

# Value of Oyster Beds and Eelgrass Meadows

*Linking Habitats and Building  
Capacity to Adapt to Rising  
Seas*



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Project Manager

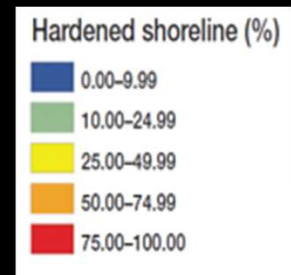


State of California  
**Coastal Conservancy**

# A Legacy of Shoreline Hardening



**14% of U.S. shoreline is hardened**



**Hard Infrastructure**  
Necessary in certain locations  
Impacts to shorelines, wetlands  
and submerged habitats



**Nature-Based Infrastructure**  
Biological and Physical Benefits  
Habitat Connectivity  
Climate Adaptation



# Living Shorelines

## Dynamic Designs

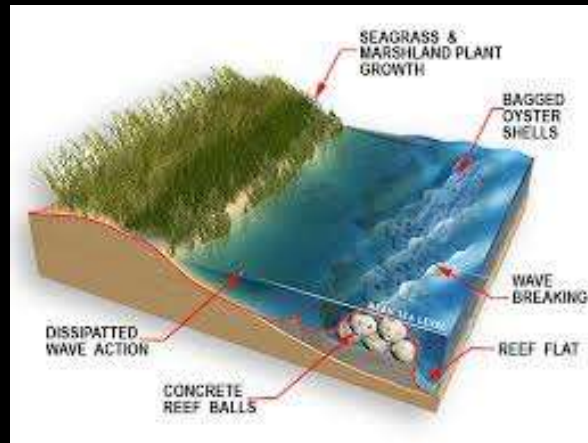
### Physical and Biological Goals

### Using Nature's Architects



# East and Gulf Coast Projects

- private shorelines
- short linear length
- stone sills, oyster breakwaters, plantings



## Maryland Living Shorelines Protection Act of 2008

### States - programmatic permits

- North Carolina
- Alabama
- Mississippi
- Maryland
- Delaware
- New Jersey

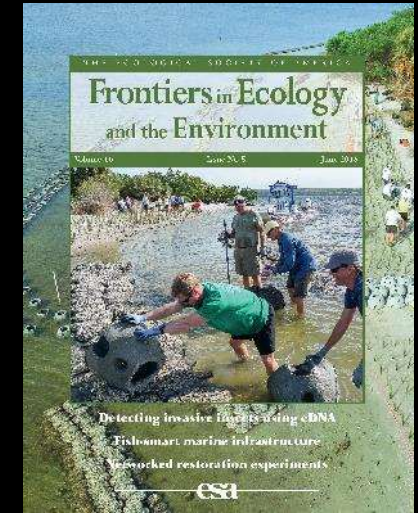
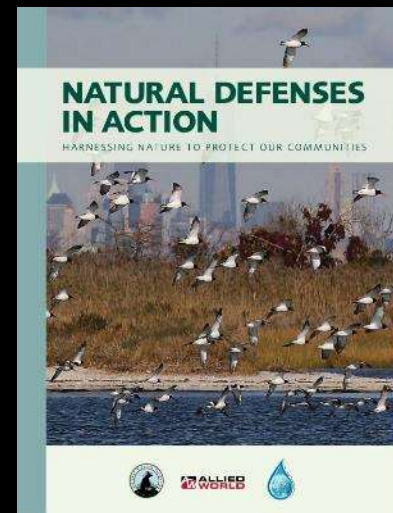
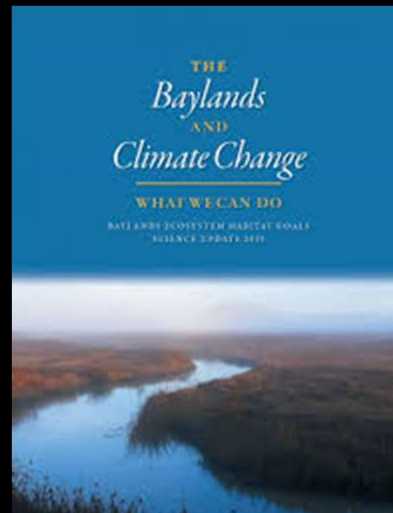


# ACOE Nationwide Permit 54- Living Shorelines

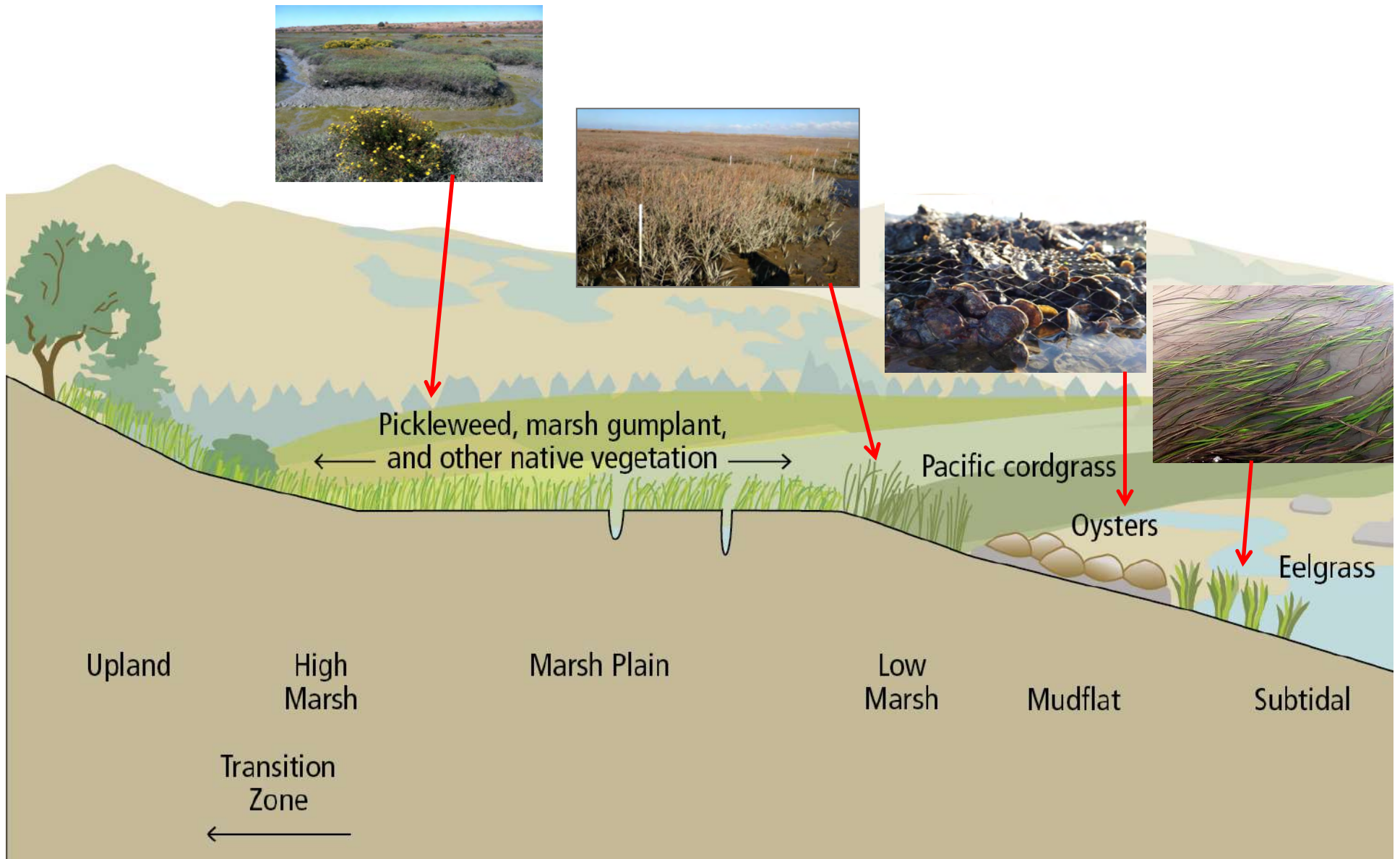
## Policy Support in California

**Exec Order B-30-15- Prioritize natural infrastructure solutions**

**SB 246: Integrated Climate Adaptation and Resiliency Program**



# Restore COMPLETE SYSTEMS





# Green-Grey Spectrum for Living Shorelines

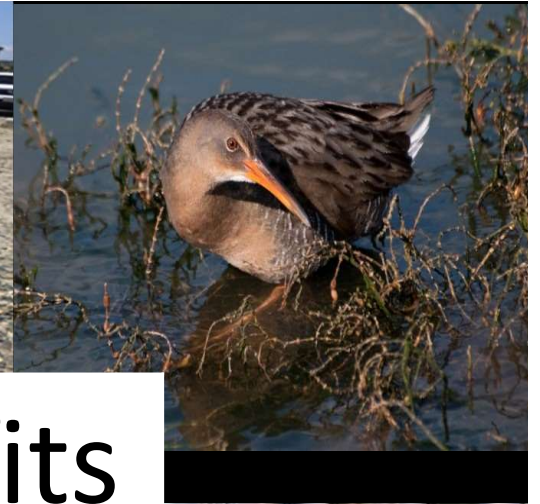
**GREEN - SOFTER TECHNIQUES**  
Small Waves | Small Fetch | Gentle Slope | Sheltered Coast

**HOW GREEN OR GRAY SHOULD YOUR SHORELINE SOLUTION BE?**

**GRAY - HARDER TECHNIQUES**  
Large Waves | Large Fetch | Steep Slope | Open Coast

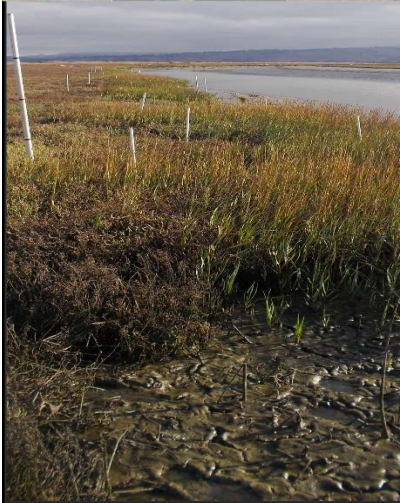
LIVING SHORELINE				COASTAL STRUCTURE				
VEGETATION ONLY	EDGING	SILLS	BEACH NOURISHMENT ONLY	BREAKWATER	GROIN	REVETMENT	BULKHEAD	SEAWALL
<p>Roots hold soil in place to reduce erosion. Provides a buffer to upland areas and breaks small waves.</p> <p><b>Suitable For</b> Low wave energy environments.</p> <p><b>Material Options</b></p> <ul style="list-style-type: none"> <li>Native plants*</li> </ul> <p><b>Benefits</b></p> <ul style="list-style-type: none"> <li>• Dissipates wave energy</li> <li>• Slows inland water transfer</li> <li>• Increases natural storm water infiltration</li> <li>• Provides habitat and ecosystem services</li> <li>• Minimal impact to natural community and ecosystem processes</li> <li>• Maintains aquatic/terrestrial interface and connectivity</li> <li>• Flood water storage</li> </ul> <p><b>Disadvantages</b></p>	<p>Structure to hold the toe of existing or vegetated slope in place. Protects against shoreline erosion.</p> <p><b>Suitable For</b> Most areas except high wave energy environments.</p> <p><b>Material Options</b> (low wave only, temporary)</p> <ul style="list-style-type: none"> <li>• "Snow" fencing</li> <li>• Erosion control blankets</li> <li>• Geotextile tubes</li> <li>• Living reef (system/mass)</li> <li>• Rock gabion baskets</li> </ul> <p><b>Benefits</b></p> <ul style="list-style-type: none"> <li>• Dissipates wave energy</li> <li>• Slows inland water transfer</li> <li>• Provides habitat and ecosystem services</li> <li>• Increases natural storm water infiltration</li> <li>• Provides habitat and ecosystem services</li> <li>• Toe protection helps prevent</li> </ul>	<p>Parallel to existing or vegetated shoreline, reduces wave energy and prevents erosion. A gap/void approach would allow habitat connectivity, greater tidal exchange, and better water/soil access.</p> <p><b>Suitable For</b> Most areas except high wave energy environments.</p> <p><b>Vegetation*</b> Base with.</p> <p><b>Material Options</b></p> <ul style="list-style-type: none"> <li>• Stone</li> <li>• Sand breakwaters</li> <li>• Living reef (system/mass)</li> <li>• Rock gabion baskets</li> </ul> <p><b>Benefits</b></p> <ul style="list-style-type: none"> <li>• Provides habitat and ecosystem services</li> <li>• Dissipates wave energy</li> <li>• Slows inland water transfer</li> </ul>	<p>Large volume of sand added from outside source to an eroding beach. Widens the beach and moves the shoreline seaward.</p> <p><b>Suitable For</b> Low-lying oceanfront areas with existing sources of sand and sediment.</p> <p><b>Material Options</b></p> <ul style="list-style-type: none"> <li>• Sand</li> </ul> <p><b>Benefits</b></p> <ul style="list-style-type: none"> <li>• Expands usable beach area</li> <li>• Lower environmental impact than hard structures</li> <li>• Flexible strategy</li> <li>• Redesigns with relative ease</li> <li>• Provides habitat and ecosystem services</li> </ul> <p><b>Disadvantages</b></p> <ul style="list-style-type: none"> <li>• Requires continual sand resources for replenishment</li> </ul>	<p>Offshore structures intended to break waves, reducing the force of wave action and encourages sediment accretion. Can be floating or fixed to the ocean floor, attached to shore or not, and continuous or segmented. A gapped approach would allow habitat connectivity, greater tidal exchange, and better water/soil access.</p> <p><b>Suitable For</b> Most areas except high wave energy environments offer in conjunction with marshes.</p> <p><b>Material Options</b></p> <ul style="list-style-type: none"> <li>• Group-filled fabric bags</li> <li>• Wood</li> <li>• Amortures</li> <li>• Pre-cast concrete blocks</li> <li>• Living reef (system/mass)</li> <li>• if low wave environment</li> </ul> <p><b>Benefits</b></p> <ul style="list-style-type: none"> <li>• Reduces wave force and height</li> <li>• Stabilizes wetland</li> </ul>	<p>Perpendicular, projecting from shoreline. Intercept water flow and sand moving parallel to the shoreline to prevent beach erosion and break waves. Retain sand placed on beach.</p> <p><b>Suitable For</b> Coordination with beach nourishment.</p> <p><b>Material Options</b></p> <ul style="list-style-type: none"> <li>• Concrete/stone rubble*</li> <li>• Timber</li> <li>• Metal sheet piles</li> </ul> <p><b>Benefits</b></p> <ul style="list-style-type: none"> <li>• Protection from wave forces</li> <li>• Methods and materials are adaptable</li> <li>• Can be combined with beach nourishment projects to sustain their life</li> </ul> <p><b>Disadvantages</b></p>	<p>Lays over the slope of a shoreline. Protects slope from erosion and waves.</p> <p><b>Suitable For</b> Sites with pre-existing hardened shoreline structures.</p> <p><b>Material Options</b></p> <ul style="list-style-type: none"> <li>• Stone rubble</li> <li>• Concrete blocks</li> <li>• Cast concrete slabs</li> <li>• Sand/concrete filled bags</li> <li>• Rock-filled gabion basket</li> </ul> <p><b>Benefits</b></p> <ul style="list-style-type: none"> <li>• Mitigates wave action</li> <li>• Little maintenance</li> <li>• Indefinite lifespan</li> <li>• Minimizes adjacent site impact</li> </ul> <p><b>Disadvantages</b></p> <ul style="list-style-type: none"> <li>• No major flood protection</li> <li>• Require more land area</li> <li>• Loss of intertidal habitat</li> </ul>	<p>Parallel to the shoreline, vertical retaining wall. Intended to hold soil in place and allow for a stable shoreline.</p> <p><b>Suitable For</b> High energy settings and sites with pre-existing hardened shoreline structures. Accommodates working water fronts (e.g. docking for ships and ferries).</p> <p><b>Material Options</b></p> <ul style="list-style-type: none"> <li>• Steel sheet piles</li> <li>• Rock</li> <li>• Concrete</li> <li>• Composite carbon fibers</li> <li>• Gabions</li> </ul> <p><b>Benefits</b></p> <ul style="list-style-type: none"> <li>• Moderates wave action</li> <li>• Manages tide level fluctuation</li> <li>• Long lifespan</li> </ul>	<p>Parallel to shoreline, vertical or sloped wall. Soil on one side of wall is the same elevation as water on the other. Absorbs and limits impacts of large waves and directs flow away from land.</p> <p><b>Suitable For</b> Areas highly vulnerable to storm surge and wave forces.</p> <p><b>Material Options</b></p> <ul style="list-style-type: none"> <li>• Stone</li> <li>• Rock</li> <li>• Concrete</li> <li>• Steel/vinyl sheets</li> <li>• Steel sheet piles</li> </ul> <p><b>Benefits</b></p> <ul style="list-style-type: none"> <li>• Prevents storm surge flooding</li> <li>• Reduces strong wave forces</li> <li>• Shoreline stabilization behind structure</li> </ul> <p><b>Disadvantages</b></p> <ul style="list-style-type: none"> <li>• Low maintenance costs</li> <li>• Less space intensive horizontally</li> </ul>





# Multiple Co-Benefits

- Create Fish and Wildlife Habitat
- Attenuate Wave Energy
- Accrete Sediment
- Reduce Erosion
- Can Provide Outdoor Recreation
- May Sequester Carbon
- May Buffer Ocean Acidification



Multiple Co-Benefits



# One Size Does Not Fit All



## Design for specific conditions

- Substrate/ soil
- Shoreline type/slope
- Wave exposure
- Adjacent infrastructure

## Local support

- Government willingness
- Community engagement



# Site Specific Considerations

Existing Uses

Parcel Ownership

Bathymetry

Depths for Habitat Restoration

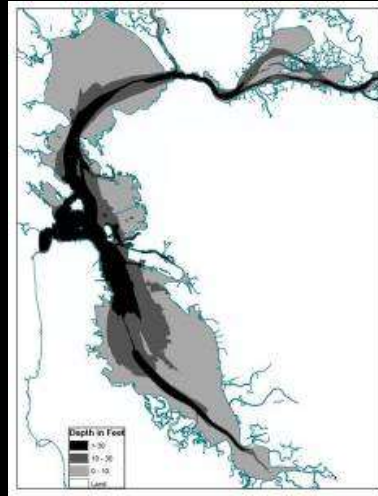
Depths for Access

Orientation to Wind/Waves

Existing Species and Habitats

Sea Level Rise Modeling

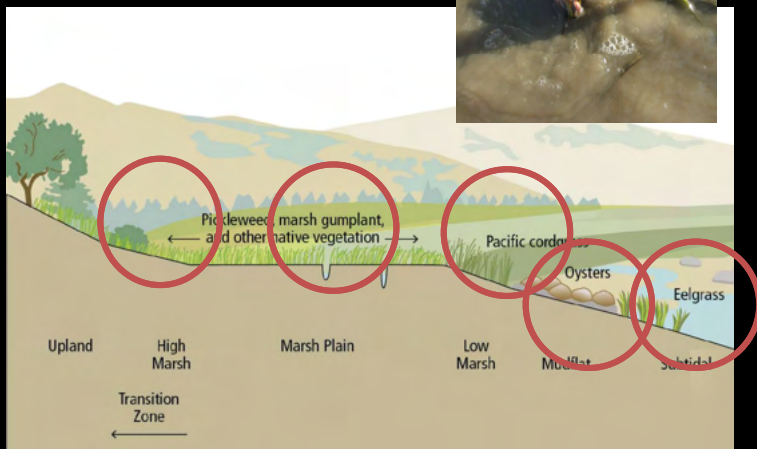
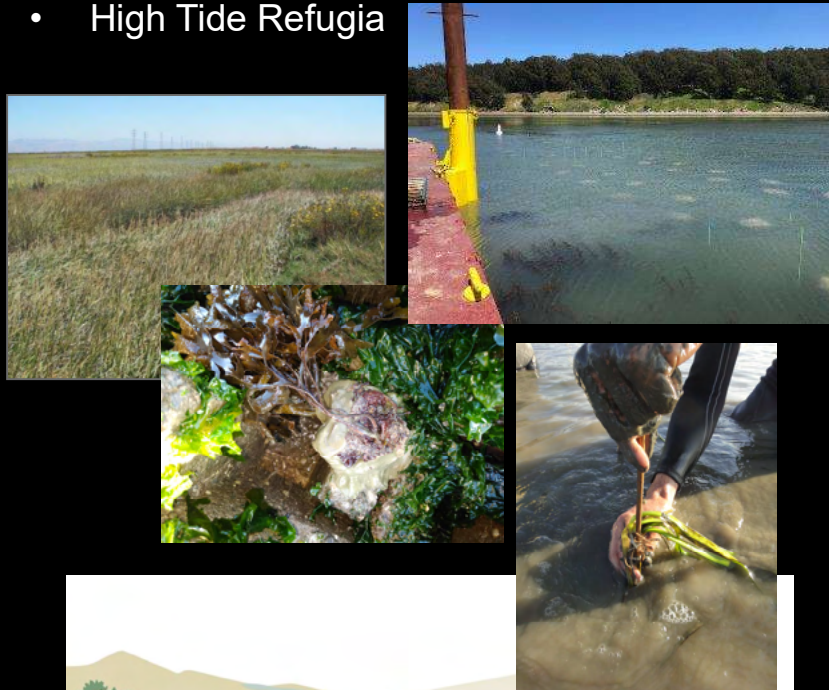
Physical Space Required



# Giant Marsh Living Shorelines Project – Point Pinole

*Oysters, Eelgrass, Rockweed, Pacific Cordgrass, CA Seablite, Upland Ecotone*

- Tidal marsh habitat
- Endangered Species
- High Marsh/ Ecotone
- High Tide Refugia



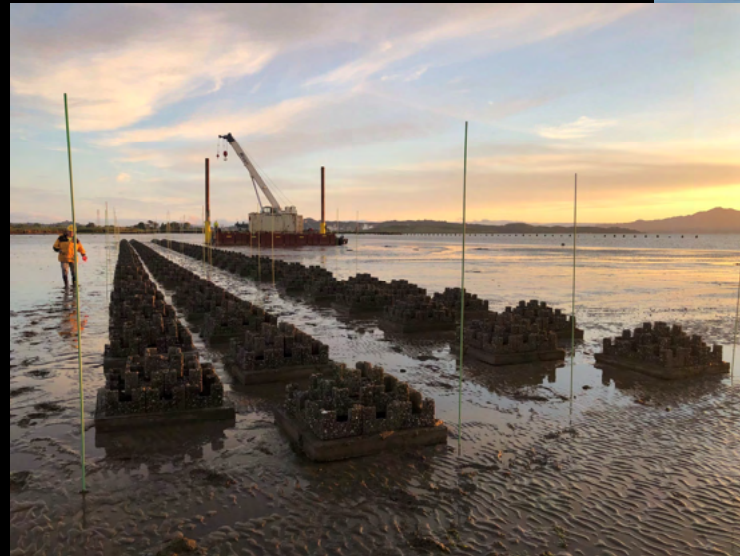
# Collaborative Partnerships People, Technology, and Science



# Green Jobs and Job Training



# Local Contractors and Equipment



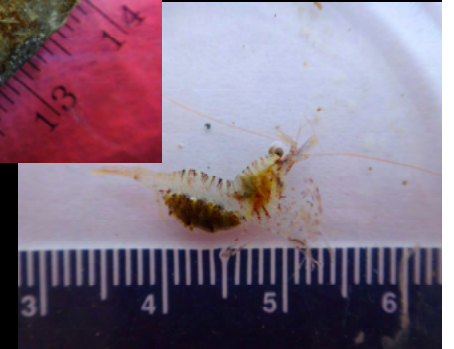
# Permitting Multi-Habitat Projects





# Intensive Monitoring

- Eelgrass and Oyster success
- Invertebrates- benthic and on reefs
- Fish- traps, seining, acoustic imaging
- Birds- shorebirds and waterfowl
- Physical-
  - bathymetry
  - sediment accretion and erosion
  - reef elements
  - water quality
  - wave attenuation



# So Much Life Out There!



**Physical Benefits**  
**Reduce Wave Energy ~30%**  
**Sedimentation**

# Informing Additional Pilot Projects in CA

*More Local Demonstration Projects Needed!*



**Humboldt Bay Living Shorelines**  
*(City of Arcata, SCC, others)*

**SF Bay Creosote Removal Project** *(SCC, City of Richmond, Ducks Unlimited, AECOM, others)*

**SF Bay Living Shorelines Project**  
*(SCC, SF State, UC Davis, ESA, USGS)*

**Dunphy Park Living Shoreline** *(Conservation Corps North Bay, City of Sausalito, ESA, others)*

**Heron's Head Project** *(Port of SF, ESA, SFSU, LEJ, others)*

**Cardiff Dunes Living Shorelines**  
*(SCC, City of Cardiff, OPC, others)*

**Newport Bay Living Shorelines Project**  
*(SCC, CSU Fullerton, Heal the Bay, others)*

**San Diego Bay Living Shorelines** *(SCC, Port of SD, CSU Fullerton, ESA, others)*



# Threading the Needle

## *Innovation and Feasibility*

### Barriers to Innovation:

- **Science and data gaps**
- **Institutional Inertia**
- **Lack of broader context**
- **Lack of an advocate**



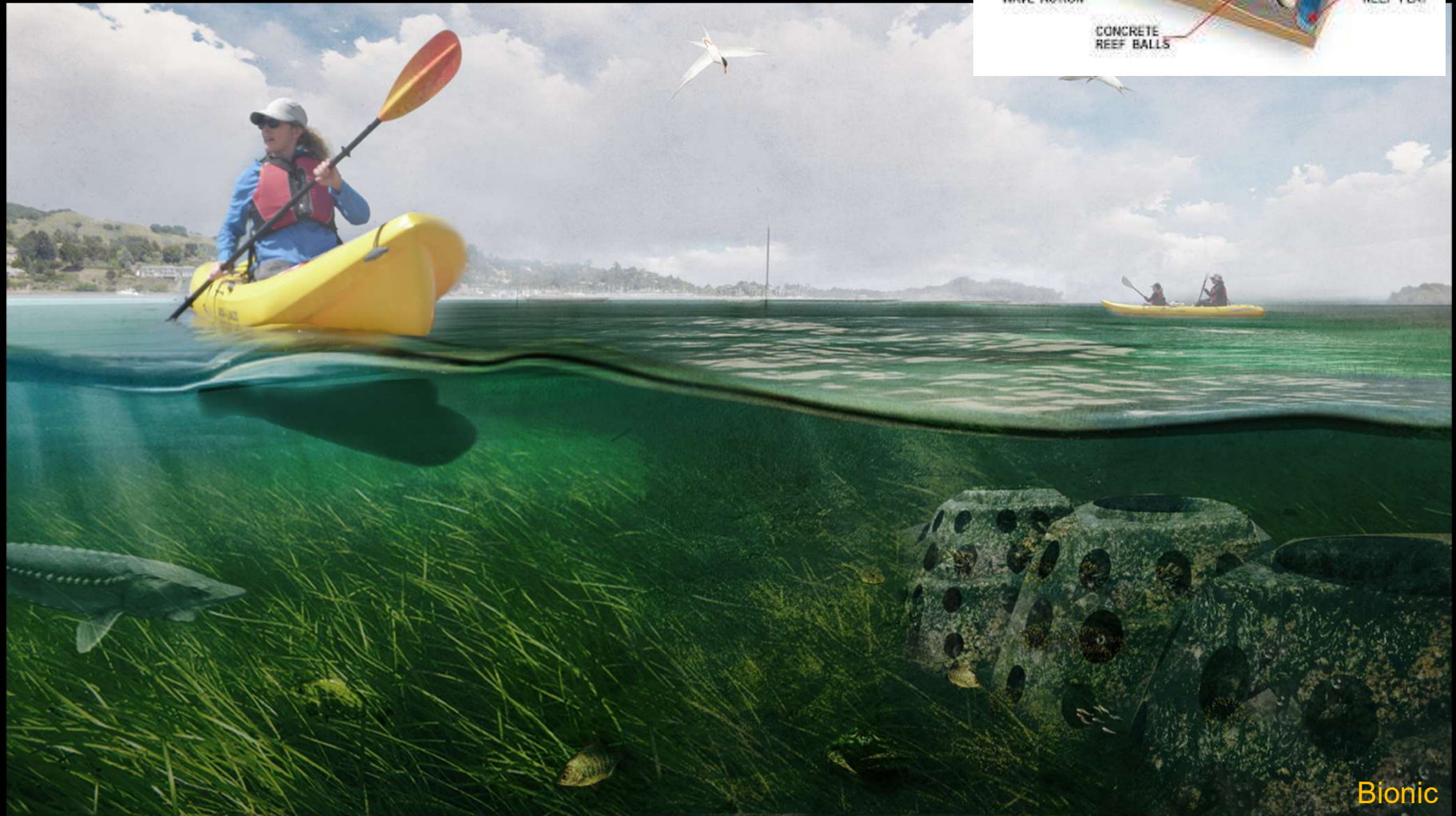
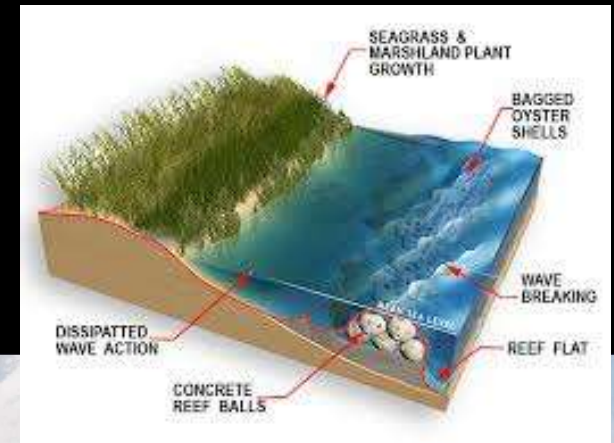
### Importance of Feasibility:

- **Habitat and species**
- **Pilot projects – test**
- **Develop Best Management Practices**
- **Document success before scaling up**
- **Monitor long-term benefits and impacts**



# Designing for the Future

- **Habitat connectivity- above and below**
- **Nature-based approaches**
- **Technology and Science**
- **Encourage local labor and involvement**



Design and Monitoring

# Thanks Partners!

Lead Agency

Kathy Boyer, Lead Scientist

Marilyn Latta, Project Manager

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Cassie Pinnell

Stephanie Kiriakopolos

Kevin Stockmann

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Margot Buchbinder

Melissa Patten



Construction and Nursery support



Ted Grosholz

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Stephanie Kiriakopolos

Lara Martin



Michelle Orr

Jeremy Lowe

Doug George

Elena Vandebroek

Damien Kunz

Dane Behrens



Funders and landowners



Chela Zabin

Jeff Blumenthal

Rebecca



Jeanne Hammond

Kevin Eng



Susan De La Cruz

Ashley Smith

Tanya Graham

Laura Hollander

Margaret Tzen

Aliya McCarthy

Dave Nelson

