Toward Natural Infrastructure for Coastal Adaptation

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Restore America’s Estuaries—December 11, 2018
Bridging the gap between science and decision-making

Advancing climate-smart conservation for wildlife and people through science, partnerships, and outreach.
What do coastal practitioners need now?

- Sea level rise is the most important issue for coastal managers now (2011 it was a concern for the future)
- Practitioners are informed about climate change risks but there is high demand for adaptation training
- Dominant information need now: solution options and how to implement them (costs, trade offs)

Moser et al. 2018
Toward Natural Infrastructure to Manage Shoreline Change in California
‘Natural shoreline infrastructure for adaptation’ means using natural ecological systems or processes to reduce vulnerability to climate change related hazards while increasing the long-term adaptive capacity of coastal areas by perpetuating or restoring ecosystem services.
Case studies
design, implementation, performance

1. Seal Beach Thin-layer Salt Marsh Sediment Augmentation
2. Surfers’ Point Managed Shoreline Retreat
3. SF Bay Living Shorelines: Nearshore Linkages
4. Hamilton Wetland Restoration
5. Humboldt Coastal Dune Vulnerability and Adaptation

GOAL: Provide real world examples and increase familiarity

Report available at:

Led by: Jenna Judge
Engineering Guidelines

- Cobble Berms
- Vegetated Dunes
- Oyster Reefs
- Eelgrass Beds
- Tidal Bench
- Marsh Sill
- Lagoon Mouth Management
- Managed Retreat

Led by: Bob Battalio and Tiffany Cheng
DECISION FRAMEWORK

— Vulnerability Assessment

— Adaptation Options (Measures)

— Plausible/Desired Futures

— Adaptation Strategies

— Evaluate and Prioritize Strategies

### Table: Decision Framework

<table>
<thead>
<tr>
<th>Economic</th>
<th>Hazard Risk Reduction</th>
<th>Biodiversity Support</th>
<th>Social</th>
<th>Climate Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>Wave attenuation</td>
<td>Bird Abundance</td>
<td>Recreation</td>
<td>GHGs</td>
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<tr>
<td>• $ estimates</td>
<td>• Tidal marsh</td>
<td>• Use metrics</td>
<td>• Carbon stock</td>
<td></td>
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<tr>
<td>• Proxy variables (e.g., amount of fill necessary, # people displaced)</td>
<td>• Shorebirds</td>
<td></td>
<td>• Methane emissions</td>
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<td></td>
<td>• Waterfowl</td>
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<tr>
<td>Timing/Duration</td>
<td>Flood reduction</td>
<td>Salt Marsh</td>
<td>Aesthetics</td>
<td>Ocean Acidification?</td>
</tr>
<tr>
<td>(phased vs. up front outlay)</td>
<td>• Bay vs. riverine?</td>
<td>harvest mouse abundance</td>
<td></td>
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<tr>
<td>Funding diversity</td>
<td>Saltwater intrusion?</td>
<td>Oysters</td>
<td>Services to disadvantaged communities (weighting)</td>
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<tr>
<td></td>
<td></td>
<td>• Area of habitat</td>
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<tr>
<td>• Metric cumulative over space and time; or for particular time points</td>
<td>Eelgrass</td>
<td>Legal/political/community acceptability</td>
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<td></td>
<td>• Area of habitat</td>
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<td></td>
<td>Habitat connectivity</td>
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<td></td>
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<td>Fish</td>
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</table>
Key lessons learned

Stakeholders need a common definition for “Natural Shoreline Infrastructure”

Implemented NI projects are not widespread in California

California can build on extensive experience with restoration (transferable lessons learned)

Guidance documents can help increase the willingness of practitioners to consider NI options
Contact: Sam Veloz sveloz@pointblue.org

Marin County Project In progress:

- Framework guidebook in preparation

Case Studies:

Technical Report:
California’s Fourth Climate Change Assessment, California Natural Resources Agency. Publication number: CNRA-CCC4A-2018-3B.
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. 15 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.

The National Centers for Coastal Ocean Science | coastalscience.noaa.gov

Some graphics courtesy of the Integration and Application Network, University of Maryland Center for Environmental Science (iamces.org/symbiosis/
• Lack of technical standards to guide implementation and evaluation;

• Low levels of cross-jurisdiction coordination among local, state, and federal entities;

• Insufficient funding for localized data collection, strategic planning, and regional coordination; and

• Lack of public familiarity with nature-based strategies, leading to a lack of political support.
A wide range of coastal settings requires a range of approaches.
Coastal Natural Infrastructure: A Project Under California’s Fourth Climate Assessment

- Definition of Natural Infrastructure
- Case Studies in California (available now)
- Engineering Guidelines
- Example Application (Spatial “Blueprints”)

Final Report Fall 2018
How does it all fit together?

Tide range  Wave exposure  Total Water Levels

Assuming slope of 5H:1V and a toe elevation at \( X \), a cobble berm would take up \( XX \) feet.

Guidance thresholds

Is that space available?
H/M/L ranking of NI types based on required vs. available space.