The impacts of large-scale breakwaters on ecosystem functioning in high wave energy environments

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Coastal restoration
Coastal restoration

Functional
Cost-effective
Sustainable
End-user derived questions

1. Should shorelines in high-energy areas be planted?

2. Do breakwaters enhance shoreline vegetation in high-energy areas?

3. How do breakwaters, vegetated shorelines, and the combination of both impact ecosystem services?
Constructed in 2012
Variables

- Breakwaters
  - Present
  - Absent

- Nursery plants

- SLR

- Ecosystem services

Purpose

- End-user derived research to improve the effectiveness, sustainability, and prevalence of coastal restoration projects

Experimental Design

- Breakwaters
  - Present
  - Absent

- Plants (4m² plots)
  - Natural
  - Planted
    - 50% density
    - 1 gallon pots
  - None
  - 8 replicates

- Planted in Summer 2016
Measurements

- Biannually or quarterly
- Marsh health
- Marsh expansion
- Sediment accretion

- Shoreline topography
- Nekton
- Infauna
- Porewater nutrients
**Natural - Cover**

- Plant Percent Cover (%)

**Planted - Cover**

- Plant Percent Cover (%)
  - Breakwater
  - No Breakwater

**Natural - Biomass**

- S. alterniflora biomass (g/m²)

**Planted - Biomass**

- S. alterniflora biomass (g/m²)
  - Breakwater
  - No Breakwater
No colonization in open (unvegeted) plots
Old breakwaters
(2012 – 0.6km – 4.5 breakwaters)

New breakwaters
(2017 – 3km – 21 breakwaters)
Spartina polygon results

South No Breakwaters

Old Breakwaters

Recently Built Breakwaters

North No Breakwaters

Winter 2017
Spartina polygon results

South No Breakwaters

Old Breakwaters

Recently Built Breakwaters

North No Breakwaters

Winter 2017

Summer 2017
Spartina polygon results

South No Breakwaters

Old Breakwaters

Recently Built Breakwaters

North No Breakwaters

Winter 2017

Summer 2017

Winter 2018
Spartina polygon results

- South No Breakwaters
- Old Breakwaters
- Recently Built Breakwaters
- North No Breakwaters

Winter 2017
Summer 2017
Winter 2018
Summer 2018
Spartina polygon results

Percent Change from Winter 2017 to Summer 2018

Old Breakwaters: +25.25%
New Breakwaters: +71.72%
South No Breakwaters: 0%
North No Breakwaters: -23.53%

Number of S. alterniflora Patches

Total S. alterniflora Patch Area (m^2)

Winter 2017 | Summer 2017 | Winter 2018 | Summer 2018

-20.43% | +21.51% | +20.12% | +130.69%
Preliminary summary

1. Should shorelines in high-energy areas be planted? Depends on budget, better than not planting

2. Do breakwaters enhance shoreline vegetation in high-energy areas? Just now seeing it – 6 years after construction

3. How do breakwaters, vegetated shorelines, and the combination of both impact ecosystem services? Too early to tell
Tradeoffs

$2.8 million + $580k = $3.4 million
Acknowledgements
Next steps