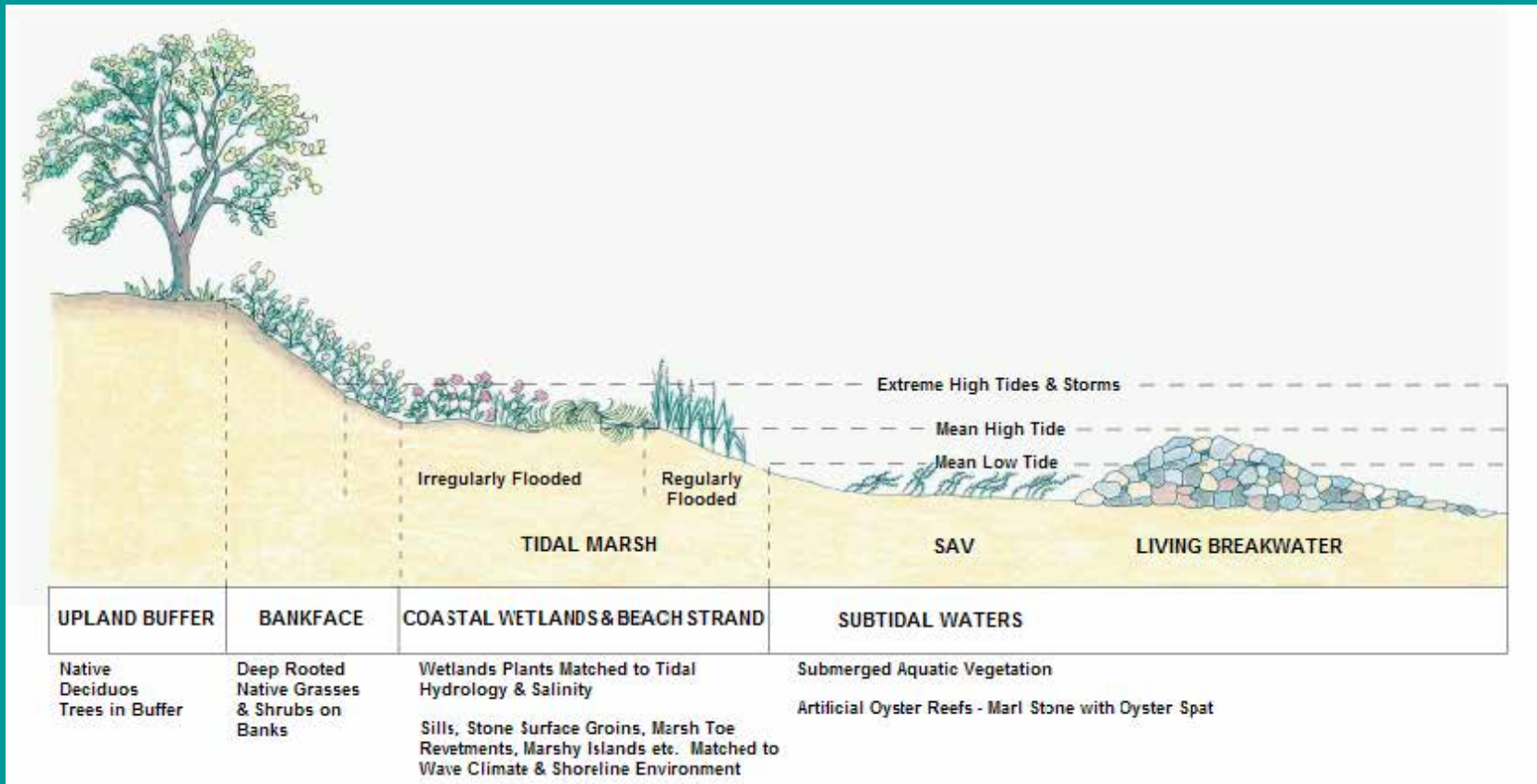


# SF Bay Living Shorelines: Near-shore Linkages Project

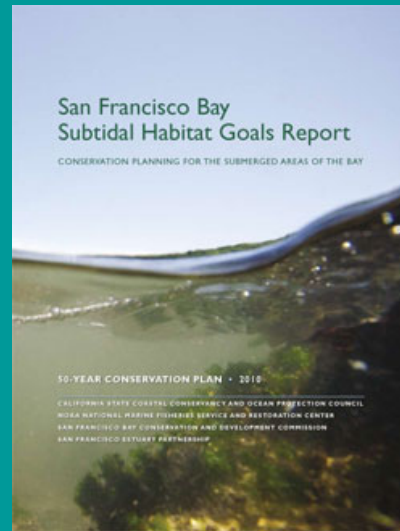


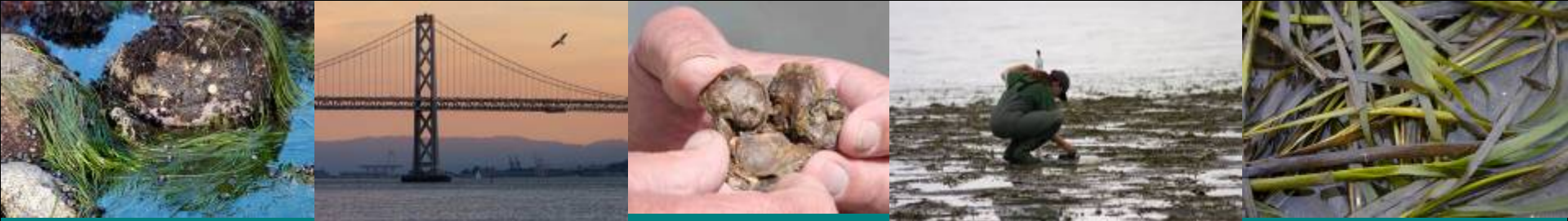
# Living Shorelines: East Coast and Gulf Coast



# Multiple Objectives

- Link to Subtidal Habitat Goals
- Pilot scale, experimental approach
- Monitor: invertebrates, fish, birds
- Evaluate physical benefits
- Pilot climate change adaptation
- Apply lessons learned





# Native Eelgrass: *Zostera marina*

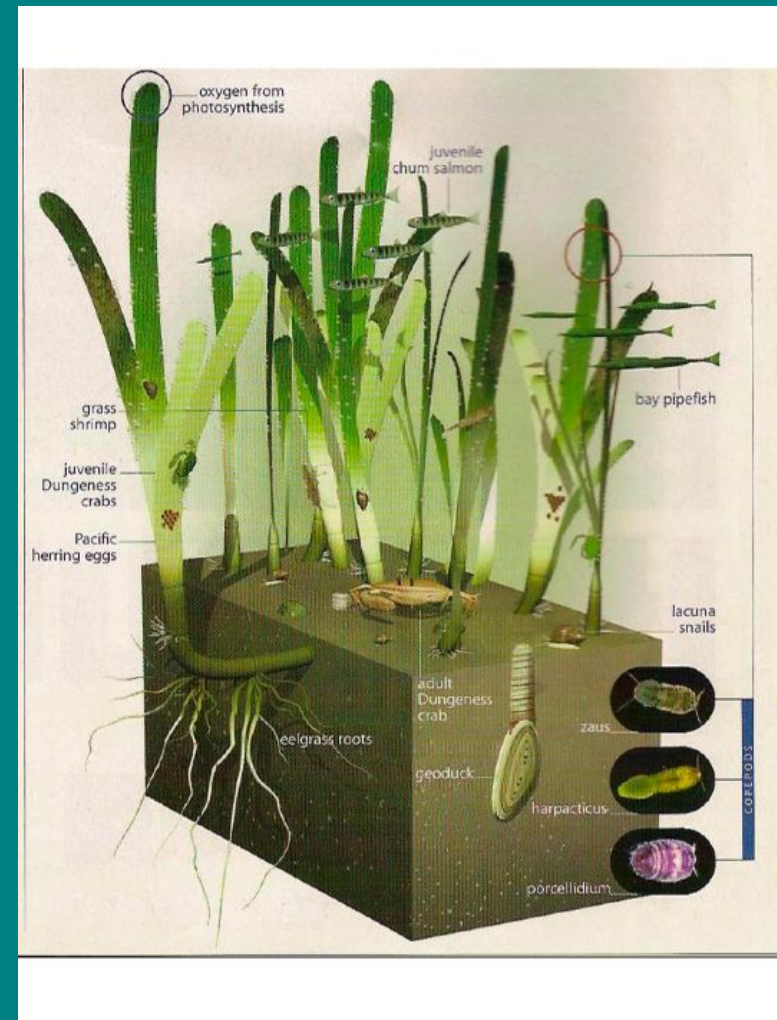
## Habitat Builders:

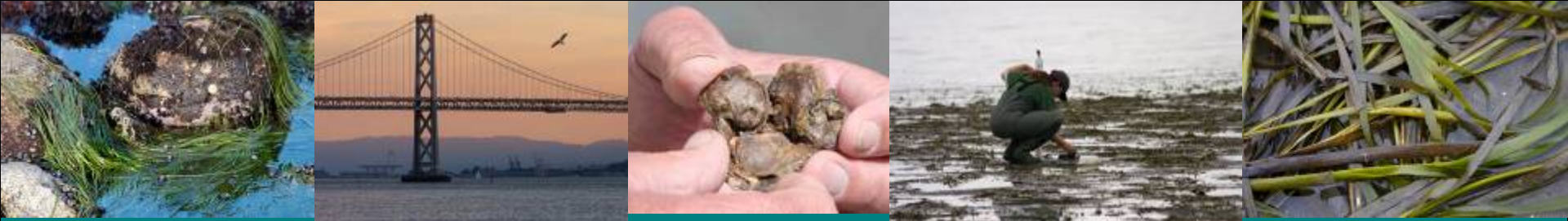
- sediment infauna (clams, worms, etc.)
- epibenthic invertebrates (sponges, etc.)
- fishes (pipefish, anchovy, etc.)

Traps sediments, reduces erosion

Breeding ground for Pacific herring

Foraging area for birds & marine mammals





# Native Olympia Oysters: *Ostrea lurida*

## Habitat Engineers:

- Range: Chile to Alaska
- Small: usually 1.5 - 2", some to 3"
- Attach to shell, hard substrate, mud/cobble
- Planktonic larvae, settle in embayments
- Filter feeders, water quality
- Co-evolved with natives, key niche space
- Food source for other invertebrates, birds, fish



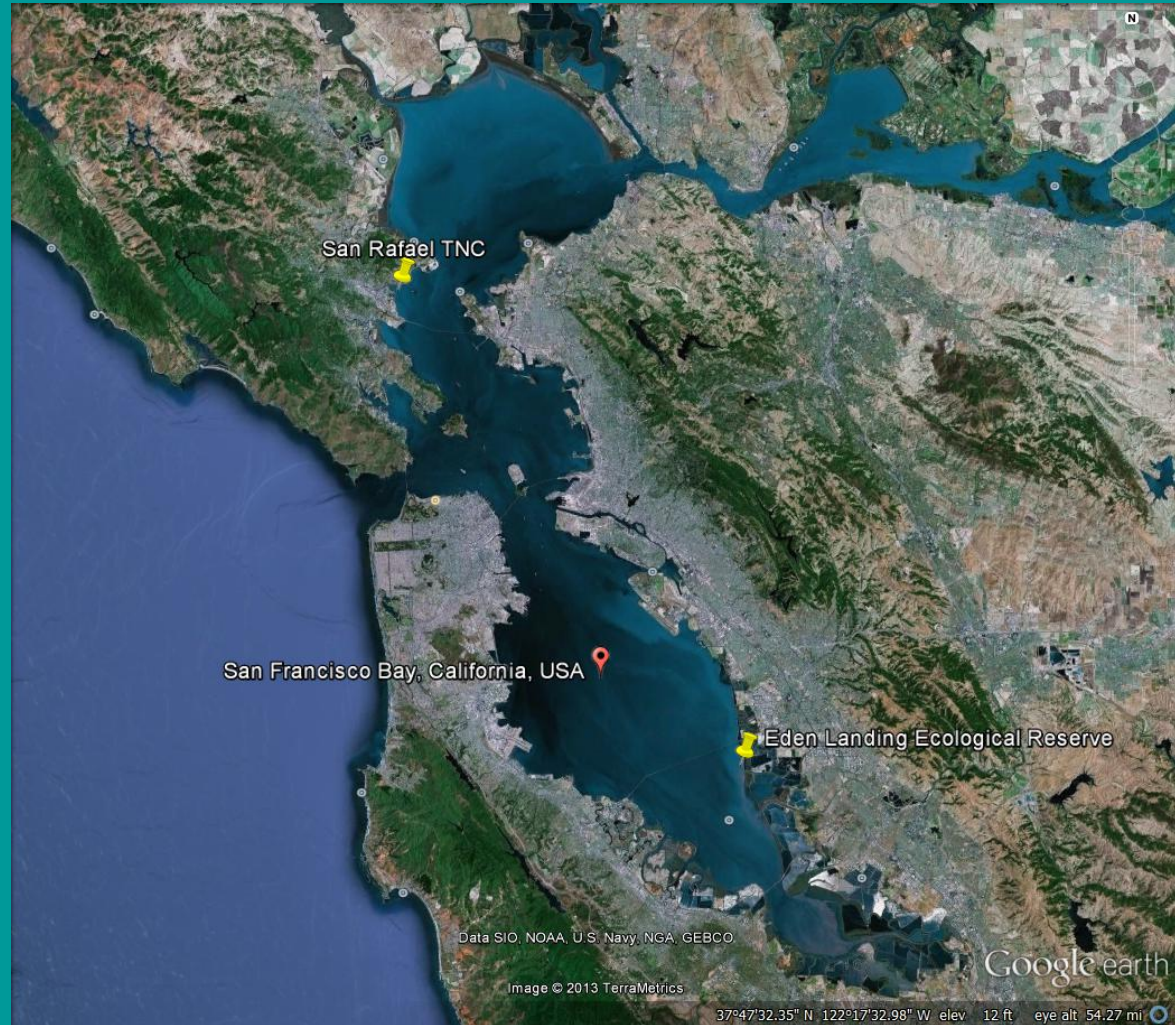
# Existing populations assessed pre-construction and post-construction



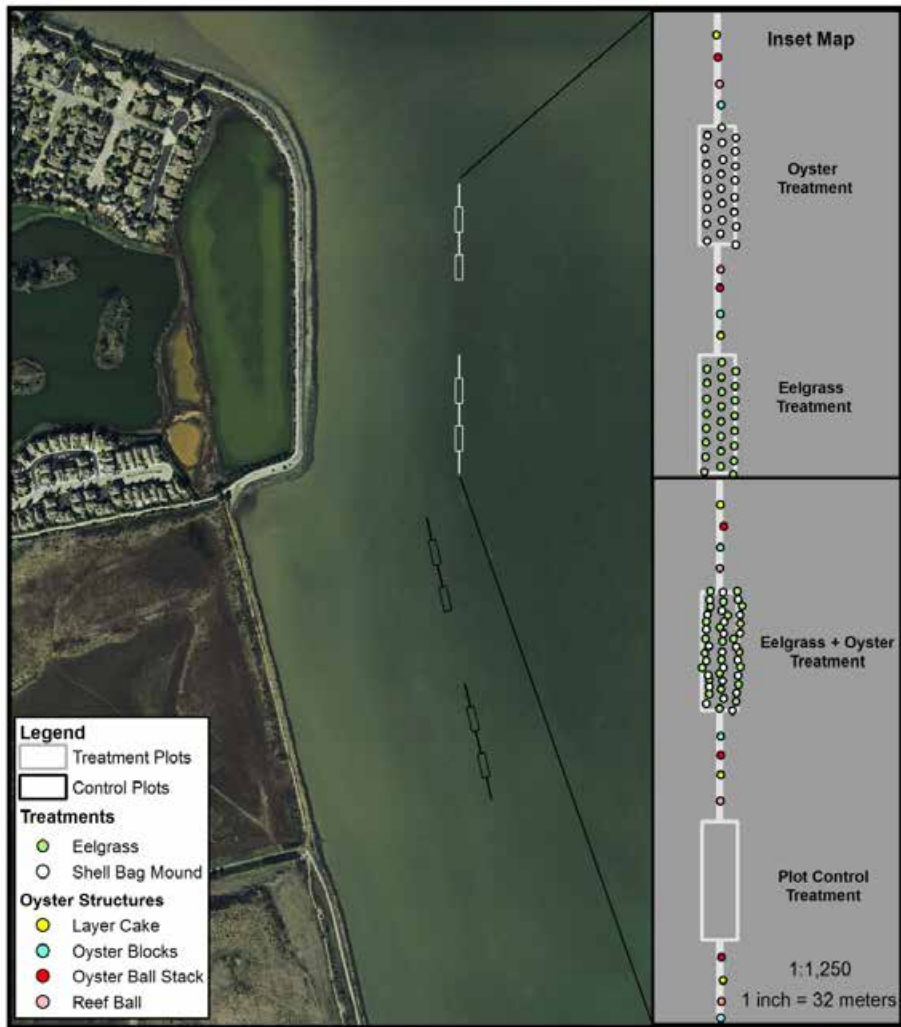
C. Zabin

# Project location

San Rafael (TNC)



Hayward (ELER)



**Figure 1.**  
Treatment and Control Locations  
The Nature Conservancy

Living Shorelines Project  
Marin County, CA

1:6,000

0 30 60 120 Meters



Data: SFSU, USGS, ESA-PWA 2012  
Map produced by C. Pinneil, Jan 2013  
TNC\_2013-0116-overview.mxd



S. Kiriakopolos



S. Kiriakopolos

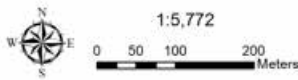




**Legend**

- Control Plots
- Treatment Plots
- Treatment Units**
- Eelgrass
- Eelgrass plus Shell Bag Mound
- Oyster Block
- Oyster Ball Stack
- Reef Ball
- Shell Bag Mound

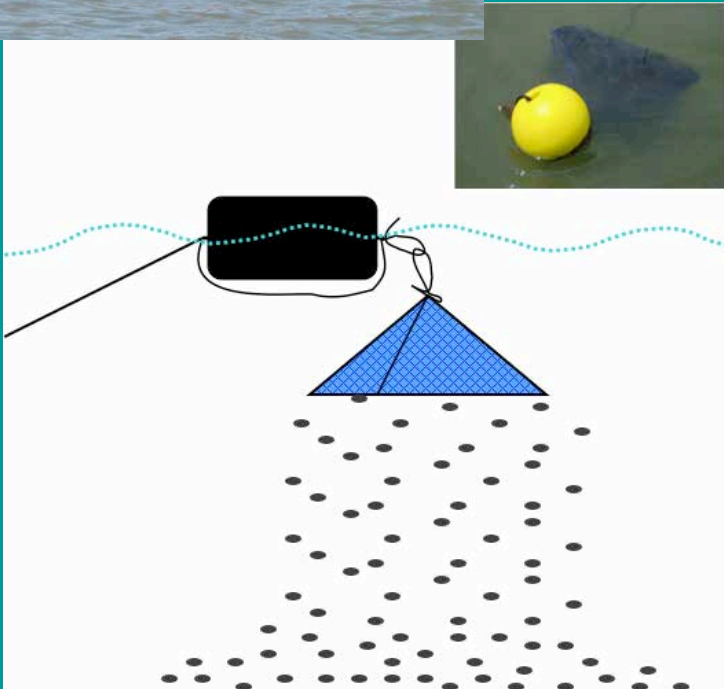
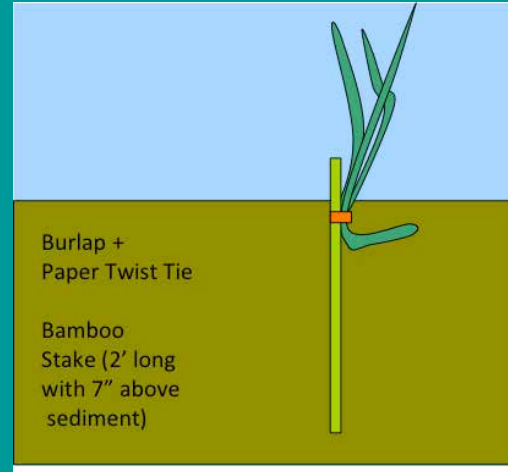
**Figure 2.**  
**Treatment and Control Locations**  
**Eden Landing Ecological Reserve**  
**Living Shorelines Project**  
**Alameda County, CA**



Data: SFSU, USGS, USDA 2009  
 Map produced by C. Pinnell, Jan 2013  
 Fig2\_EL\_2013-0116-overview.mxd



# Native Eelgrass Methods



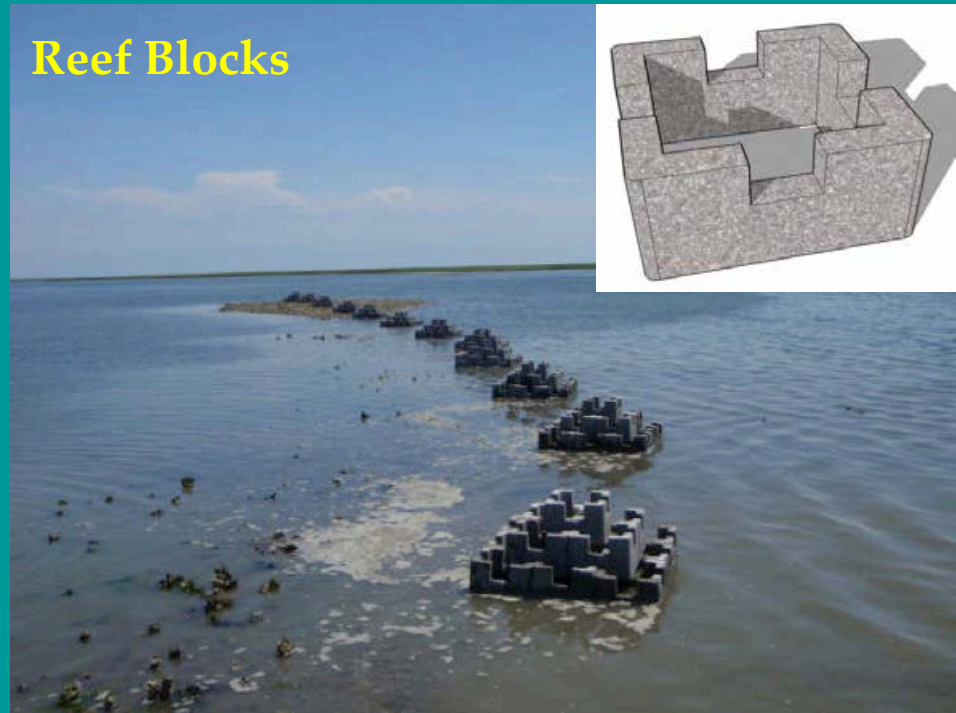
# Native Oyster Methods

Large Plots: 15M x 30M

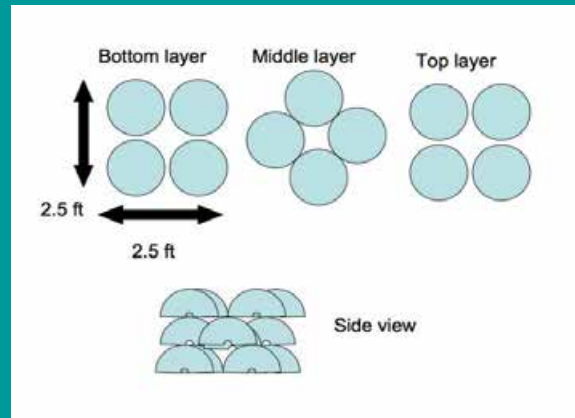
Shell bag mounds



Reef Blocks

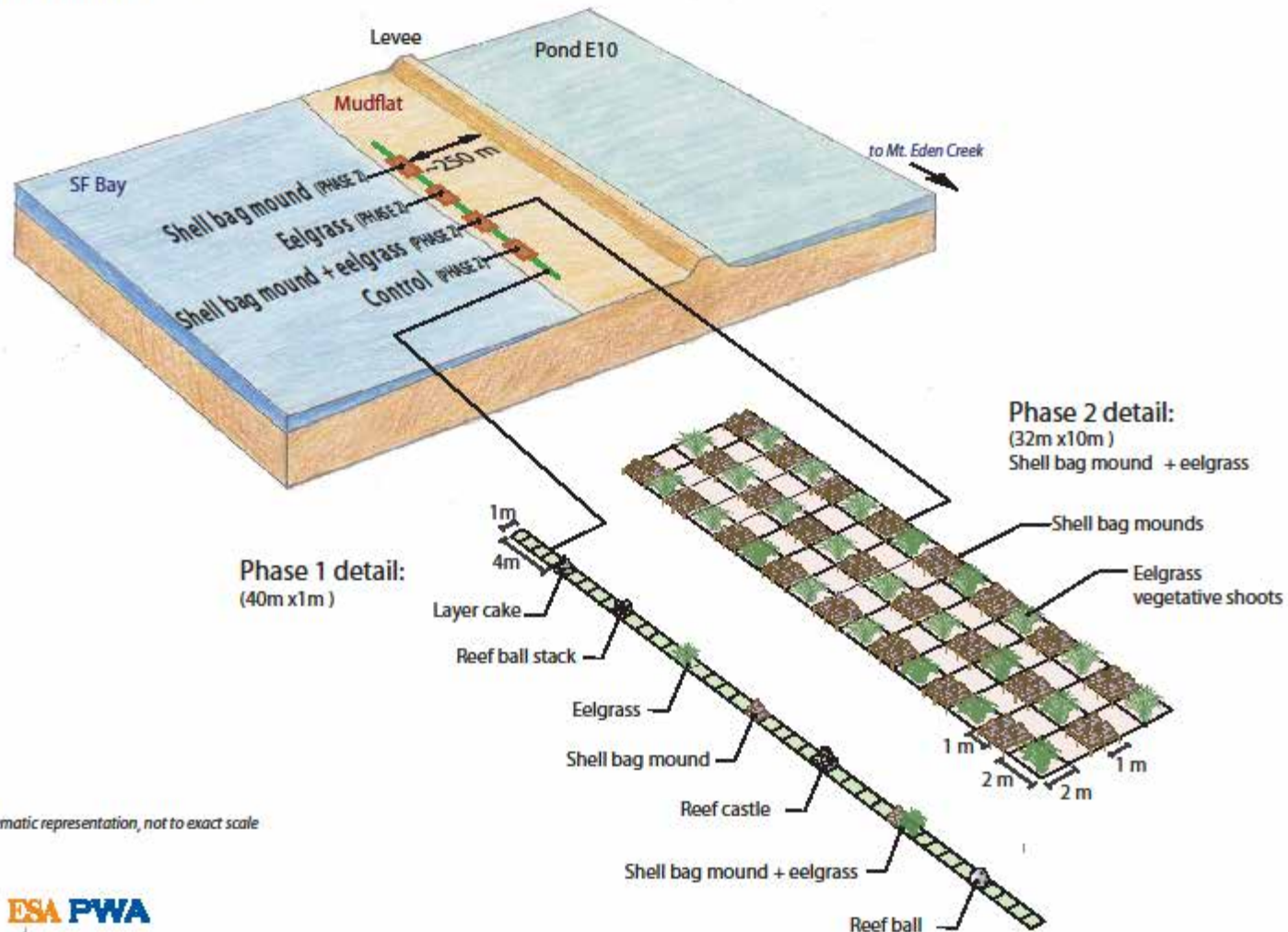


Small Plots



# Shell Bag Mounds and Artificial Reef Oyster Elements

## Proposed Array of Treatments at Eden Landing Ecological Reserve North Phase 1 and Phase 2

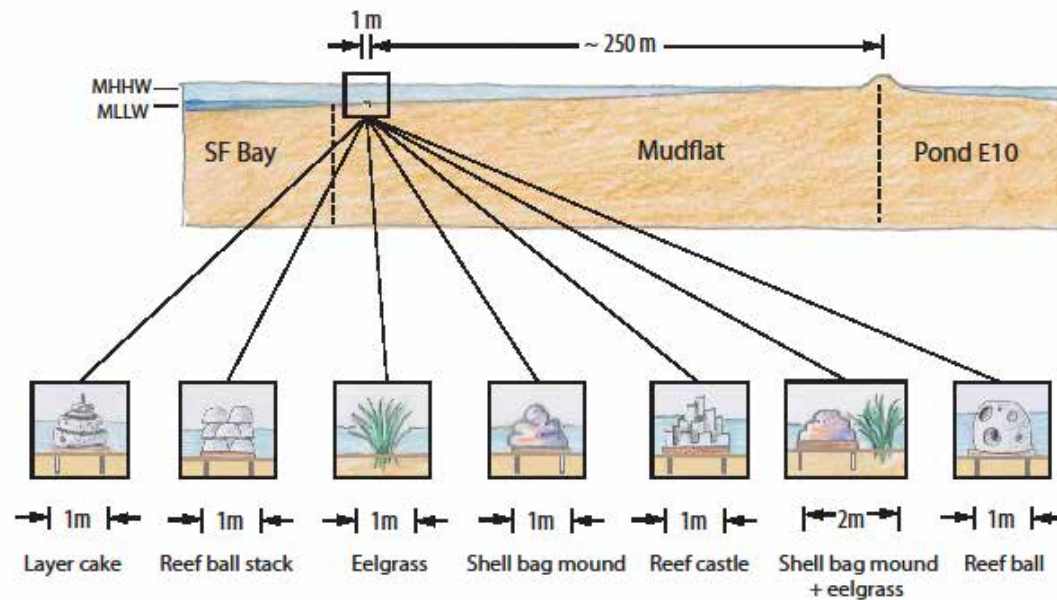


# Small-scale substrate project design

1x1 m plots, 5 replicate blocks

Between and on ends of larger scale plots

Substrate Elements at Eden Landing Ecological Reserve North  
Cross Section





# Construction



# Construction Prep: Pacific Oyster Shell Bags



# Construction Prep: "Baycrete" Reef Balls





# Construction Prep: "Baycrete" *Oyster Balls, Layer Cakes, Oyster Blocks*



# Construction Prep: Eelgrass Collection *Flowering and Vegetative Shoots*



# Construction July 2012







## Preliminary Results



# Oyster monitoring

1. How does oyster performance vary-  
across different element types  
with and without eelgrass  
in comparison to controls?

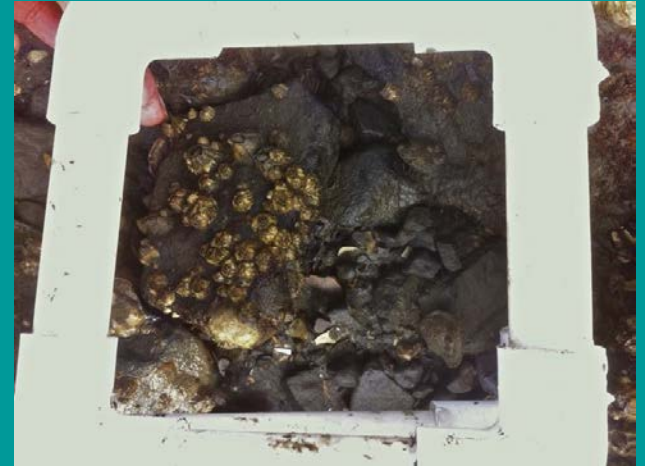
Recruitment: #spat/time/unit area

Growth: tracking marked individuals

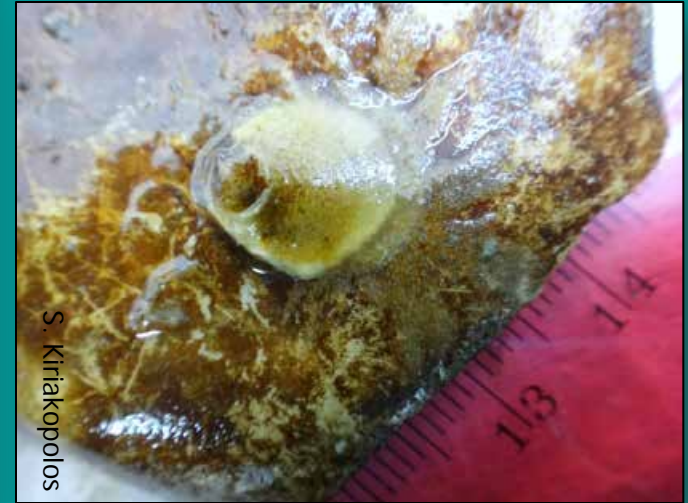
Survivorship: tracking marked oysters

Population: # individuals/size/area

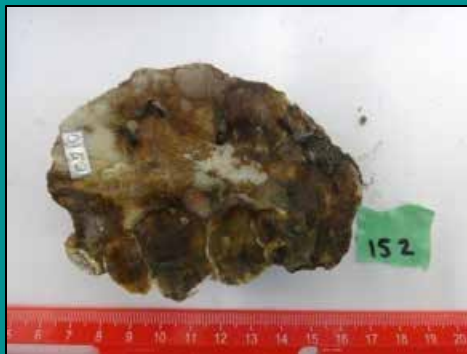
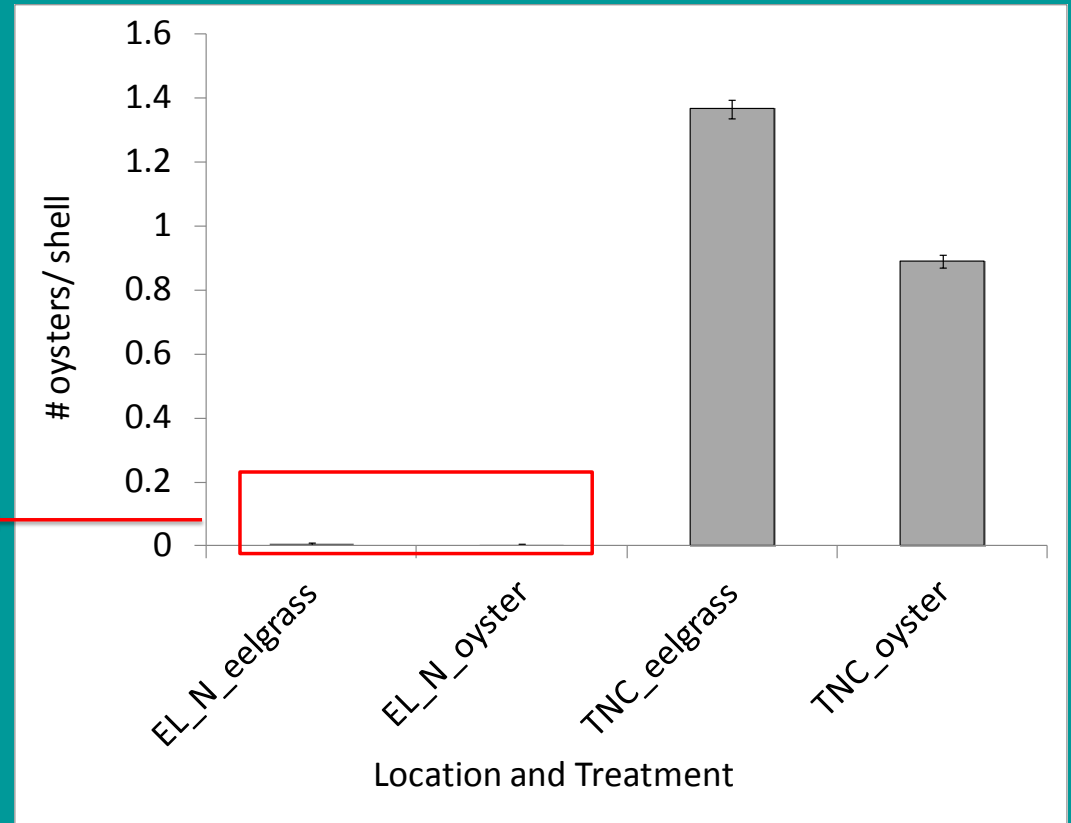
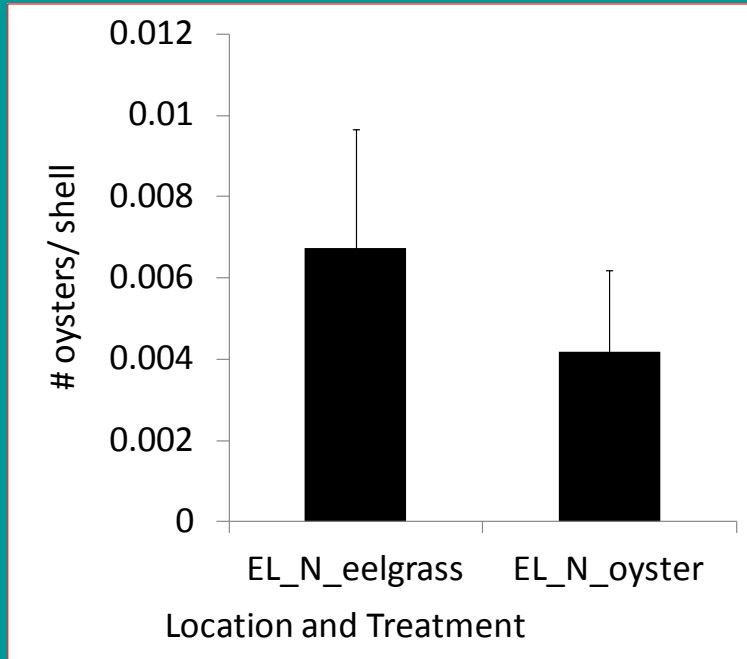
Fecundity: % individuals/brooding/stage



# Initial Assessment of Structures (Nov 2012, April 2013)



# Oyster Recruitment to Shell Bags November 2012



Bags will be monitored fall, spring and summer

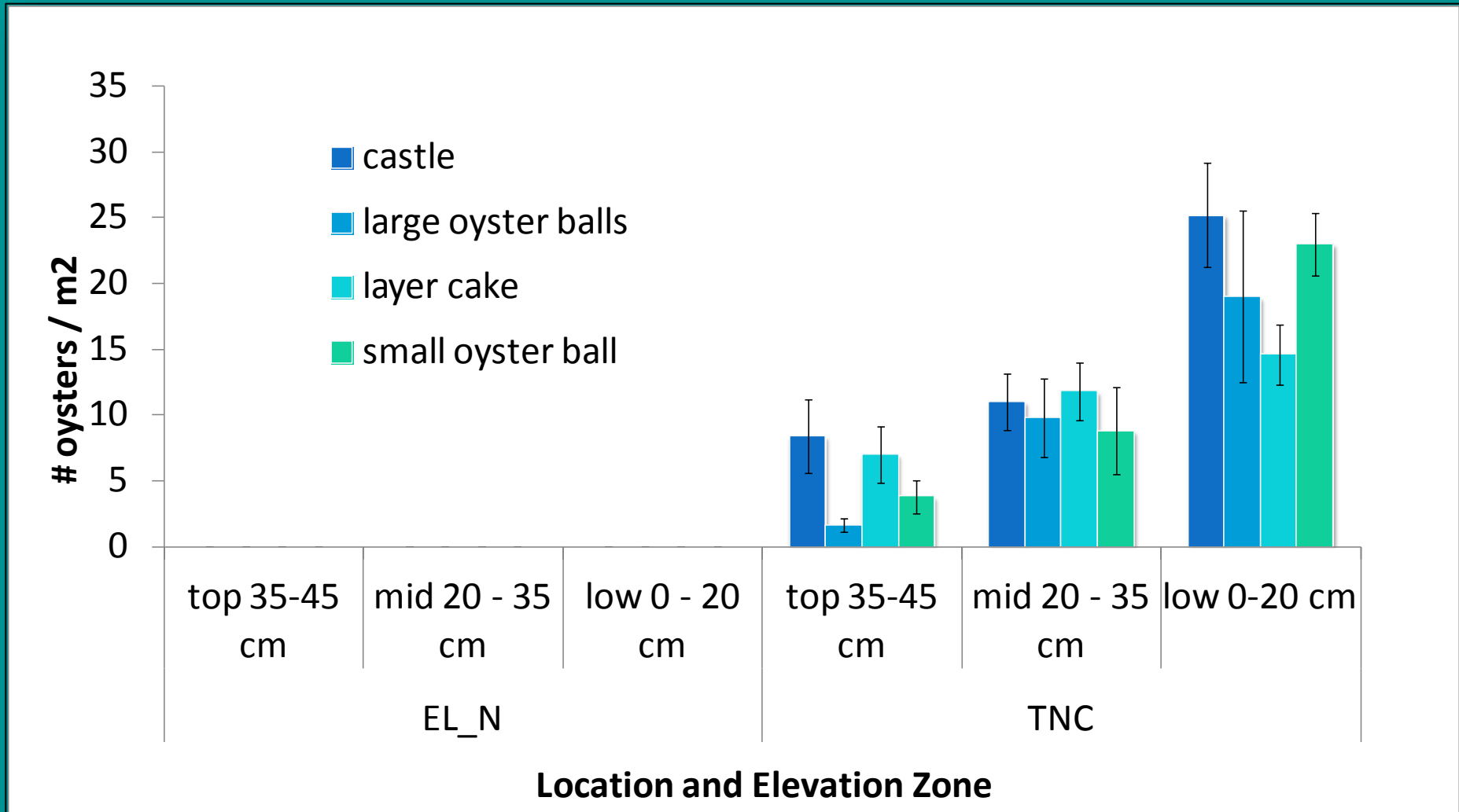


# Baycrete elements subsampled

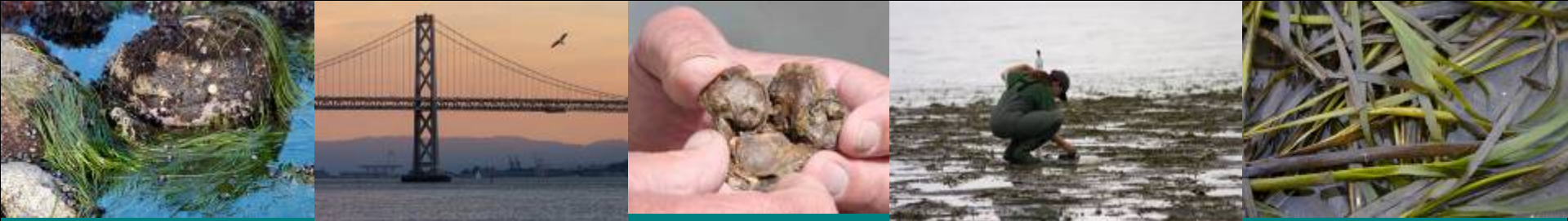


S. Kiriakopoulos

# Oyster Recruitment to Elements November 2012



Elements to be monitored fall, spring and summer



## April 2013 Monitoring:

- Oysters doing well through winter/spring
- Higher counts than in November 2012
- No significant difference between baycrete elements
- Heat stress/dessication playing a role in survival
  - north side of structures
  - low and mid tidal elevations
  - vertical surfaces
- High densities of mobile invertebrates
  - Gravid crabs
  - Nudibranchs laying eggs
  - Small fishes



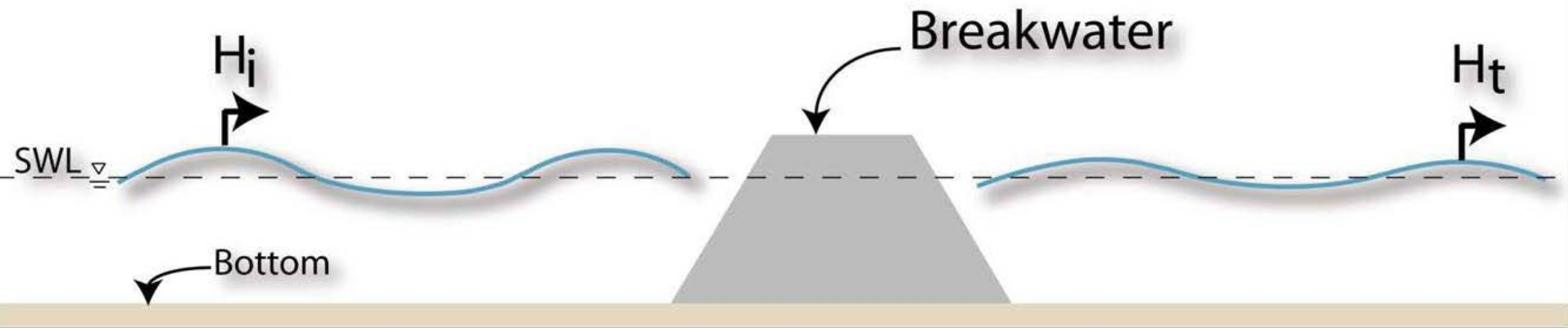
# Element Elevations

- Concern about rate of subsidence of reef structures into the bed
- Using monthly total station surveys to track the vertical motion of each test element at both sites and a subset of the treatment plots



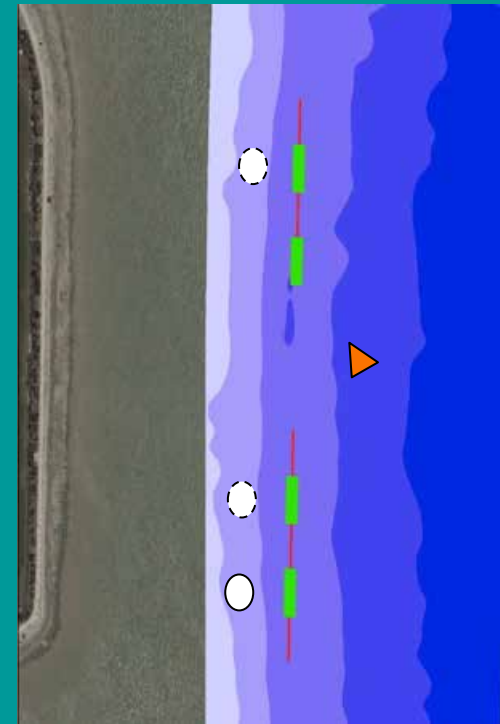
# Oyster Conceptual Model Low Crested Reef

$$K_t = \frac{H_t}{H_i}$$



# Waves & currents

- Understand how the reef structures and eelgrass affect the waves and currents
- Collected data March-April 2013 with Acoustic Doppler Current Profiler placed on bed
- Two large wind-wave events recorded in March and April 2013
- Elements appear to reduce waves at particular water elevations







# Thank You

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**State Coastal Conservancy**

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