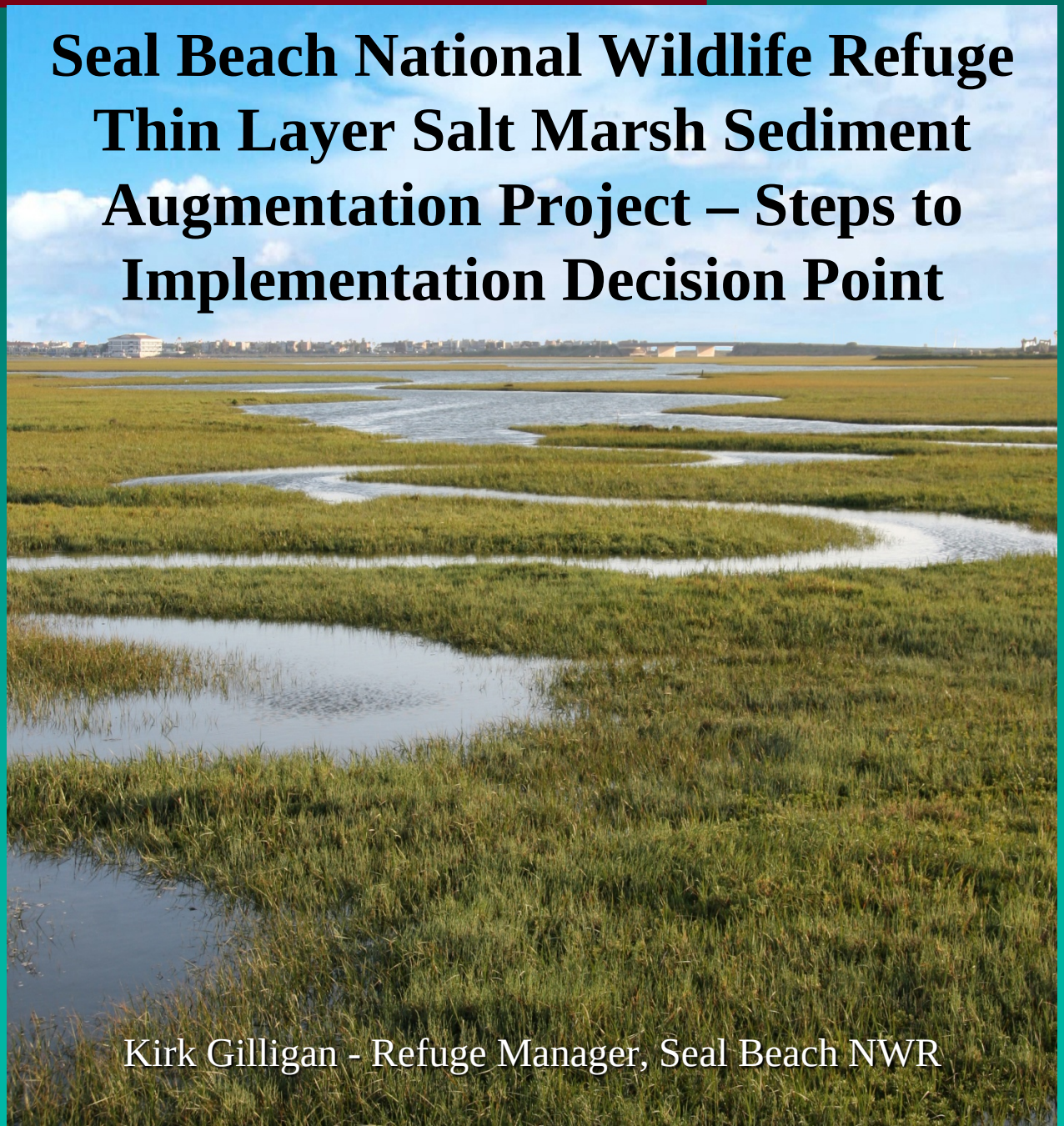
U.S. Fish & Wildlife Service

Seal Beach National Wildlife Refuge Thin Layer Salt Marsh Sediment Augmentation Project – Steps to Implementation Decision Point



Kirk Gilligan - Refuge Manager, Seal Beach NWR

U.S. Fish & Wildlife Service

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


Light-footed Ridgway's rail


California least tern

What's missing?

But of course!

Mid Tide

High Tide

U.S. Fish & Wildlife Service

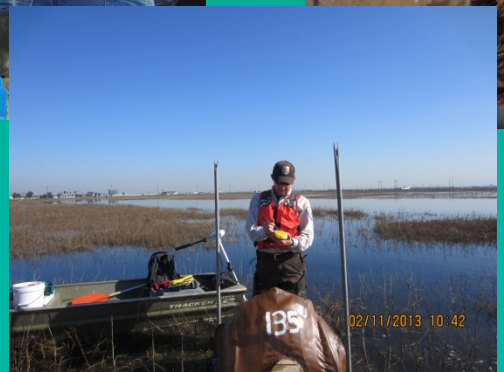
Management Programs -Endangered Species

Light-footed Ridgway's rail

2015 breeding estimate – 66 pairs

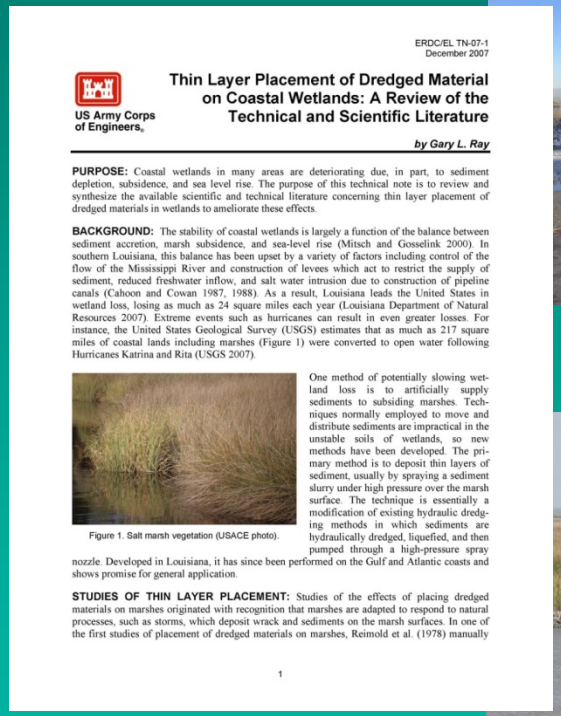
2015 LFRR Platform Maintenance: Built and replaced approximate 20 LFRR platform covers & bases. Maintained all 90 nesting platforms.

Captive-bred rail release – 2014



Beneficial Use of Dredge Material by Thin Layer Placement

- First Study – 1978 Georgia
- Many applications since - TX, LA, GA, NC, MD
- Often used where natural systems of sediment deposition have been altered
- 2015/2016 – Seal Beach NWR - First thin layer addition project on west coast of US?



ERDC/EL TN-07-1
December 2007

US Army Corps of Engineers

Thin Layer Placement of Dredged Material on Coastal Wetlands: A Review of the Technical and Scientific Literature

by Gary L. Ray

PURPOSE: Coastal wetlands in many areas are deteriorating due, in part, to sediment depletion, subsidence, and sea level rise. The purpose of this technical note is to review and synthesize the available scientific and technical literature concerning thin layer placement of dredged materials in wetlands to ameliorate these effects.

BACKGROUND: The stability of coastal wetlands is largely a function of the balance between sediment accretion, marsh subsidence, and sea-level rise (Mitsch and Gosselink 2000). In southern Louisiana, this balance has been upset by a variety of factors including control of the flow of the Mississippi River and construction of levees which act to restrict the supply of sediment, reduced freshwater inflow, and salt water intrusion due to construction of pipeline canals (Cahoon and Cowan 1987, 1988). As a result, Louisiana leads the United States in wetland loss, losing as much as 24 square miles each year (Louisiana Department of Natural Resources 2007). Extreme events such as hurricanes can result in even greater losses. For instance, the United States Geological Survey (USGS) estimates that as much as 217 square miles of coastal lands including marshes (Figure 1) were converted to open water following Hurricanes Katrina and Rita (USGS 2007).

Figure 1. Salt marsh vegetation (USACE photo).

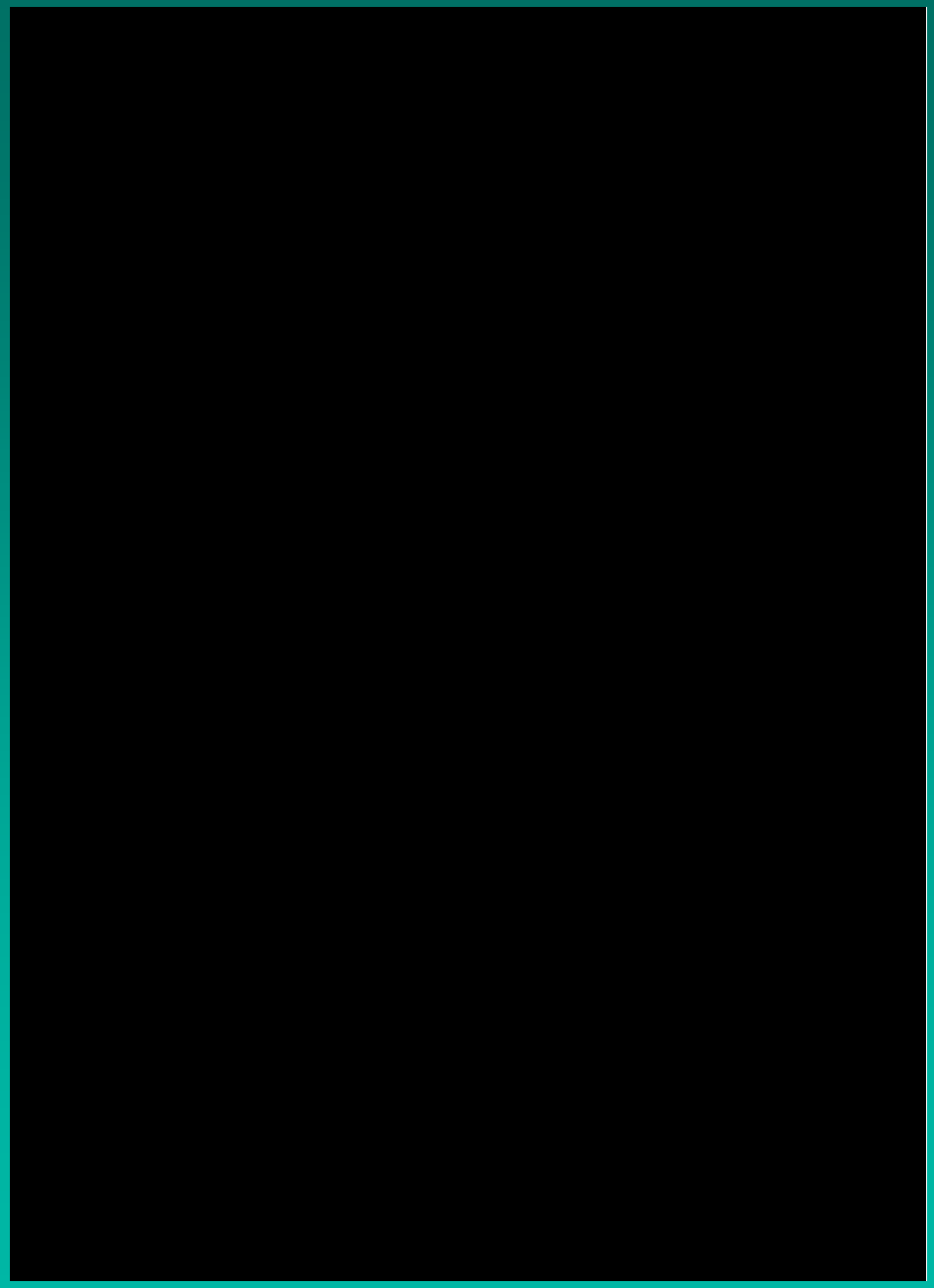
One method of potentially slowing wetland loss is to artificially supply sediments to subsiding marshes. Techniques normally employed to move and distribute sediments are impractical in the unstable soils of wetlands, so new methods have been developed. The primary method is to deposit thin layers of sediment, usually by spraying a sediment slurry under high pressure over the marsh surface. The technique is essentially a modification of existing hydraulic dredging methods in which sediments are hydraulically dredged, liquefied, and then pumped through a high-pressure spray nozzle. Developed in Louisiana, it has since been performed on the Gulf and Atlantic coasts and shows promise for general application.

STUDIES OF THIN LAYER PLACEMENT: Studies of the effects of placing dredged materials on marshes originated with recognition that marshes are adapted to respond to natural processes, such as storms, which deposit wrack and sediments on the marsh surfaces. In one of the first studies of placement of dredged materials on marshes, Reimold et al. (1978) manually

1

Photo by Kirk Gilligan

Photo by USACE



Project Planning

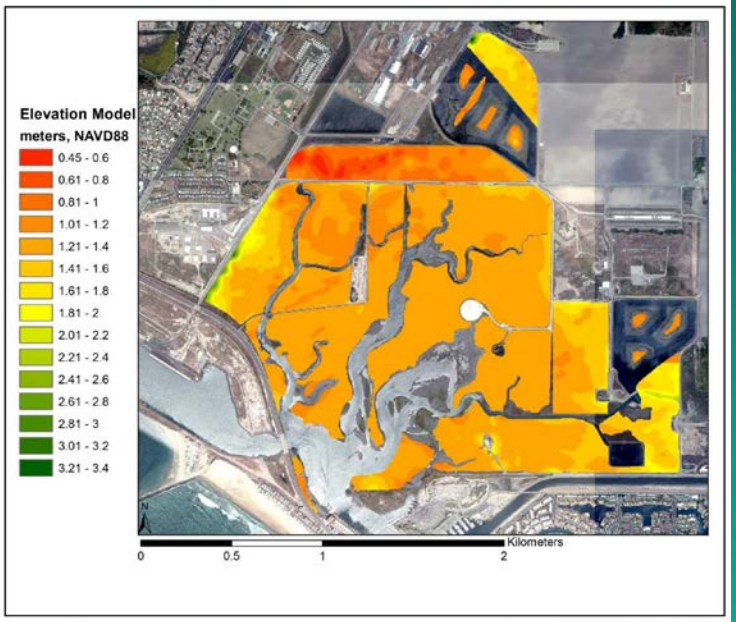
From Comprehensive Conservation Plan to Sediment Augmentation

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.

Elevation

- 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

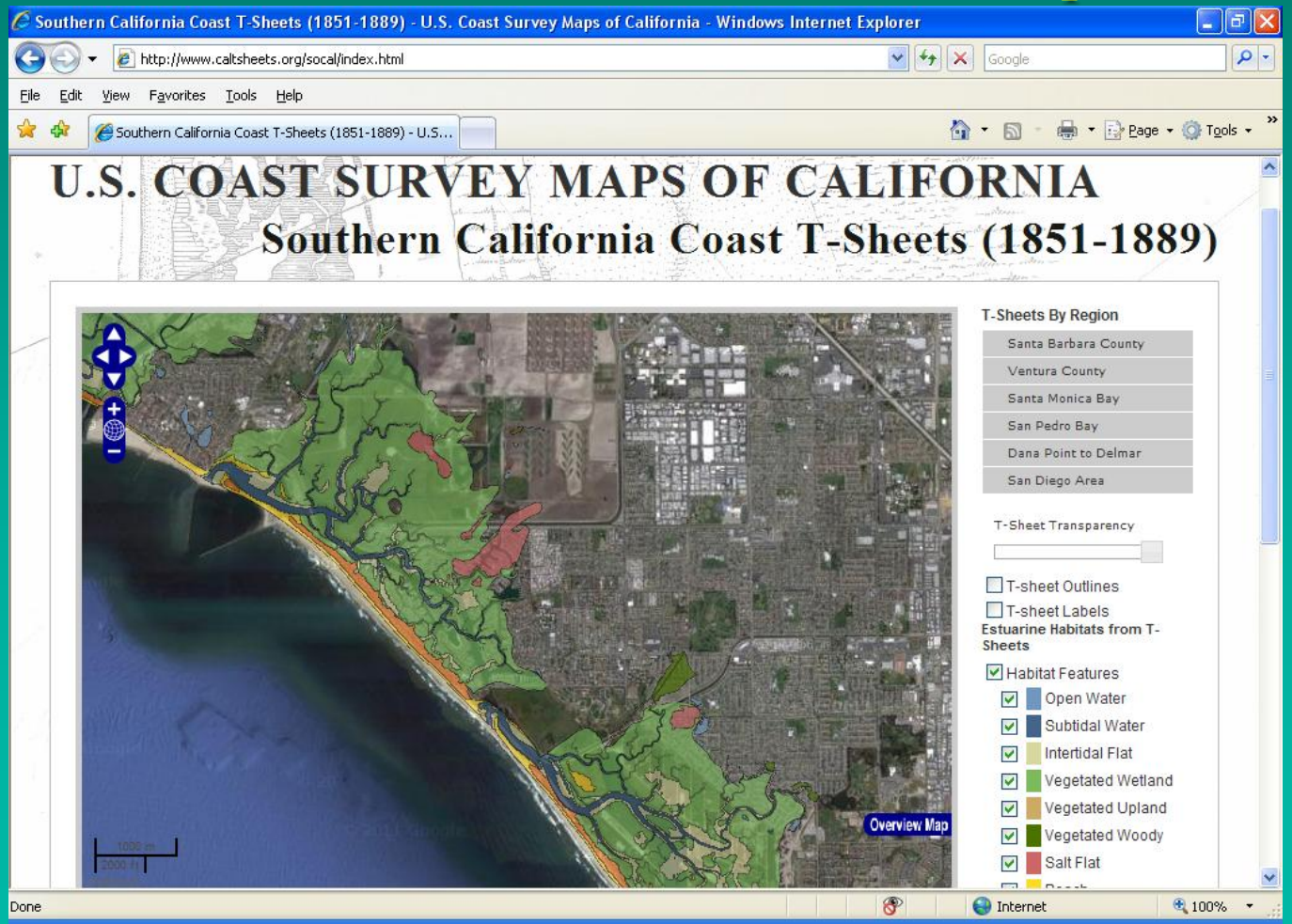


Site	Hectares	Elevation Measurements (n)	Mean Elevation	Maximum Elevation	Minimum Elevation	Elevation Range	Mean releative to MHW
Humboldt	169	3020	1.77	2.82	0.58	2.24	0.32
Bolinas	87	1832	1.58	3.42	1.12	2.3	0.03
San Pablo Bay	1410	1725	1.95	4.99	-0.17	5.16	0.11
Morro Bay	188	3115	1.63	3.05	0.5	2.55	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

USGS science for a changing world

Why elevation challenged?

1. Diversion of freshwater inputs
   - -Change in salinity
   - -Reduction or loss of sediment inputs



Sediment Budget at Seal Beach

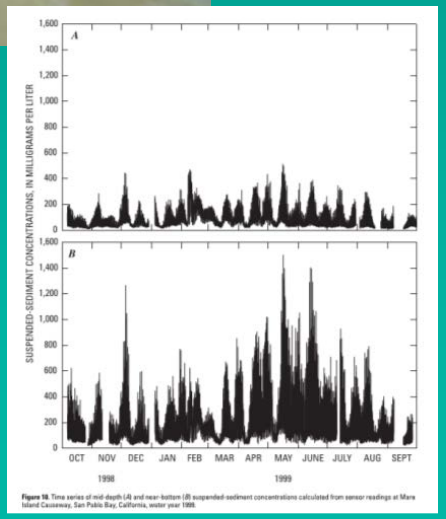
1. What is the suspended sediment flux into Seal Beach NWR via Anaheim bay?

2. Does this suspended sediment concentration vary between ebb and flow tides, throughout the year, seasonally?

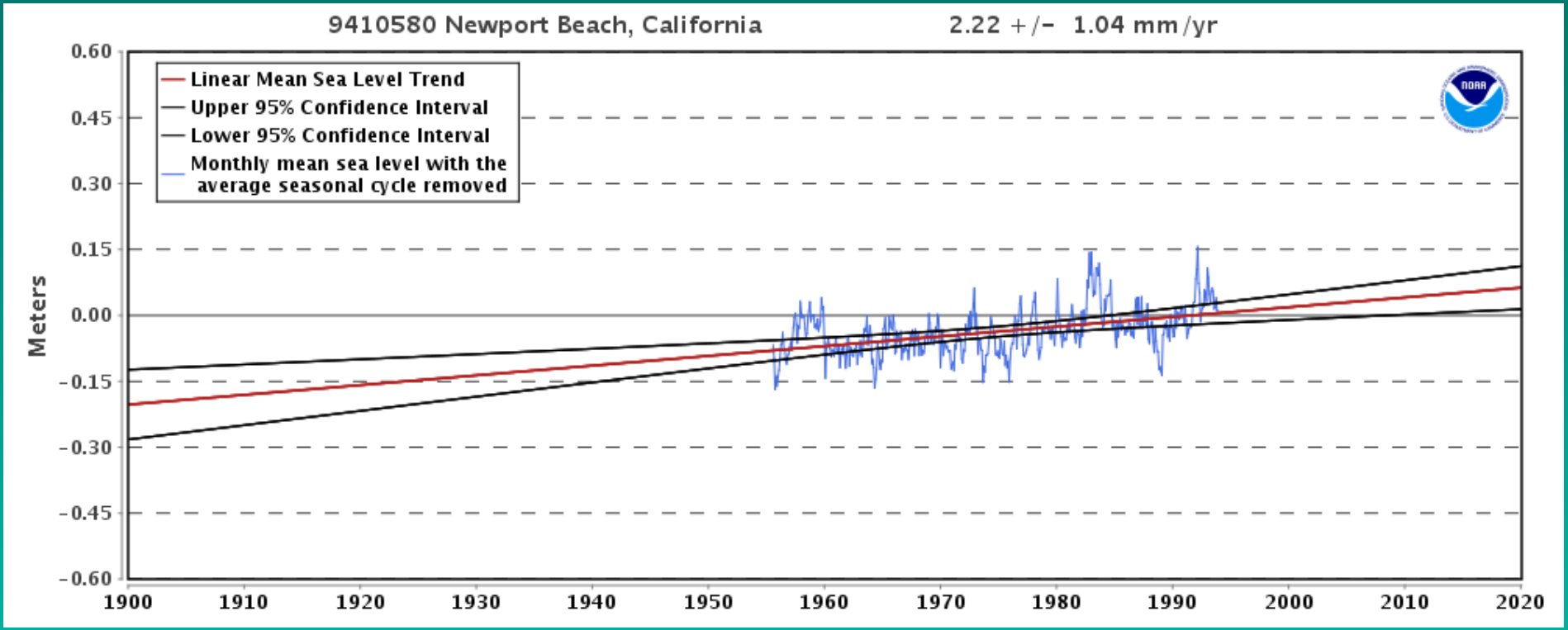
3. Does suspended sediment flux via Anaheim bay correlate with deposition rates on marsh?

- Deployed 2 water meters and 2 acoustic doppler current profilers

- Calibrated meters with water bottle samples



2. Sea level rise – historic and future

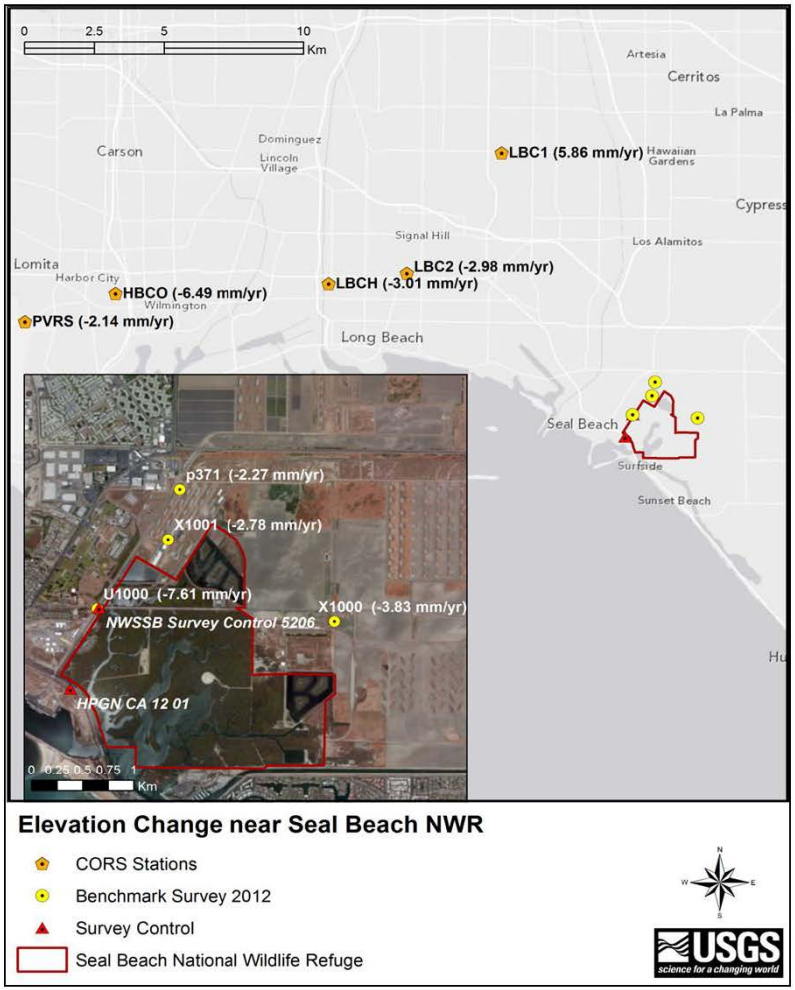


http://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?stnid=9410580

3. Land subsidence – subterranean fluid extraction and tectonic action

Evaluation of Subterranean Subsidence at Seal Beach National Wildlife Refuge (Takekawa et al, 2013)

- Subsidence occurring at NWSSB at a rate of -4.13 mm/yr (SE ± 1.21 mm/yr)
- SBNWR is experiencing a relative sea-level rise rate three times more (6.23 mm/yr) than that of similar southern California marshes not experiencing subsidence



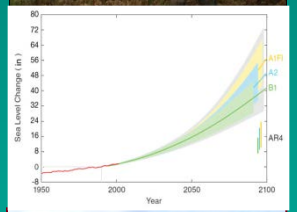
Seal Beach Climate Change Adaptation Planning at Seal Beach

1. Identify biological and non-biological targets of concern in the project area through consultation with the Refuge and the U. S. Navy.
2. Assemble and summarize current and potential climate change projections, impacts and other relevant information.
3. Assess vulnerability of targets and develop plausible scenarios of natural resource states as a result of climate change to develop and prioritize future management strategies.

Wetland Accretion Rate Model for Ecosystem Resilience (WARMER)

Field Data/Inputs

Elevation

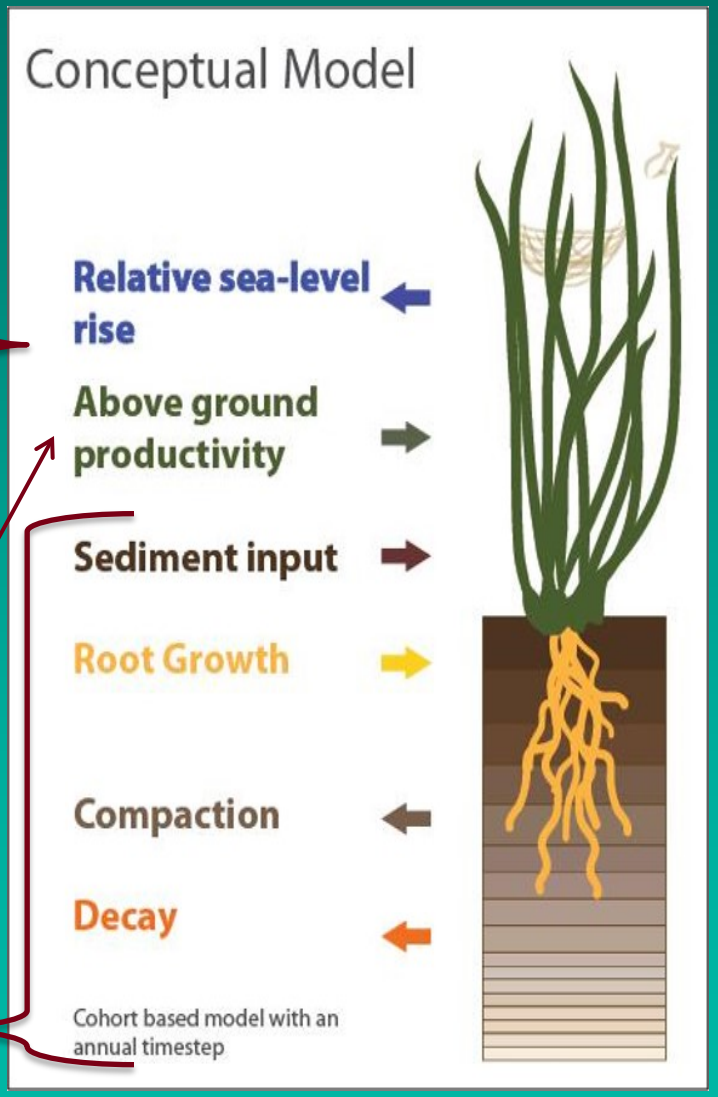


Sea-level rise

Water level

Plant communities

Sediment Budget & Cores



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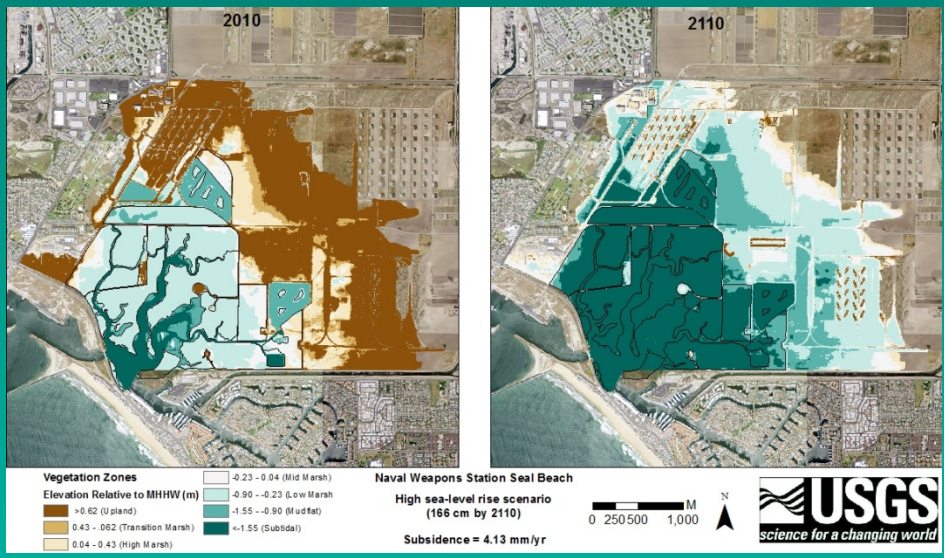
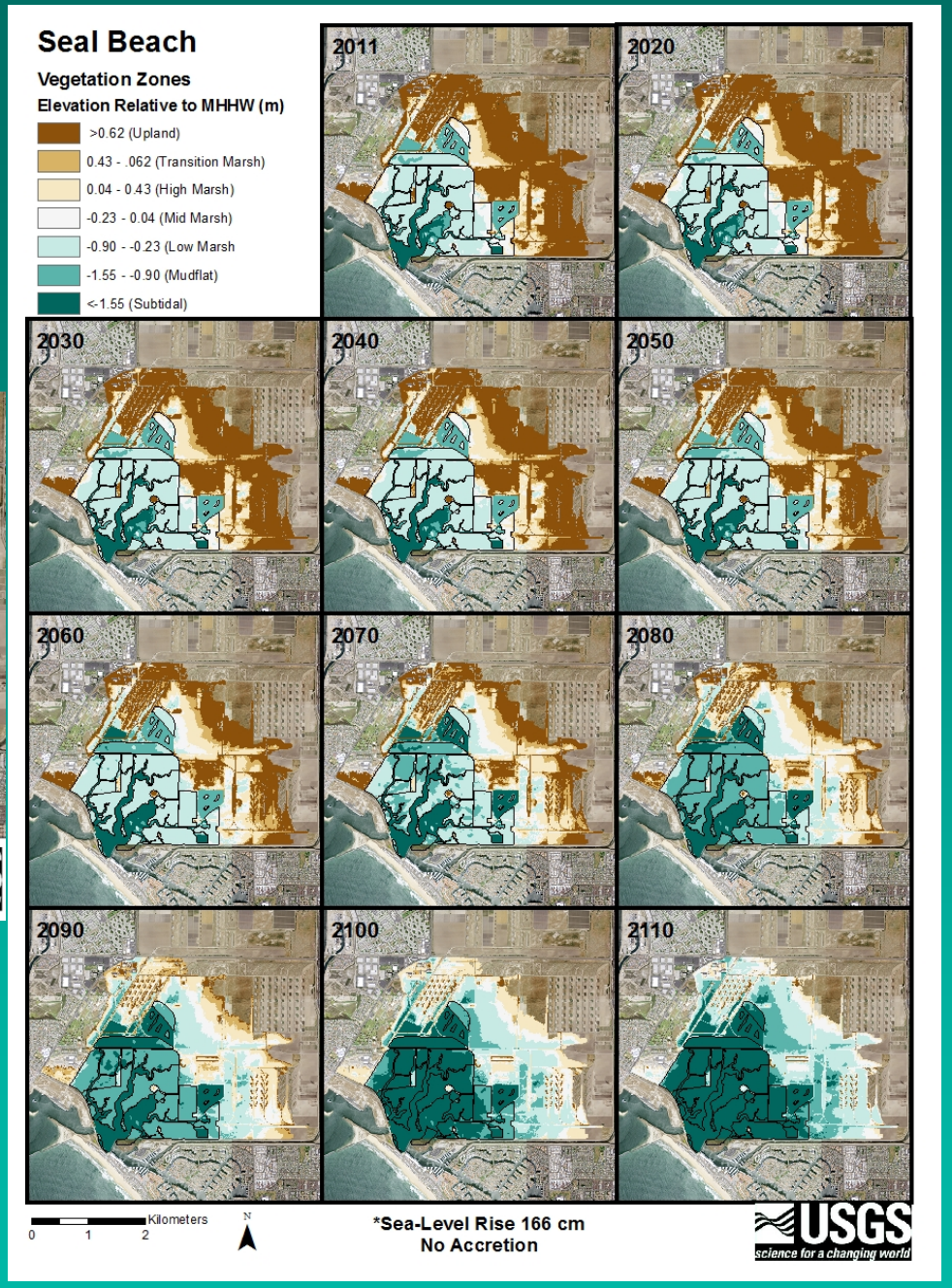


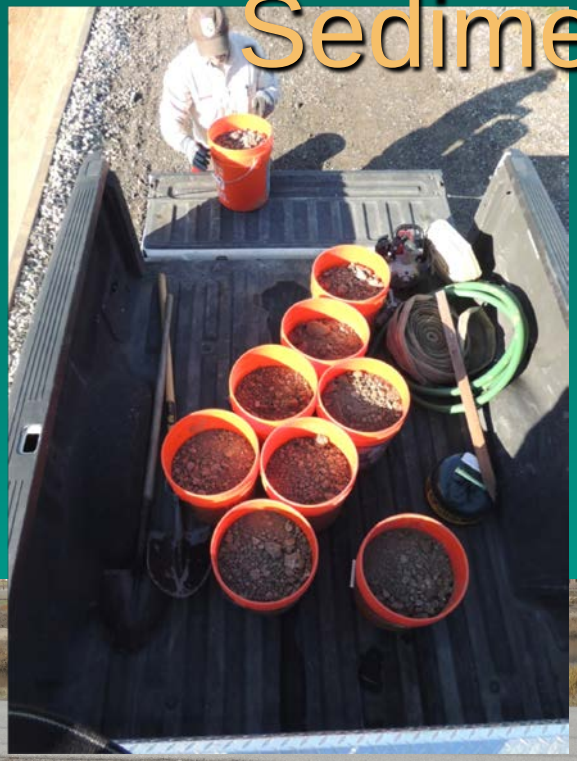
USGS – Climate Change Adaptation and Planning Team,
Karen Thorne Ph. D., 2015



Wildlife Refuge and Dredge Sites

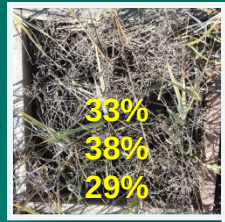
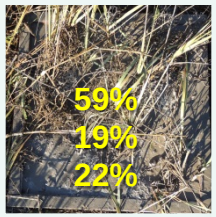
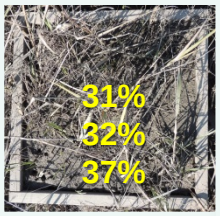
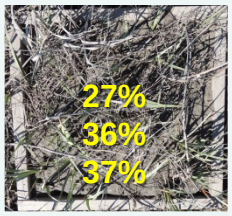
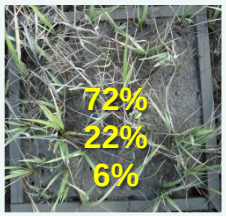
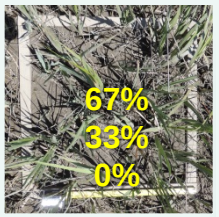
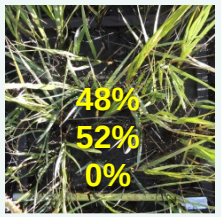
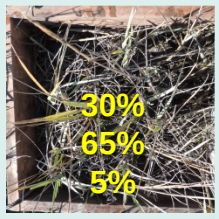
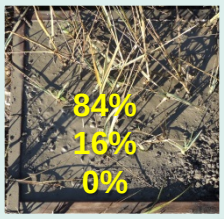
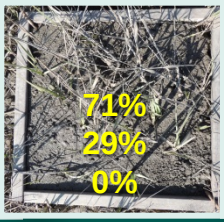
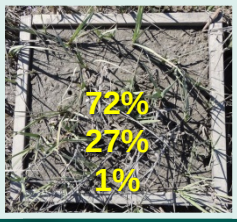
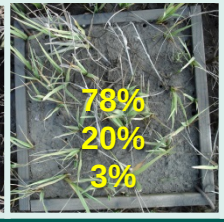
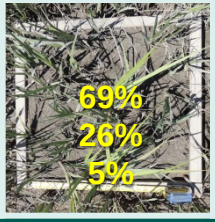
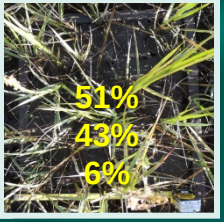
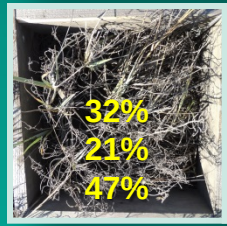
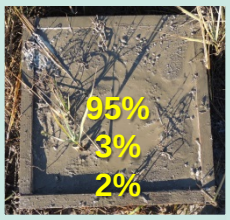
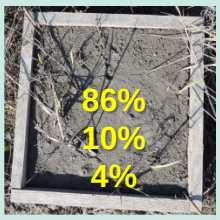
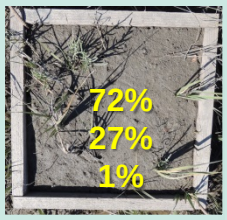
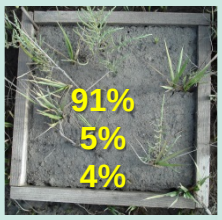
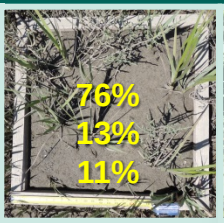
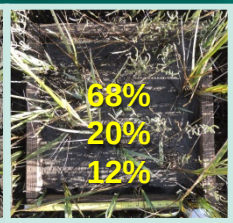
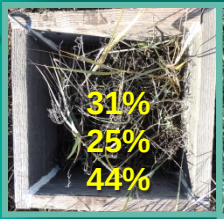
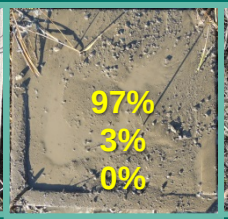
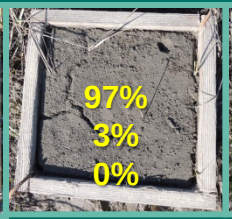
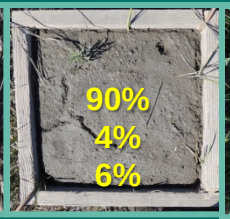
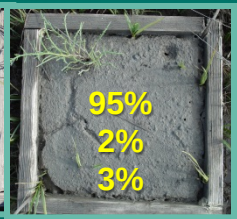
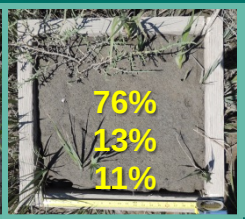
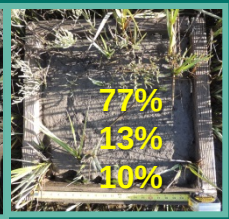
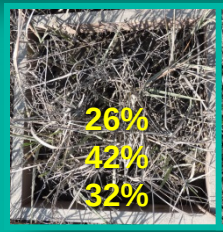
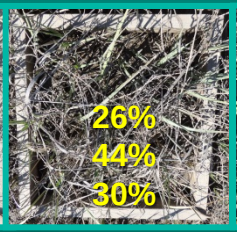
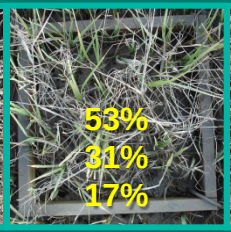
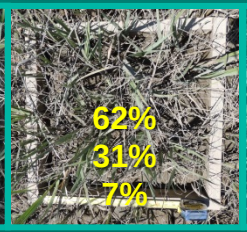
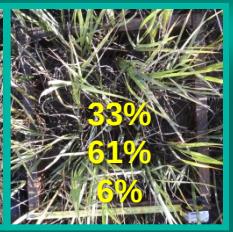
U.S. Fish & Wildlife Service

Sediment Box Experiment



Photos by Kirk Gilligan//USFWS

U.S. Fish & Wildlife Service

Sediment depth	Pre-Tx	Week 0	Week 8	Week 15	Week 22	Week 29	Week 36
9 cm/3.5”							
14 cm/5.5”							
20 cm/7.9”							
30 cm/11.8”							
Control							

% Cover
Bare Ground
S. foliosa
S. pacifica

	Bare Ground	*S. foliosa*	*S. pacifica*
9 cm/3.5”	33%	38%	29%
	59%	19%	22%
	31%	32%	37%
	27%	36%	37%
	72%	22%	6%
	67%	33%	0%
	48%	52%	0%
14 cm/5.5”	30%	65%	5%
	84%	16%	0%
	71%	29%	0%
	72%	27%	1%
	78%	20%	3%
	69%	26%	5%
	51%	43%	6%
20 cm/7.9”	32%	21%	47%
	95%	3%	2%
	86%	10%	4%
	72%	27%	1%
	91%	5%	4%
	76%	13%	11%
	68%	20%	12%
30 cm/11.8”	31%	25%	44%
	97%	3%	0%
	97%	3%	0%
	90%	4%	6%
	95%	2%	3%
	76%	13%	11%
	77%	13%	10%
Control	26%	42%	32%
	26%	44%	30%
	53%	31%	17%
	62%	31%	7%
	33%	61%	6%

Grant Funding To Date $3,305,554

California State Coastal Conservancy	$632,500
USFWS 2015 Cooperative Recovery Initiative Grant	$502,425
CDFW Wetland Restoration for GHG Reduction Grant Program	$1,055,827
USACE Ecosystem Management and Restoration Research Program	$50,252
Orange County Parks (in-kind)	$1,064,550

Funding Partners

- U.S. Fish & Wildlife Service
- Orange County Parks
- California Coastal Conservancy
- CA Dept. of Fish & Wildlife - Greenhouse Gas Reduction Program
- USACE - Ecosystem Management & Restoration Research Program

Research Partners

- USGS – Western Ecological Research Center, Karen Thorne, Ph.D.
- UCLA – Richard Ambrose, Ph.D. & Glen MacDonald, Ph.D.
- CSU Long Beach – Christine Whitcraft, Ph.D.
- Chapman University – Jason Keller, Ph.D.

Additional Partners

- Southwest Wetlands Interpretive Association
- Naval Weapons Station Seal Beach (Landowner)
- State Lands Commission (Landowner)
- Moffatt & Nichol (Engineering contractor)
- Curtin Maritime (Dredge contactor)

Bigger picture: End goal is to implement and evaluate the success of thin layer placement 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.

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