Salt Marsh Integrity in New England

An examination of how four National Wildlife Refuges will stack up against climate change

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Maine Coastal Islands

What is Salt Marsh Integrity?

- SMI is:
  - A rapid assessment effort to determine salt marsh biological integrity, diversity and environmental health
  - Developed in 2008 by USFWS, USGS, University of Delaware, and Northwest National Laboratory
  - Began assessments in 2012
  - The first large-scale assessment of salt marshes on the east coast

Why do we do SMI assessments?

Monomoy

To understand how past and present changes affect salt marsh ecology

- Past: Physical alterations for salt hay production (Fogg 1983; Daiber 1986) and mosquito ditching (Daiber 1986; Wolfe 1996)
- Present: Surrounding land uses (Deegan et al. 2012), invasive species (Roman et al. 1984), climate change, and sea level rise (Titus and Richman 2001; Stevenson and Kerney 2009)

How do we determine SMI?

- Standardized measurement techniques

Normalized scoring metrics

- Flooding duration
- Salinity
- Nekton density
- Nekton Richness
- Tidal marsh obligate bird abundance
- Herbicide use
- Percent native vegetation cover

Additional Metrics

- State Conditions
  - Historical condition and geomorphic setting
  - Ditch density
  - Surrounding land-use
  - Open water : marsh area ratio
  - Mean flood depth
  - Vegetation community composition
  - *Fundulus heteroclitus* length


Rachel Carson

When?

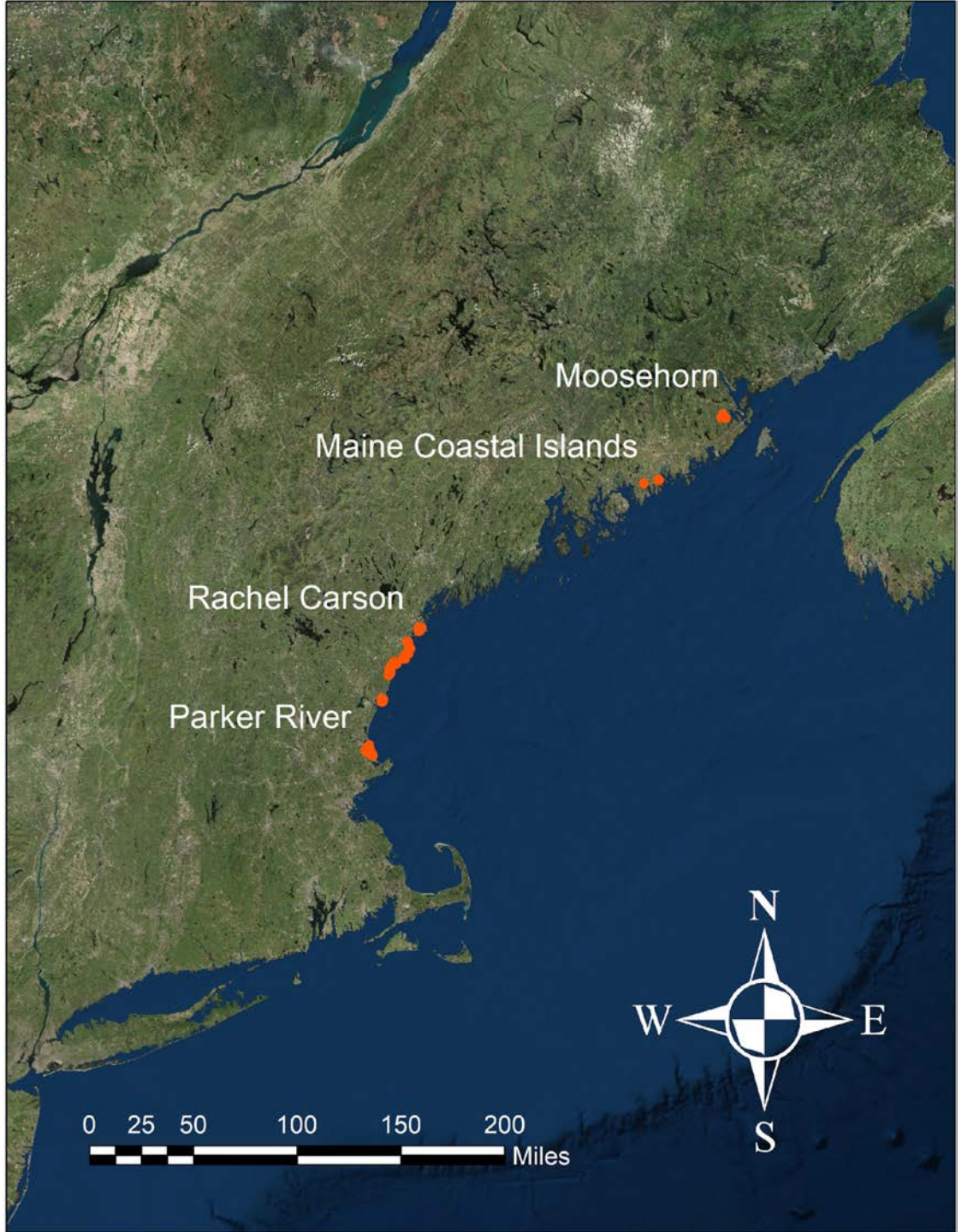
- Each metric was assessed once (except herbicide use)
- SMI assessment completed in 3.5 years on average (minimum = 1, maximum = 5)
- All surveys completed in 2016

Where?

Maine
to Virginia

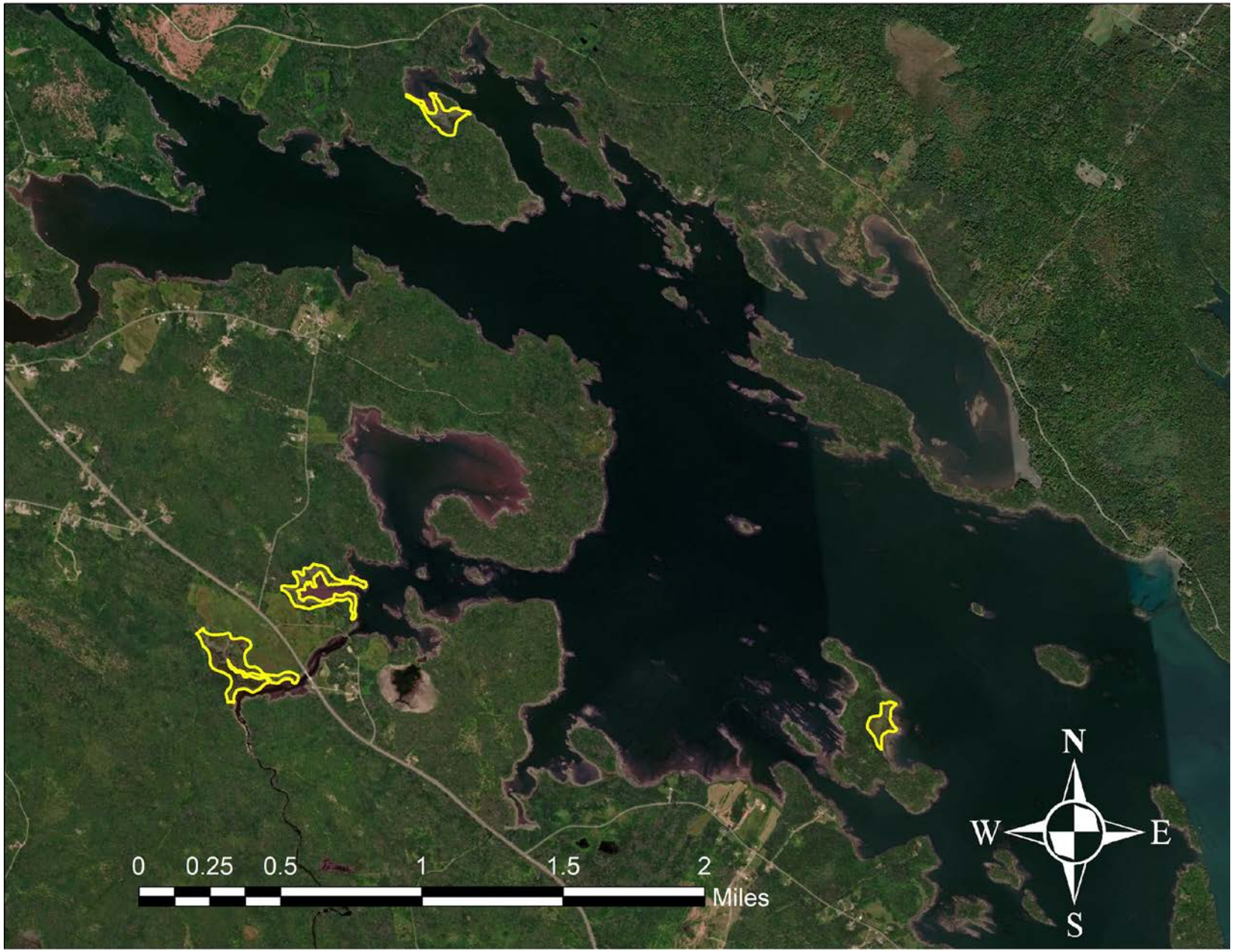
3 in Maine

1 in Massachusetts



Moosehorn background

4 units
33 acres



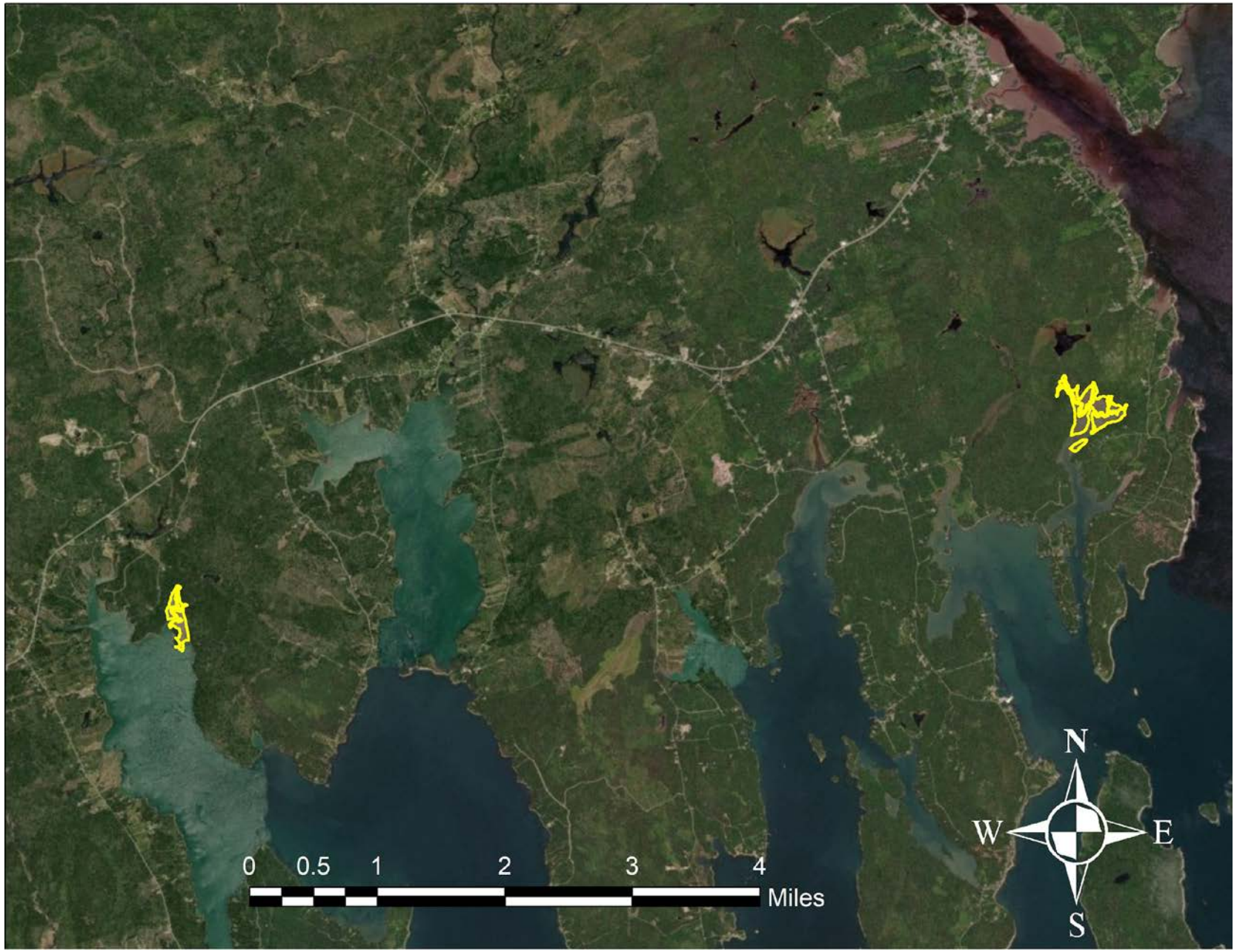
Moosehorn background

4 units
33 acres

- Smallest SMI Refuge
- Near Canadian border
- No apparent ditching
- Minimal surrounding land use pressure

Maine Coastal Islands background

2 units
74 acres



Maine Coastal Islands background

2 units
74 acres

- Near Acadia National Park
- Some ditching/embankments
- Minimal surrounding land use pressure

Rachel Carson background

23 units
1,943 acres

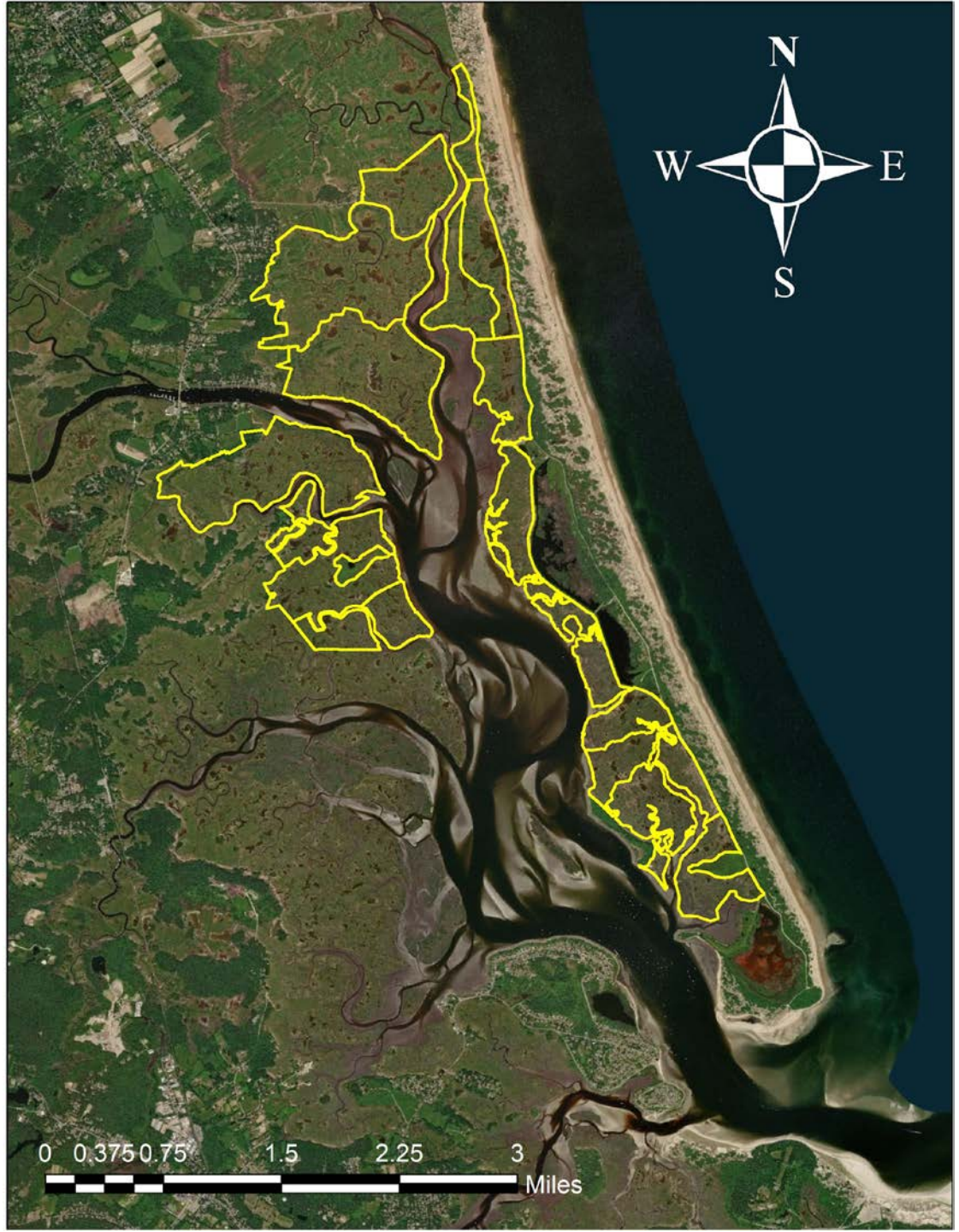
Rachel Carson background

23 units
1,943 acres

- Cape Elizabeth to Kittery
- Some ditching/embankments
- Moderate to high surrounding land use pressure

Parker River background

16 units
2,266 acres



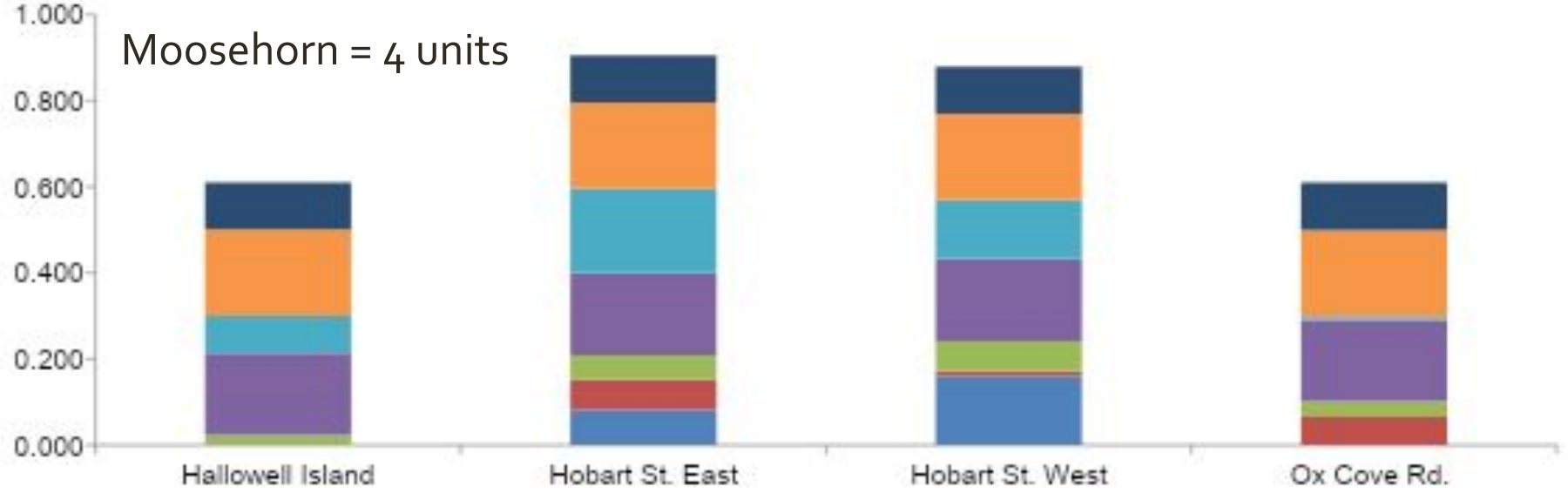
Parker River background

16 units
2,266 acres

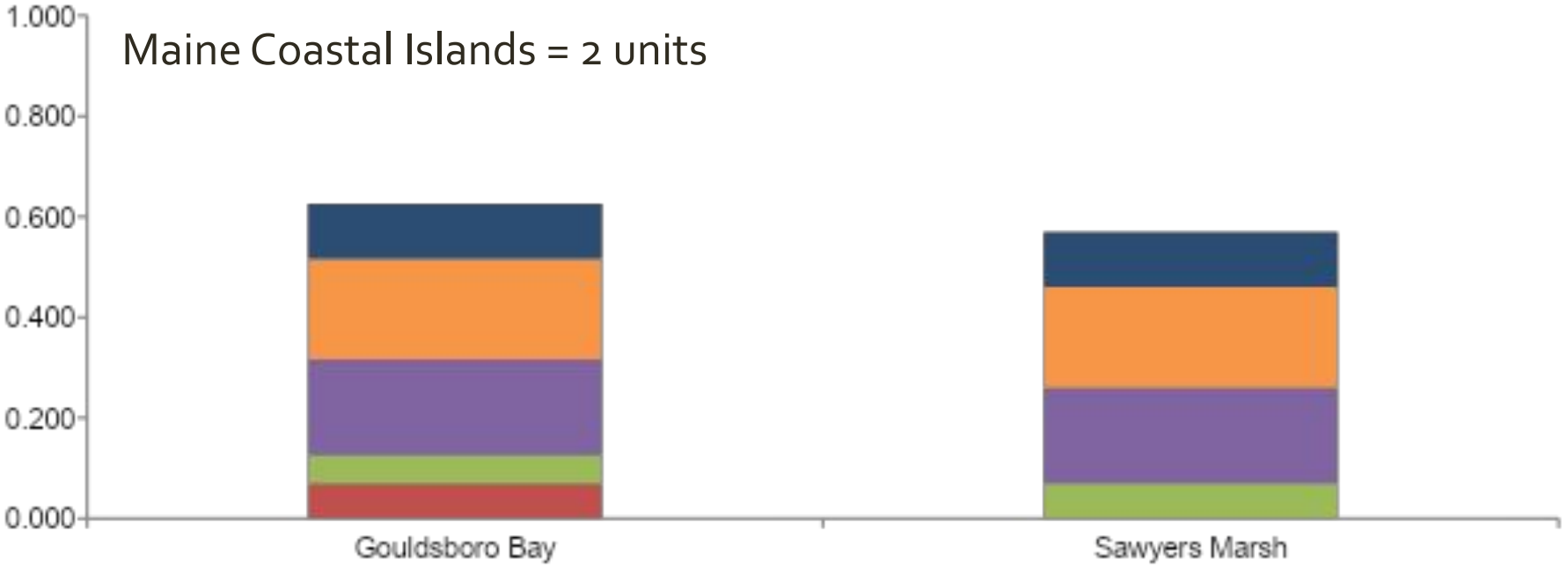
- Largest SMI Refuge
- Near Newburyport, MA
- All but four units are moderately to severely ditched
- Low to moderate surrounding land use pressure

Key

- Herbicide
- Salinity
- Duration
- % Native Cover
- Nekton Richness
- Nekton Density
- TMO Birds



Herbicide
Salinity
Duration
% Native Cover
Nekton Richness
Nekton Density
TMO Birds



Key

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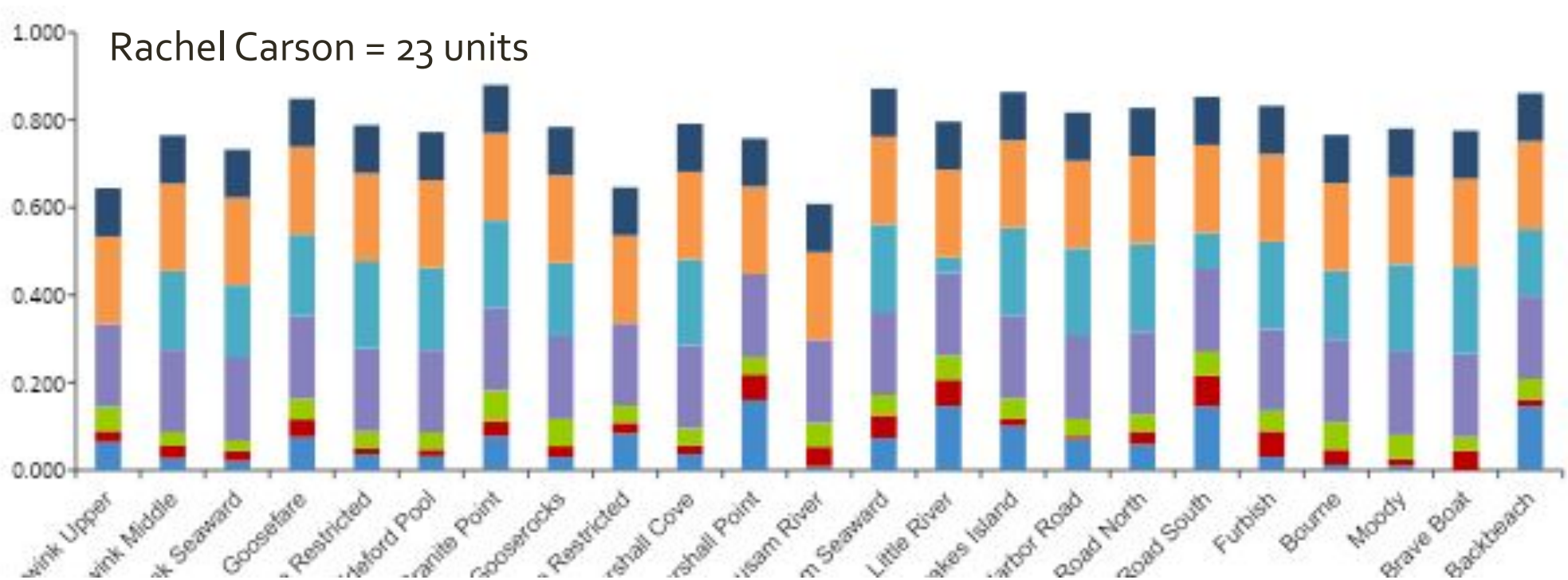
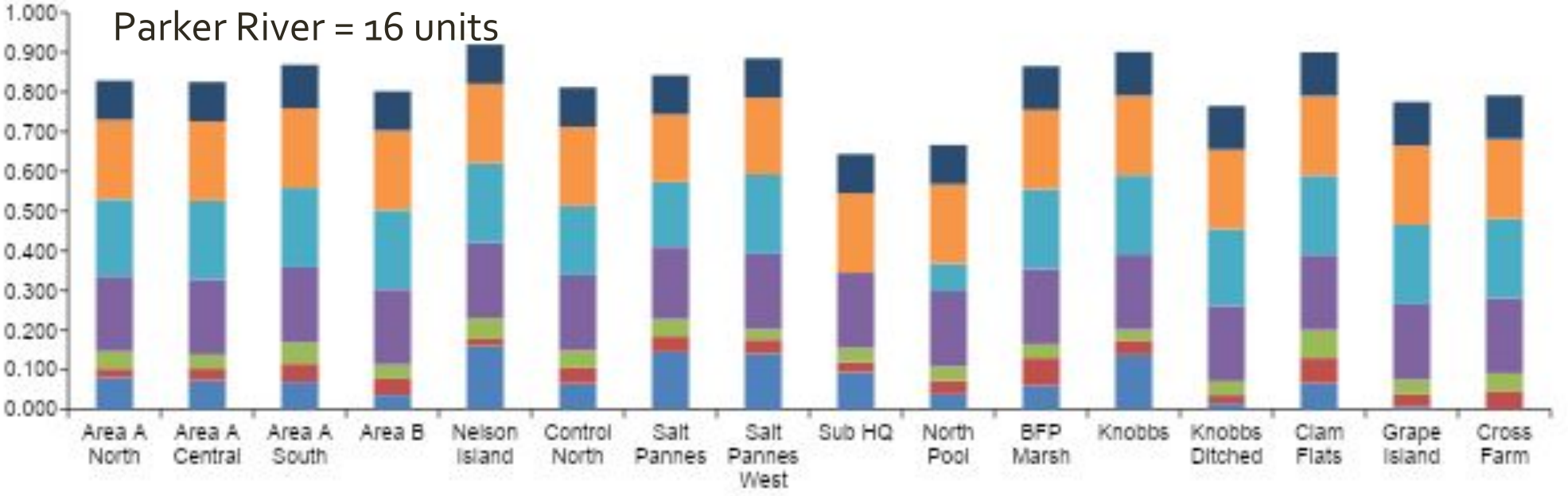
- Salinity
- Duration
- % Native Cover
- Nekton Richness
- Nekton Density
- TMO Birds

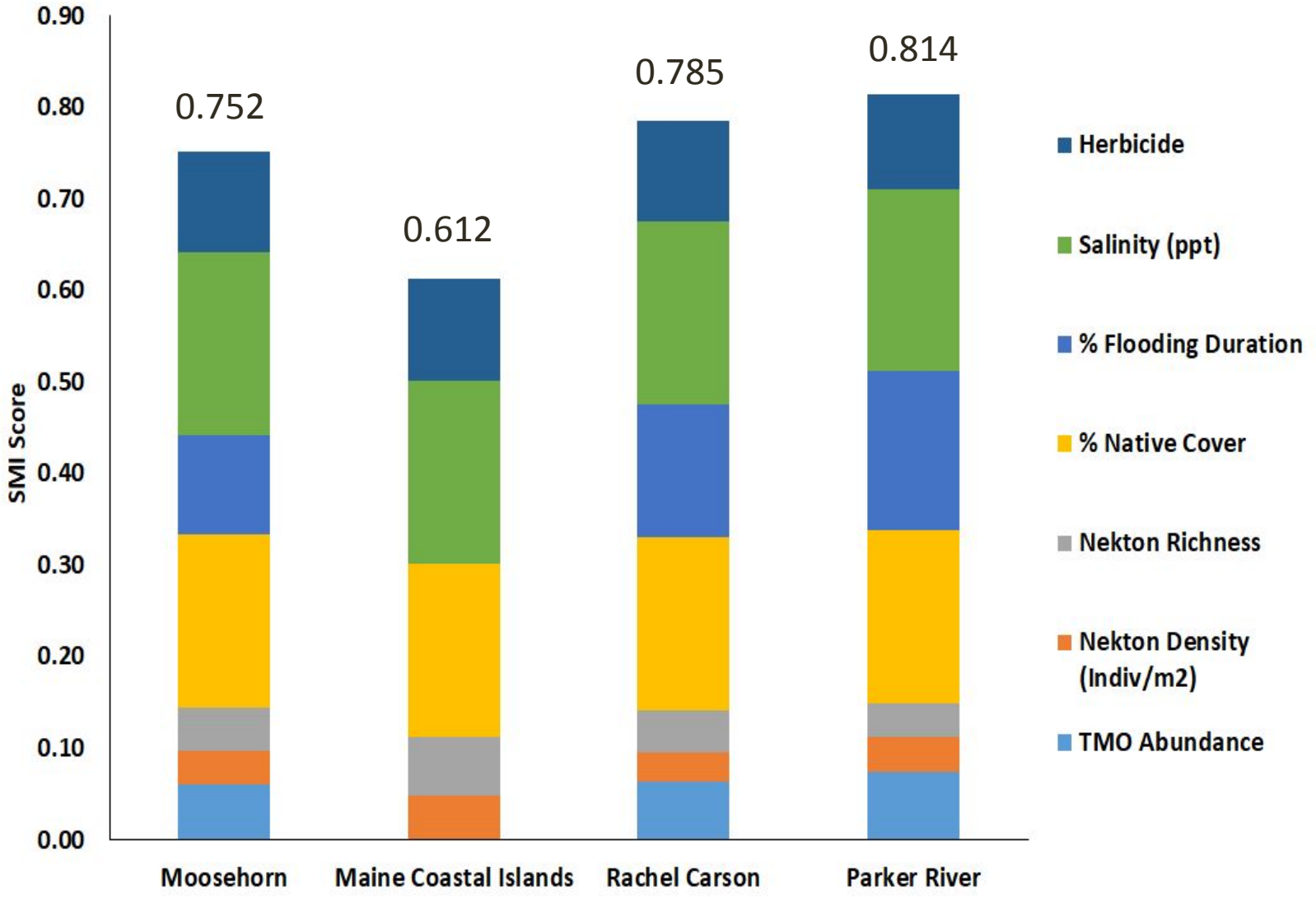




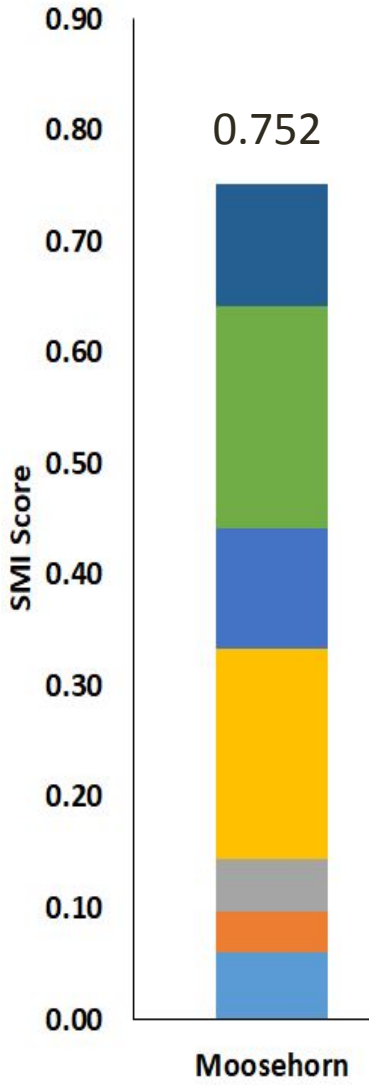
Refuge	TMO Abundance	Nekton Density (indiv/m²)	Nekton Richness	% Native Cover	% Flooding Duration	Salinity (ppt)	Herbicide
Moosehorn	0.2	52.9	4.0	99.9	44.0	29.8	0
Maine Coastal Islands	0.0	13.7	4.5	100.0	71.5	32.0	0
Rachel Carson	0.7	18.5	5.9	99.3	25.0	24.5	0
Parker River	2.2	30.1	4.6	99.2	20.3	27.1	0.6

Averaged 7 SMI metrics across units for a Refuge-level analysis

Averaged unit scores from each NWR



Moosehorn



No herbicides ✓

Satisfactory salinity ✓

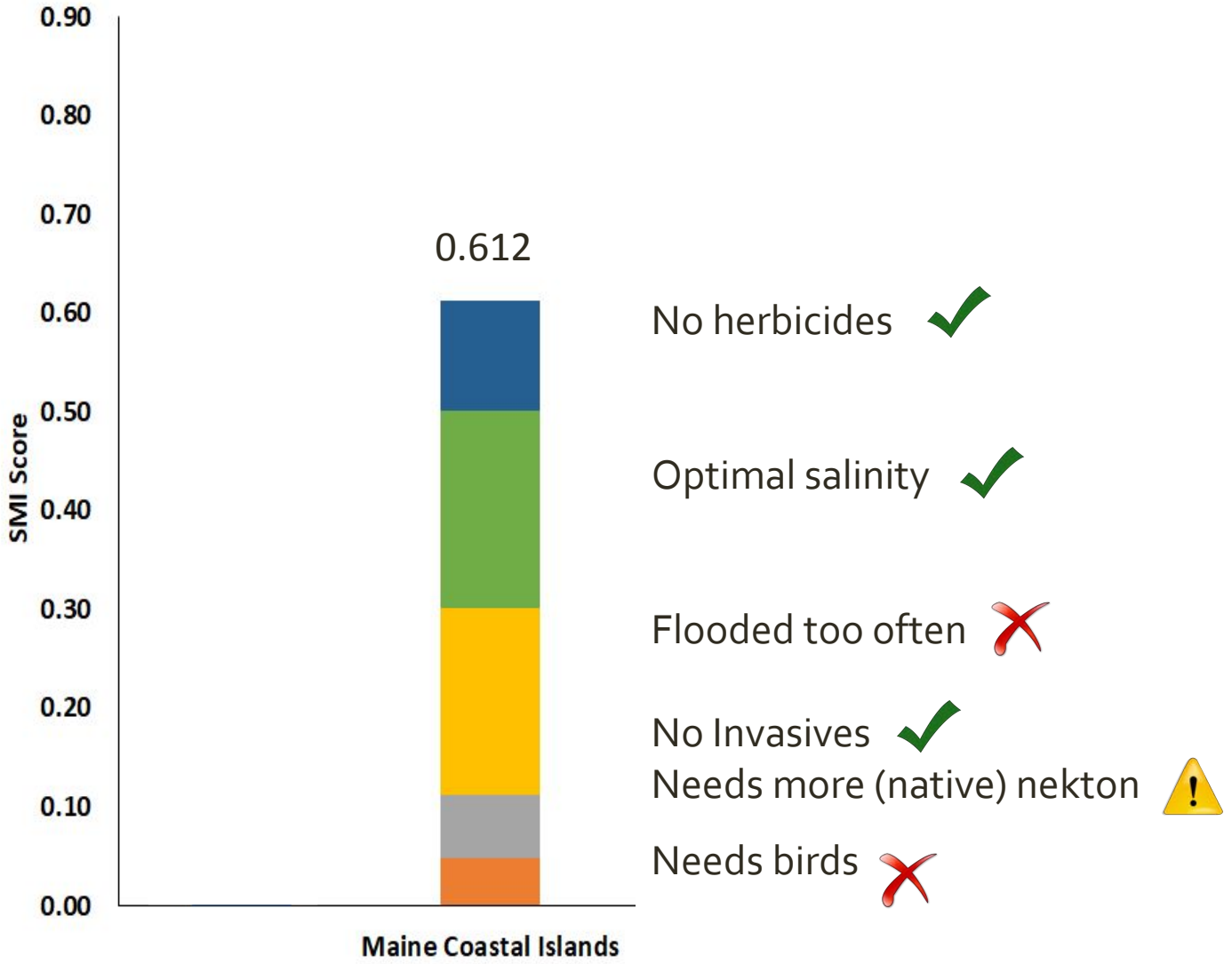
Flooded often ⚠

Few Invasives ✓

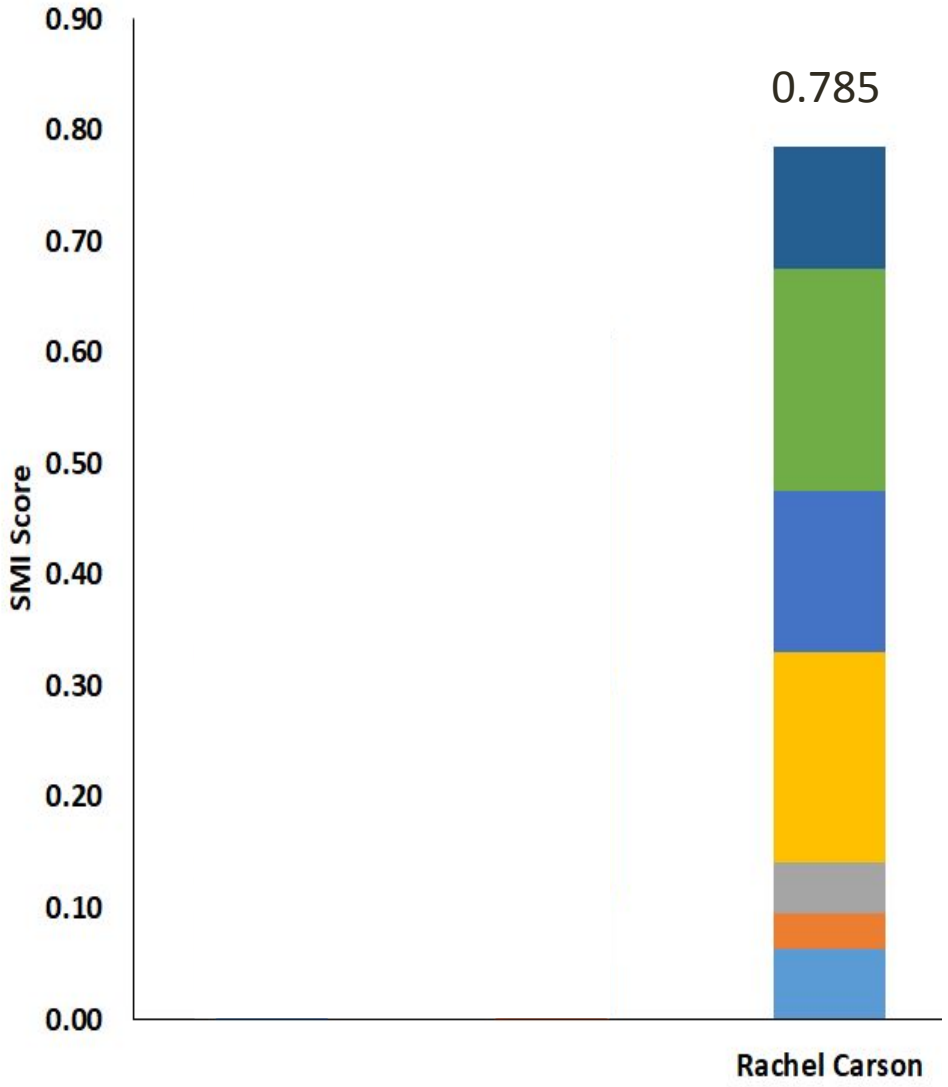
Needs more (native) nekton ⚠

Needs a bird boost ✗

Maine Coastal Islands



Rachel Carson



No herbicides ✓

Optimal salinity ✓

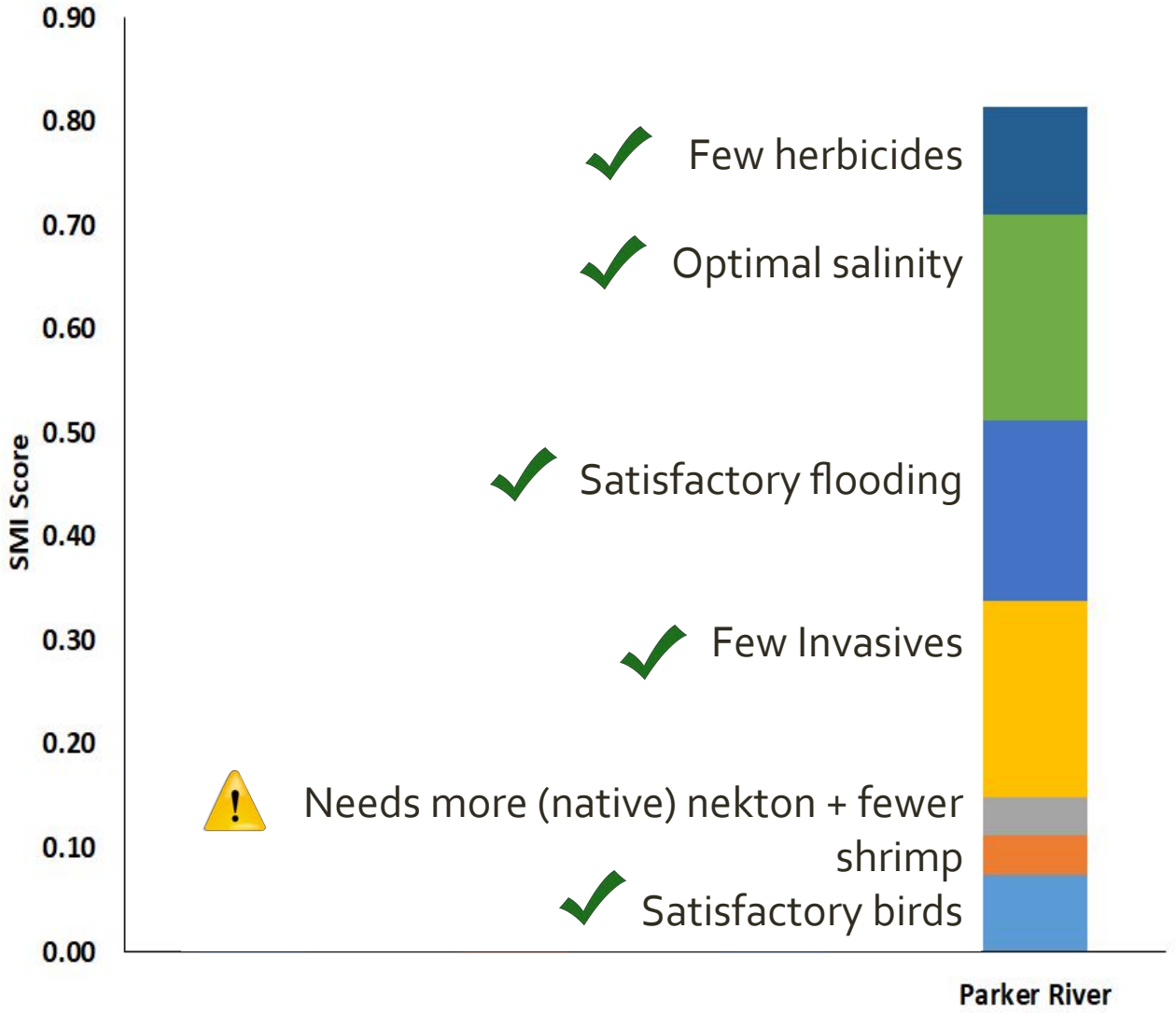
Variable flooding ⚠

Few Invasives ✓

Needs more (native) nekton + fewer shrimp ⚠

Needs a bird boost ⚠

Parker River



Moosehorn summary

- What we learned
  - Good habitat, but lacking wildlife
  - Remote and small units create sampling obstacles
  - Local topography makes marsh migration challenging
- Moving forward
  - Maintain native plant communities
  - Adjust TMO metric - Downeast region is outside the normal breeding range for clapper rail, saltmarsh sparrows and willets
  - Investigate cause of prolonged flooding

Maine Coastal Islands summary

- What we learned
  - Flooding duration could be improved by better equipment placement
  - Alternatively, poor flooding score could be real and caused by embankments
  - Highest open water:marsh ratio
  - Local topography makes marsh migration challenging
- Moving forward
  - Maintain native plant communities
  - Adjust TMO metric - Downeast region is outside the normal breeding range for clapper rail, saltmarsh sparrows and willets
  - Investigate cause of prolonged flooding

Rachel Carson summary

- What we learned
  - Second highest open water:marsh ratio
  - Embankments create tidal restrictions and impounding
- Moving forward
  - Maintain native plant community
  - Maintain TMO population
  - Address flooding duration through embankment and ditch remediation
  - More water on the marsh = less TMO habitat

Parker River summary

- What we learned
  - Embankments and other subtle alterations not identified as important features until 2018/2019
- Moving forward
  - Maintain native plant community
  - Maintain TMO population
  - Address flooding duration through embankment and ditch remediation

Conclusion

- A healthy salt marsh meadow that is keeping pace with sea level rise will be composed of:
  - mostly high marsh plant species
  - some low marsh plant species
  - some open water
  - regular tidal flushing
  - some traces of brackish or terrestrial border

Conclusion

- **Parker River** has the greatest integrity… for now
- Northern refuges may be more vulnerable to SLR and climate change due to high flooding duration, small size and topography

Conclusion

- Some metrics may not be reflective of actual marsh integrity
- Continue to document changes occurring in the marshes as a result of sea-level rise to better understand salt marsh resiliency

Acknowledgements

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