Living Shorelines

National and California Project Examples

Marilyn Latta
Project Manager

Ocean Climate Summit
San Francisco, CA
April 18, 2019
A Legacy of Shoreline Hardening

14% of U.S. shoreline is hardened

Up to 50%+ of San Francisco Bay

Gittman et al. 2015 *Frontiers in Ecology and the Environment*
Hard Infrastructure Impacts to Shorelines and Wetlands

- Dredging, fill, structures
- Loss of habitat values and species
- Impacts, erosion, high cost
- SLR: seawalls, groins, levees

Nature-Based Infrastructure Potential Benefits

- Biologically dynamic borders
- Species support and connectivity
- Shoreline protection
- Climate adaptation and habitat resilience
- Cost effective, sustainability
What are the ecological consequences of shoreline hardening?
Affected flora and fauna

- Benthic invertebrates (e.g., Seitz et al. 2006)
- Shore birds (e.g., Dugan et al. 2006, 2008)):
- Fish (Peterson et al. 2000, Gittman et al. 2016, Seitz et al. 2006)

Shoreline access and uses
At Risk in California:

- 1.4M SLR – 480,000 people
- Property valued at $1B
- Habitats and Species
Living Shorelines can include any shoreline management system that is designed to protect or restore natural shoreline ecosystems through the use of natural elements and, if appropriate, manmade elements.

Any elements used must not interrupt the natural water/land continuum to the detriment of natural shoreline ecosystems.
East and Gulf Coast Projects

• protection of private shorelines
• short linear length, high intertidal
• lack of monitoring data
• originally not climate adaptation

Maryland Living Shorelines Protection Act of 2008

States - programmatic permits

• Virginia
• North/ South Carolina
• Alabama
• Mississippi
• Maryland
Recent Innovation & Popularization of Living Shorelines

A new kind of levee

The Bay Institute, an environmental group, has proposed a number of "Horizontal Levees" for San Francisco Bay that blend a traditional earthen levee with restored tidal marshes. The marshes would be built up with sediment from local flood control channels. Marsh vegetation would be irrigated with reclaimed wastewater.

Marshes as barriers

Tidal marshes can slow open wave run-up, meaning levees treated by marshes can be built half as tall as those protected as traditional levees made of earth and clay.

Living shorelines support resilient communities

Living shorelines use plants or other natural elements—sometimes in combination with harder shoreline structures—to stabilize estuarine coasts, bays, and tributaries.

One square mile of salt marsh stores the carbon equivalent of 76,000 gal of gas annually.

Marshes trap sediments from tidal waters, allowing them to grow in elevation as sea level rises.

Living shorelines improve water quality, provide fisheries habitat, increase biodiversity, and promote recreation.

Marshes and oyster reefs act as natural barriers to waves. 1 ft of marsh can absorb 50% of incoming wave energy.

Living shorelines are more resilient against storms than bulkheads.

33% of shorelines in the U.S. will be hardened by 2100, decreasing fisheries habitat and biodiversity.

Hard shoreline structures like bulkheads prevent natural marsh migration and may create seaward erosion.
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*

- Safeguarding CA Plan
- 4th Climate Assessment
- CA Coastal Commission
- CA Coastal Conservancy
- CA Ocean Protection Council
- SF Bay BCDC
- Counties: Marin, San Mateo

[Images of books and websites for references]
CA Living Shorelines

soft shorelines  green infrastructure  nature-based adaptation etc

Multiple Habitat Types in Designs
Intertidal and subtidal connectivity
Offshore, nearshore, and onshore treatments
Estuaries and Outer Coast
Climate Adaptation
Landscape Scale Approach
Submerged Aquatic Vegetation

Soft and coarse substrate: Sand, gravel beaches

Shellfish Beds

Artificial Structures

Rock Habitats

Macroalgal Beds

Soft Substrate: Mud/shell mix

Tidal wetlands
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
CA Living Shoreline Examples
(Oysters, Eelgrass, Beaches, Dunes, Tidal Marsh)

Tiscornia Marsh (Marin Audubon Society, SF Bay NERR, ESA, City of San Rafael)

Hamilton Wetlands Restoration Project (SCC, ACOE, others)

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

Ora Loma Demonstration Project (Ora Loma Sanitary District, SFEP, Save SF Bay)

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

Terminal Four Wharf Removal (SCC, City of Richmond, Ducks Unlimited, others)

Humboldt Bay Coastal Dunes and Living Shorelines (City of Arcata, SCC)

Arambaru Island Restoration Project, Bay Beaches (Richardson Bay Audubon, SFSU, Marin County, others)

Tiscornia Marsh (Marin Audubon Society, SF Bay NERR, ESA, City of San Rafael)
Baylands Goals Regional Climate Adaptation Recommendations

1. Restore estuary-watershed connections
2. Design complexity and connectivity
3. Complete tidal wetlands systems
4. Plan for migration
5. Actively recover wildlife
6. Invest in planning and research
Using Nature’s Architects

Habitat forming species

Native Olympia Oysters and Eelgrass

Creosote Piling Removal for Pacific herring

Tidal marsh and upland ecotones
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
Issues to Consider Thoughtfully

Regulatory Framework

Army Corps of Engineers:
Nationwide 27, Nationwide 54

USFWS/ National Marine Fisheries Service:
Endangered Species/ Essential Fish Habitat

SF BCDC:
Minor Permit, Major Permit

CA Department of Fish and Wildlife:
State-listed species consultation

State Water Resources Control Board:
Section 401 Clean Water Certification

State Lands Commission:
Lease Agreement if SLC owns land

Local Permits:
City Council
Regional landowner permits
Considerations and Challenges

- Lack of data/ constructed projects
- Beneficial Fill Justification
- Species Protection Windows
- Suitable Materials- Green to Grey
- Construction Methods/ Timing
- Sequential permits
- Long timeframes
- Cost – concept development
California needs demonstration projects

- Efficacy of natural habitats as shoreline protection
- Green-grey infrastructure
- Biological performance
- Public education
- Horizontal & vertical methods
One Size Does Not Fit All

- Small and Large Scale
  - both needed!

- Permitting

- Design for specific conditions
  - Substrate/soil
  - Wave energy
  - Adjacent infrastructure

- Local support
  - Government willingness
  - Community engagement
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
• Document success before scaling up
• Monitoring of long-term benefits and impacts
Thank You

Marilyn Latta
marilyn.latta@scc.ca.gov