Impact of sediment augmentation on vegetation and invertebrate communities in a southern California coastal wetland

Dr. Christine Whitcraft, Kaelin McAtee
CSU, Long Beach
Not possible without....

Colleagues & Co-authors:
• Bruno Pernet (CSULB)
• Jason Keller (Chapman)
• Rich Ambrose (UCLA)
• Karen Thorne (USGS)

Undergrads and Graduate students:
• Anita Arenas
• Amanda Martinez*
• Asusena Figueroa*
• Cynthia Coria
• Lorenzo Camargo
• Terry Champieux
• Elizabeth Herrera
• Chloe Van Grootheest
• Molly Burdick-Whipp
• Nick DaSilva
• Kenneth McCune
• Madison Thomas
• Kaelin McAtee*

SBNWR
• Kirk Gilligan
• Richard Nye
Salt marshes up and down the coast.

- Alamitos Bay: 2400 acres
- Anaheim Bay: 2300 acres
- Bolsa Bay: 2300 acres
- Newport Bay: 2350 acres
- Santa Ana River Estuary: 2950 acres
- Wilmington Lagoon: 3450 acres

Historical Estuaries of San Pedro Bay circa 1870-80

12,063 Acres of Total Wetlands Loss 1880-2016

Courtesy of E. Zahn
Seal Beach National Wildlife Refuge

391 ha

Los Angeles
Why do this project here?
Seal Beach National Wildlife Refuge

- Low initial elevation
- Subsidence - 4.13 mm/yr subsidence
- Low accretion rates
- No upland migration areas

Data from Thorne et al.
High tide
Team effort

Sediment elevation tables

Plants – abundance and photosynthesis

Invertebrates

Feldspar plots – sediment accumulation

Greenhouse gas flux

Eelgrass

Turbidity

Photos: K. McAtee, J. Keller and R. Ambrose, UCLA
Pre-augmentation
Sediment augmentation via sediment slurry delivered via high pressure hose to depth of 10 cm.
Post-augmentation
How much vertical elevation change was achieved?

After sediment application completion, initial decrease in elevation averaged -46.60 mm (April-June), however the rate of decrease in elevation then slowed averaging -16.56 mm (June-October). Between October and January elevation change was small, gaining 0.93 mm. However during the most recent interval (Jan-May), elevation decreased again (-13.38 mm).

Data from Thorne et al. USGS
Experimental Design

*Batis maritima* (Bama)

Standing water (Pond)

*Spartina foliosa* (Spfo)
Monitoring Parameters

- Plant cover
- Abiotic parameters: porewater salinity, temperature
- Macrofaunal invertebrates: abundance, richness, community composition
Plant cover decreased following augmentation

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Habitat</th>
<th>SiteClass*Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Cover</td>
<td>Spfo Bama</td>
<td>(pmc=0.001, pseudo F=58.19)</td>
</tr>
<tr>
<td>Fall 2016 (6 MAT)</td>
<td>Pond</td>
<td>(pmc=0.001, pseudo F=45.48)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(pmc=0.001, pseudo F=17.29)</td>
</tr>
<tr>
<td>Community Composition</td>
<td>Spfo Bama</td>
<td>(pmc=0.001, pseudo F=35.45)</td>
</tr>
<tr>
<td></td>
<td>Pond</td>
<td>(pmc=0.002, pseudo F=22.60)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(pmc=0.001, pseudo F=8.53)</td>
</tr>
</tbody>
</table>

McAtee and Whitcraft. in review
Temperature and light were significantly higher in augmentation site

McAtee and Whitcraft. in review
Invertebrate abundance & species richness decreased following augmentation

McAtee and Whitcraft. In review.
Insects dominated the post augmentation invertebrate community

McAtee and Whitcraft. in review
Regular inundation
Anoxia and sulfide stress
Invertebrate larval supply
Higher OM and decomposition
Available nutrients

Irregular inundation
Altered flow and flooding
Aerobic conditions
Reduced sulfide stress
Low invertebrate larval supply
Lower OM and ? decomposition rates
? nutrients
Absent plant canopy
Sandy sediment

Present “natural” plant canopy
Muddier sediment
Methods

Collected mud and sand at 2 weeks (September) and 6 weeks (October) after deployment.
Abundance and species richness lower with elevation, not sediment type

Elevation: p<0.001, F=41.53  
Sediment: p=0.604, F=0.28

Elevation: p<0.001, F=50.58  
Sediment: p=0.347, F=0.94

McAtee et al. in prep
Community composition differs with elevation, not sediment type

Elevation: p(mc)<0.001, Pseudo-F=19.00
Sediment: p(mc)=0.253, Pseudo-F=1.24

McAtee et al. in prep
Regular inundation
Anoxia and sulfide stress
Invertebrate larval supply
Higher OM and decomposition
Available nutrients

Irregular inundation
Altered flow and flooding
Aerobic conditions
Reduced sulfide stress
Low invertebrate larval supply
Lower OM and ? decomposition rates
? nutrients
Absent plant canopy
Sandy sediment

Present “natural” plant canopy
Muddier sediment
Thank you