



Resistance: Thin Layer Sediment Augmentation Project Seal Beach National Wildlife Refuge



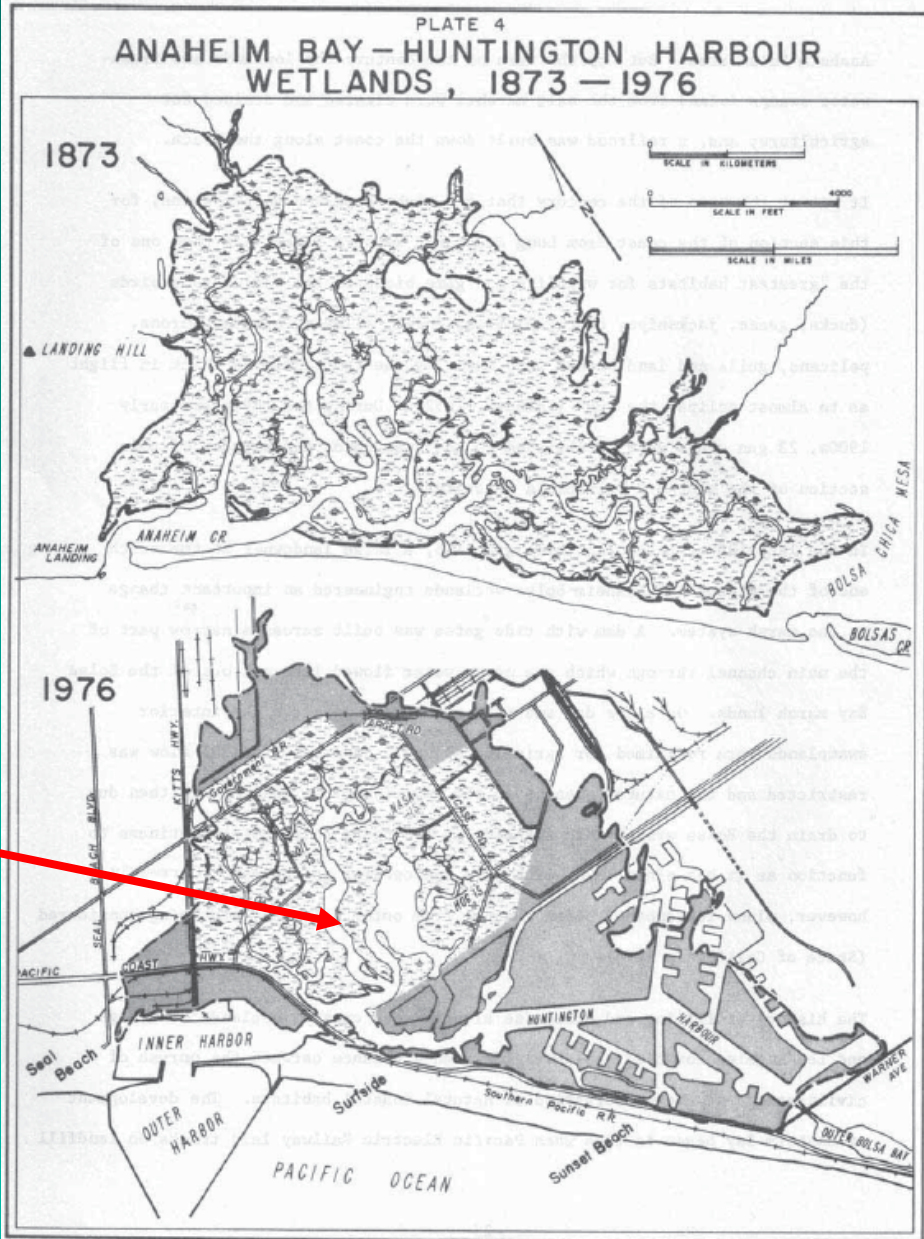


U.S. Fish & Wildlife Service
Seal Beach
 National Wildlife Refuge



MAP DATE: Aug 01, 2014
 IMAGE SOURCE: US Navy
 C:\Users\jlgilpin\Documents\Management\ies\ESRI\SRDATA\Seal Beach Data\SealBeach_Template\WbimageryAndLabels.mxd

Legend
 Seal Beach NWR Boundary





Field observations of sea level rise



Project Evolution

- Seal Beach NWR Comprehensive Conservation Plan
- USGS SLR studies
- Climate change adaptation planning
- Sediment augmentation project

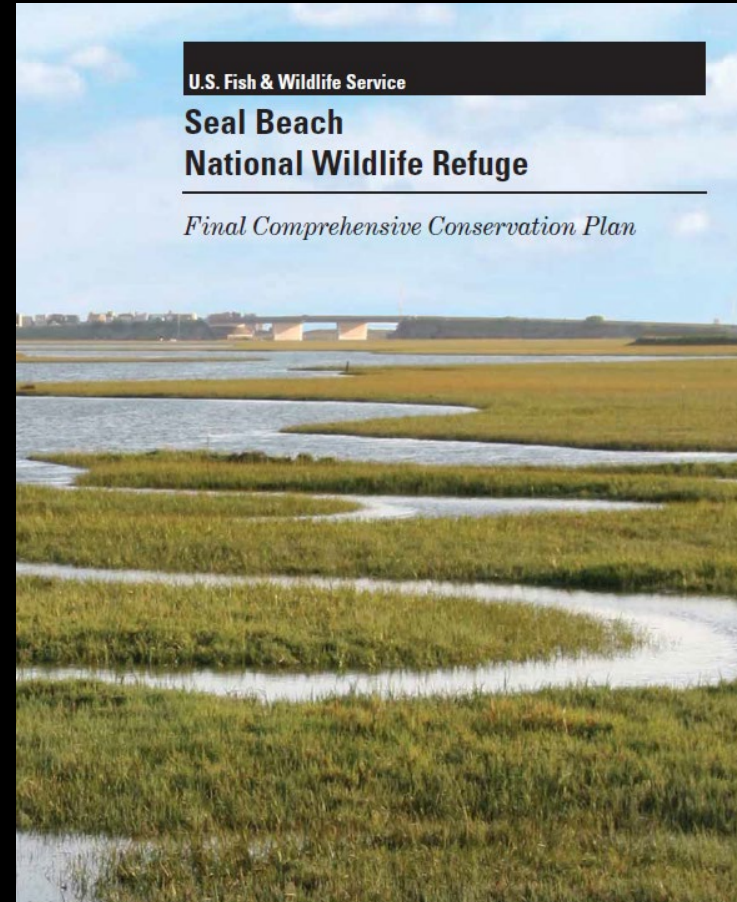
From Planning to Augmentation

2012 – Seal Beach National Wildlife Refuge Comprehensive Conservation Plan is completed. Several areas on the Refuge identified for future thin-layer augmentation.

15-year management plan

- Identified issues (marsh subsidence, loss of natural nesting areas for rails)
- Met with agencies, researchers, public to refine issues and develop strategies

Goal 1: Support recovery and protection efforts for the federally and State listed threatened and endangered species and species of concern that occur within the Seal Beach NWR.



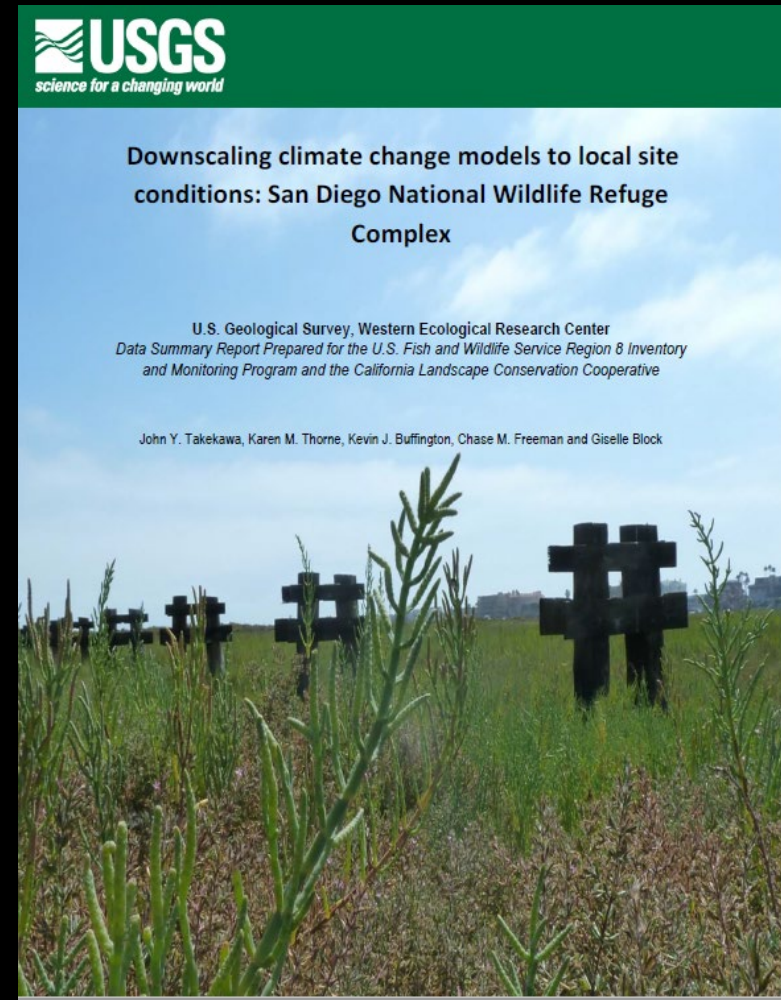
From Planning to Augmentation

2011 - 2013 –Sea level rise studies on the Refuge

2014 – 2015 Climate change adaptation planning process for Seal Beach NWR and portions of Naval Weapons Station Seal Beach

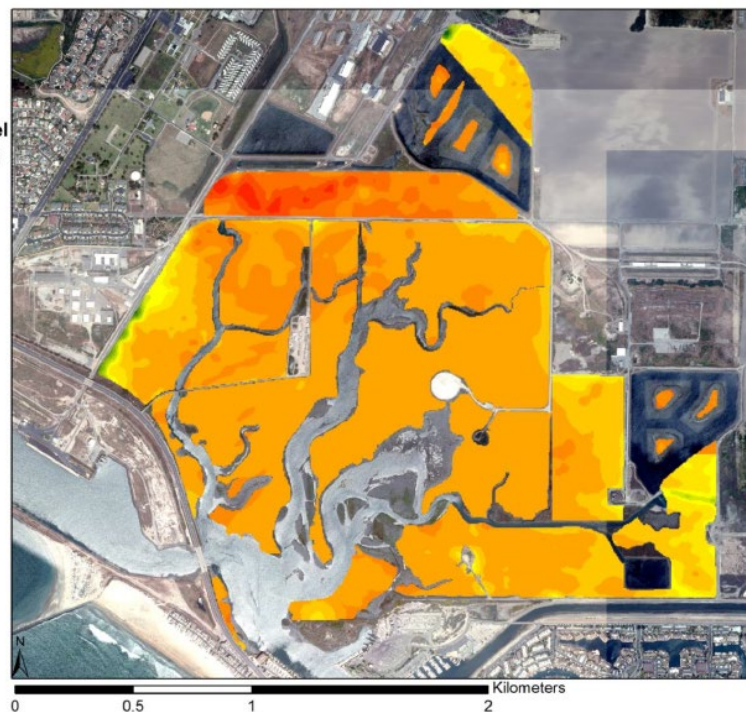
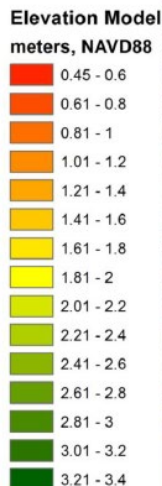
2014 – Coordination with public agencies and researchers to permit and implement the augmentation project underway

June 2015 - \$3,305,554 in grant funding secured for augmentation and pre- and post-augmentation monitoring

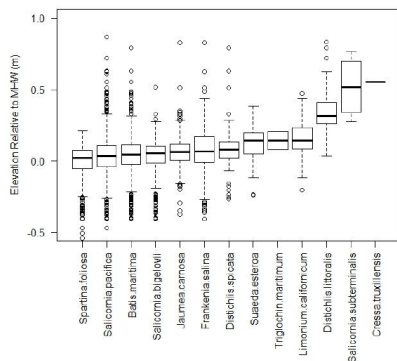




Detailed studies of elevations, vegetation, tidal flows, and sediment flux at the Seal Beach NWR by USGS



Elevation of Plant species relative to MHW at Seal Beach NWR



Percent Time Inundated for Seal Beach NWR

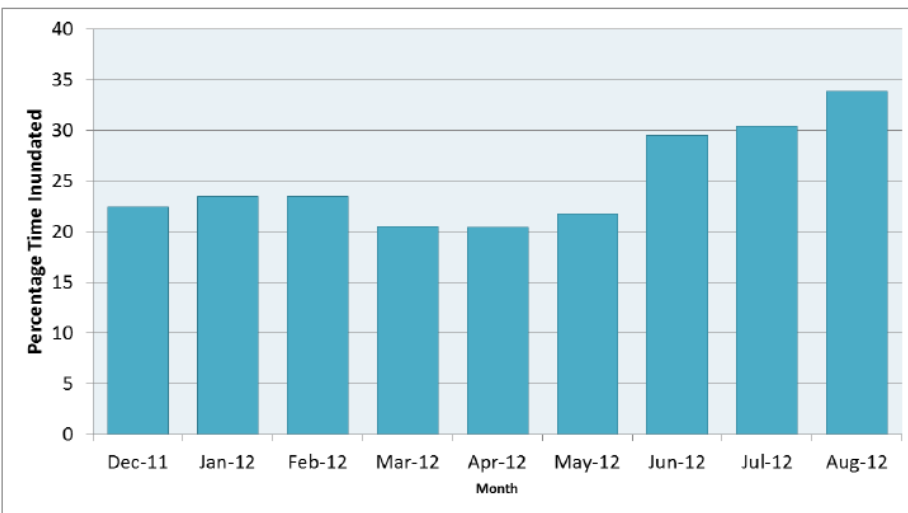


Figure 12. Elevation, vegetation, and water level sampling locations at Seal Beach NWR, September 2010.



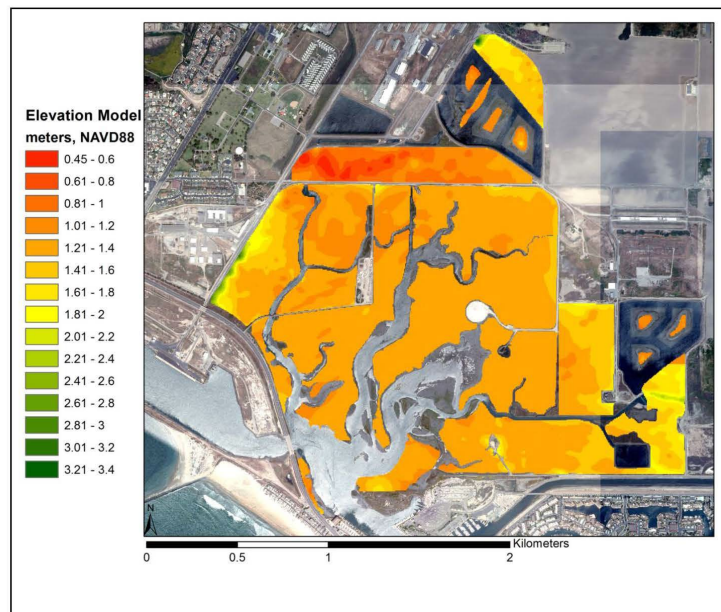
Seal Beach NWR – Lowest of the Low

Seal Beach NWR had the lowest mean elevation and mean elevation relative to MHW out of 8 CA marshes studied by UCLA and USGS.

- We conducted surveys with a Leica Real Time Kinematic GPS (± 2 cm x, y, z, accuracy)
- Surveyed along transects every 12.5m; transects separated by 50 m
- 4757 elevation measurements; 266 hectares



Elevation



Site	Hectares	Elevation Measurements (n)	Mean Elevation	Maximum Elevation	Minimum Elevation	Elevation Range	Mean relative to MHW
Humboldt	169	3020	1.77	2.82	0.58	2.24	0.32
Bolinas	87	1832	1.58	3.42	1.12	2.3	0.03
San Pablo Bay	1410	1725	1.95	4.99	-0.17	5.16	0.11
Morro Bay	188	3115	1.63	3.05	0.5	2.55	0.25
Pt. Mugu	112	1924	1.73	2.76	1.04	1.72	0.35
Seal Beach	266	4757	1.34	3.56	0.31	3.25	0.01
Newport	61	1234	1.53	1.53	0.68	0.85	0.17
Tijuana Slough	374	5832	2.22	5.32	0.99	4.33	0.21



Diversion of freshwater and sediment inputs into Seal Beach NWR

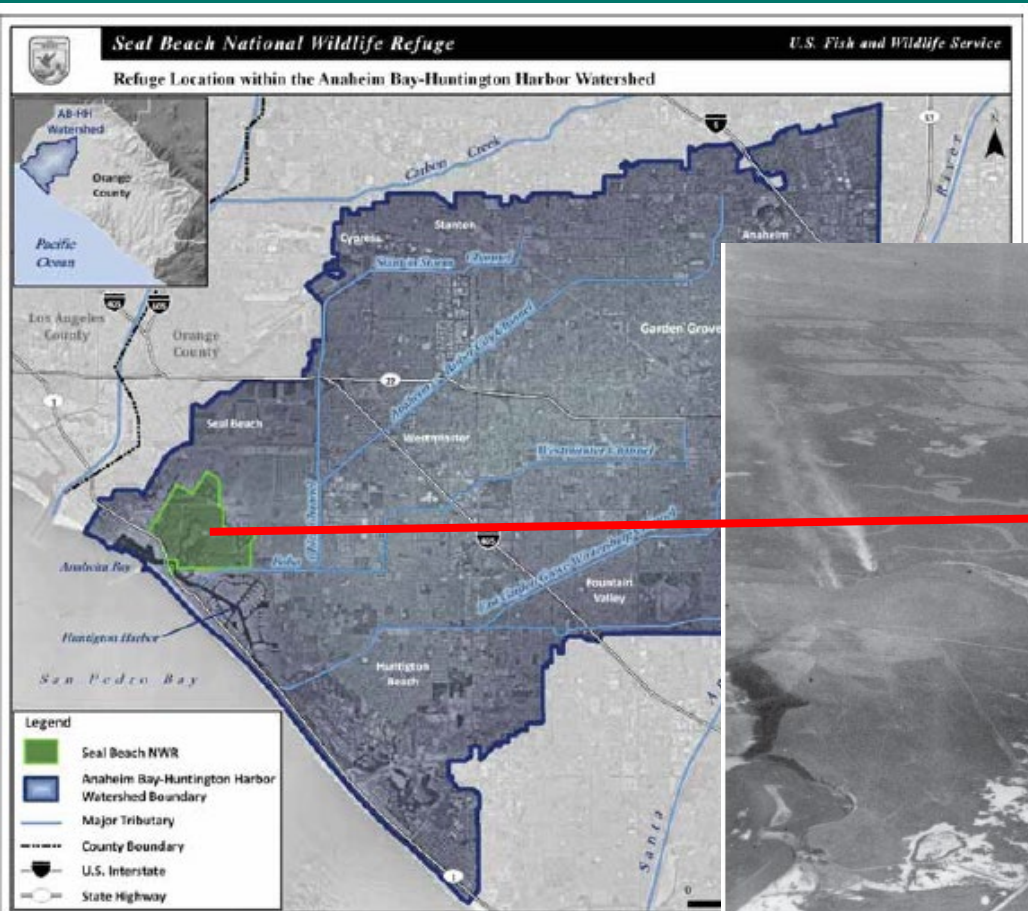


Figure 4-10. Anaheim Bay-Huntington Harbour Watershed



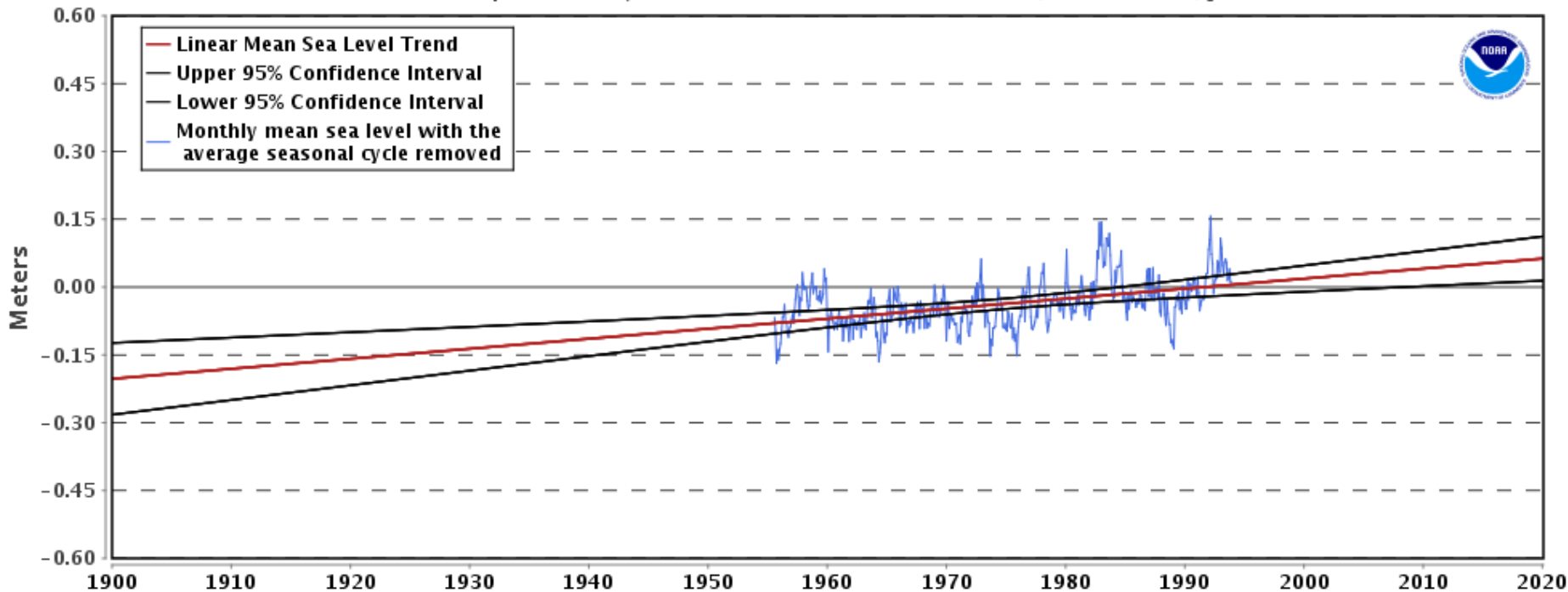
Figure 4-4. Aerial View of Anaheim Bay and Salt Marsh Complex in 1922



Sea level rise – historic and future

9410580 Newport Beach, California

2.22 +/- 1.04 mm/yr



http://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?stnid=9410580



Subsidence occurring at Naval Weapons Station Seal Beach at a rate of -4.13 mm/year.

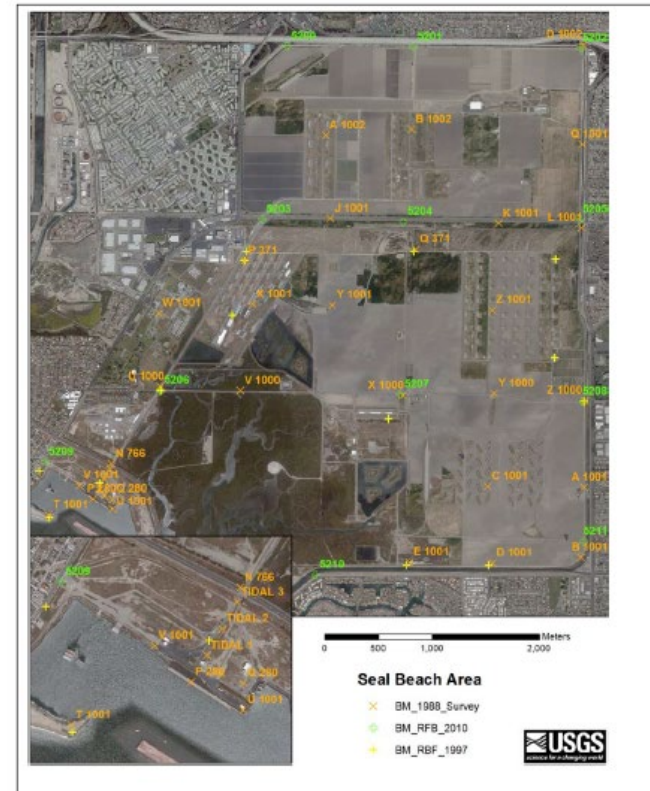
Seal Beach NWR is experiencing a relative sea level rise three times more (-6.23 mm/year) compared to other similar southern California marshes not experiencing subsidence.



Evaluation of Subterranean Subsidence at Seal Beach National Wildlife Refuge

U. S. Geological Survey, Western Ecological Research Center
Data Summary Report Prepared for the U. S. Fish and Wildlife Service
Region 8 Inventory and Monitoring Program

John Y. Takekawa, Karen M. Thorne, Kevin J. Buffington, Chase M. Freeman, and Giselle Block





Climate Change Adaptation Planning for Seal Beach National Wildlife Refuge

Karen Thorne¹, Kat Powelson¹, Giselle Block², Kirk Gilligan³, Robert Schallmann⁴, Slader Buck⁵, Chase Freeman¹, and Kevin Buffington¹



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³ Seal Beach National Wildlife Refuge, U.S. Fish and Wildlife Service, 800 Seal Beach Blvd., Bldg. 226, Seal Beach, CA 90740

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⁵ San Diego National Wildlife Refuge Complex, 1080 Gunpowder Point Drive, Chula Vista, CA 91910



- Identify priority conservation targets and threats in consultation with the Refuge and the U. S. Navy
- Model environmental response of natural resources to sea-level rise
- Assess the vulnerability of conservation targets to climate change
- Identify the optimal set of management actions

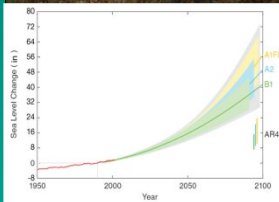


Wetland Accretion Rate Model for Ecosystem Resilience (WARMER)

Field Data/Inputs



Elevation



Sea-level rise



Water level



Plant communities



Sediment Budget & Cores

Conceptual Model

Relative sea-level rise ←

Above ground productivity →

Sediment input →

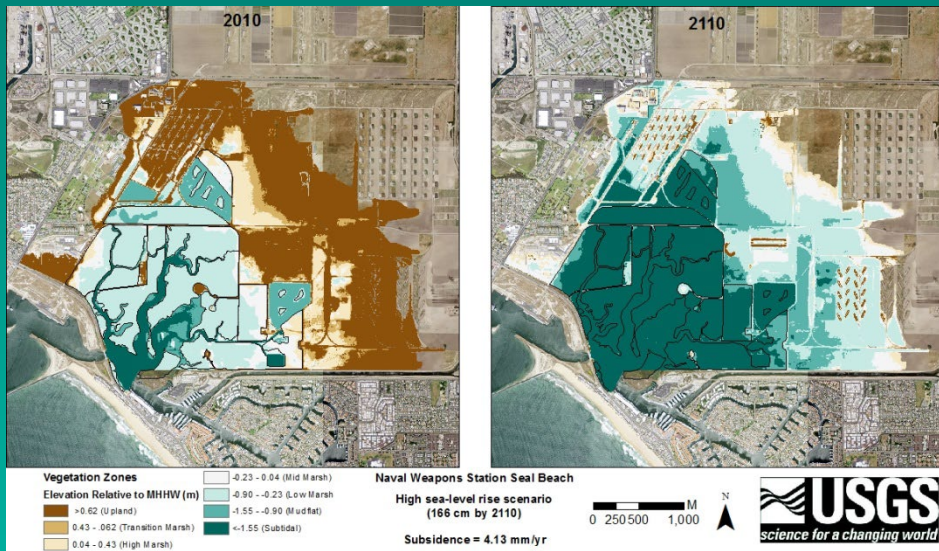
Root Growth →

Compaction ←

Decay ←

Cohort based model with an annual timestep

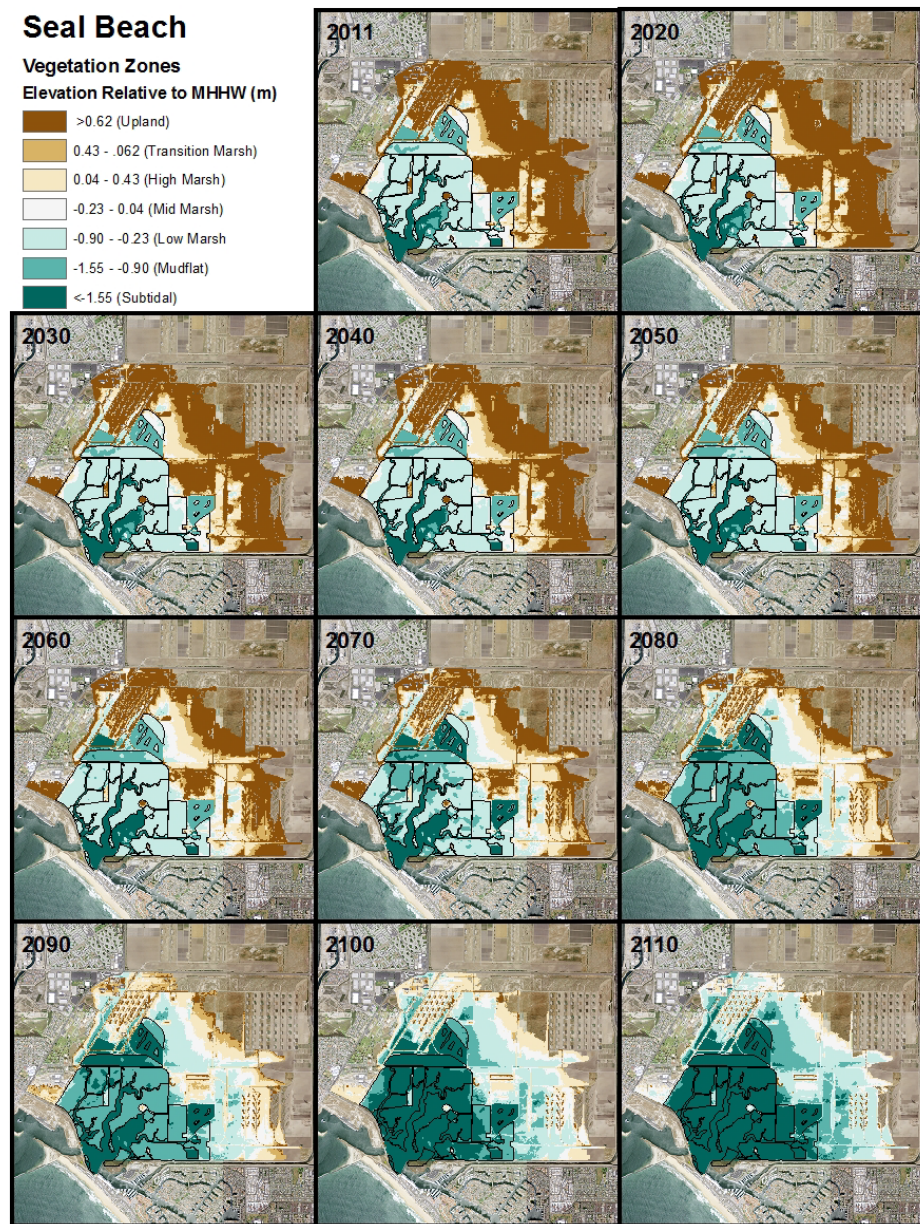
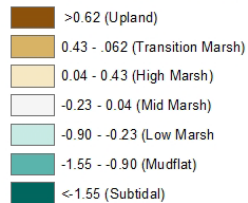




USGS – Climate Change Adaptation and Planning Team, Karen Thorne Ph. D., 2015

Seal Beach

Vegetation Zones Elevation Relative to MHHW (m)





Top Rated Management Actions

Management Action	Near-term Best Case Scenario (2030)	Near-term Worst Case Scenario (2030)	Long-term Best Case Scenario (2110)	Long-term Worst Case Scenario (2110)
Predator management*	18.23	15.67	12.70	10.87
Tidal marsh restoration on Navy Lands*	6.70	11.90	15.50	17.97
Marsh sediment augmentation (active placement of dredge material to raise marsh elevations)*	8.73	11.53	14.47	16.13
Plant restoration: marsh transition zone, upland*	11.67	11.07	10.88	10.62
Off-site actions to conserve marsh-associated targets	6.15	8.28	9.48	10.68
Eelgrass study: understand factors that influence eelgrass distribution on the refuge (including future climate change)	6.80	5.13	1.97	1.63
Culvert maintenance*	6.25	5.07	2.97	0.07
Tern island substrate enhancement: place shells, vegetation management*	5.67	4.33	2.47	1.33
Re-engineer CA least tern nest site*	1.33	3.33	2.82	2.42
Invasive plant management	4.23	2.97	2.33	2.00
Light-footed clapper rail nest platforms	3.33	2.87	2.33	2.00



End goal is to implement and evaluate the success of thin layer sediment augmentation as a regional sea level rise and climate change adaptation strategy that can be used at regular intervals to ensure the long term sustainability of Pacific coast marshes.



Refuge Purpose

“Preserve and manage the habitat necessary for the perpetuation of two endangered species – the light-footed clapper rail and CA least tern.”

“Preserve habitat used by migratory waterfowl, shorebirds, and other water birds.”



Western snowy plover



Pacific green sea turtle



Belding's savannah sparrow

© Marie Read



Light-footed Ridgway's rail



California least tern