Heavily Oiled Salt Marsh and the *DWH* Spill: Shoreline Treatment, Restoration Planting, and Ecological Recovery (2013-2015)

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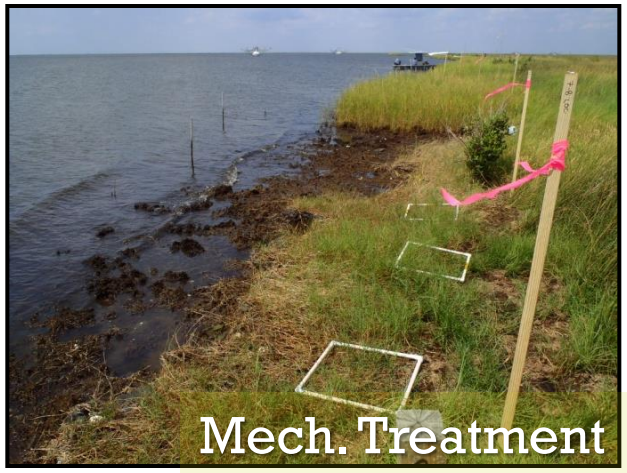


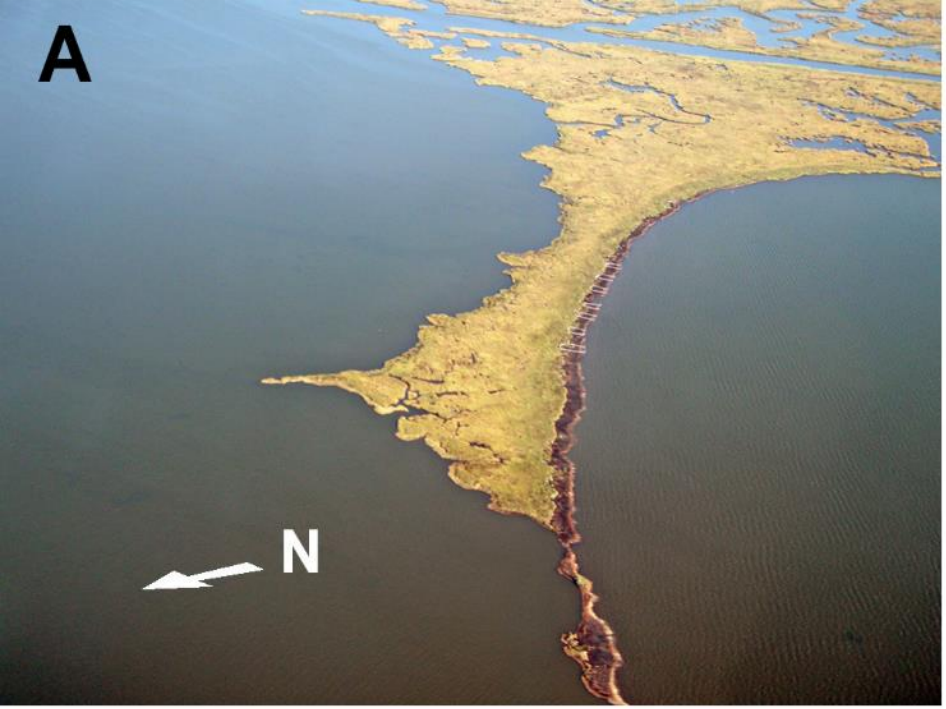
Different talk than planned – two reasons

- 1) (Scott) Discovered I had a 30 minute time slot – Gene said I needed to fill it up!
- And will still include the meta-analyses on marsh periwinkles and fiddler crabs
- 2) (Brie) Last minute substitution to give Scott's talk
- Adds new results showing effects of vegetation genetics on marsh outcomes

Questions

- Did shoreline cleanup treatments improve marsh oiling conditions and ecological recovery vs. no treatment (natural recovery)?
- Did restoration planting following treatment help even more?
- What would we do next time in a similar situation?
- What challenges do we see ahead?


June 2010


A
N


B
October 2010


C
15 CM

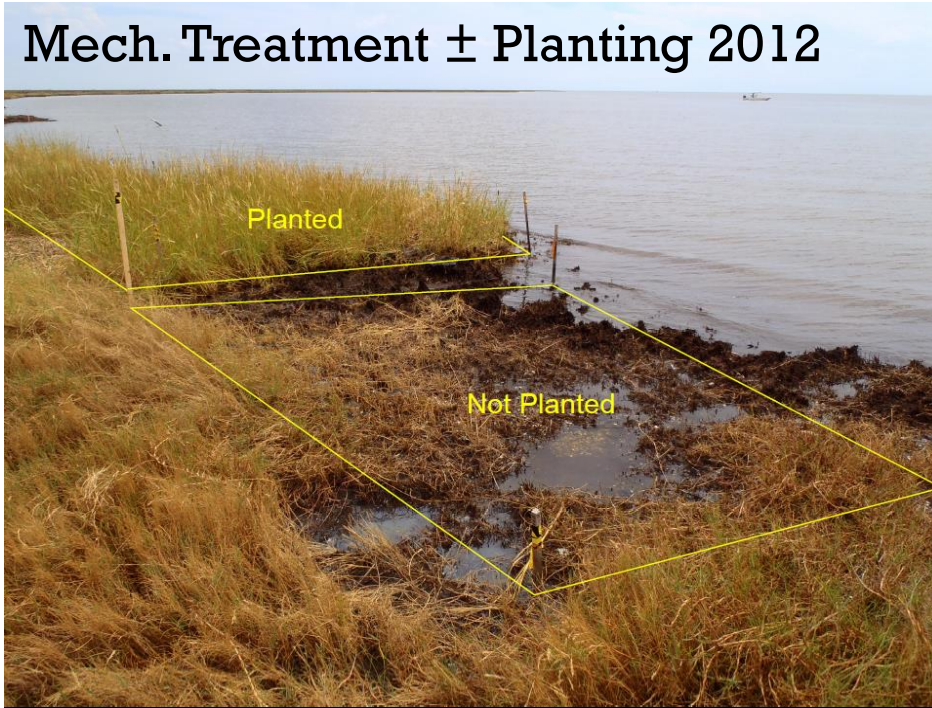

D

Reference 2012

Manual Treatment 2012

No Treatment 2012

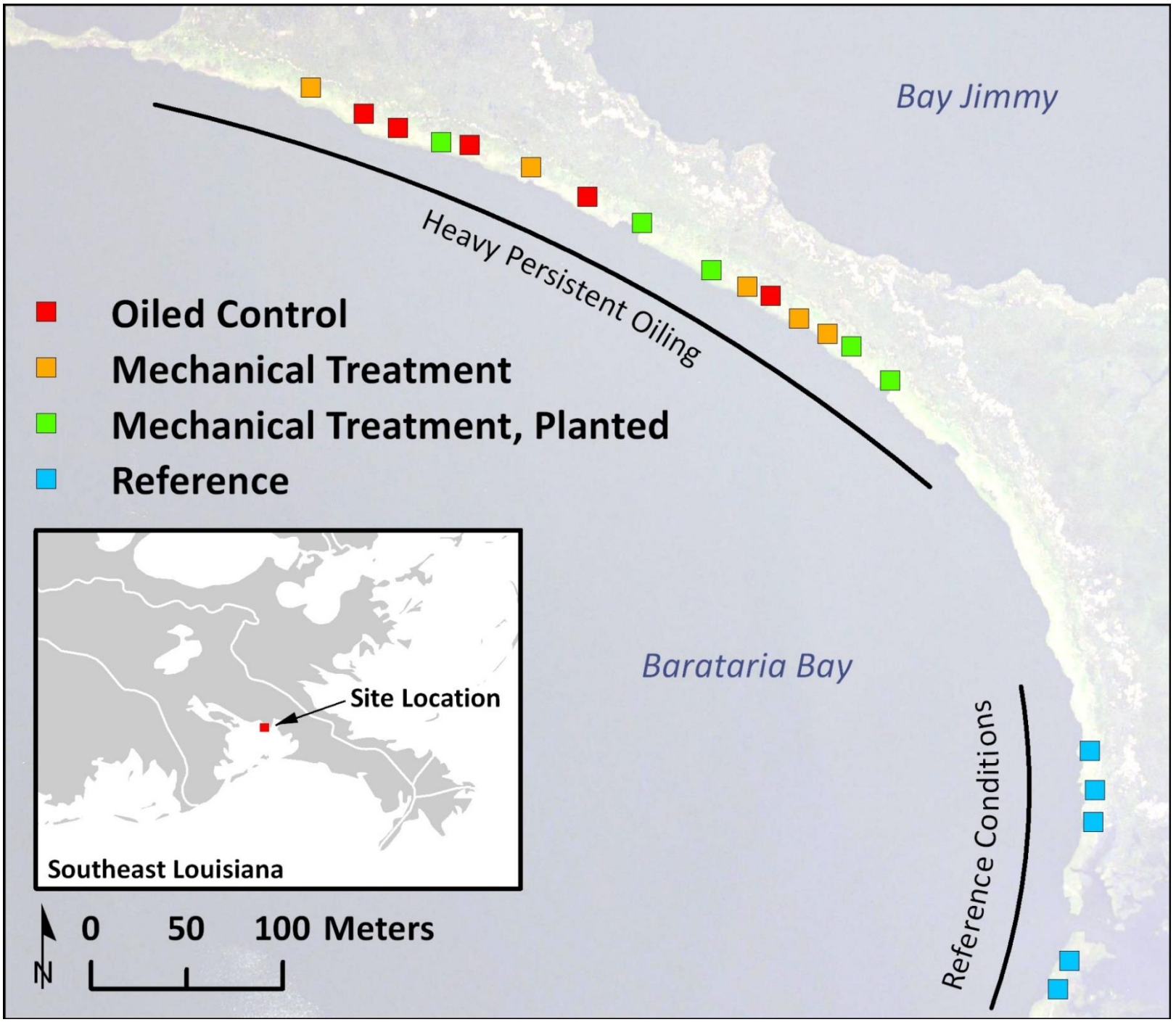
Mech. Treatment ± Planting 2012



Current Study Design (2013-present)

- 4 oiling/treatment classes
  - Reference (lighter to no oiling, intact vegetation)
  - Heavily oiled, control (no treatment)
  - Heavily oiled, mechanical treatment
  - Heavily oiled, mechanical treatment + planting

- Data collection
  - Late Summer 2013-2015
  - 3-5+ years after initial oiling
  - 2-4 growing seasons after treatment and planting
  - 5 replicate plots per class
  - Plot size 15 m^2, with 3 x 0.25 m^2 quadrats per plot

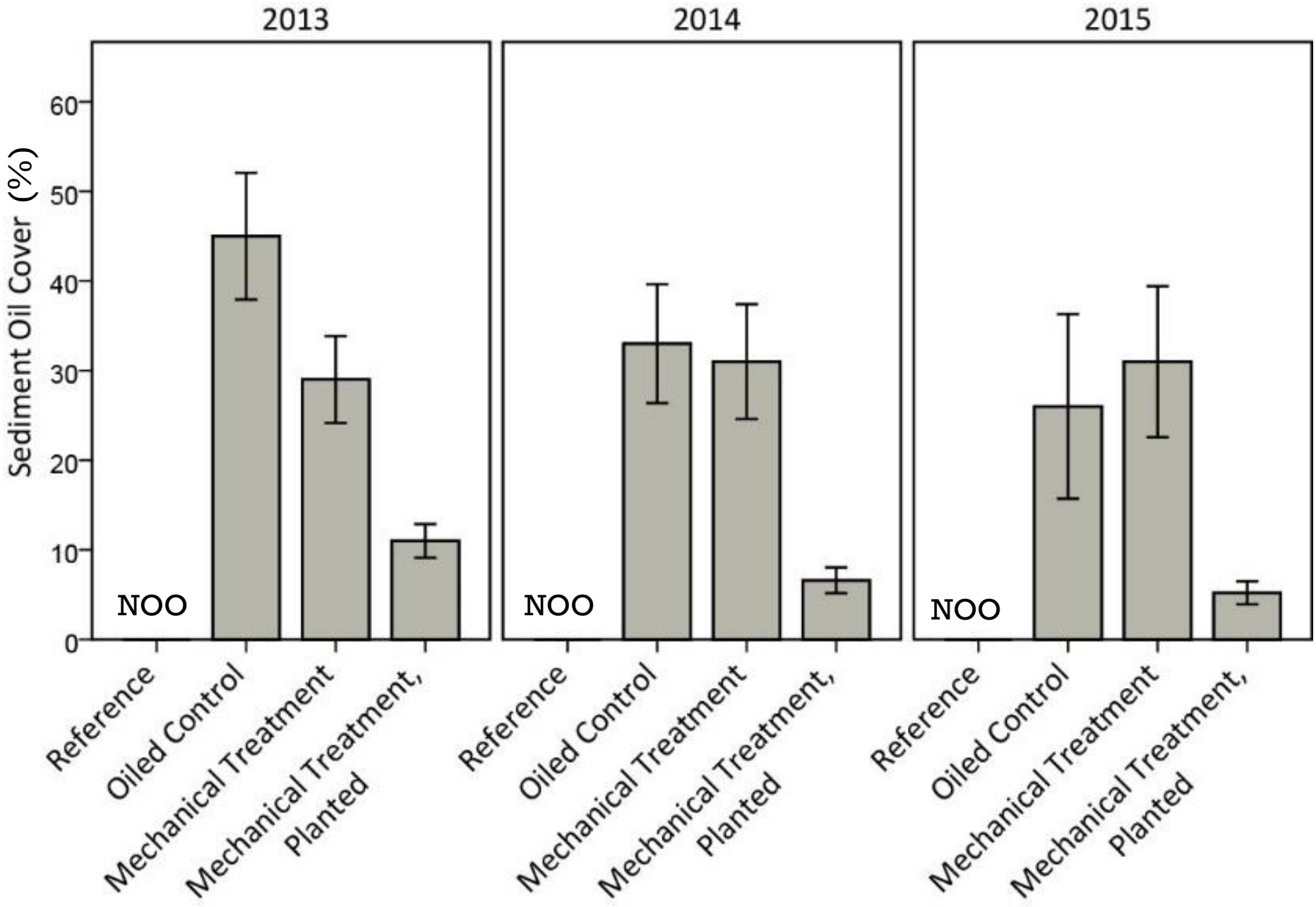

Bay Jimmy
Heavy Persistent Oiling
Oiled Control
Mechanical Treatment
Mechanical Treatment, Planted
Reference
Site Location
Southeast Louisiana
Barataria Bay
Reference Conditions
0
50
100 Meters
N


October 2010


15 CM

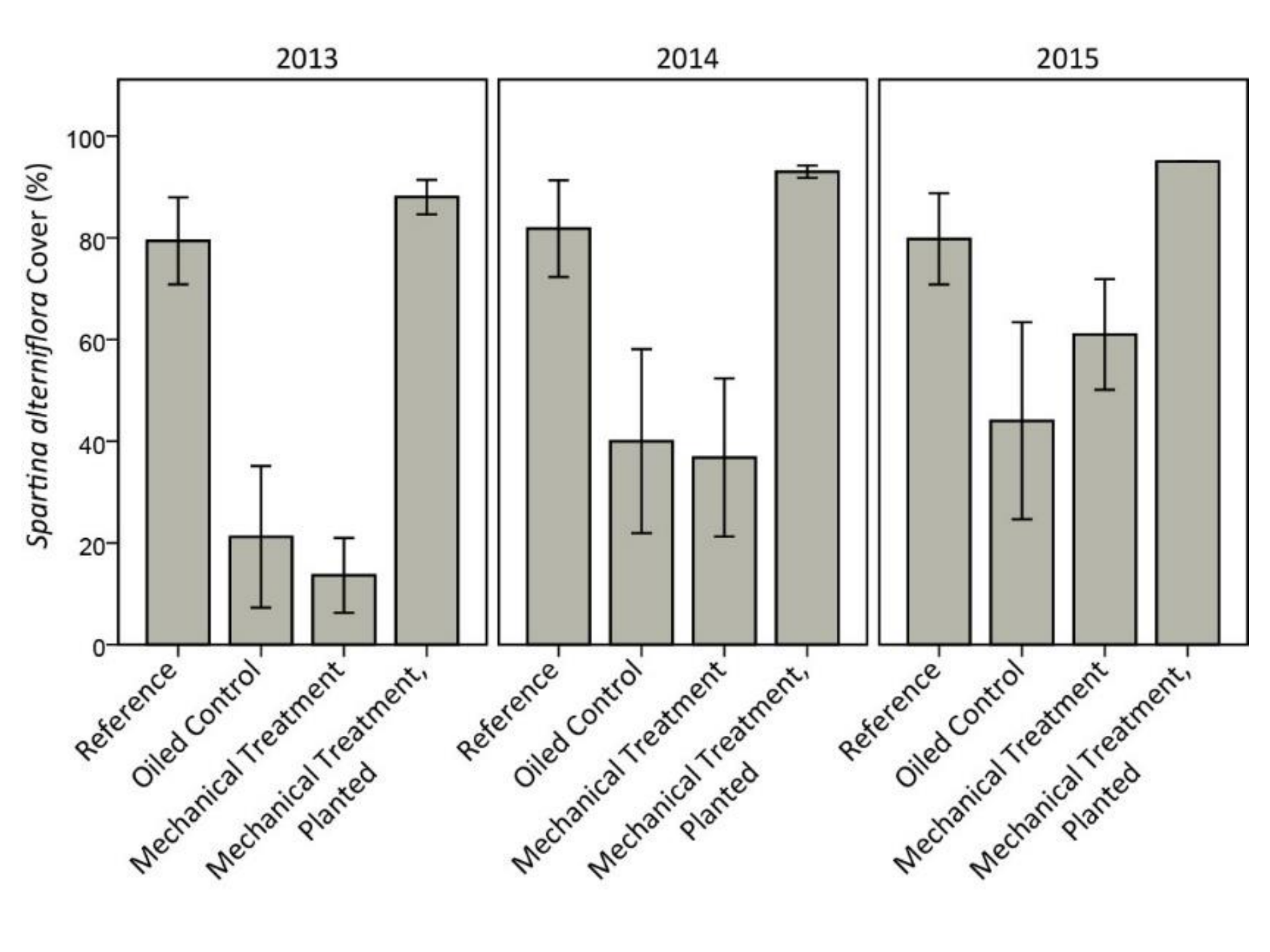

15 CM

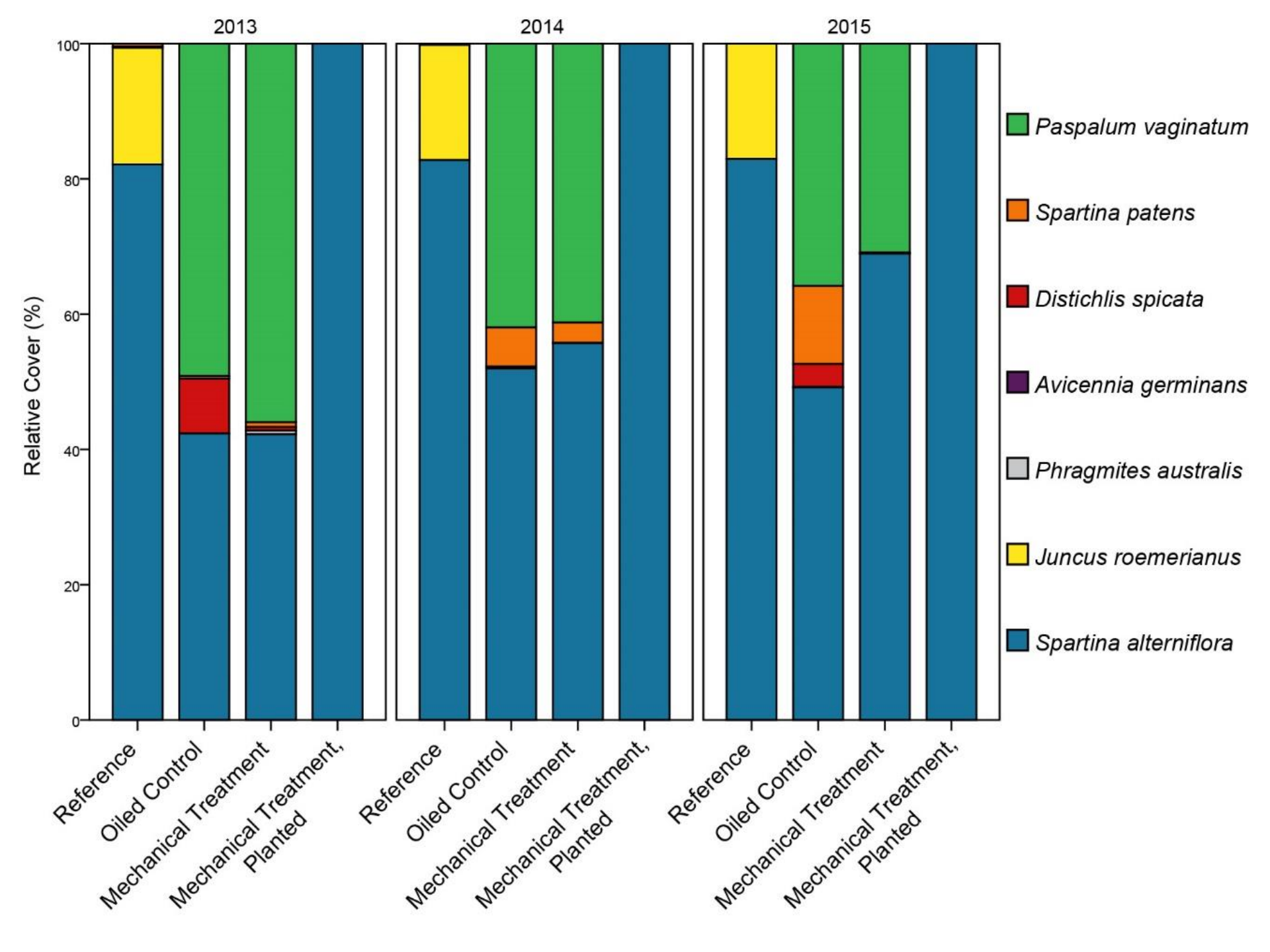

15 CM


2013
2014
2015
Sediment Oil Cover (%)
60
50
40
30
20
10
0
NOO
NOO
NOO
Reference
Oiled Control
Mechanical Treatment
Mechanical Treatment, Planted
Reference
Oiled Control
Mechanical Treatment
Mechanical Treatment, Planted
Reference
Oiled Control
Mechanical Treatment
Mechanical Treatment, Planted

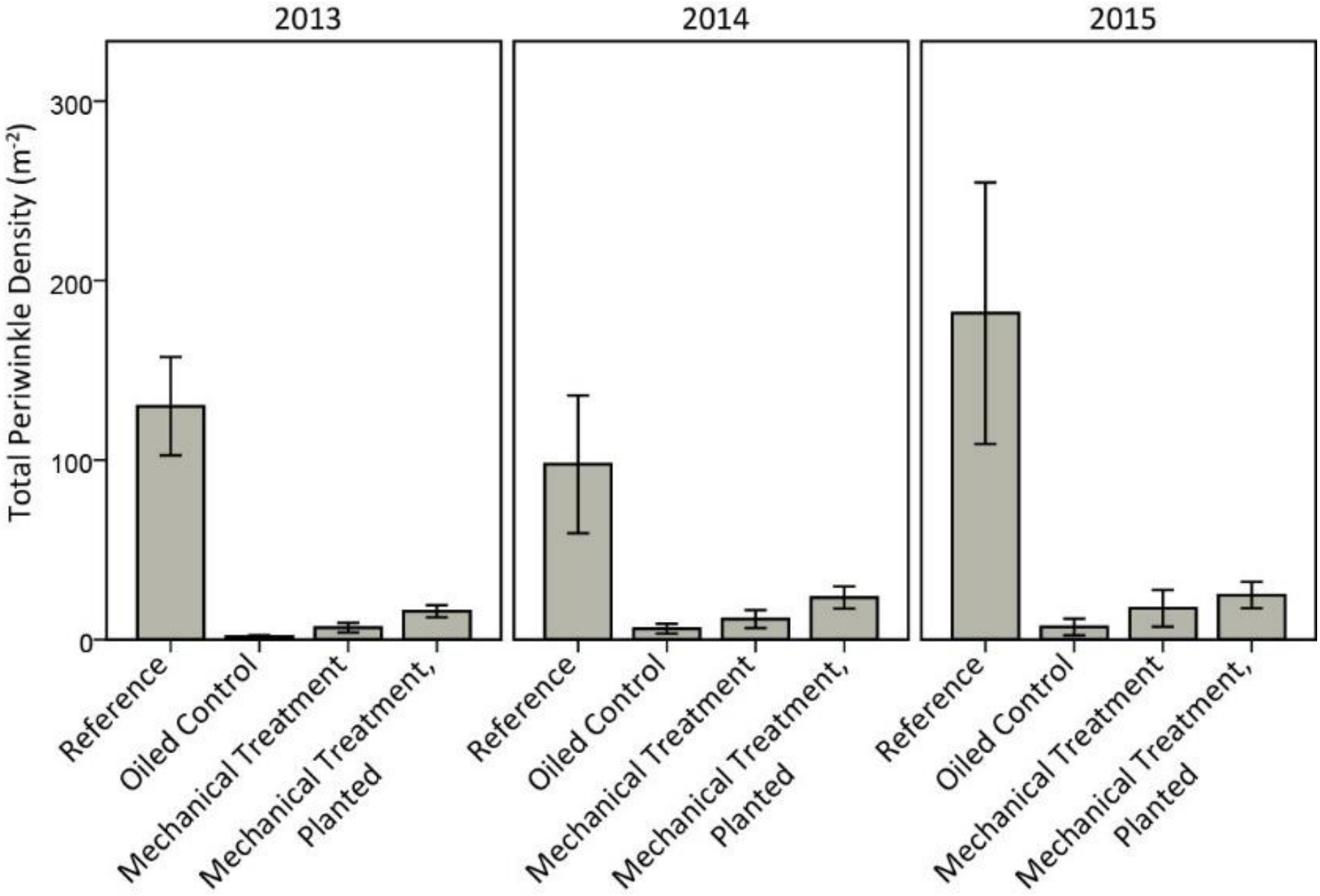

November 2011


September 2013

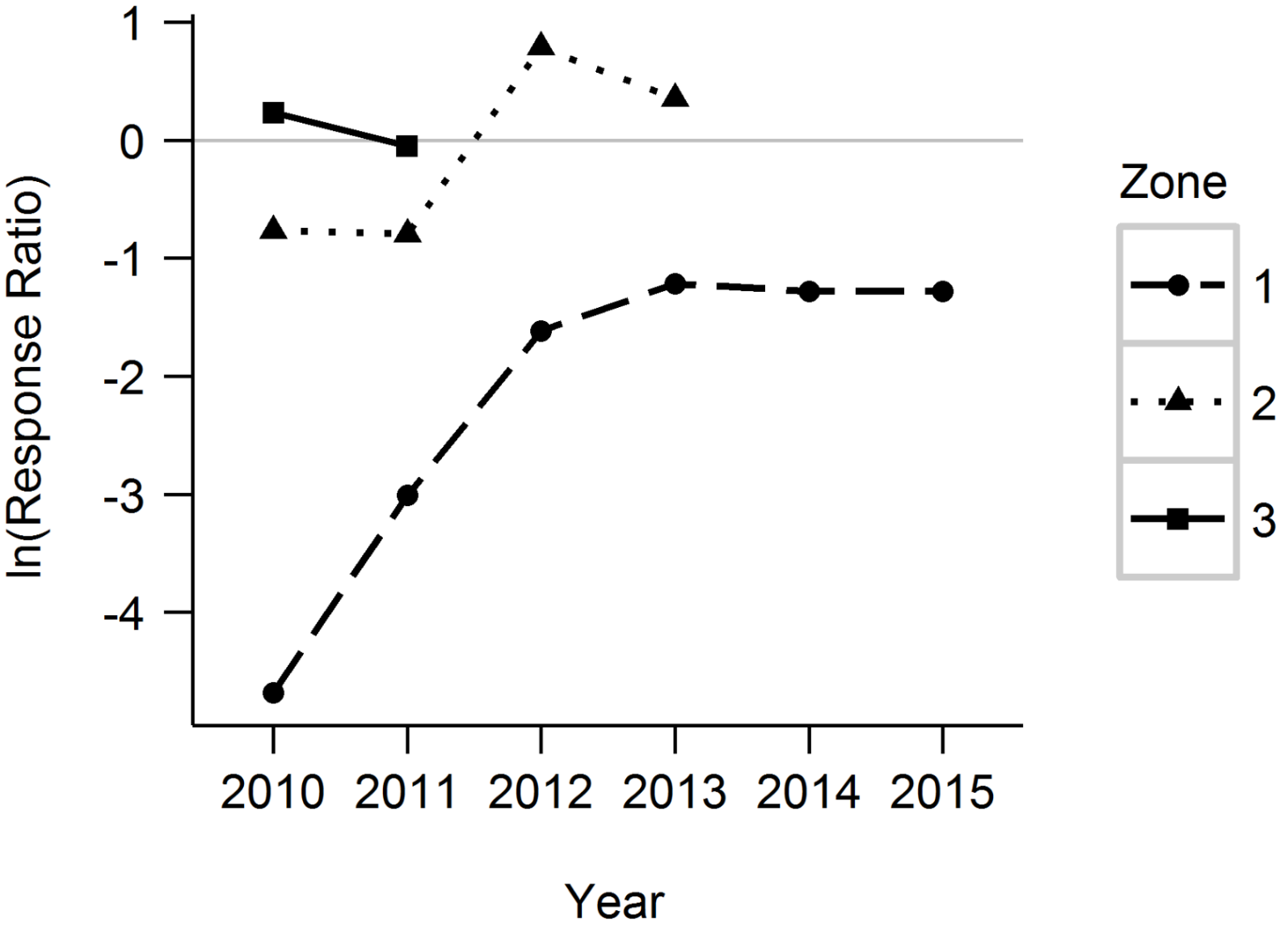

2013
2014
2015
Spartina alterniflora Cover (%)
100
80
60
40
20
0
Reference
Oiled Control
Mechanical Treatment
Mechanical Treatment, Planted
Reference
Oiled Control
Mechanical Treatment
Mechanical Treatment, Planted
Reference
Oiled Control
Mechanical Treatment
Mechanical Treatment, Planted


2013
2014
2015
Relative Cover (%)
100
80
60
40
20
0
Reference
Oiled Control
Mechanical Treatment
Mechanical Treatment, Planted
Paspalum vaginatum
Spartina patens
Distichlis spicata
Avicennia germinans
Phragmites australis
Juncus roemerianus
Spartina alterniflora

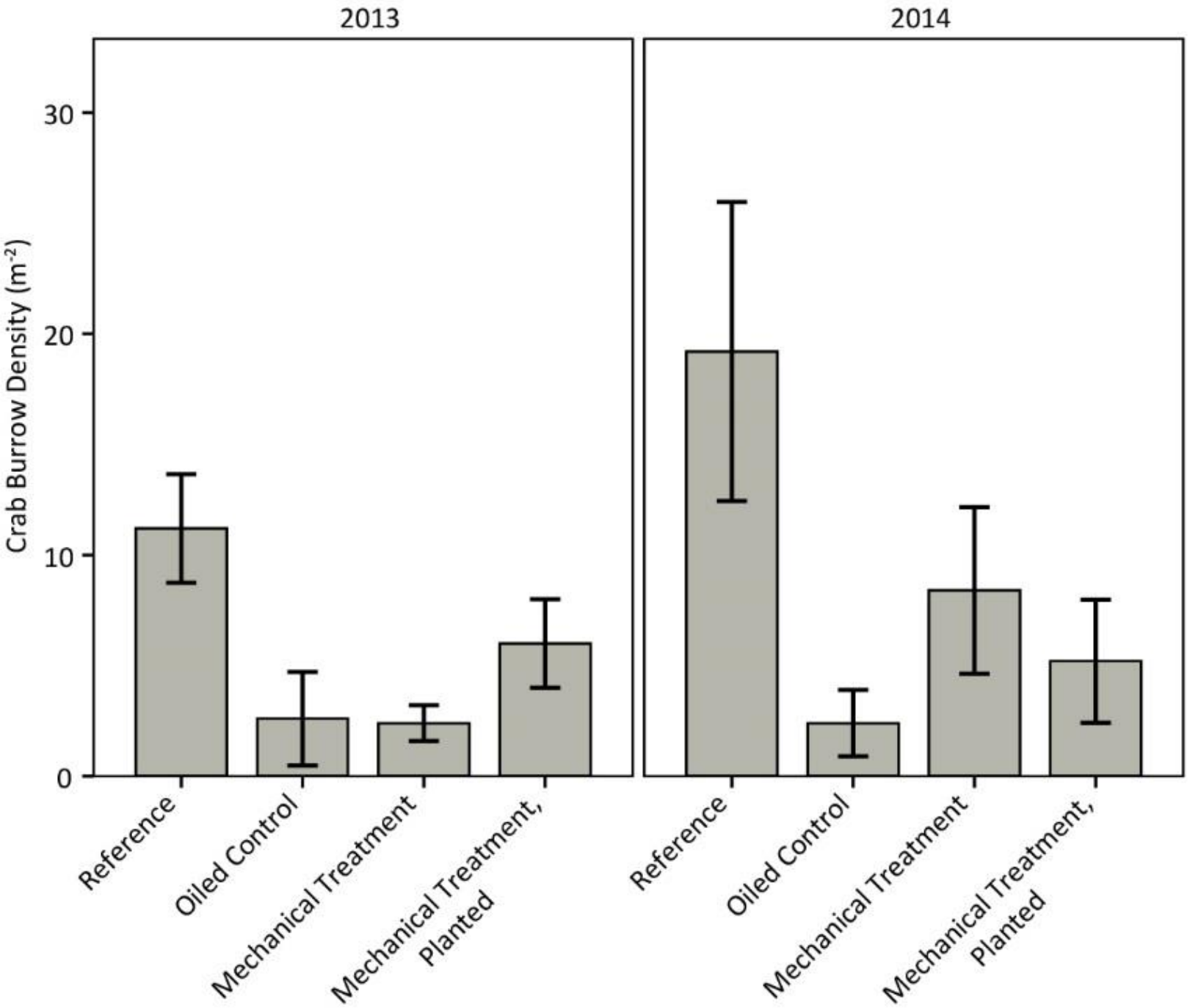

15 CM


2013
2014
2015
Total Periwinkle Density (m-2)
300
200
100
0
Reference
Oiled Control
Mechanical Treatment
Mechanical Treatment, Planted

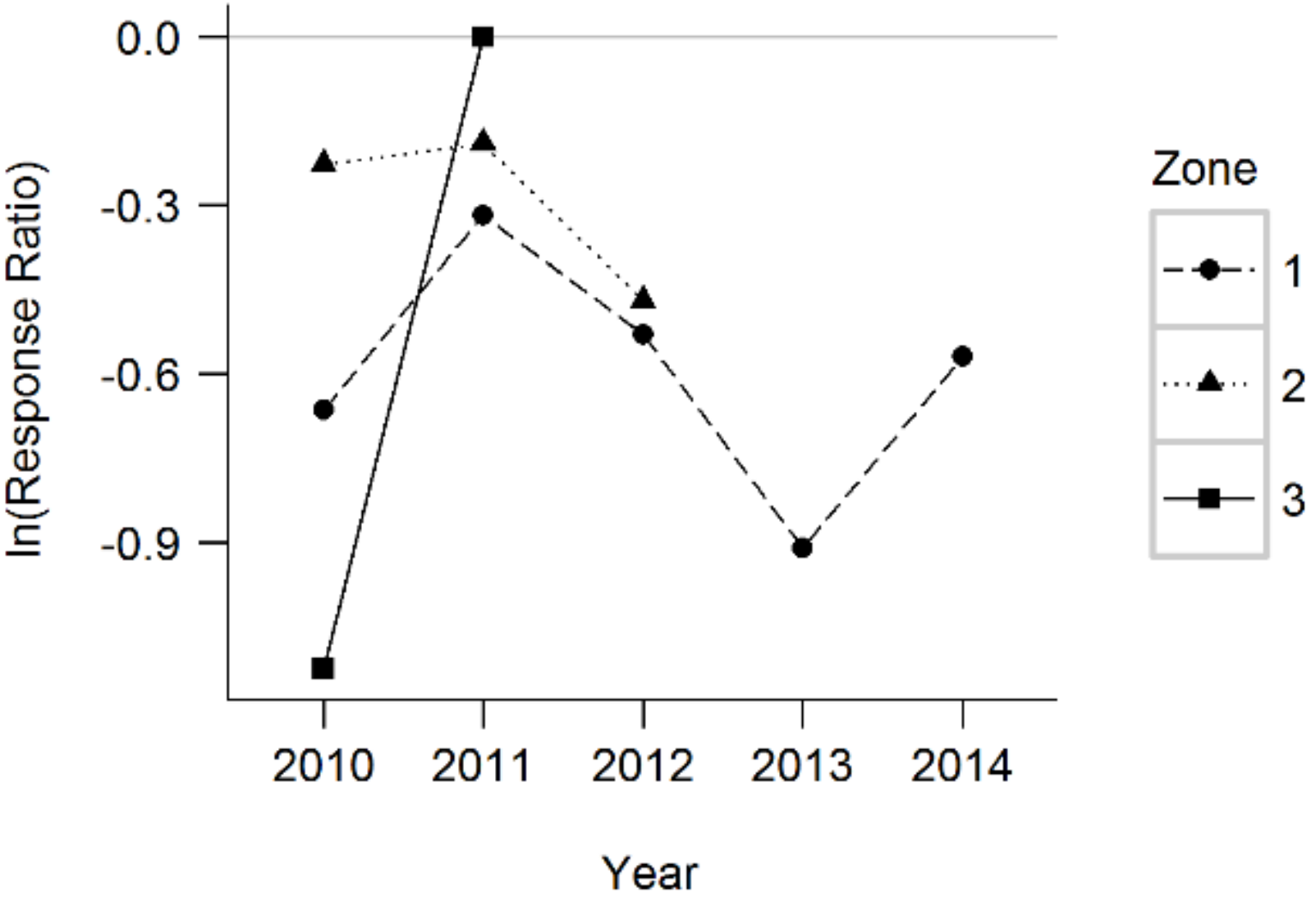
Marsh periwinkle meta-analysis, density (m^{-2})

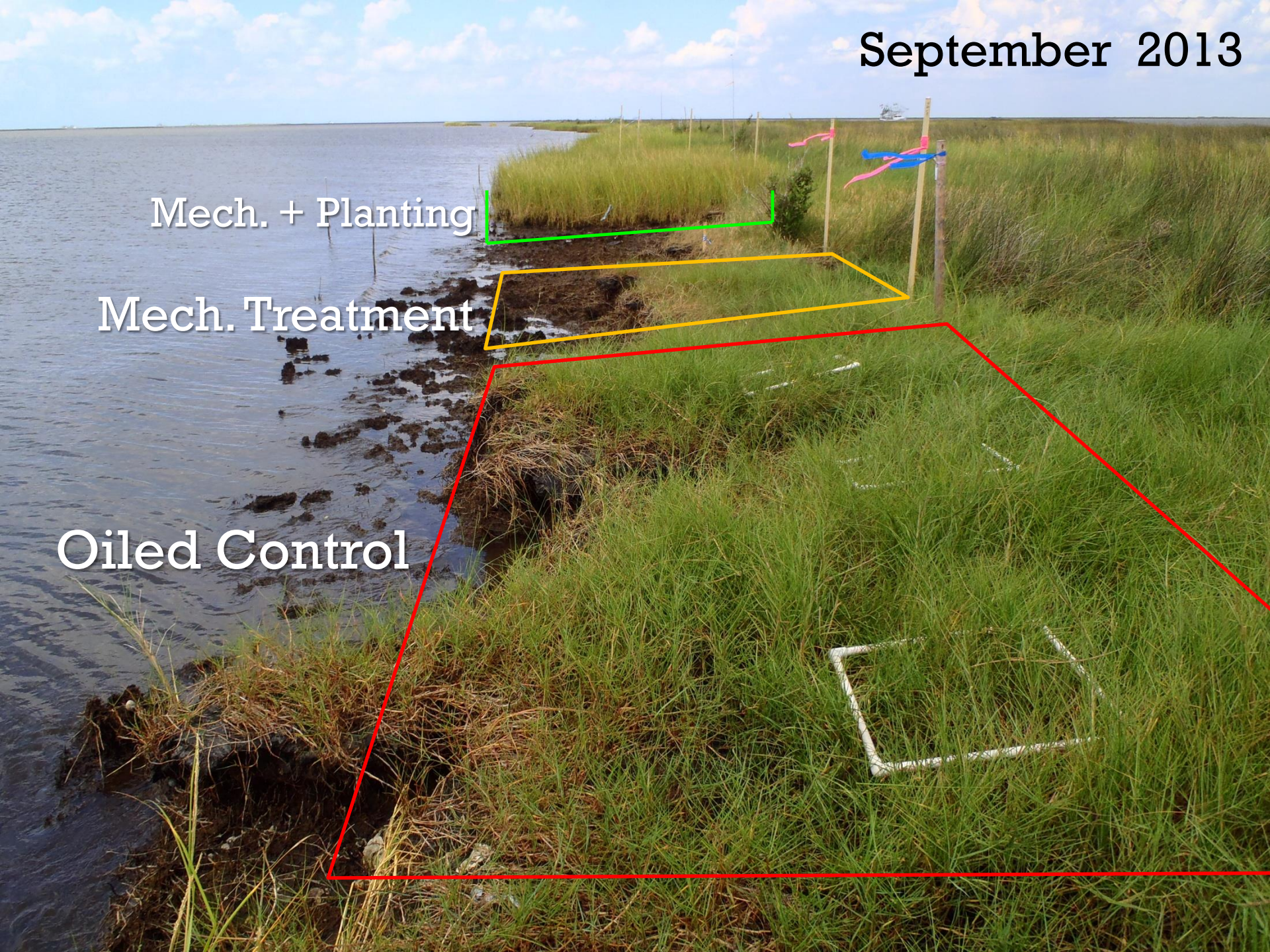


September 2016


2013
2014
Crab Burrow Density (m-2)
30
20
10
0
Reference
Oiled Control
Mechanical Treatment
Mechanical Treatment, Planted
Reference
Oiled Control
Mechanical Treatment
Mechanical Treatment, Planted

Fiddler meta-analysis, burrow density (m^{-2})




September 2013
Mech. + Planting
Mech. Treatment
Oiled Control


September 2014


September 2015
8

Conclusions

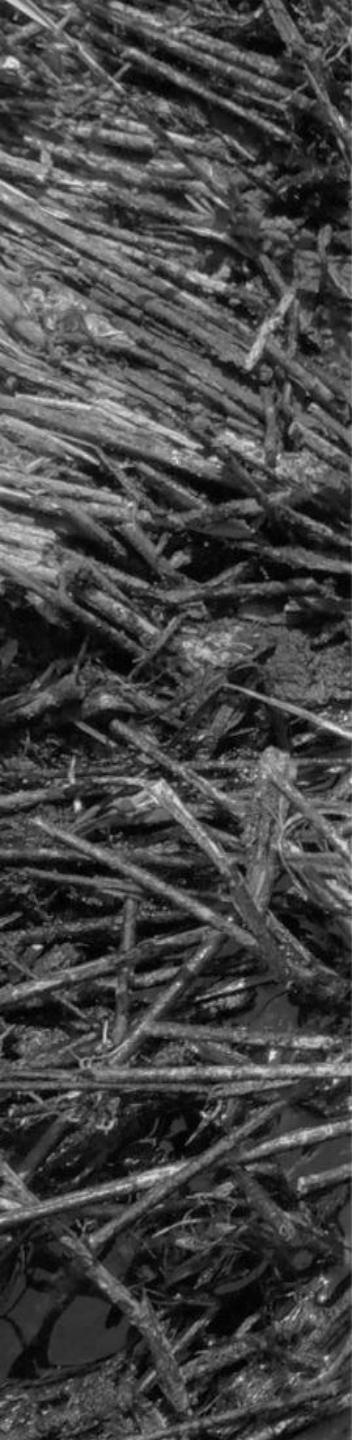
- **Did shoreline treatment improve oiling conditions and recovery?** Yes, over first few years especially, but with some negative side effects in some cases.

- **Did planting after treatment help even more?** Yes, to a large degree, especially for vegetation recovery, invertebrates have been slower to recover but still improved; no downsides observed.

- **What would we do next time in similar situation?** Recommendation: carefully tailor treatment type and intensity, and follow immediately with planting.

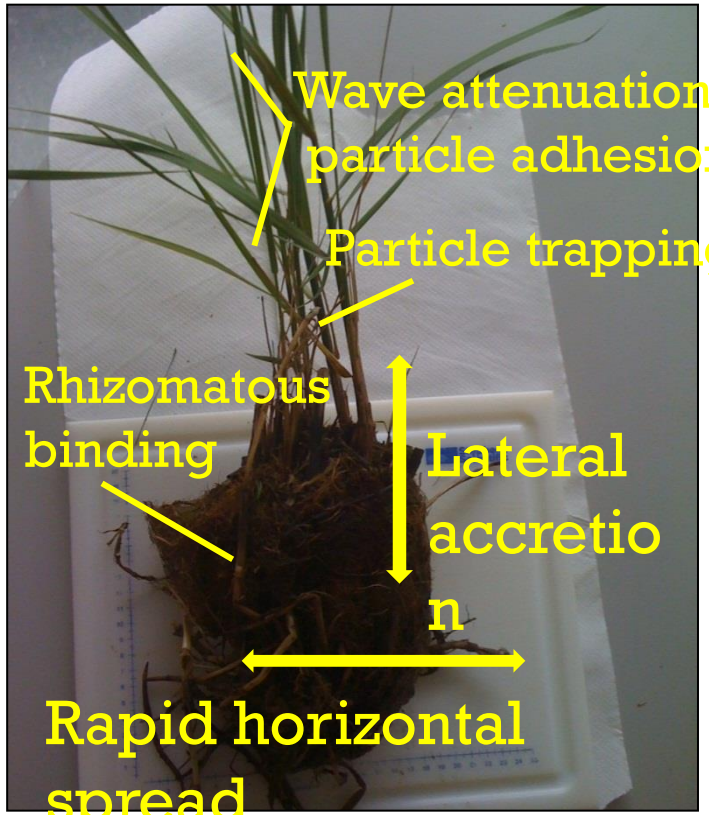
Conclusions

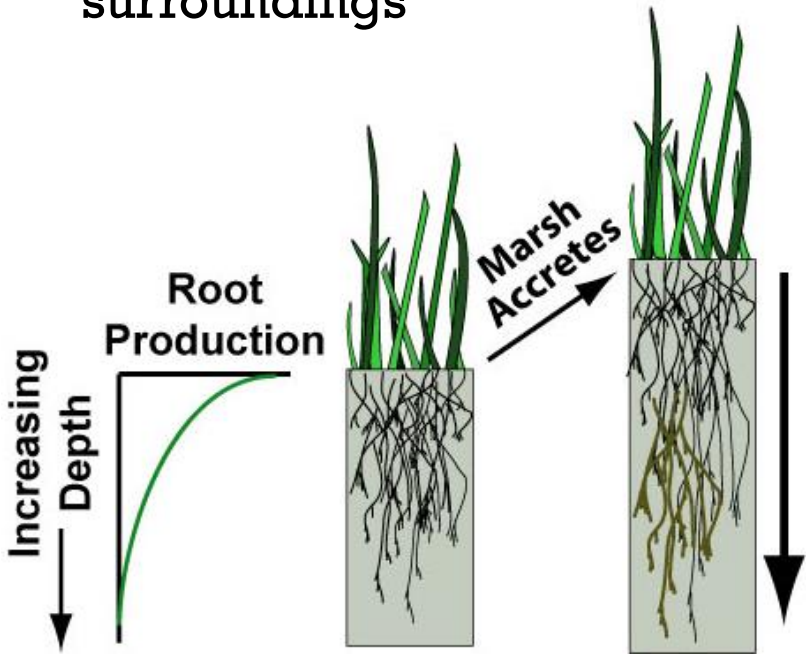
- **Challenges?**
  - Determining the best treatment type and intensity; and holding back when appropriate
  - Finding a fit for planting in response or as NRDA emergency restoration
  - Establishing set-asides (controls) for comparisons
  - New questions – best planting methods and materials?



Introduction: Salt marsh species composition

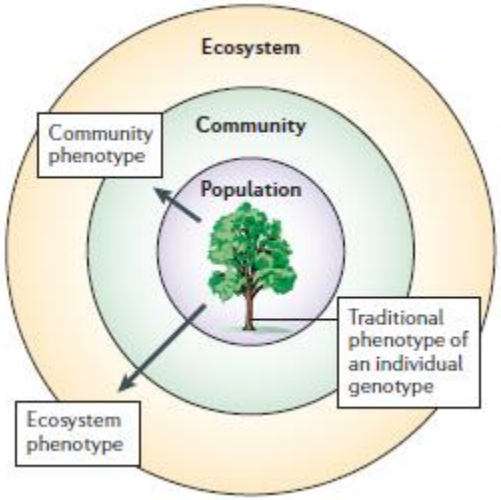
- Biotic interactions can mediate geomorphologic processes
- Clonal grasses dominate salt marshes (e.g., *Spartina* spp.)
- Engineers modify, maintain, and create habitat by causing physical state changes in surroundings





Subsidence:
-compaction
-decomposition
-extraction

Introduction: Extended phenotypes



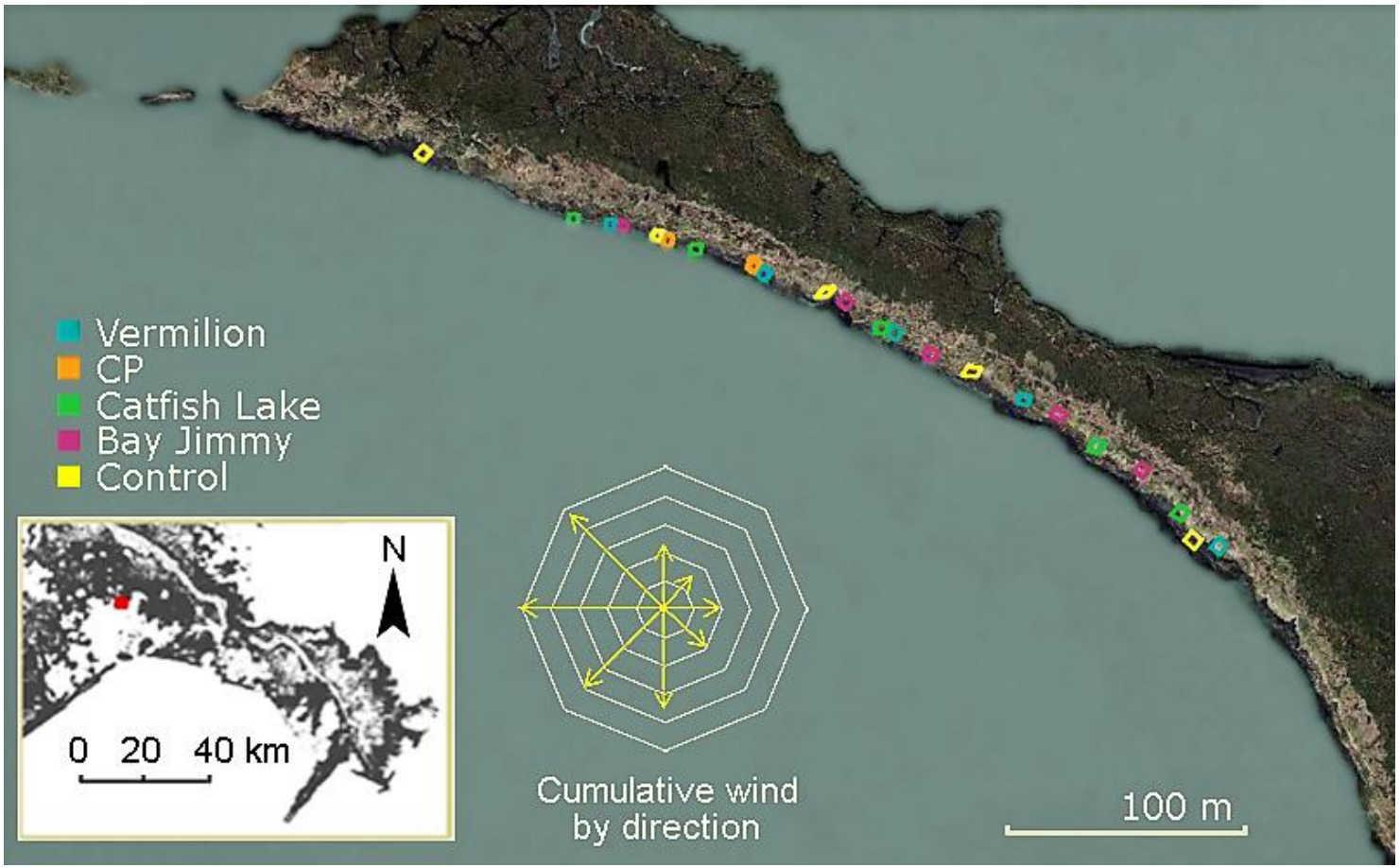
(Whitham et al. 2006)

- Traditional examples of species with community and ecosystem effects of genetic variation: *Populus*, *Pinus*, *Eucalyptus*, *Phalaris* spp.
- *S. alterniflora* community and ecosystem effects: light, algal communities, detritivore activity, fish use, facilitation/suppression of other plant species

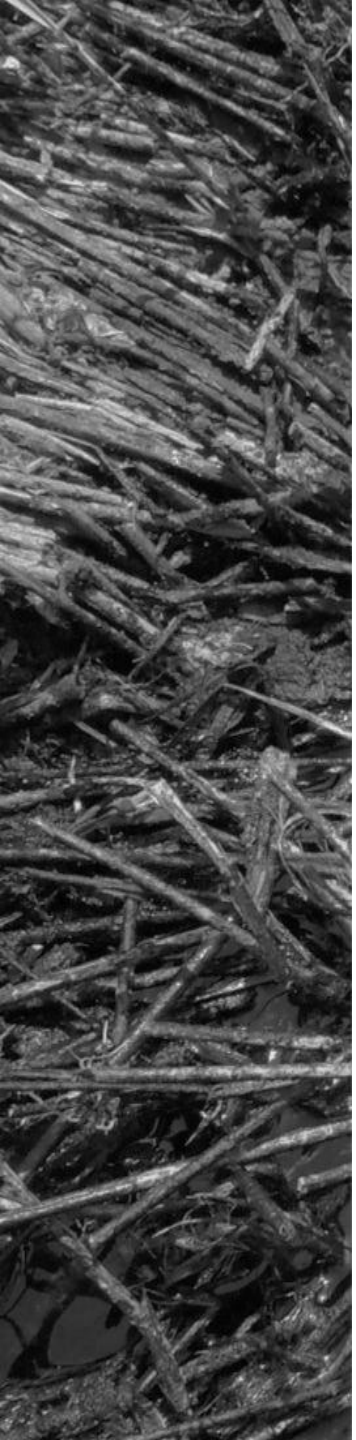
(USGS)

- Unknown ecosystem consequences of changing population composition

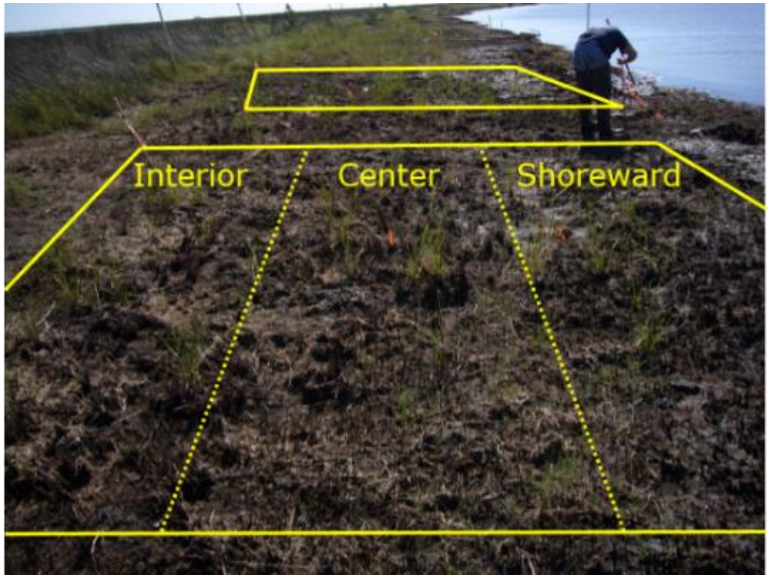
Intraspecific variation affects shoreline erosion in marshes restored using *Spartina alterniflora*



- Common garden experiment comparing shoreline erosion for plots restored with different populations



Intraspecific variation affects shoreline erosion in marshes restored using *Spartina alterniflora*



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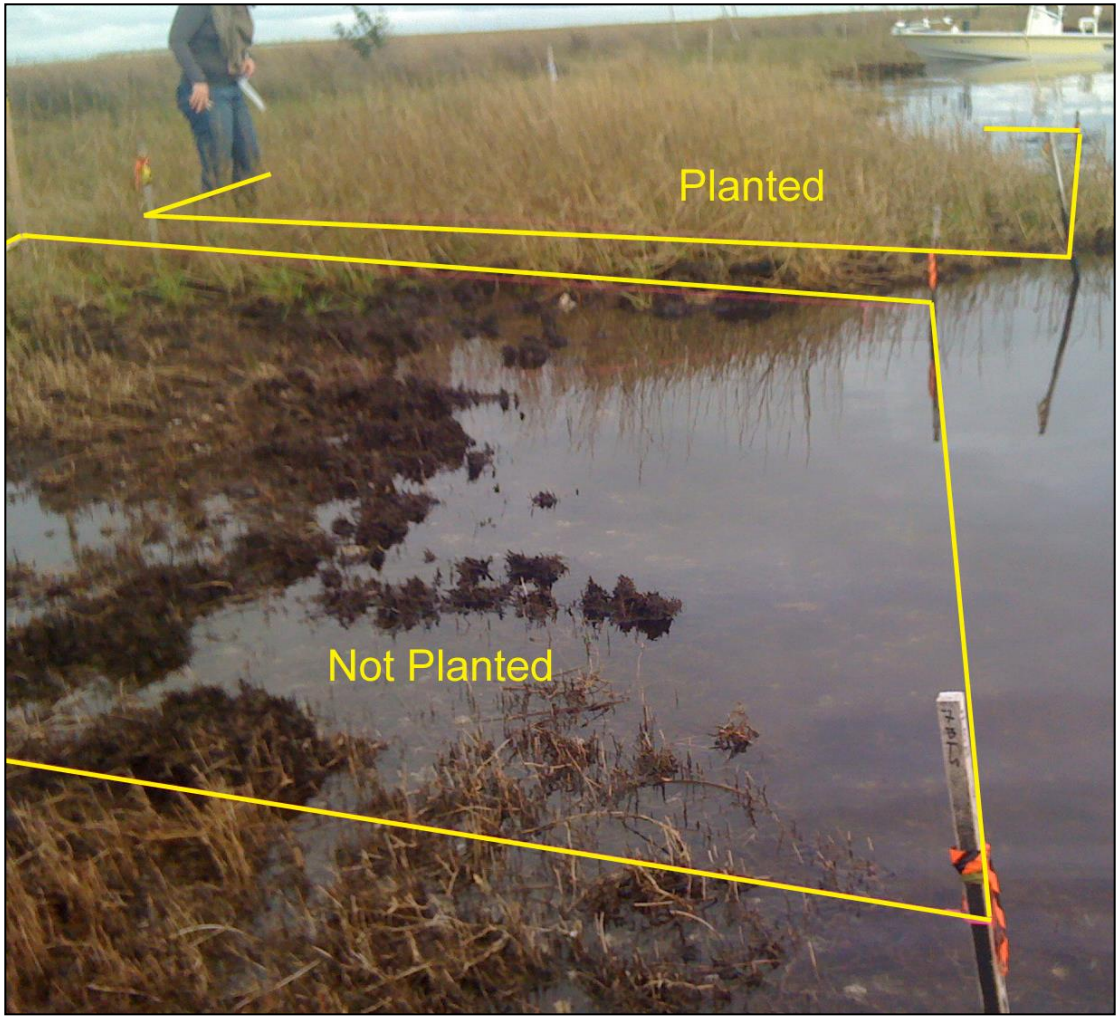
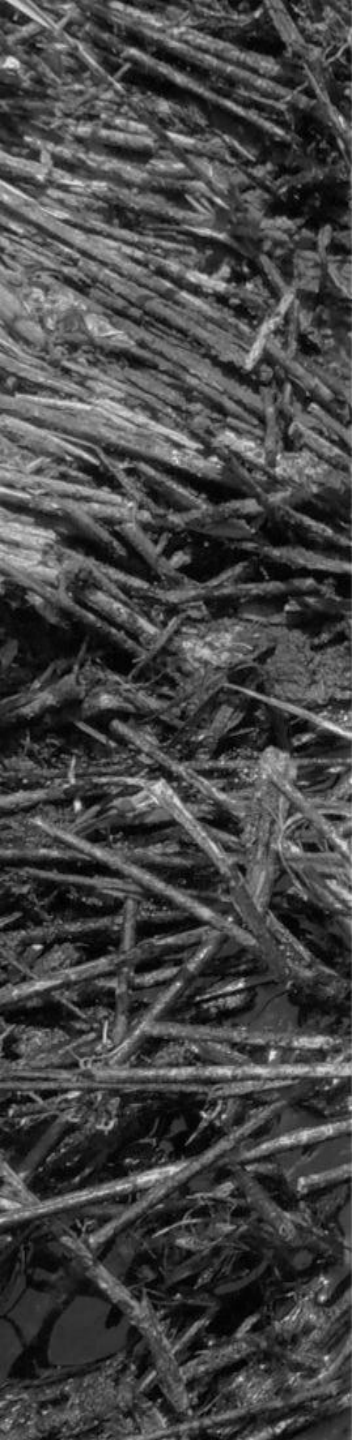


(Courtesy Scott



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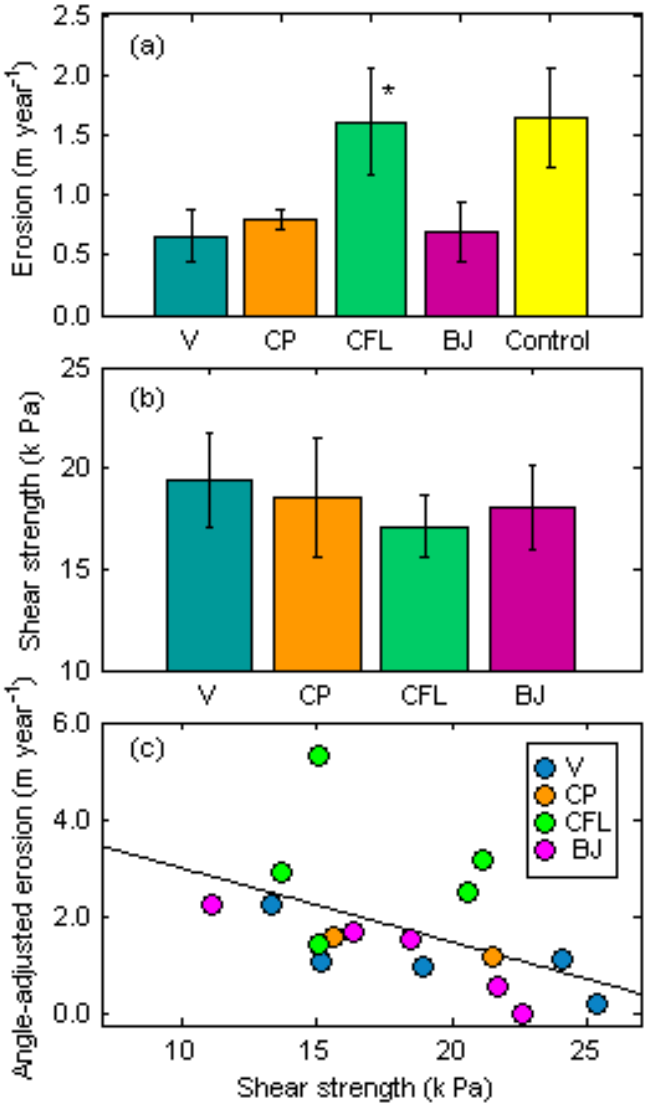
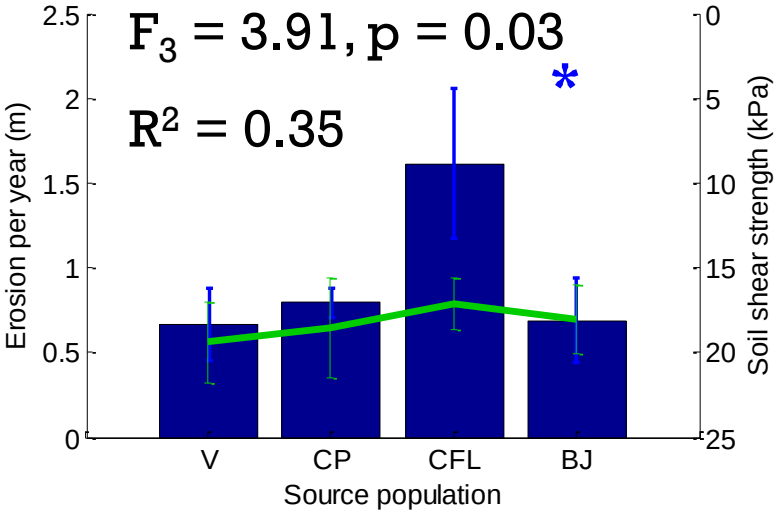
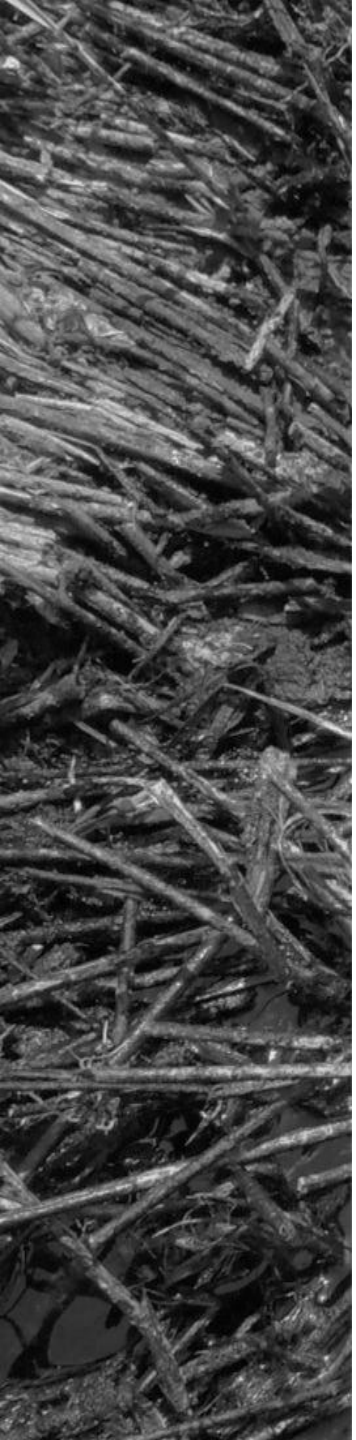




Trait	F_{df}	p value
AG biomass	2.68_3	0.06
BG biomass	5.59_3	0.002*
Density	12.76_3	0.005*
Height	10.69_3	*
Stem diam.	3.92_3	0.01*



Intraspecific variation affects shoreline erosion in marshes restored using *Spartina alterniflora*

- Ecosystem engineering was observed, with vegetation reducing shoreline erosion

- There is evidence of an extended phenotype of *S. alterniflora*, with some genotypes further reducing erosion compared to others

- Factors mediating differences may include establishment success, growth rate, and survivorship

- Belowground trait differences may be responsible for influencing soil shear strength, helping to reduce erosion

- For the processes monitored, cultivars performed as well as or better than local genotypes, but trait differences emphasize the potential influence of genetic identity on ecosystem properties

Coastal Protection and Restoration Authority of Louisiana

LOUISIANA STATE UNIVERSITY