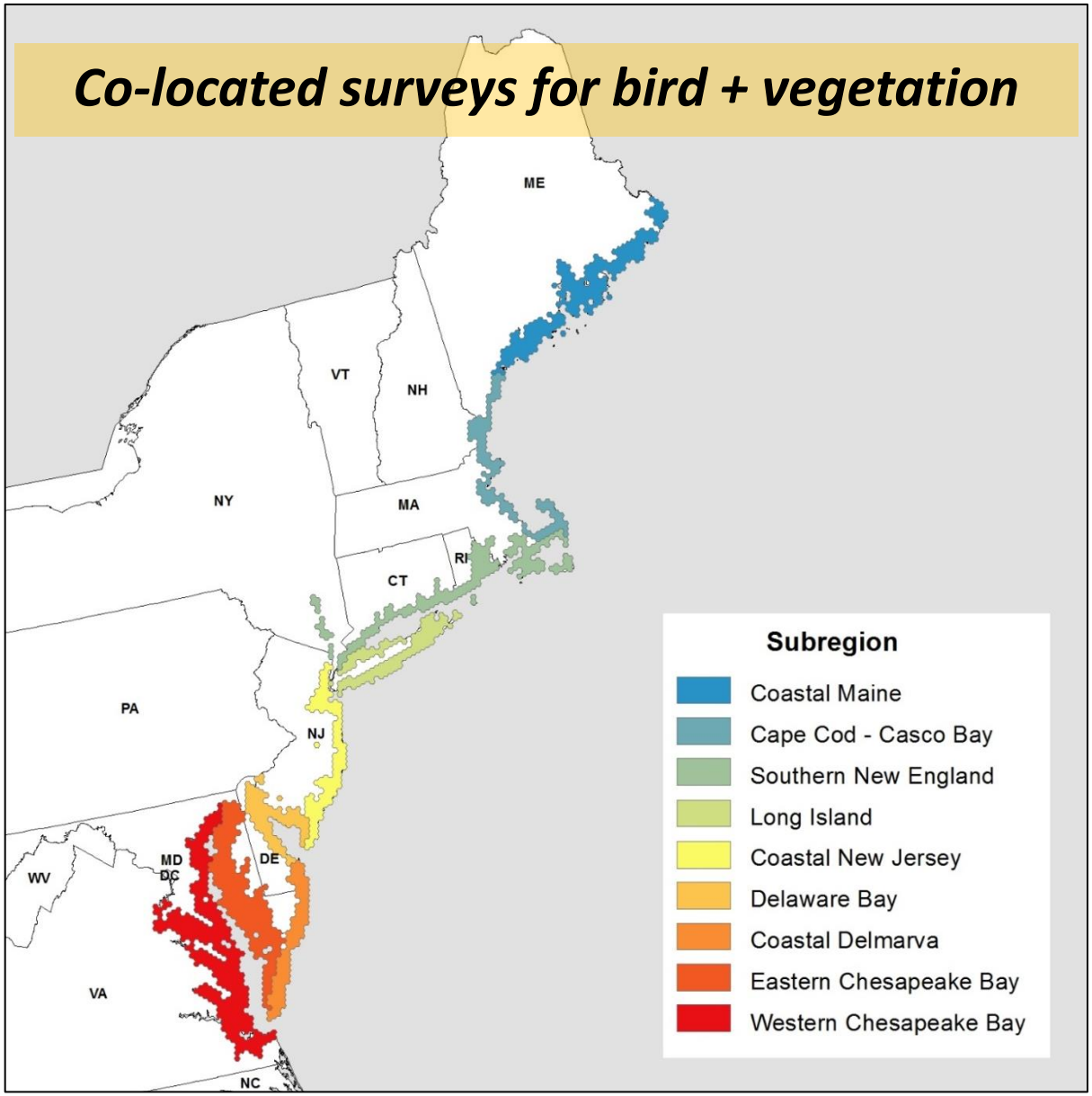
vegetation: ground surveys (structure & composition)

abiotic factors: e.g., elevation (RTK GPS surveys)

vegetation: remote sensing (marsh zonation mapping)

Survey design 2015: Restoration focus for birds & vegetation

Co-located surveys for bird + vegetation



With help from LCC, contacted 27 potential NFWF project partners

(ME <-> VA)

- RI Coastal Management Council
- NJ Dept. of Environmental Protection
- DE Dept. of Natural Resources
- Suffolk County Dept. of Economic Development & Planning (NY)
- American Littoral Society
- Town of North Beach, MD
- CT Fund for the Environment
- The Conservation Fund
- Rutgers University
- Little Egg Township, NJ
- Wampanoag Tribe of Gay Head, MA
- City of Newark, NJ
- National Wildlife Federation
- Town of Middletown, RI
- NYC Dept. of Parks & Rec
- City of Norfolk, VA
- Back Bay Restoration Foundation, VA
- Shinnecock Indian Nation, NY

Restoration types investigated (7)

(oyster or fish castles; reduce wave force and add structure for biota)

(1) Living shoreline

(2) Thin-layer sediment deposition

(layer of sediment used to raise marsh surface elevation; keep accretion apace with sea level rise)

Restoration types investigated (7)

(3) Restore hydrology

(natural sinuous channels)

(4) Vegetation planting
(5) Invasive species removal

(pepperweed removal: Parker River NWR)

Photo credit: L. Healey (Gulf of ME Research Institute)

Restoration types investigated (7)

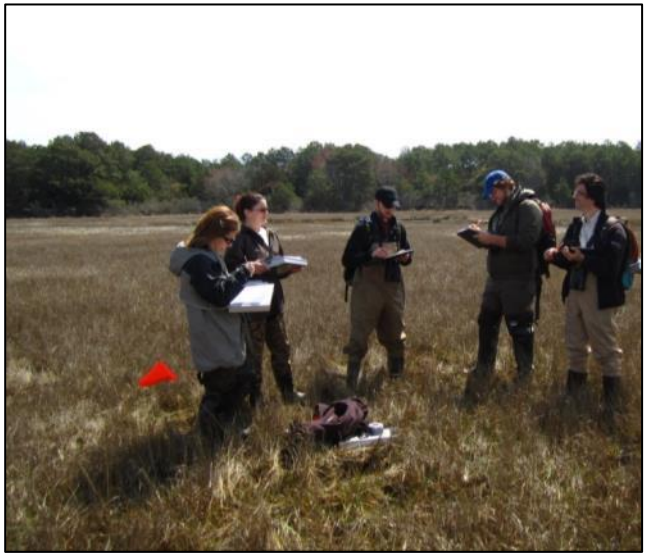
(6) Pole removal
(E.B. Forsythe NWR)

(7) Enhance marsh migration (marine transgression)

How to conduct a point count survey?

Standardized North American Marsh Bird Monitoring Protocols

- 5-minute point count + 30-second marsh bird call-broadcast suite
- Distance bands: 0-50 m, 50-100 m, 100+ m
- 2-3 surveys/point during 2011-2012 breeding seasons (mid-April to July)
- Co-located vegetation surveys at each restoration point



Ref: Conway 2011

Co-located bird and vegetation surveys

At each restoration / control survey point, we conducted:

(1) Rapid assessment vegetation survey (50-m radius)

- Dominant species % cover
- Communities & habitats % cover

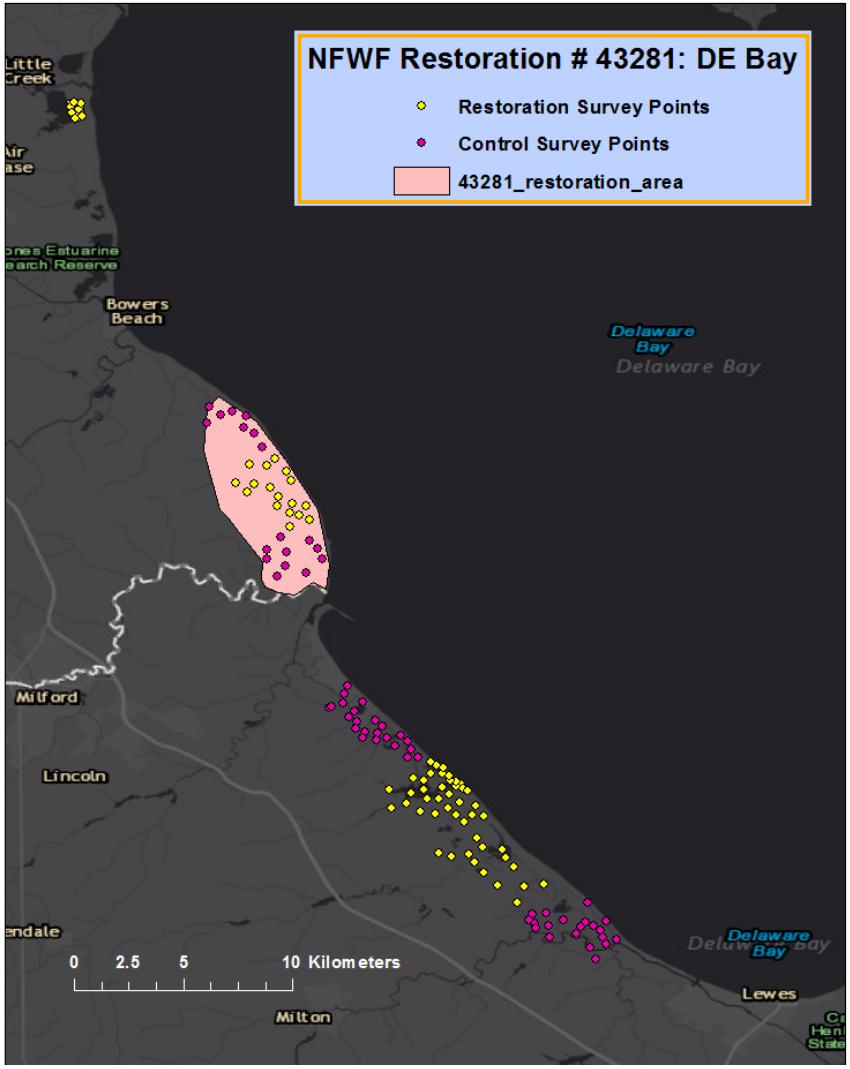
(methods modified from Neckles 2010)

(2) Point-intercept line transect vegetation survey

- Species composition
- Species occurrence

Building partnerships: Hurricane Sandy Saltmarsh Resiliency Projects

Co-located surveys for bird + vegetation



- **Built partnerships with 27 NFWF projects** (different time scales for restoration and levels of internal organization)

Assistance from Megan Tyrrell (LCC)

- **In 2015, conducted surveys at:**

9 NFWF-funded projects

13 refuges (USFWS)

(select historical locations)

(SMI locations – USFWS)

Total # restored locations = 560
Total # control locations = 349
(Total # survey locations = 1145)

Building partnerships: Hurricane Sandy Saltmarsh Resiliency Projects

National Fish & Wildlife Foundation (NFWF)-funded Projects Surveyed by SHARP in 2015

Project Number	Location	State	Organization	Restoration Type	Number of Survey Points
44157	Little Creek	DE	DE DNREC	sediment deposition; restore hydrology	7
43281	Mispillion Harbor Reserve, Milford Neck Conservation Area	DE	DE DNREC	restore hydrology	17
44167	North Beach	MD	Town of North Beach	living shoreline; sediment deposition; restore hydrology; vegetation planting	1
43429	Heislerville	NJ	American Littoral Society	sediment deposition	4
43290	Jersey City	NJ	NJ DEP	restore hydrology	5
43095	Stone Harbor, Fortescue	NJ	NJ DEP	sediment deposition	44
42442	Sunken Meadow SP	NY	CT Fund for the Environment	restore hydrology	9
43006	Suffolk County	NY	Suffolk Co. Department of Economic Development and Planning	sediment deposition; restore hydrology	28
41739	Ninigret NWR	RI	RI Coastal Resources Management Council	sediment deposition; vegetation planting	4
Total	**9 projects**			**4 restoration types**	**119 points**

Building partnerships: Hurricane Sandy Saltmarsh Resiliency Projects

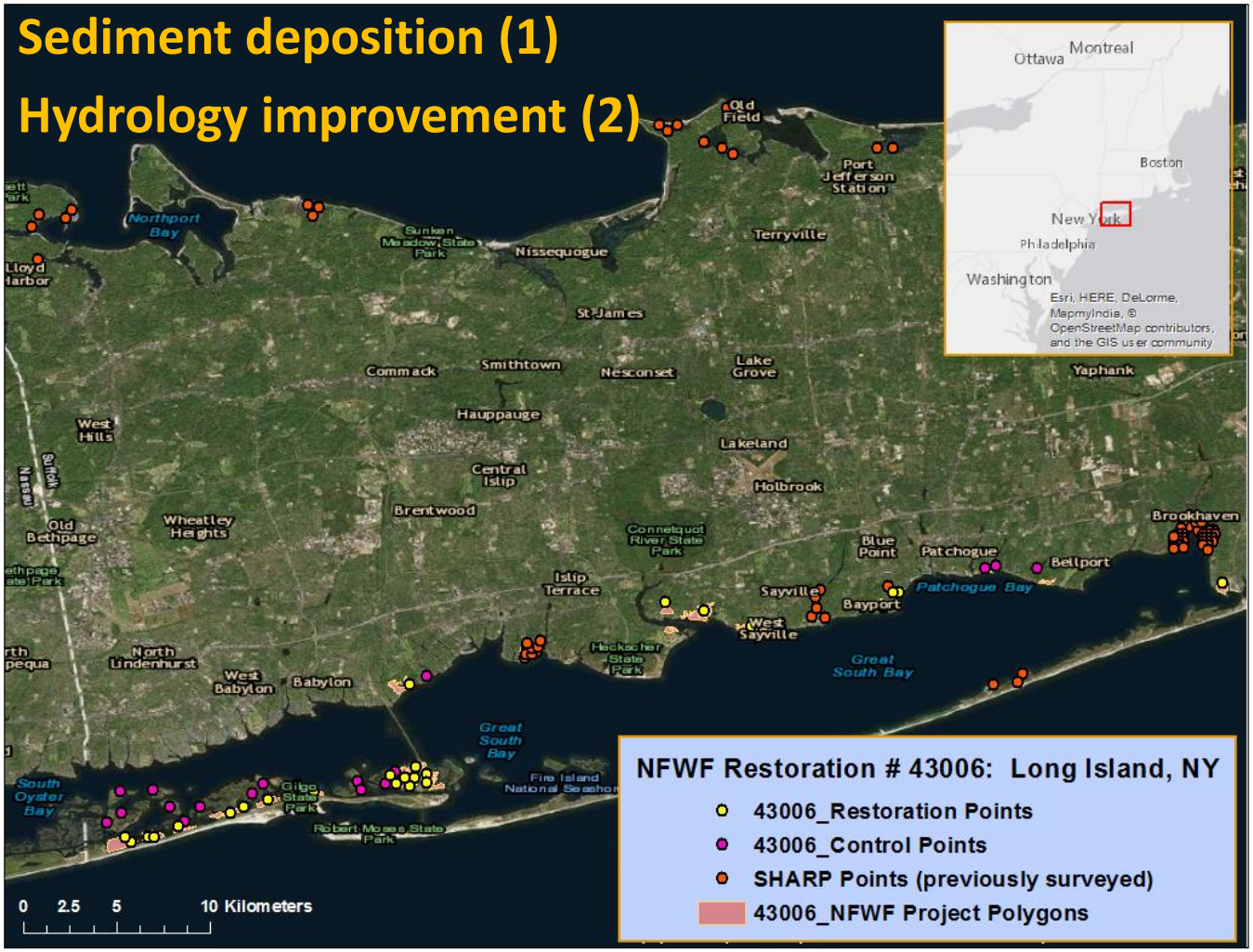
U.S. Fish & Wildlife Service (USFWS) Projects Surveyed by SHARP in 2015

Refuge	State	Restoration Type	Number of Survey Points
Cape May	NJ	sediment deposition	18
Chincoteague	VA	living shoreline	5
Eastern Neck	MD	living shoreline	20
Edwin B. Forsythe	NJ	sediment deposition, restore hydrology, pole removal	102
John H. Chafee	RI	living shoreline, sediment deposition, restore hydrology, enhance marsh migration, invasive species removal	38
Lido Beach WMA	NY	living shoreline	3
Parker River	MA	restore hydrology, invasive species removal	147*
Prime Hook	DE	restore hydrology	46
Sachuest Point	RI	living shoreline, sediment deposition, restore hydrology, invasive species removal, vegetation planting	7
Seatuck	NY	living shoreline, sediment deposition, restore hydrology, invasive species removal	10
Supawna Meadows	NJ	restore hydrology	33
Wertheim	NY	living shoreline, restore hydrology, invasive species removal	40
Total	**13 refuges**	**7 restoration types**	**469 points**

Preliminary results: Two NFWF-project case studies

Project #43006: Long Island, NY

Suffolk County Dept. of Economic Planning & Development



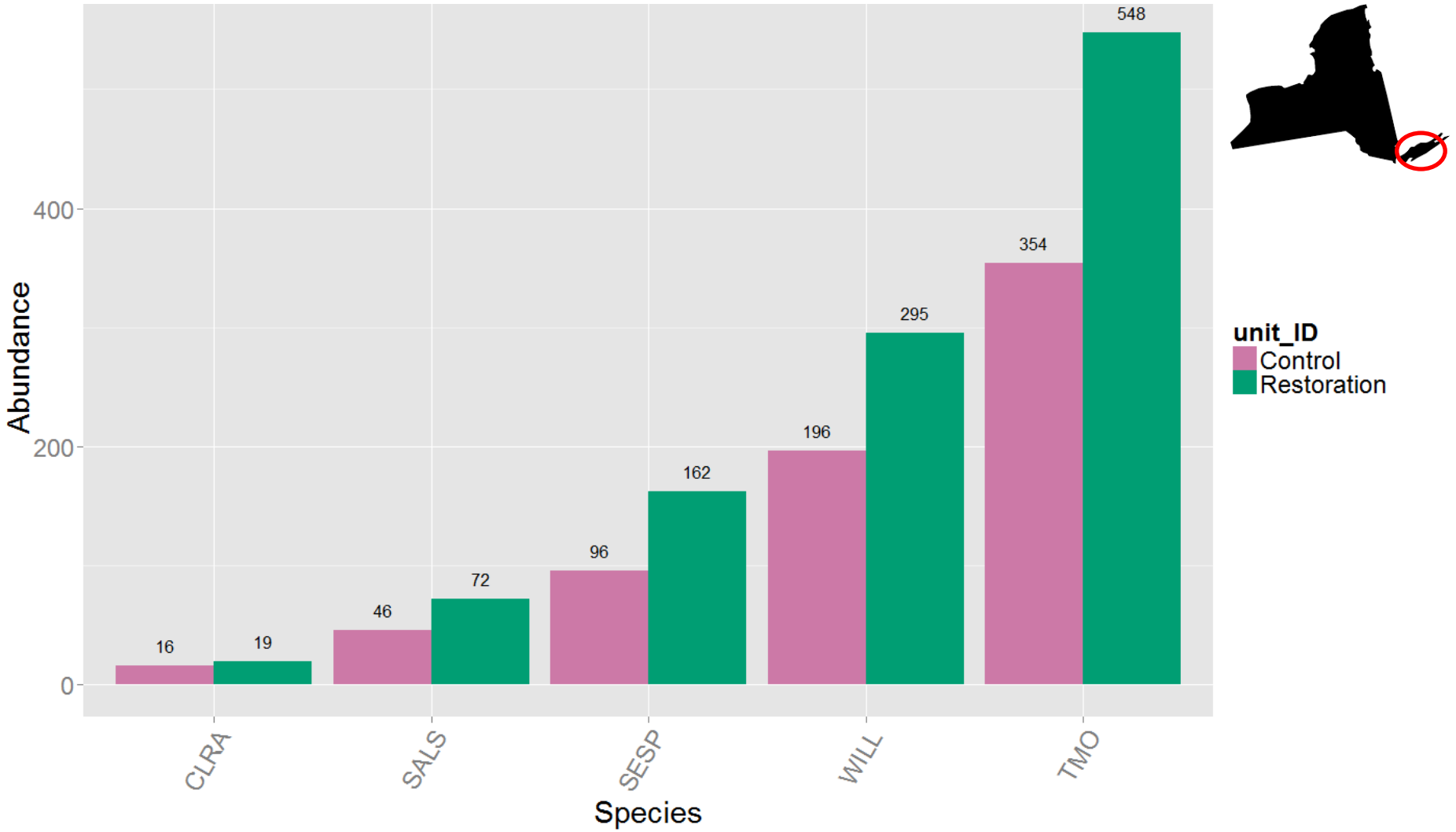
POC: Camilo Salazar

Restoration points:
(n = 28)
20 new
8 existing (SHARP)

Control points:
(n = 18)
18 existing (SHARP)

Preliminary results: Project #43006 (Long Island, NY)

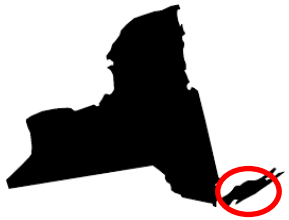
Raw abundance of TMO species (pre-restoration): NFWF #43006

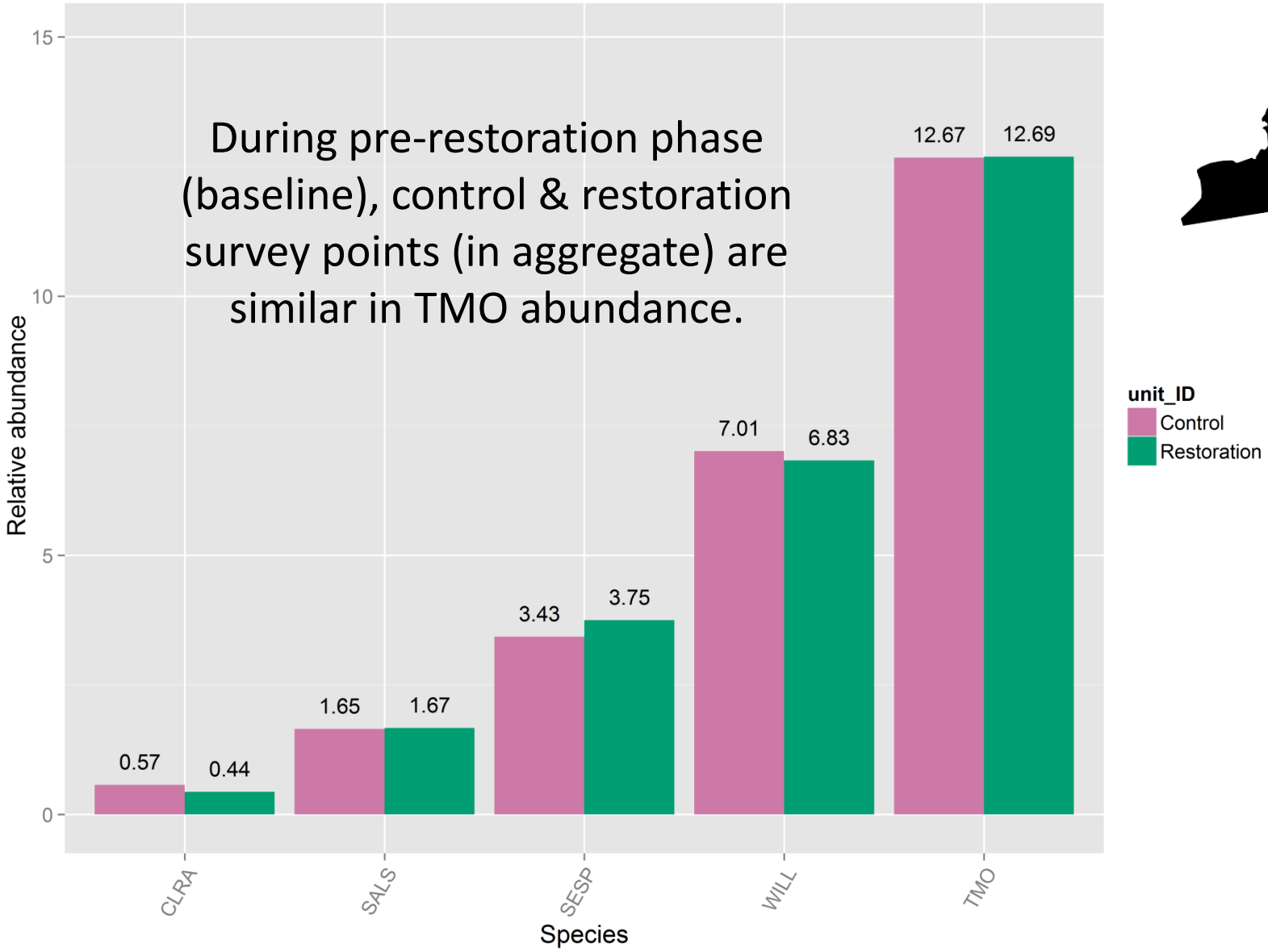


Preliminary results: Project #43006 (Long Island, NY)

Relative abundance of TMO species (pre-restoration)

During pre-restoration phase (baseline), control & restoration survey points (in aggregate) are similar in TMO abundance.

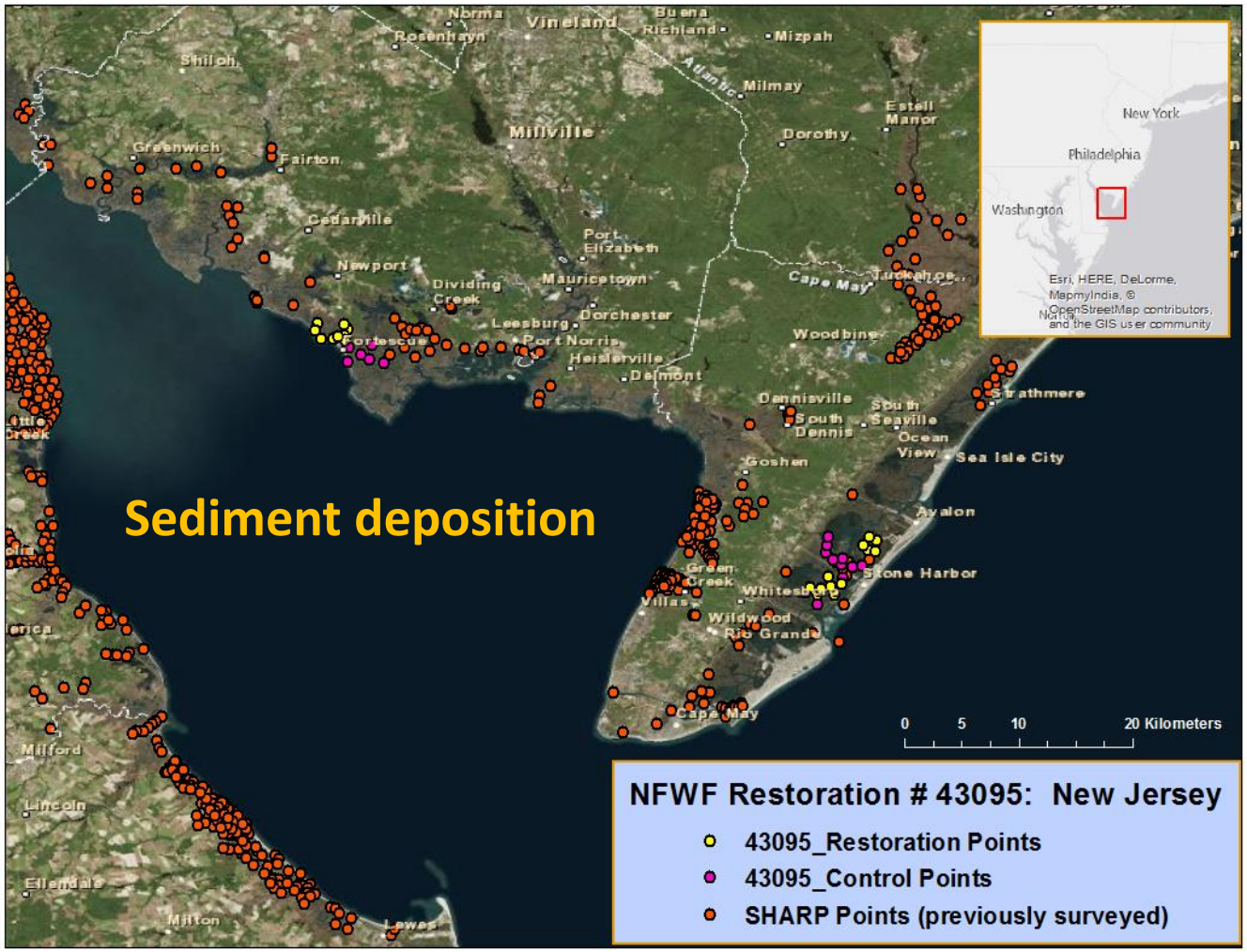




Preliminary results: Two NFWF-project case studies

Project #43095: Stone Harbor, Avalon, and Forescue, NJ

NJ Dept. of Environmental Protection (NJ DEP)



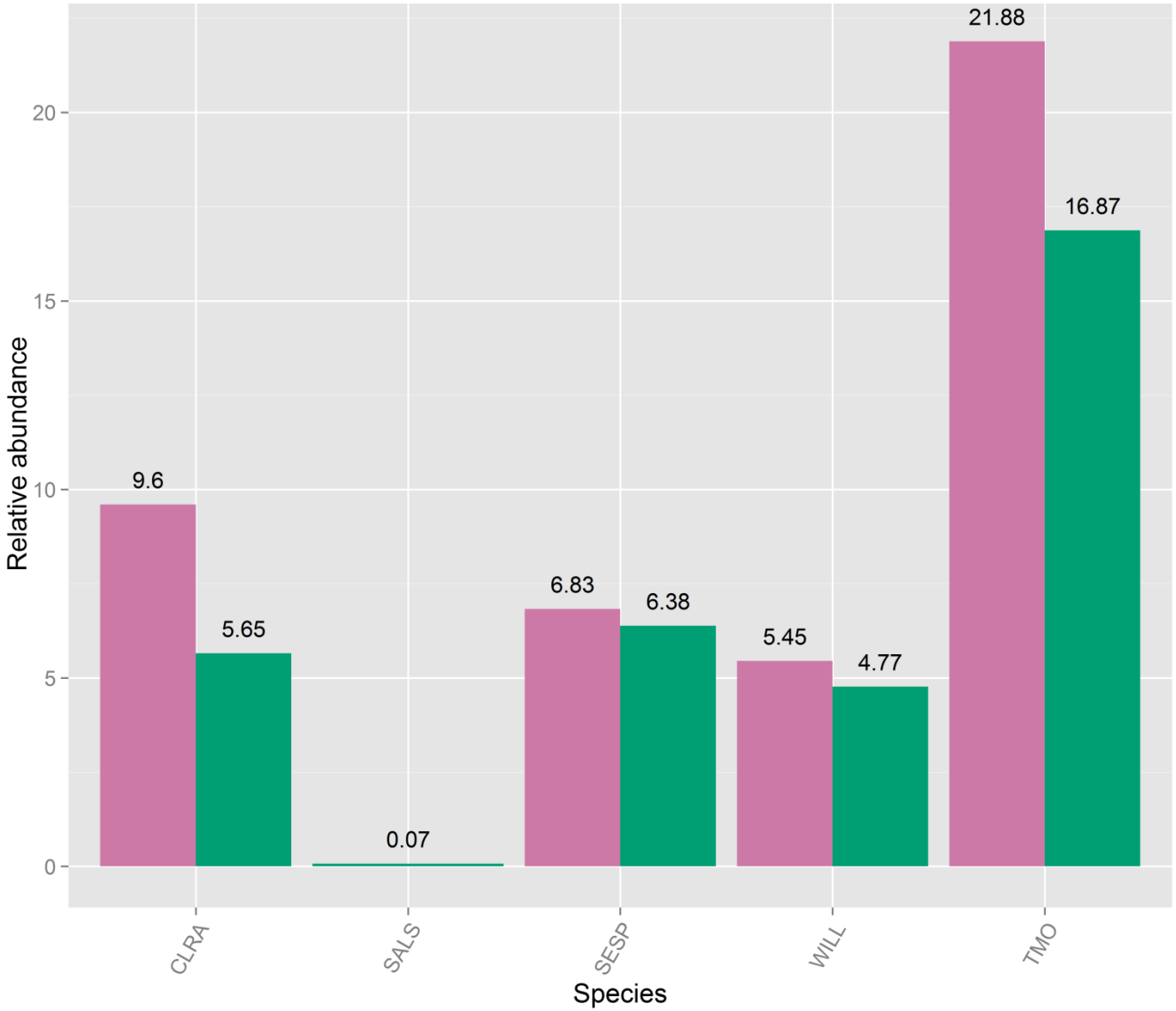
POC: David Golden

Restoration points:
(n = 22)
18 new
4 existing (SHARP)

Control points:
(n = 17)
17 existing (SHARP)

Preliminary results: Project #43095 (NJ)

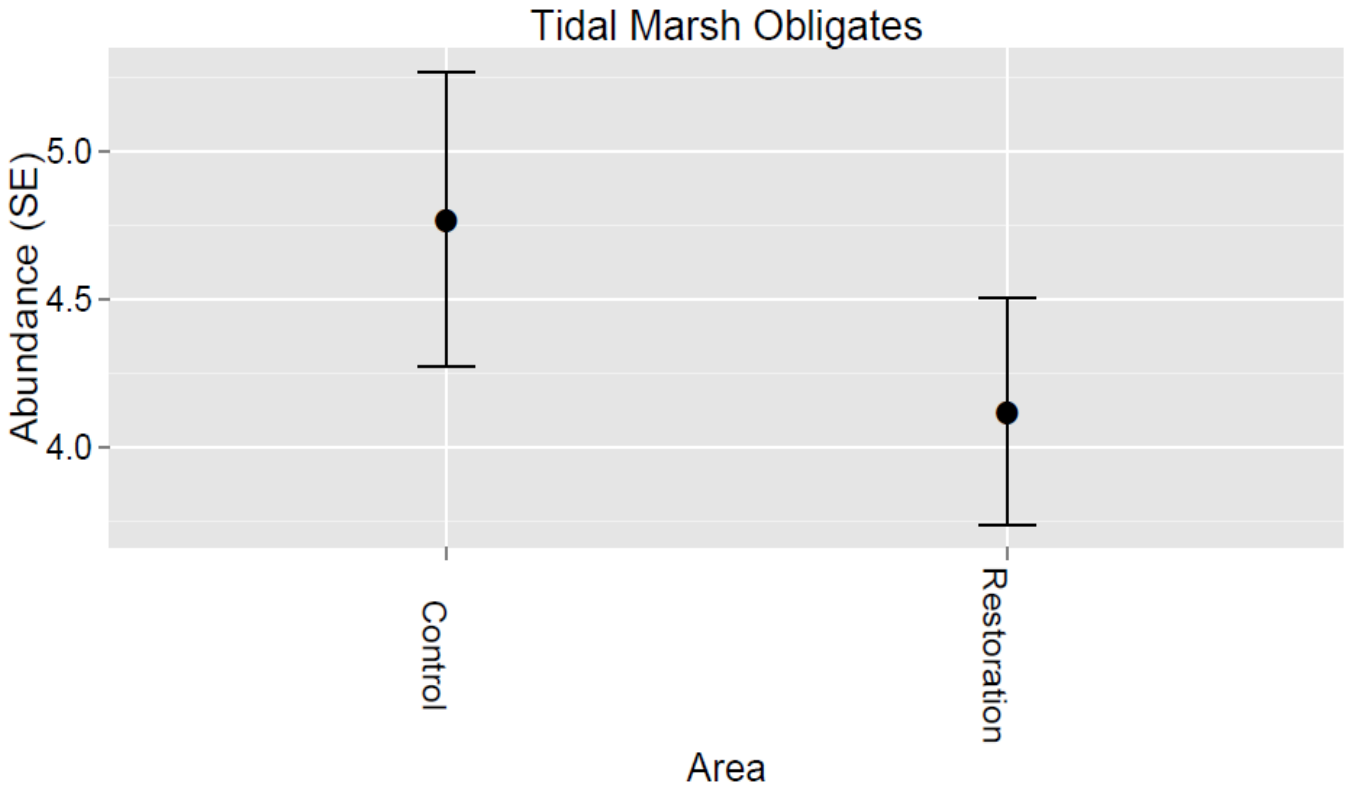
Relative abundance of TMO species (pre-restoration)



NFWF-funded projects: Future data analyses

Using observed data across all points, sites:

- Model abundance of TMO / SGCN species (e.g., 'unmarked'; program R)
- Calculate bird community metrics
- Evaluate in context of marsh restoration practices



NFWF Project #43095

Current efforts to centralize data management

Centralized SHARP relational database:

- Eventual inclusion of all SHARP tidal marsh datasets (survey, veg, demo, RTK)
- Generalizable region-wide (across agencies and collaborative entities)

Data entry:

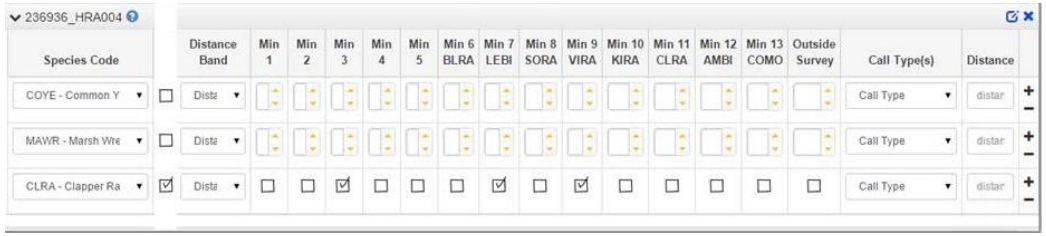
Online portal

Data queries & manipulation:

MSAccess “front end” /
SQL Server Management Studio
(SSMS for administrators)

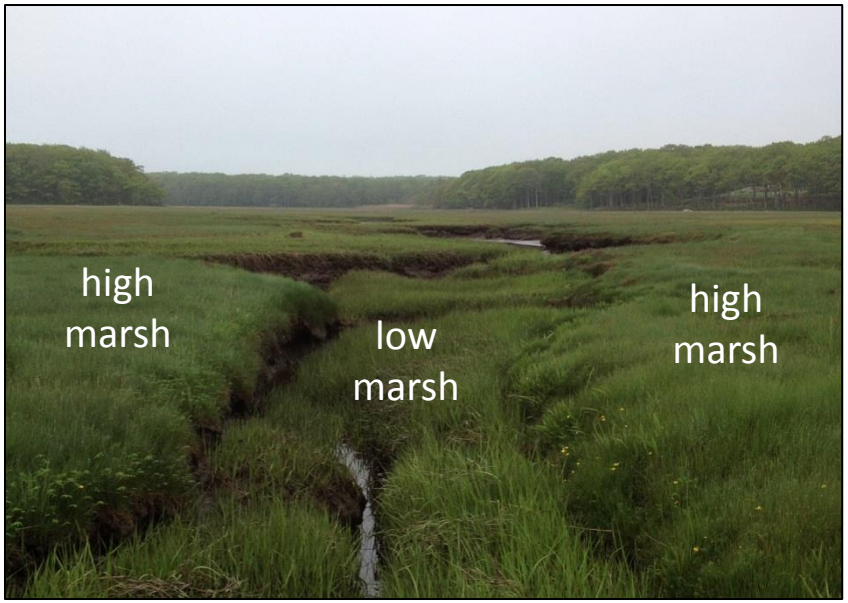
Data storage:

SQL Database
(located at UMaine)



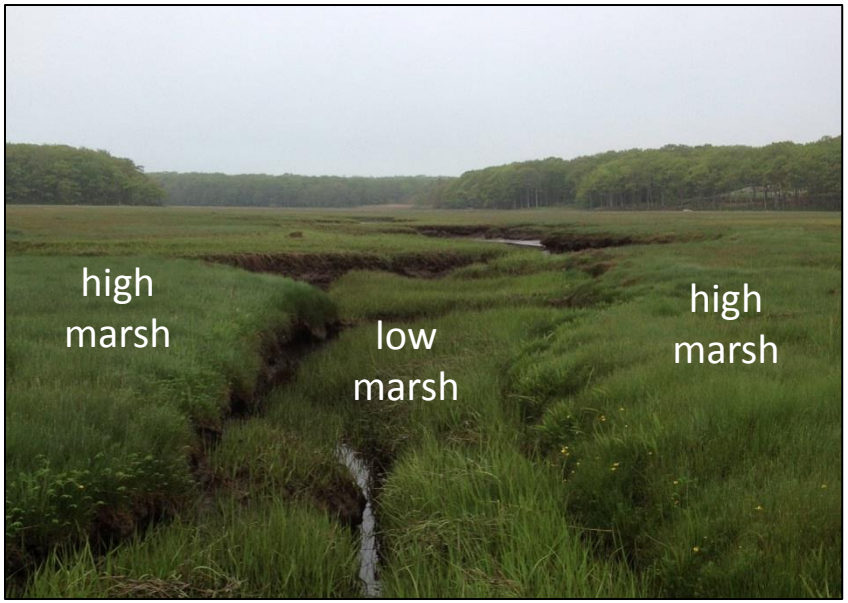
Vegetation community delineation

Plant communities matter.



Vegetation community delineation

Plant communities matter.



THE BIOGEOGRAPHY AND CONSERVATION OF TIDAL MARSH BIRD COMMUNITIES ACROSS A CHANGING LANDSCAPE

By
Maureen D. Correll
B.S. The College of William and Mary, 2003

A DISSERTATION
Submitted in Partial Fulfillment of the
Requirements for the Degree of
Doctor of Philosophy
(in Ecology and Environmental Science)

The Graduate School
The University of Maine
December 2015

Advisory Committee:
Brian J. Olsen, Associate Professor, School of Biology and Ecology, Co-advisor
Thomas P. Hodgman, Biologist, Maine Department of Inland Fisheries and Wildlife, Co-advisor
Brian J. McGill, Assistant Professor, School of Biology and Ecology
Kate O'Brien, Refuge Biologist, Rachel Carson National Wildlife Refuge, United States Fish and Wildlife Service
Steven S. Sader, Full Professor, School of Forest Resources, The University of Maine

Chapter 5:

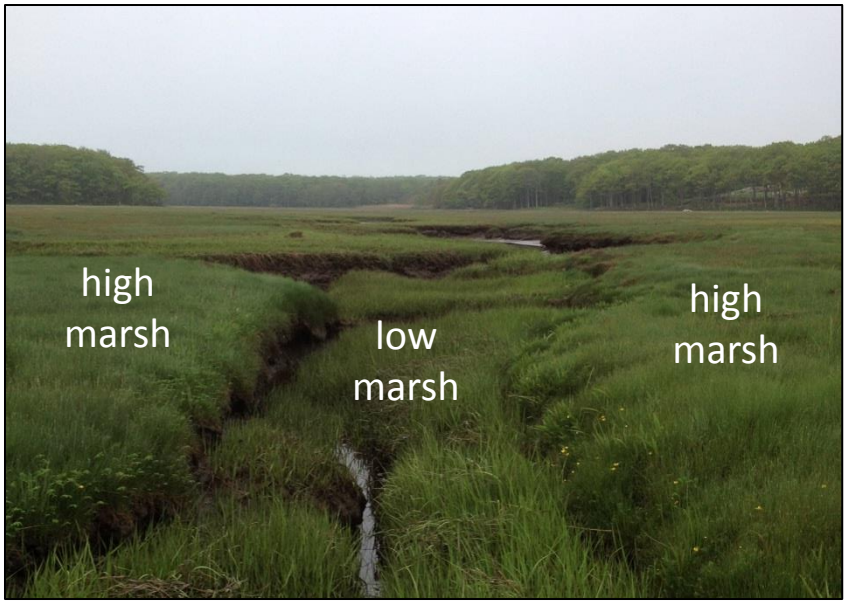
Predicting tidal marsh communities via remote sensing: a potential tool for coastal conservation

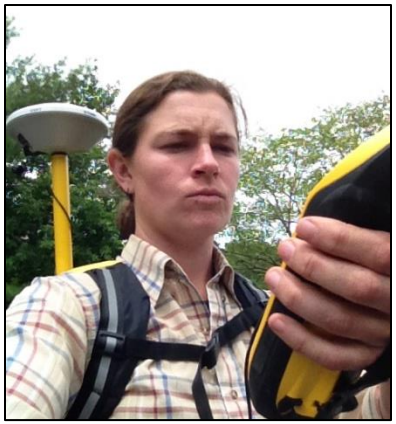
Vegetation community delineation

Field season 2015:

1086 polygons delineated from Maine to Virginia following GRTS sampling framework

These polygons are now being used to develop and assess predictive models of marsh communities using remote sensing





Trimble GEO

30 cm horizontal accuracy

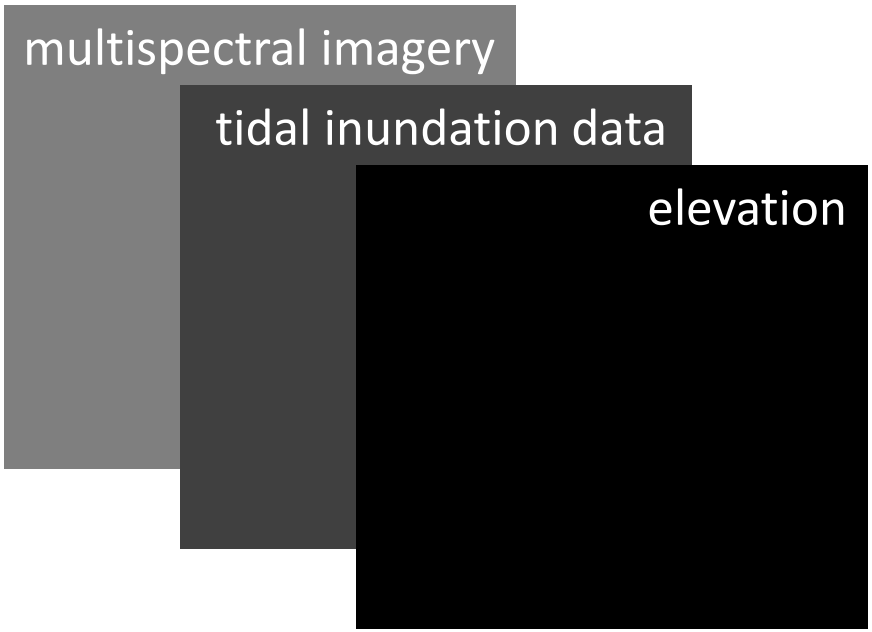
Communities/cover types delineated:

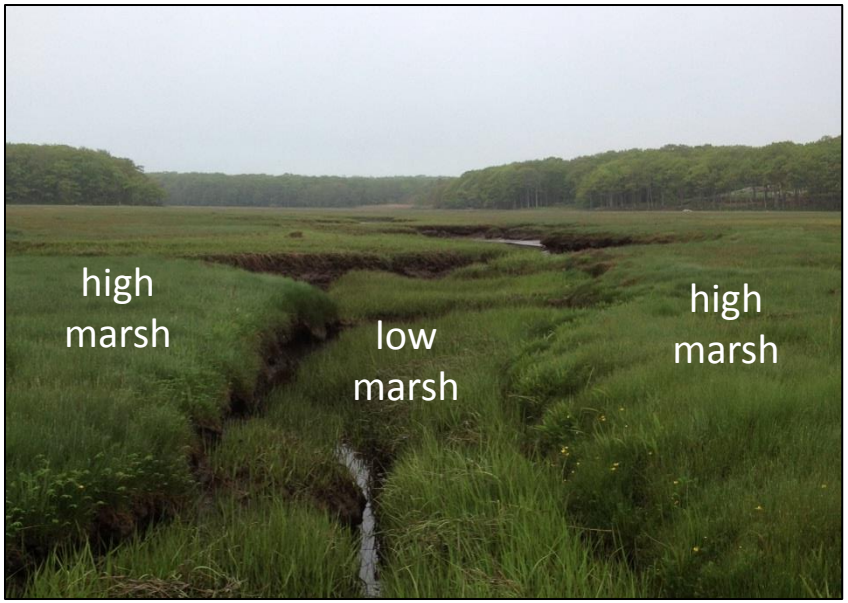
high marsh	Phragmites
low marsh	pools/pannes*
mixed marsh	mudflat*

** Will be delineated post-hoc via aerial imagery*

Vegetation community prediction

Developing a tool for predicting marsh vegetation in the northeastern United States





National Agriculture Imagery Program (NAIP)

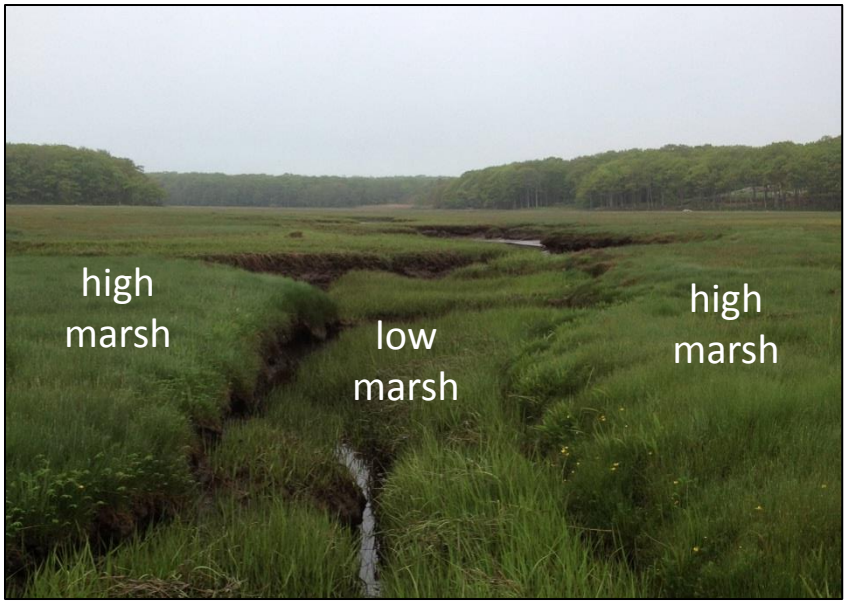
1 meter resolution

National Elevation Dataset (NED)

10 meter resolution

Vegetation community prediction

Developing a tool for predicting marsh vegetation in the northeastern United States



multispectral imagery

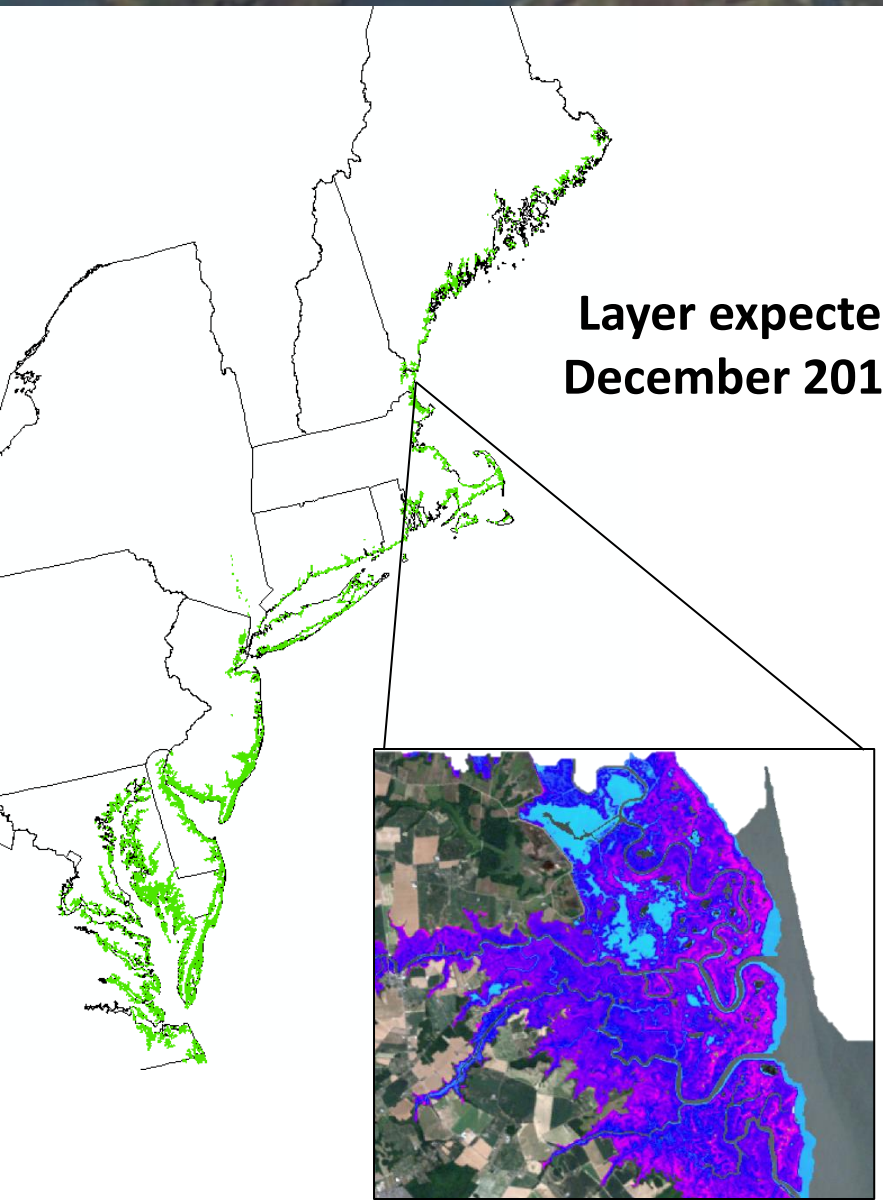
tidal inundation data

elevation

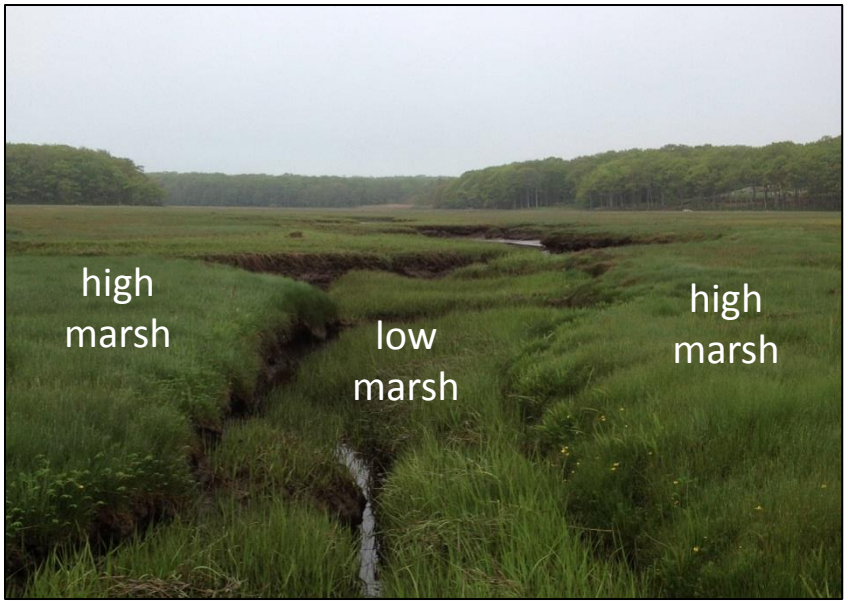
Wouter Hantson,

GIS Analyst

A marsh vegetation layer for the northeast



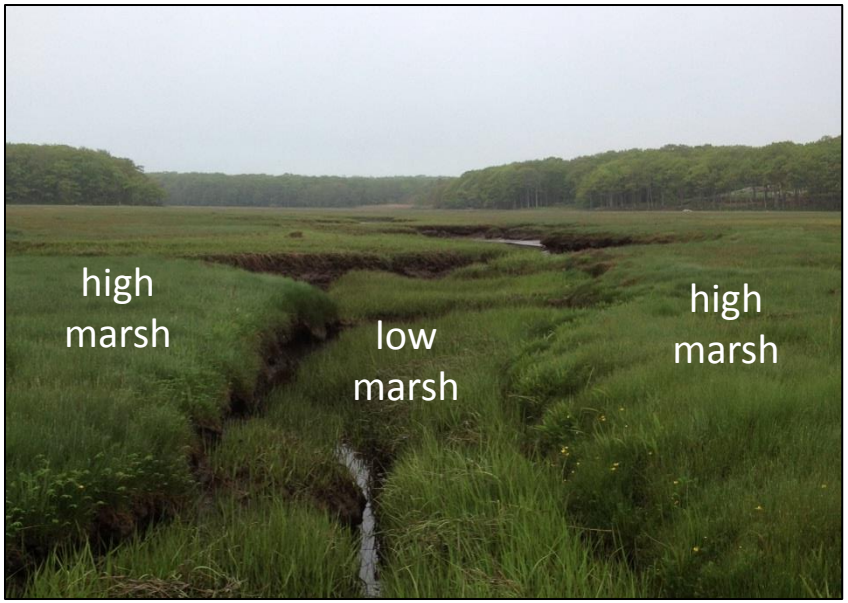
Layer expected December 2016.



Continuous delineation of coastal marshes from Maine to Virginia:

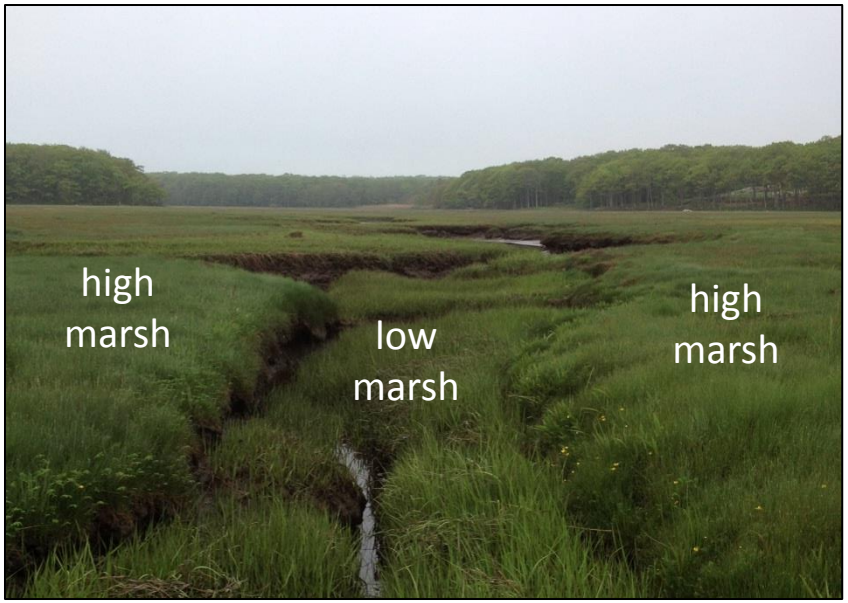
- high marsh
- low marsh
- mixed marsh
- Phragmites
- pools/pannes*
- mudflat*

A marsh vegetation layer for the Atlantic coast



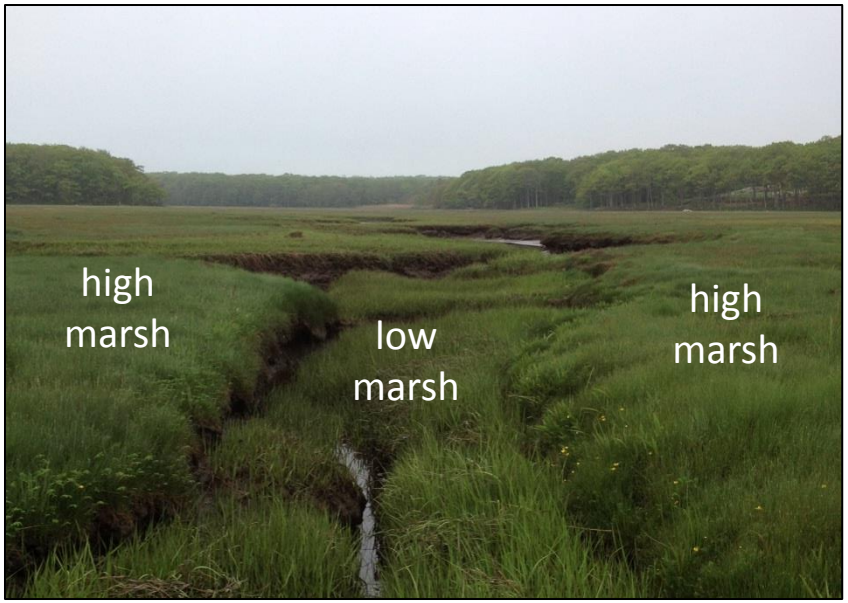
Combining forces with similar efforts will produce a near-contiguous layer from Maine to Florida.

Elevation in tidal marshes



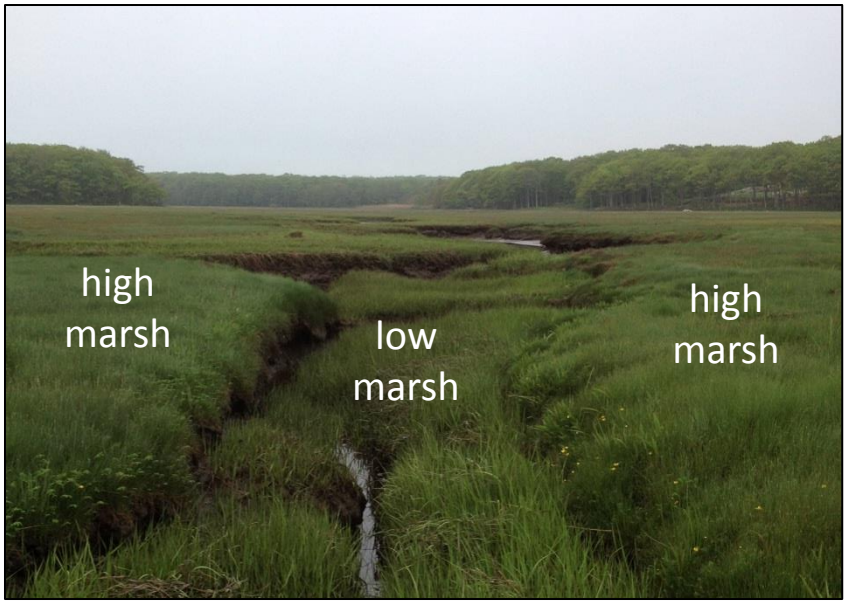
Elevation in tidal marshes

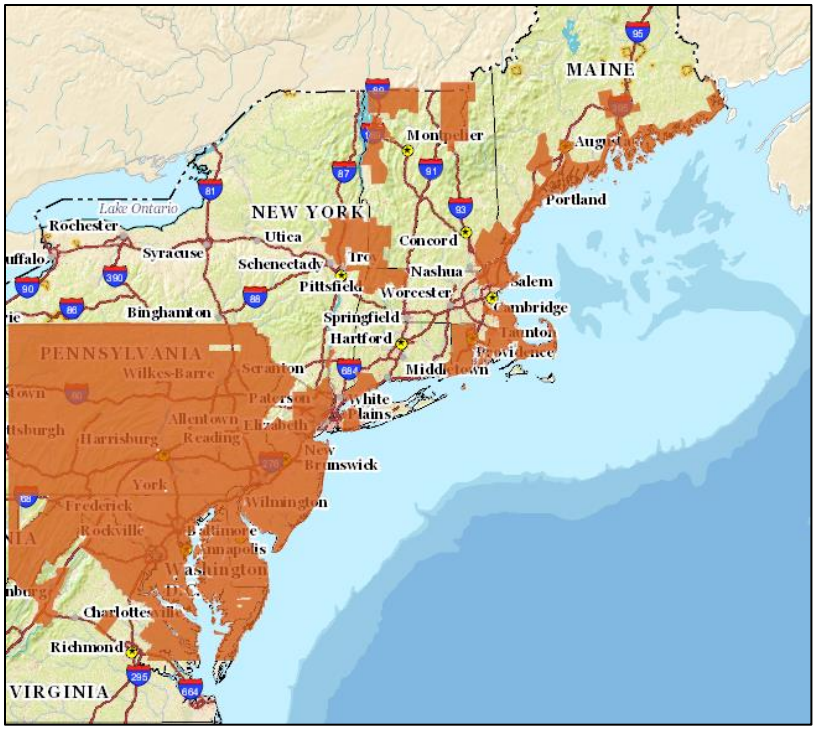
Small differences in elevation can indicate large ecological changes in tidal marshes.



Elevation in tidal marshes

Small differences in elevation can indicate large ecological changes in tidal marshes.





National Elevation Dataset (NED) provides:

3 meter (1/9 arc-second, LiDAR-source)

10 meter (1/3 arc-second)

30 meter (1 arc-second)

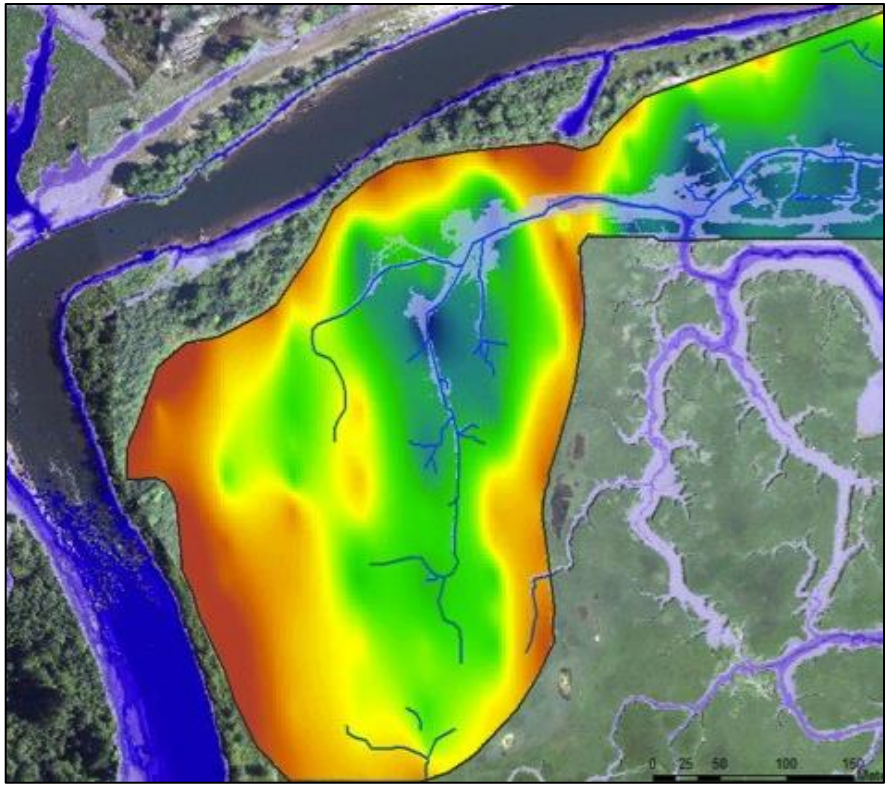
3-meter DEM availability

Real-Time Kinematic (RTK) elevation data

RTK units collect highly precise and accurate elevation data in tidal marshes.

RTK provides vertical accuracy of 3 cm.

San Francisco Bay, CA (USGS)



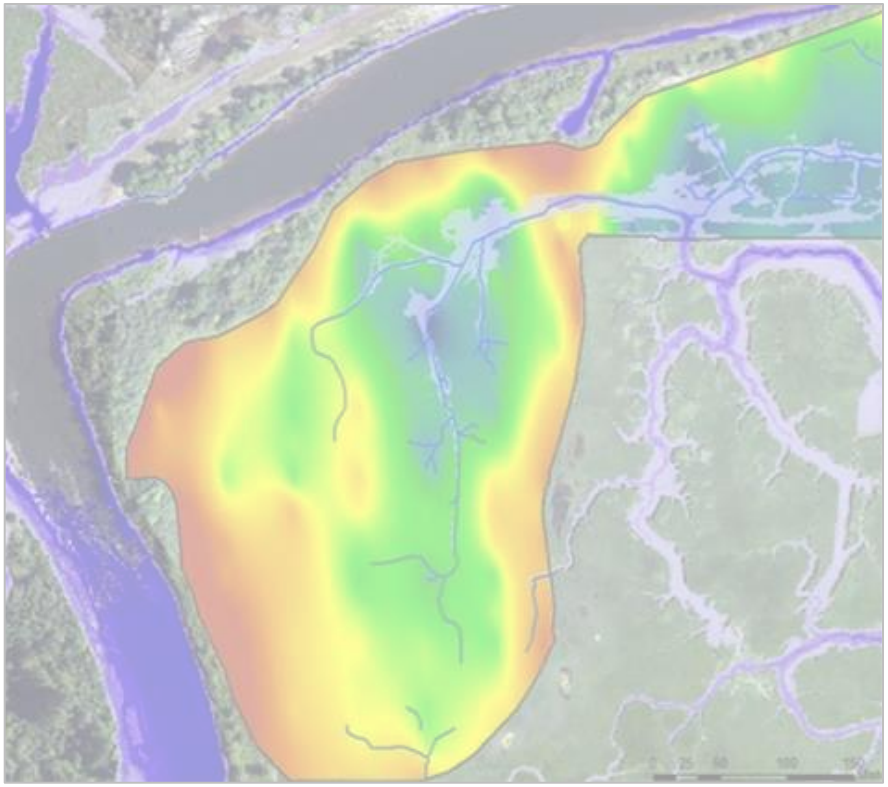
Real-Time Kinematic (RTK) elevation data

RTK units collect highly precise and accurate elevation data in tidal marshes.

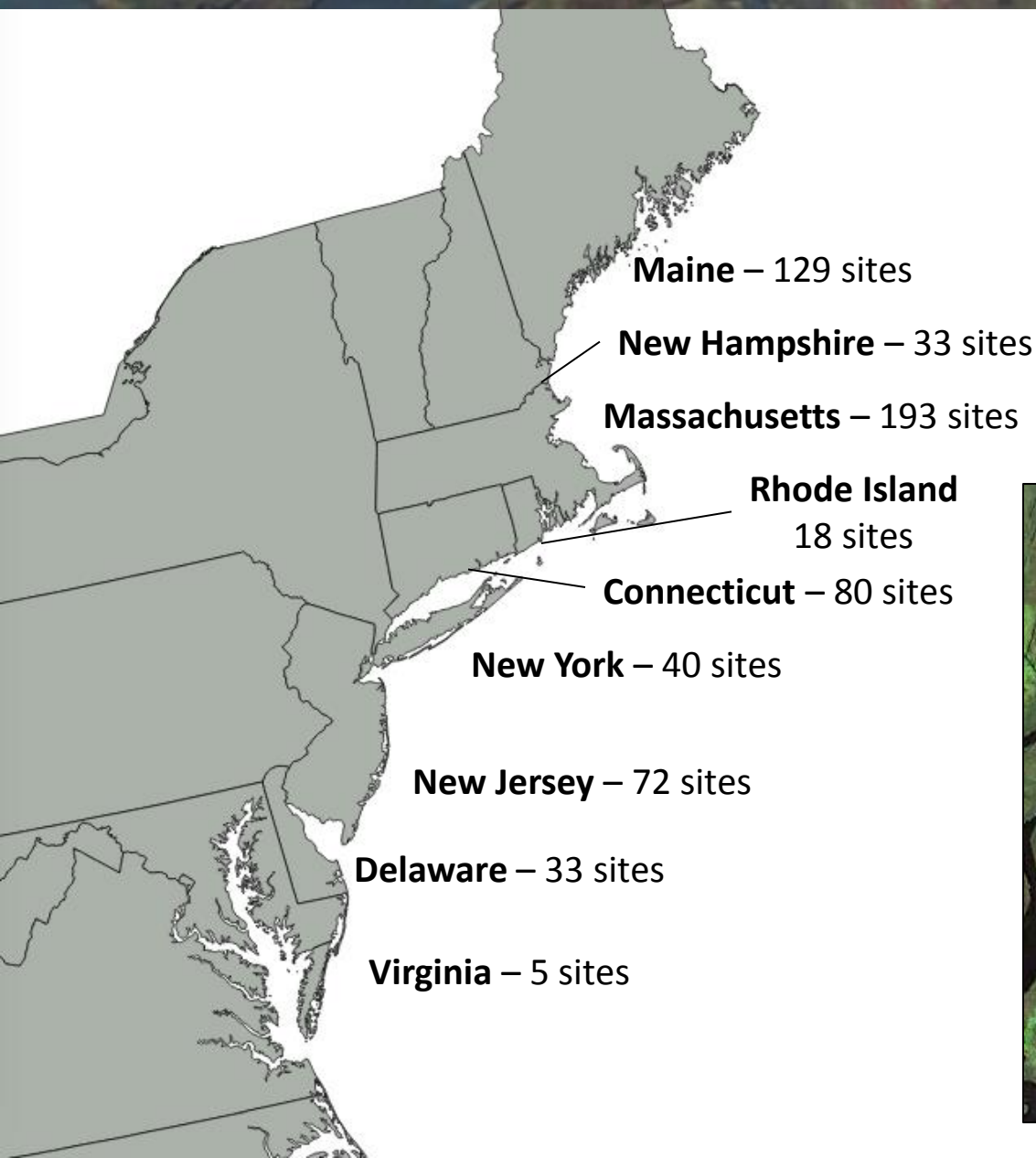
RTK provides vertical accuracy of 3 cm.

How do RTK measurements compare to other elevation data sources in tidal marshes?

San Francisco Bay, CA (USGS)

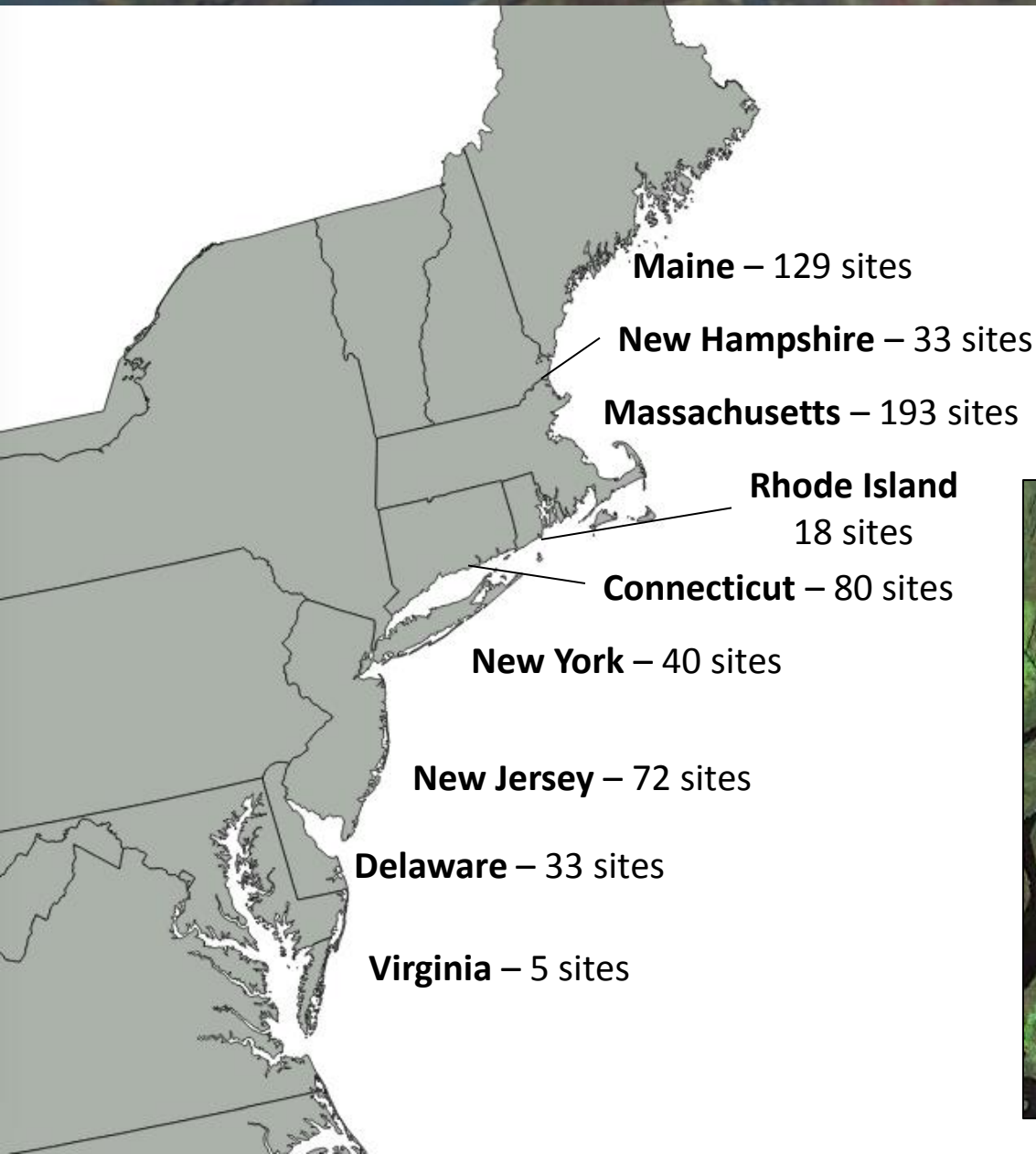


Real-Time Kinematic (RTK) elevation data



RTK data collected at 650 individual marsh sites following GRTS and restoration sampling

Real-Time Kinematic (RTK) elevation data



RTK data collected at 650 individual marsh sites following GRTS and restoration sampling

Real-Time Kinematic (RTK) elevation data

Maine – 129 sites

New Hampshire – 33 sites

Massachusetts – 193 sites

Rhode Island
18 sites

Connecticut – 80 sites

New York – 40 sites

New Jersey – 72 sites

Delaware – 33 sites

Virginia – 5 sites

RTK data collected at 650 individual marsh sites following GRTS and restoration sampling

(10,010 total points)

Real-Time Kinematic (RTK) elevation data

Maine – 129 sites

New Hampshire – 33 sites

Massachusetts – 193 sites

Rhode Island 18 sites

Connecticut – 80 sites

New York – 40 sites

New Jersey – 72 sites

Delaware – 33 sites

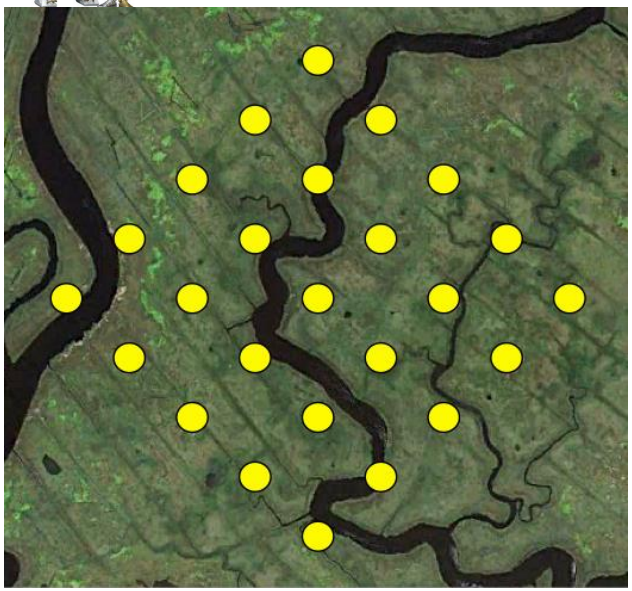
Virginia – 5 sites

RTK data collected at 650 individual marsh sites following GRTS and restoration sampling

(10,010 total points)

Real-Time Kinematic (RTK) elevation data

How do RTK measurements compare to other elevation data sources in tidal marshes?



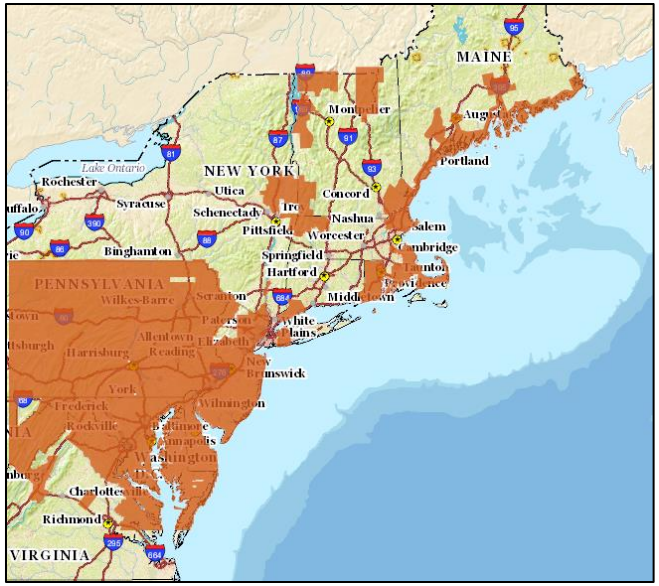
vs

National Elevation Dataset (NED) :

3 meter (1/9 arc-second, LiDAR-source)

10 meter (1/3 arc-second)

30 meter (1 arc-second)

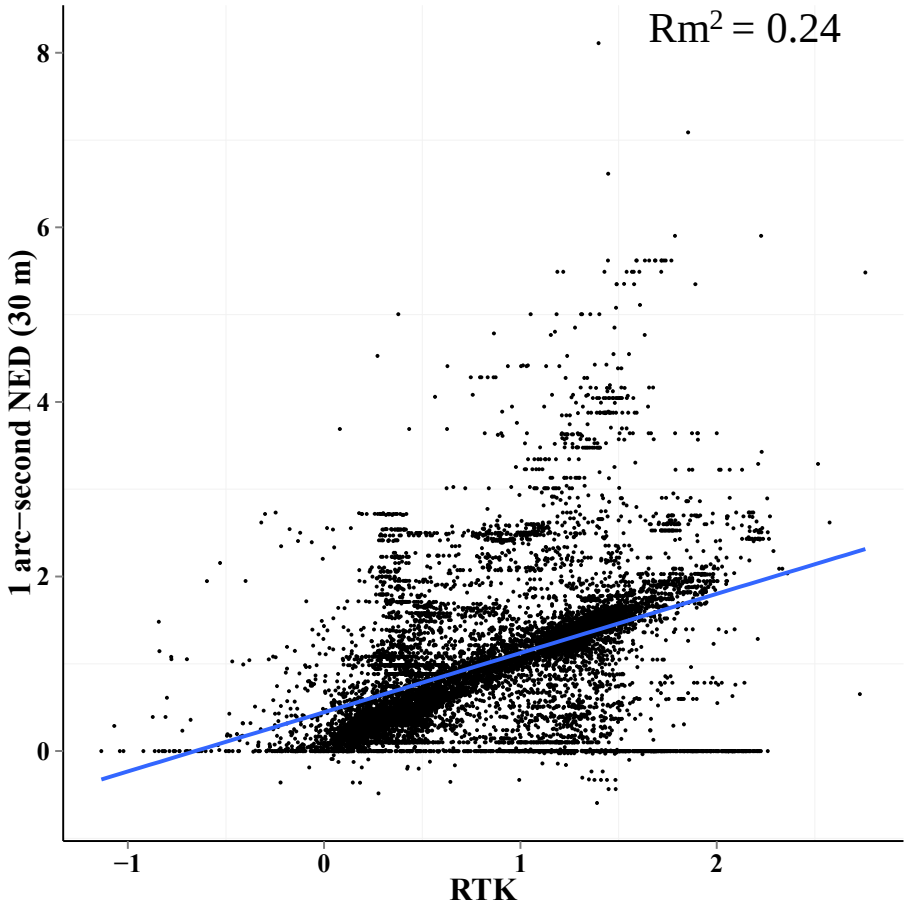


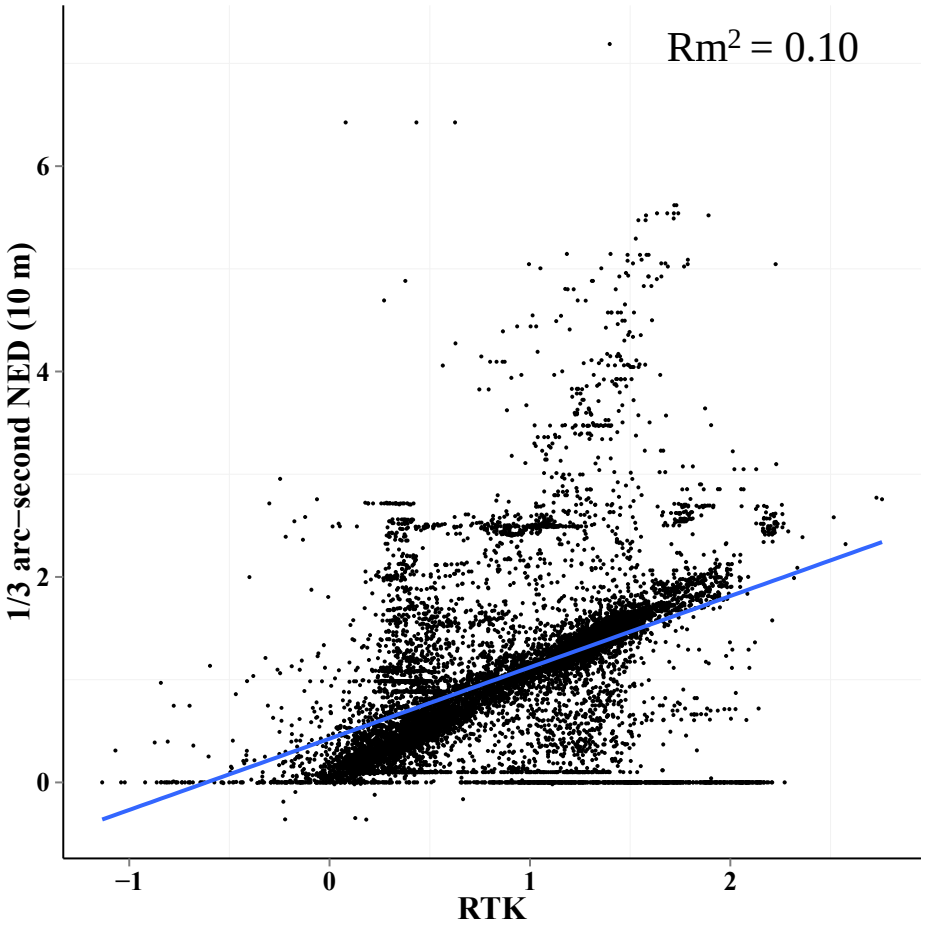
Digital Elevation Models (DEM)

Real-Time Kinematic (RTK) elevation data

The finer the DEM resolution, the tighter the relationship between RTK and DEM measurements

LMMs evaluated using marginal R^2

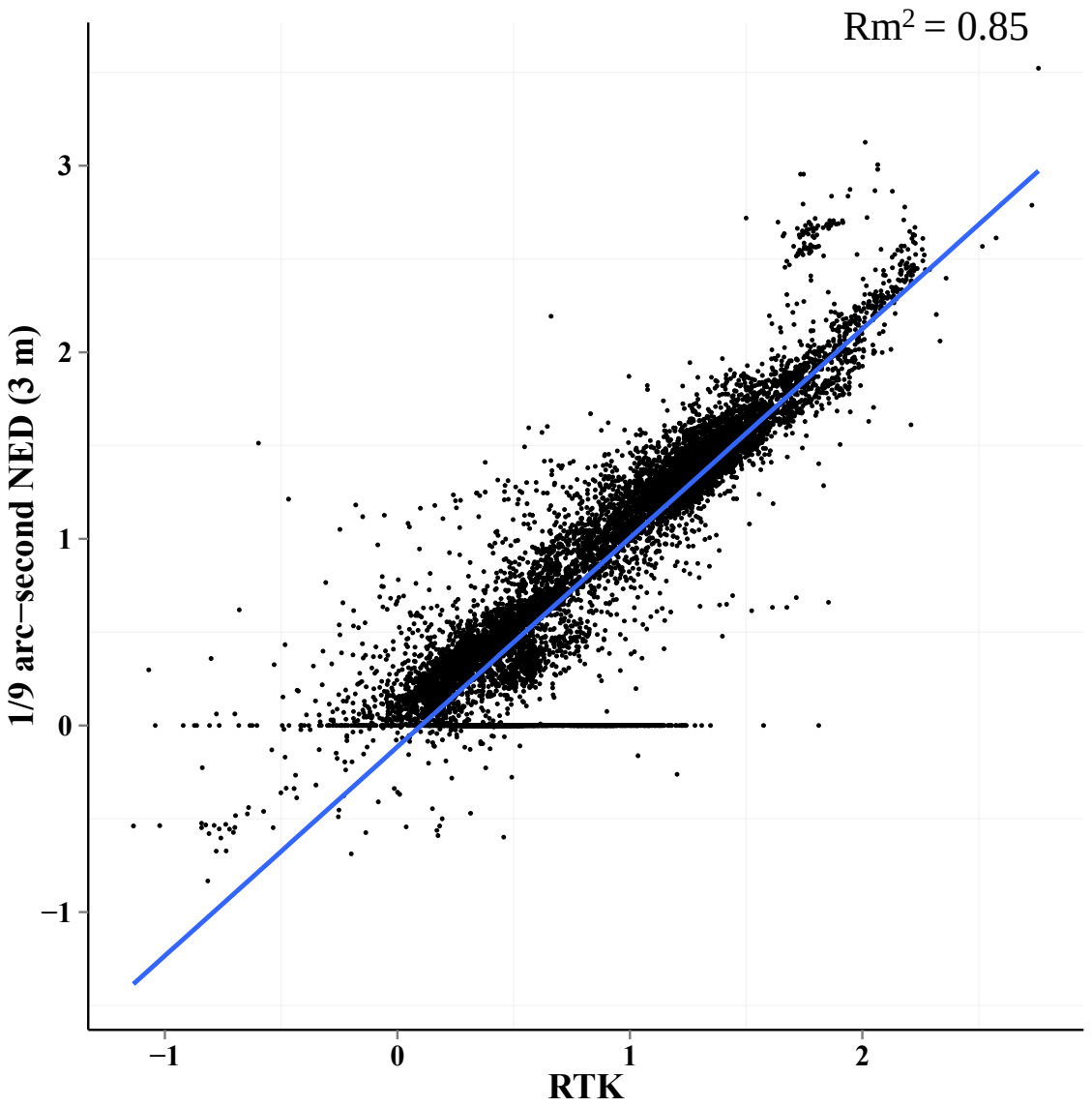




Real-Time Kinematic (RTK) elevation data

RTK elevation data is strongly correlated with 3m LiDAR-derived DEMs.

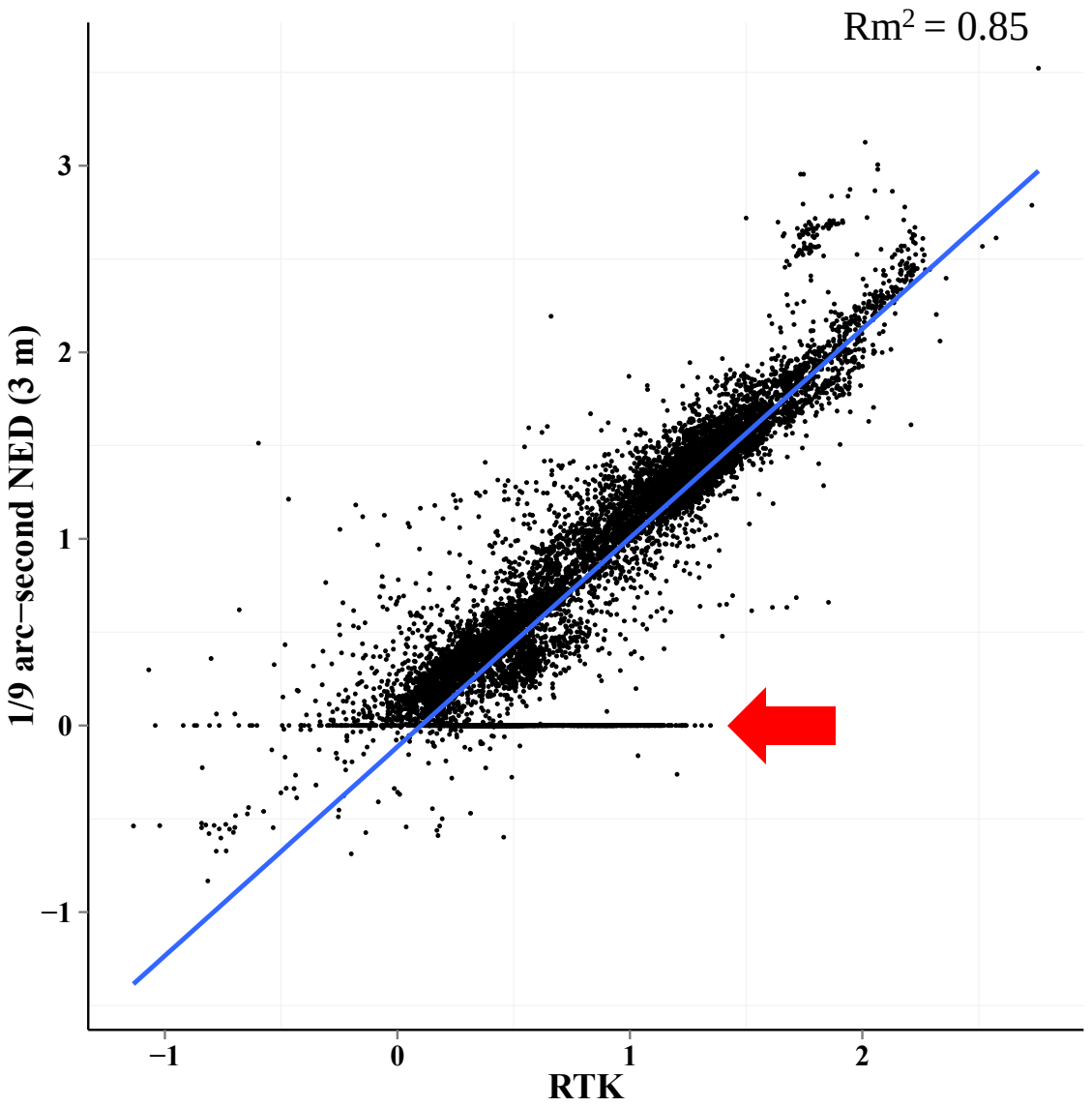
LMMs evaluated using marginal R^2



Real-Time Kinematic (RTK) elevation data

RTK elevation data is strongly correlated with 3m LiDAR-derived DEMs.

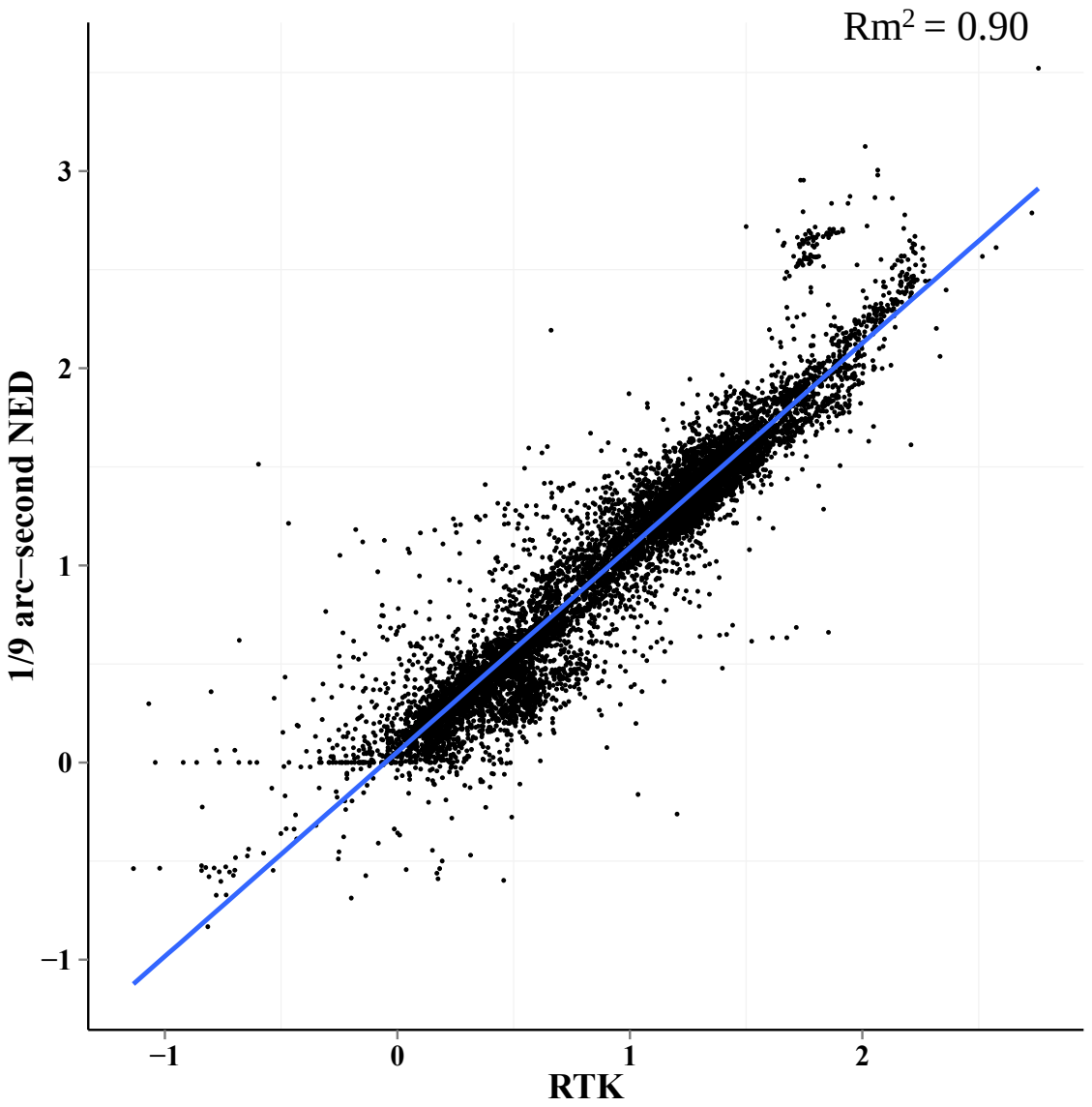
LMMs evaluated using marginal R^2



Real-Time Kinematic (RTK) elevation data

RTK elevation data is strongly correlated with 3m LiDAR-derived DEMs.

LMMs evaluated using marginal R^2



Real-Time Kinematic (RTK) elevation data

Do we need additional RTK points to further inform this relationship?

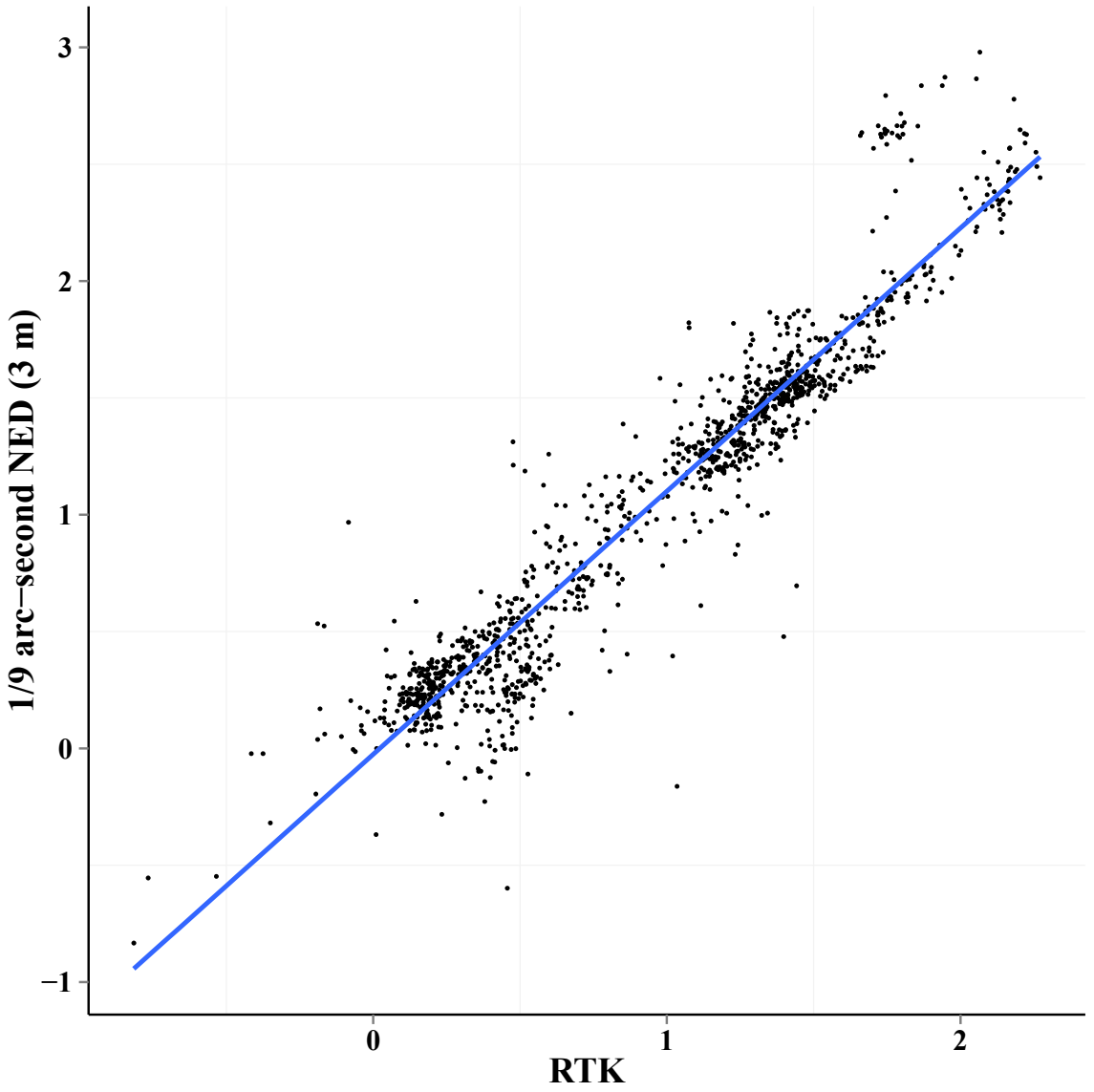
LMM analysis on sub-setted data (10% increments)

Real-Time Kinematic (RTK) elevation data

Do we need additional RTK points to further inform this relationship?

LMM analysis on sub-setted data (10% increments)

10% of data: $Rm^2 = 0.90$



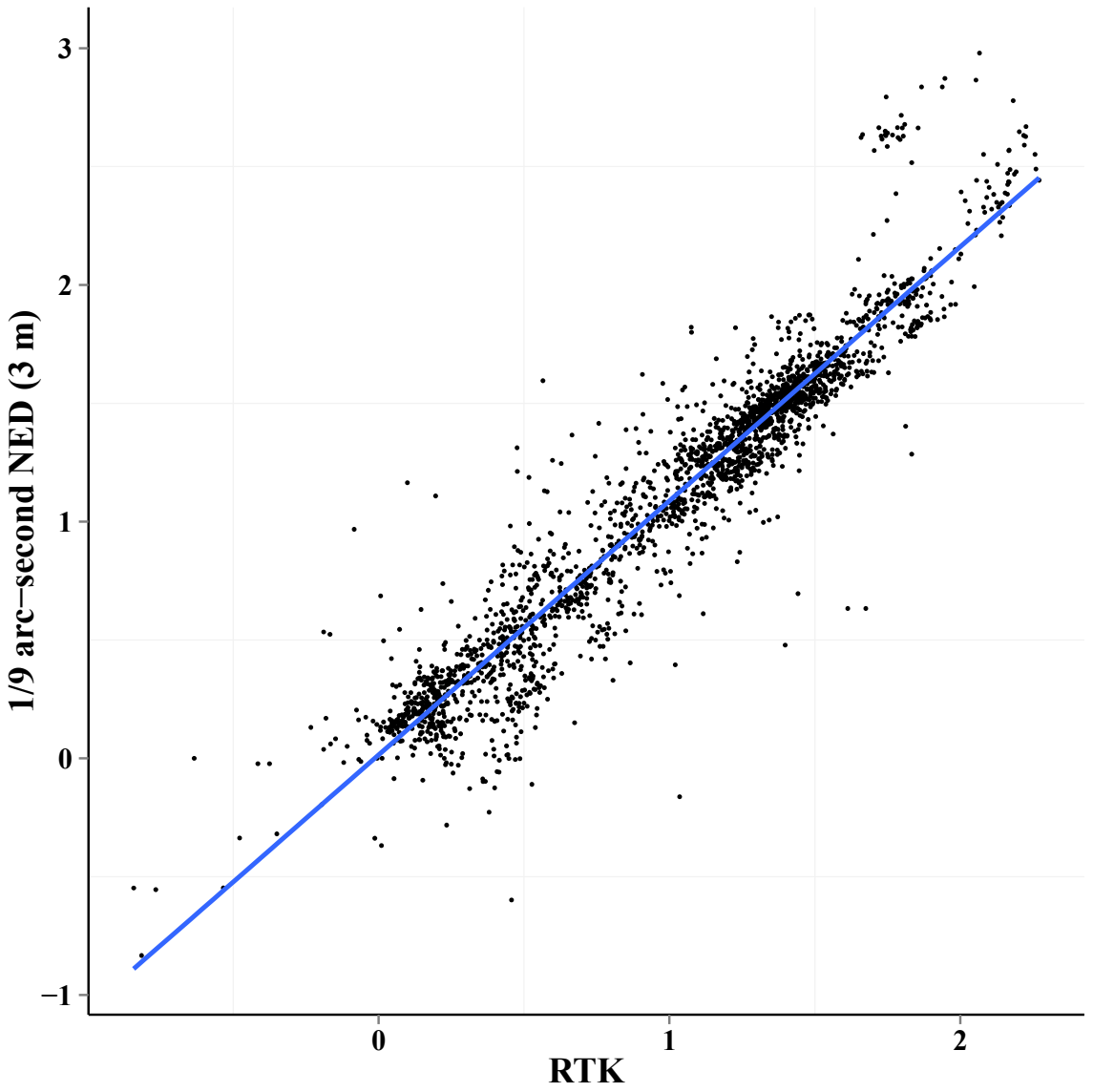
Real-Time Kinematic (RTK) elevation data

Do we need additional RTK points to further inform this relationship?

LMM analysis on sub-setted data (10% increments)

10% of data: $Rm^2 = 0.90$

20% of data: $Rm^2 = 0.90$



Real-Time Kinematic (RTK) elevation data

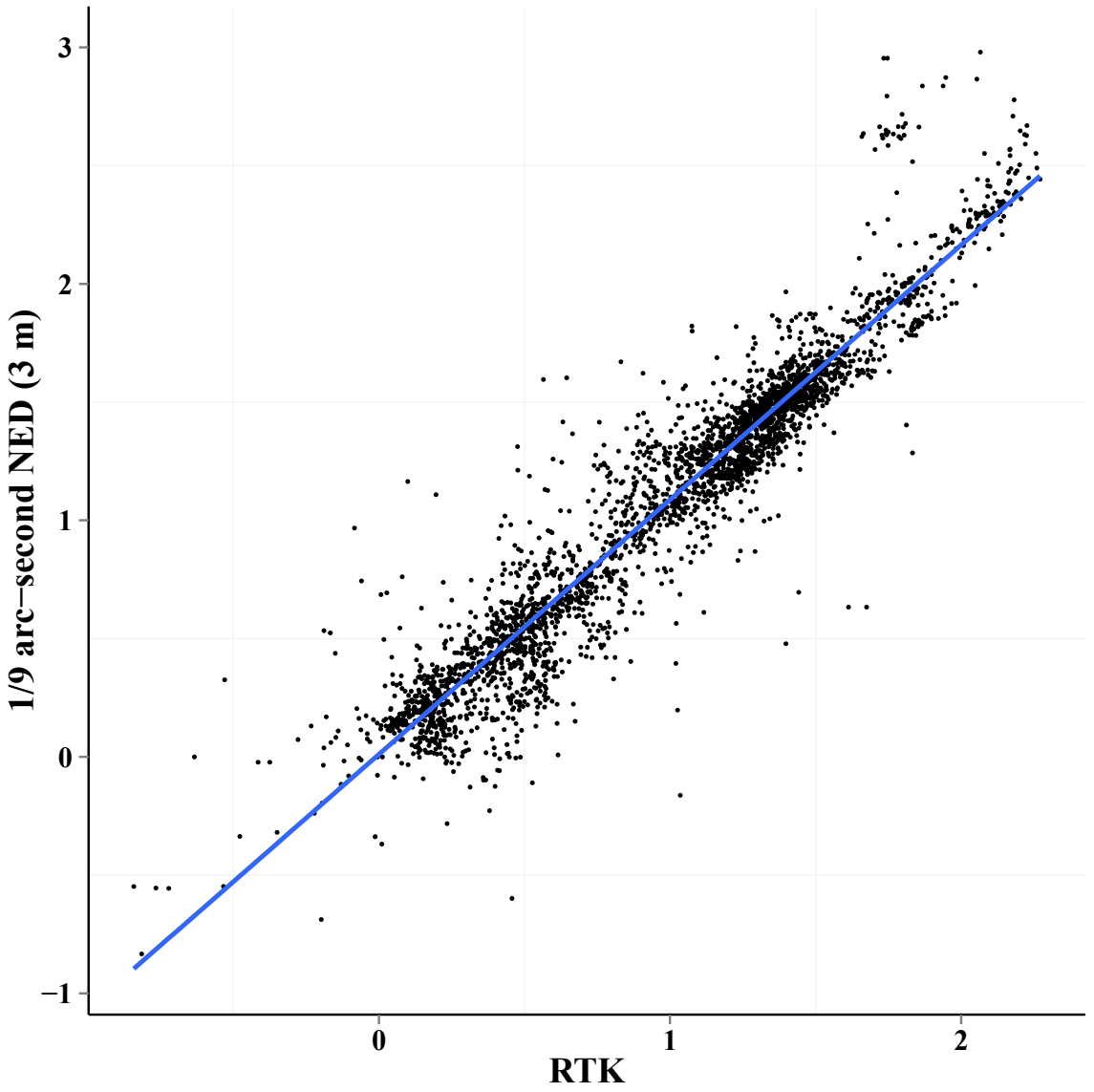
Do we need additional RTK points to further inform this relationship?

LMM analysis on sub-setted data (10% increments)

10% of data: $Rm^2 = 0.90$

20% of data: $Rm^2 = 0.90$

30% of data: $Rm^2 = 0.90$



Real-Time Kinematic (RTK) elevation data

Do we need additional RTK points to further inform this relationship?

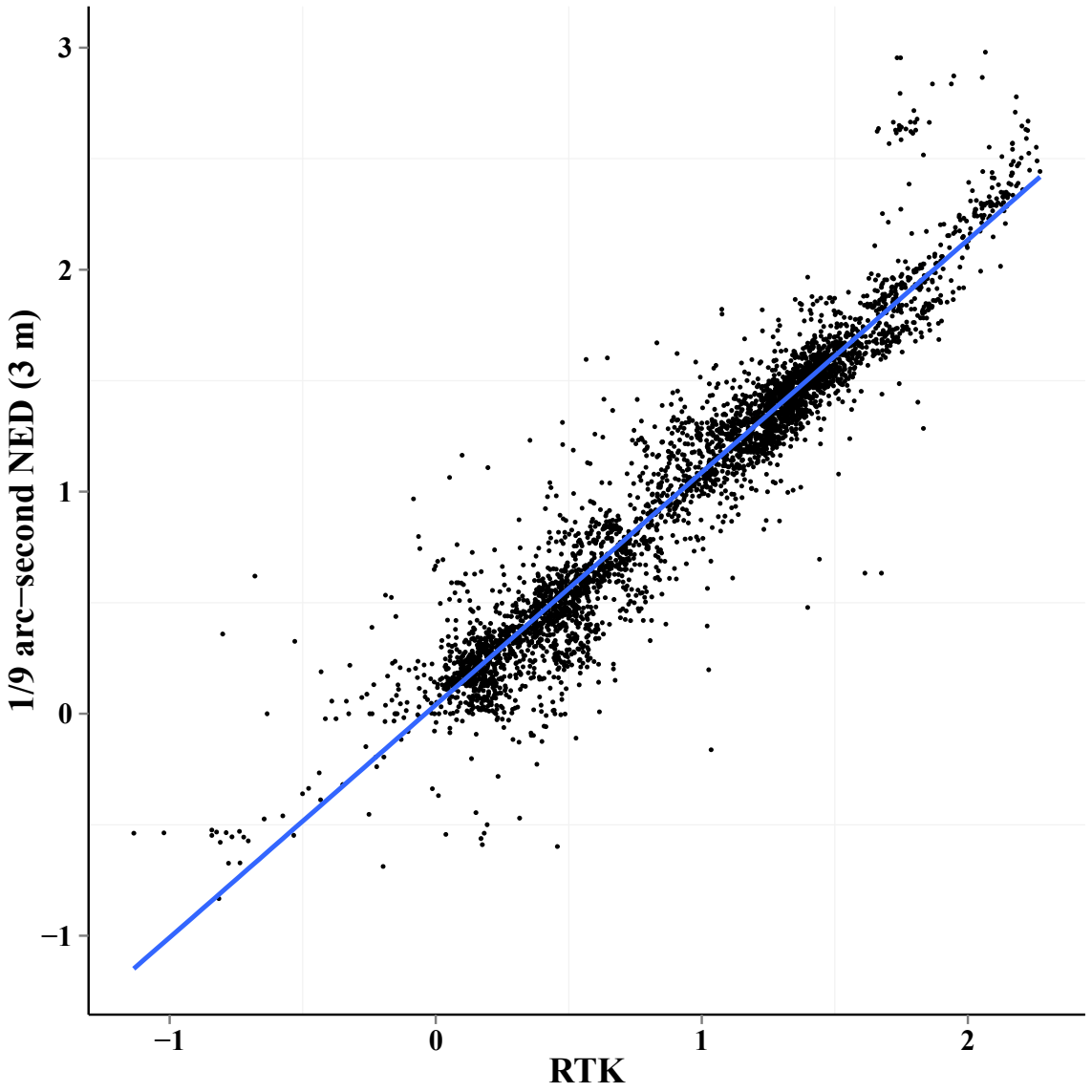
LMM analysis on sub-setted data (10% increments)

10% of data: $Rm^2 = 0.90$

20% of data: $Rm^2 = 0.90$

30% of data: $Rm^2 = 0.90$

40% of data: $Rm^2 = 0.90$



Real-Time Kinematic (RTK) elevation data

Do we need additional RTK points to further inform this relationship?

LMM analysis on sub-setted data (10% increments)

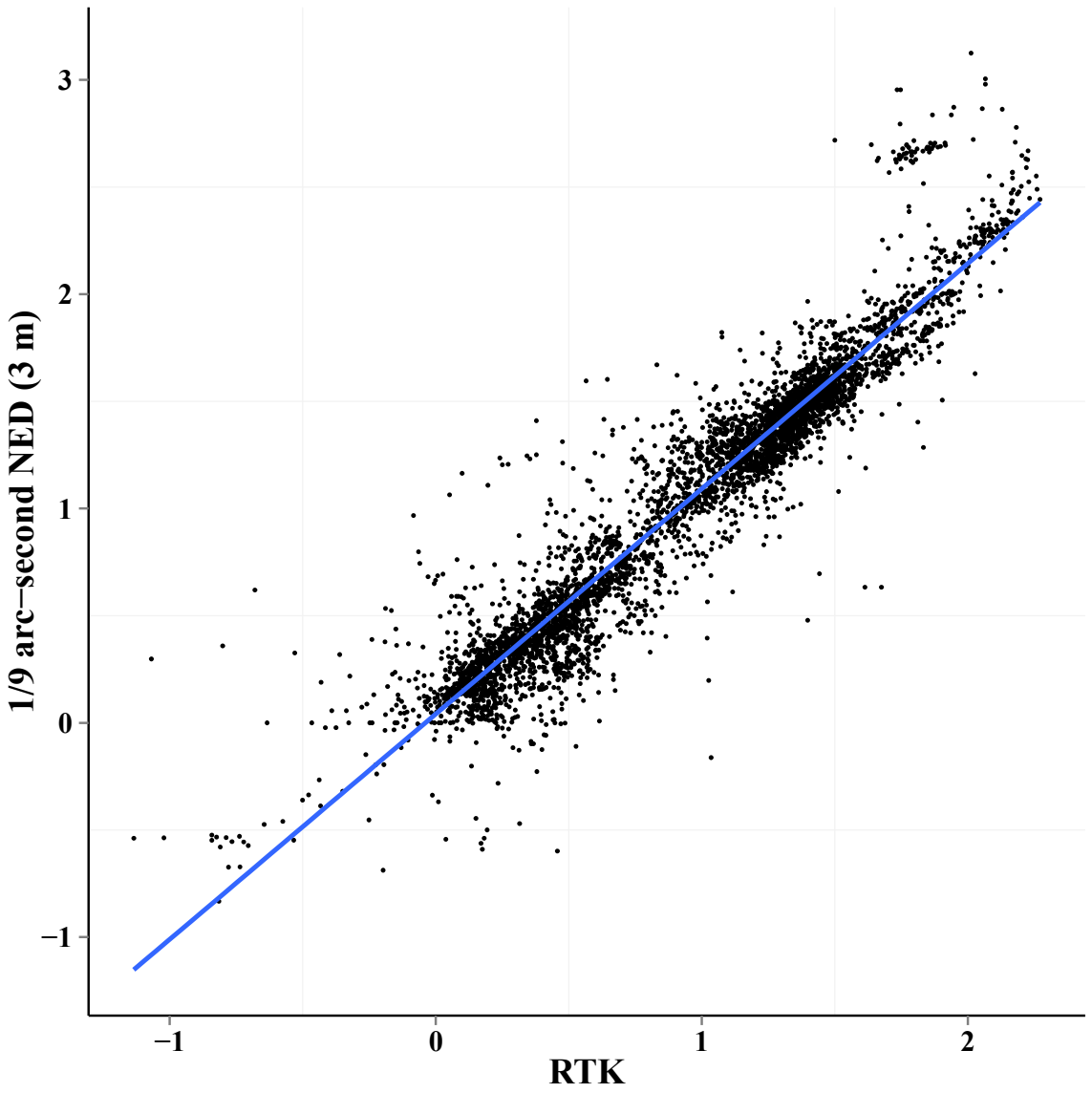
10% of data: $Rm^2 = 0.90$

20% of data: $Rm^2 = 0.90$

30% of data: $Rm^2 = 0.90$

40% of data: $Rm^2 = 0.90$

50% of data: $Rm^2 = 0.90$



Real-Time Kinematic (RTK) elevation data

Do we need additional RTK points to further inform this relationship?

LMM analysis on sub-setted data (10% increments)

10% of data: $Rm^2 = 0.90$

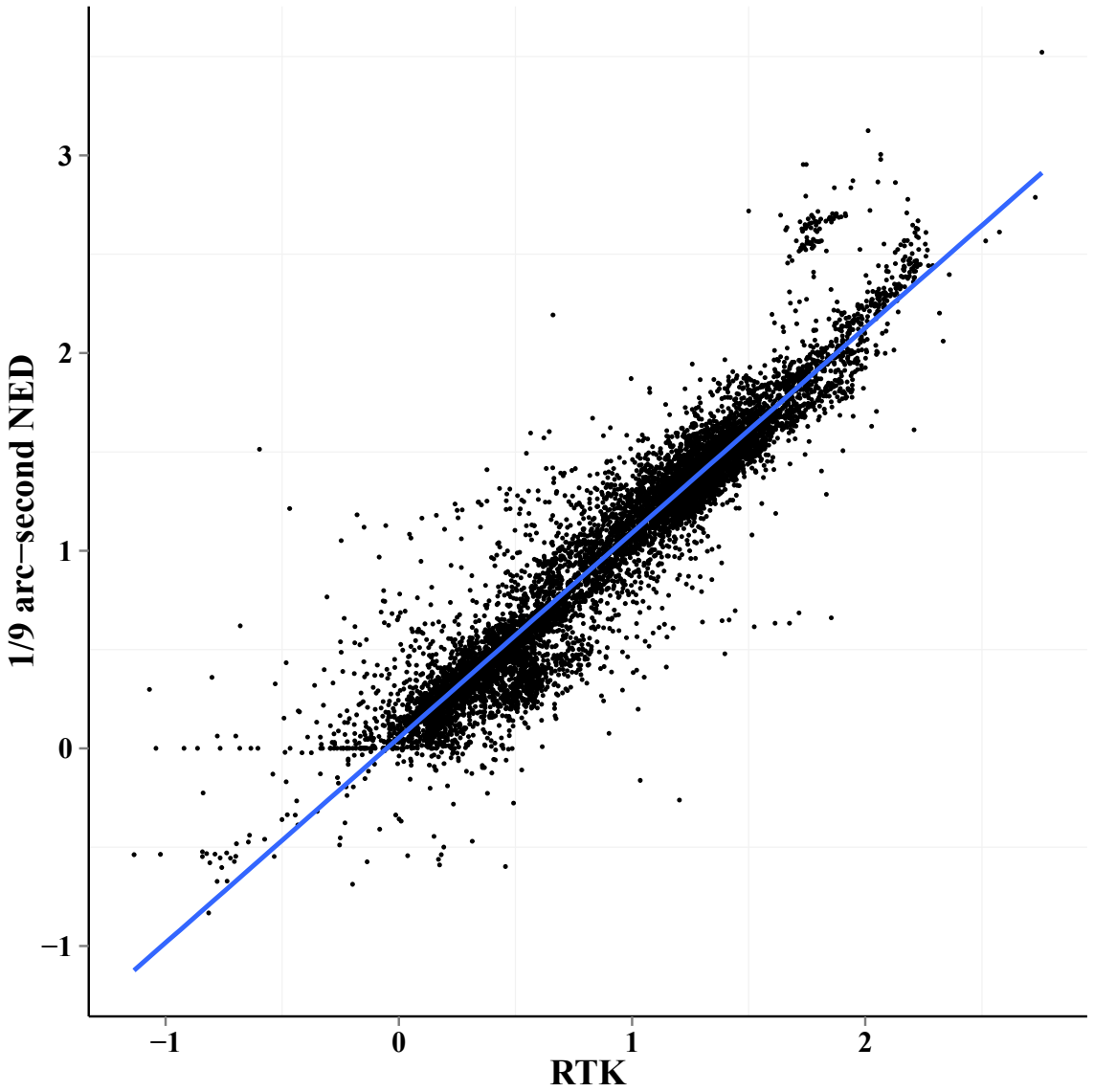
20% of data: $Rm^2 = 0.90$

30% of data: $Rm^2 = 0.90$

40% of data: $Rm^2 = 0.90$

50% of data: $Rm^2 = 0.90$

100% of data: $Rm^2 = 0.90$



Real-Time Kinematic (RTK) elevation data

Do we need additional RTK points to further inform this relationship?

LMM analysis on sub-setted data (10% increments)

10% of data: $Rm^2 = 0.90$

20% of data: $Rm^2 = 0.90$

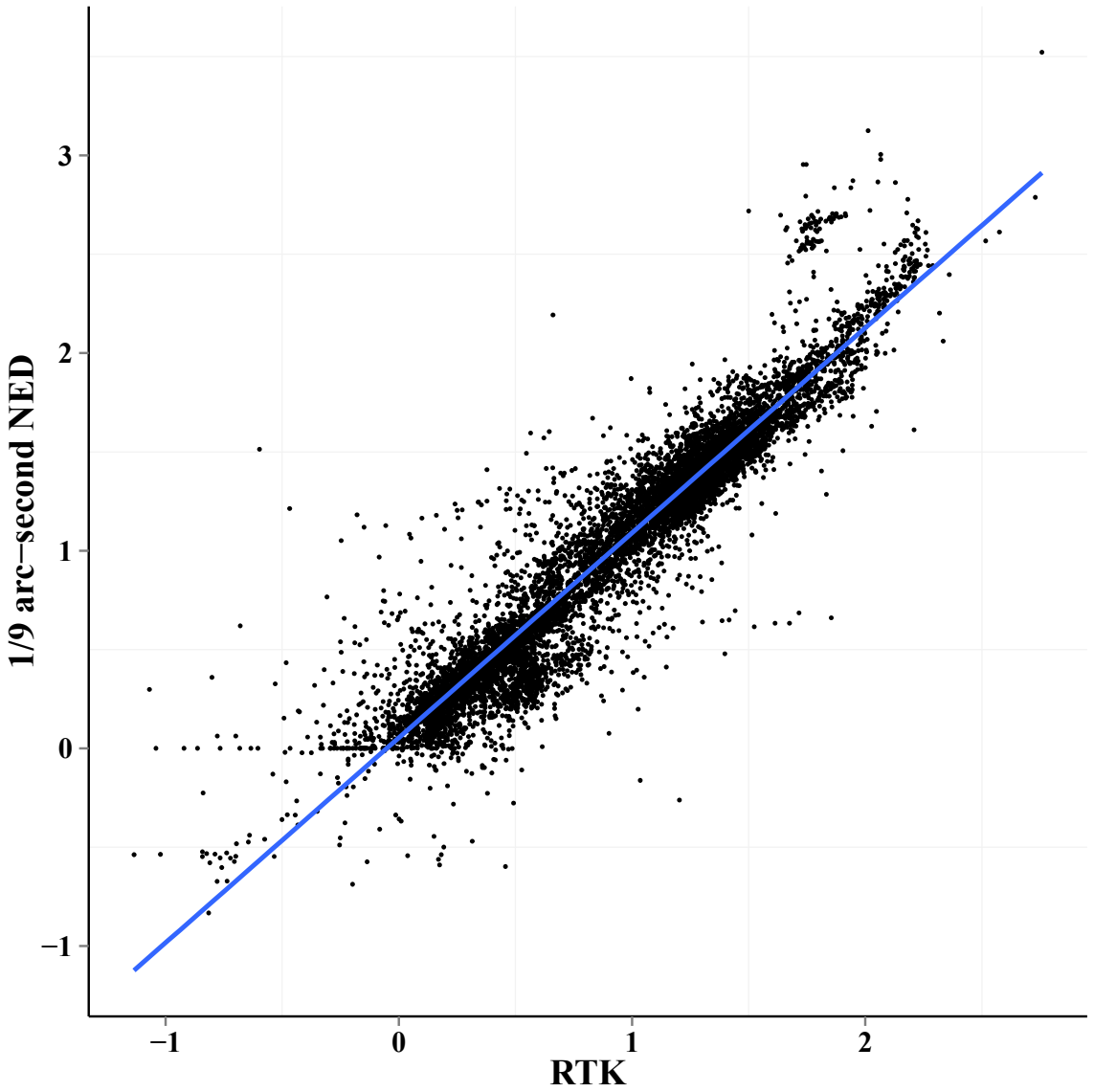
30% of data: $Rm^2 = 0.90$

40% of data: $Rm^2 = 0.90$

50% of data: $Rm^2 = 0.90$

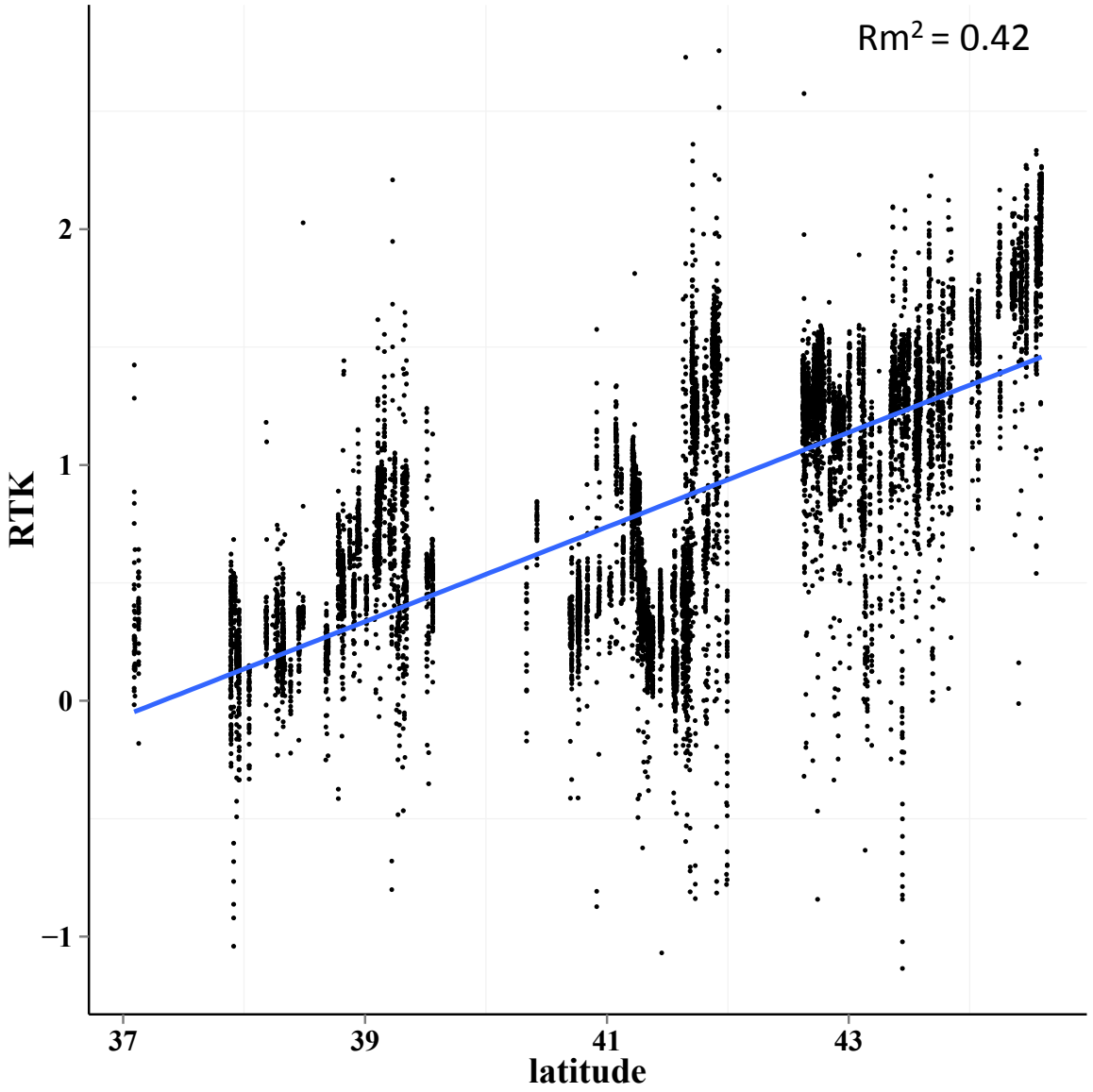
100% of data: $Rm^2 = 0.90$

No.



Real-Time Kinematic (RTK) elevation data

These data also present opportunities to explore questions about ecological mechanism.



Real-Time Kinematic (RTK) elevation data

These data also present opportunities to explore questions about ecological mechanism.

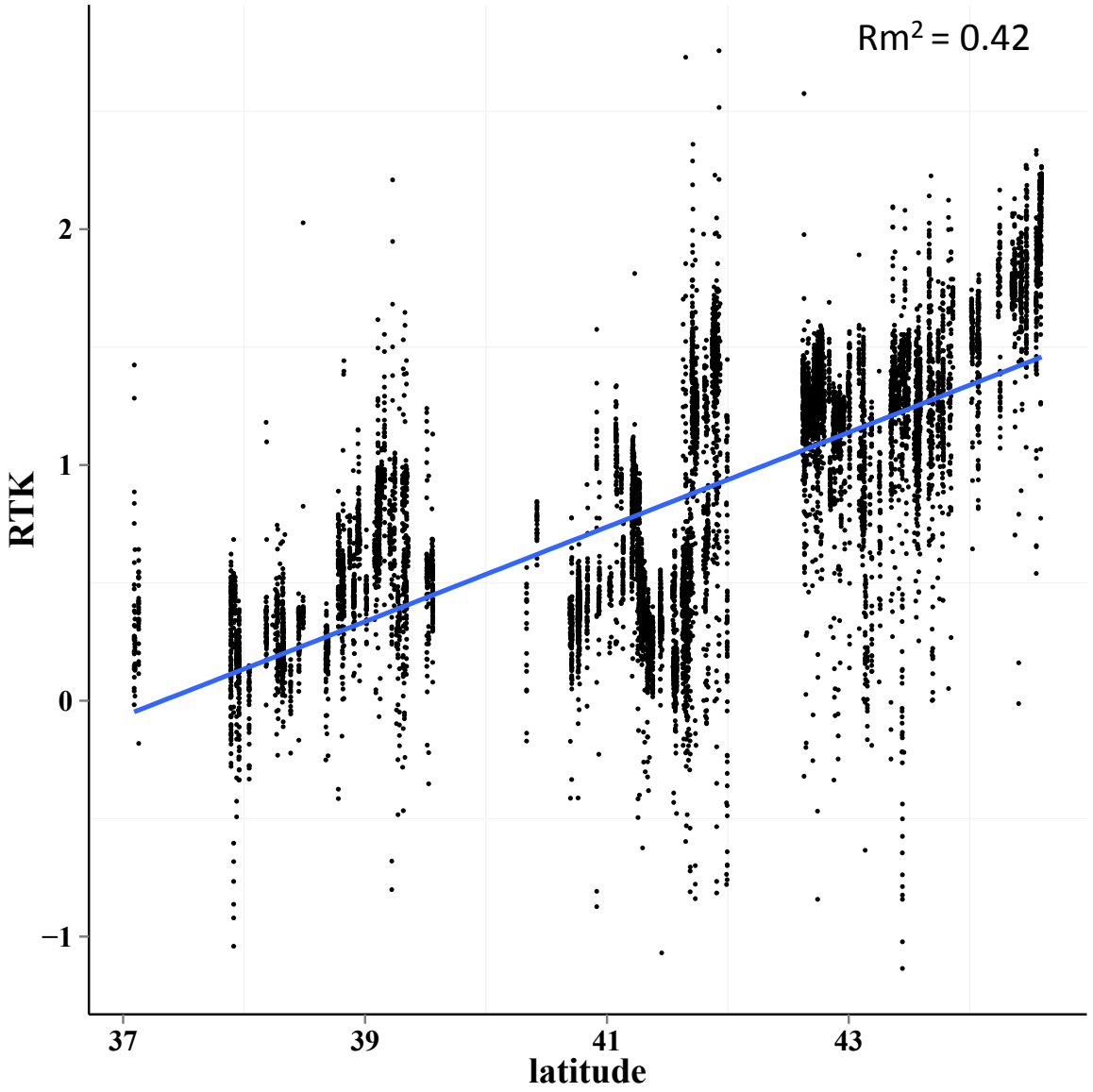
Known latitudinal gradients in tidal marshes:

Tidal amplitude

Sea-level trend

Marsh patch size

Bird diversity



There is more work to be done.

- Survey additional pre-restoration bird/veg surveys (2016)
- Foster additional partnerships with NFWF collaborators
- Complete and distribute SHARP relational database
- Collect question-driven data using RTK(?)

Acknowledgements

Acknowledgements

Questions?