Salt Marsh Vegetation and Habitat Areas
Status Update

May 3, 2023
SONGS Mitigation Monitoring Project
Marine Science Institute, University of California Santa Barbara

This presentation will provide a status update on the standards for vegetation cover and habitat areas, ending with an overview of ongoing and future investigations aimed at addressing the underperformance of these standards.

Performance standards pertaining to habitat areas and cover of salt marsh vegetation

Absolute Standard: Habitat Areas

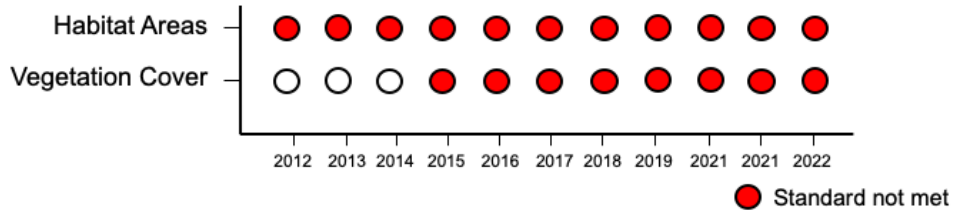
The area of different habitats shall not vary by more than 10% from the areas indicated in the final restoration plan.

Relative Standard: Vegetation

The proportion of total vegetation cover in the marsh shall be similar to those proportions found in the reference sites.

- There are two standards that pertain to the cover of vegetation.
- The first is the Habitat Areas standard. This is an absolute standard that is evaluated only in San Dieguito Wetlands and specifies that the area of different habitats shall not vary more than 10% from the areas in the final restoration plan.
- To be classified as salt marsh habitat, the cover of vegetation must be at least 30% and this 30% is evaluated within 10 x 10 m grids covering the entire wetland as Rachel discussed in the Performance talk.
- The second standard that pertains to the cover of vegetation is the Vegetation standard.
- This standard requires that the proportion of total vegetation cover in the marsh shall be similar to those proportions found in the reference sites.
- In practice, this standard is only evaluated in habitat that has been classified as salt marsh, with least 30% cover.

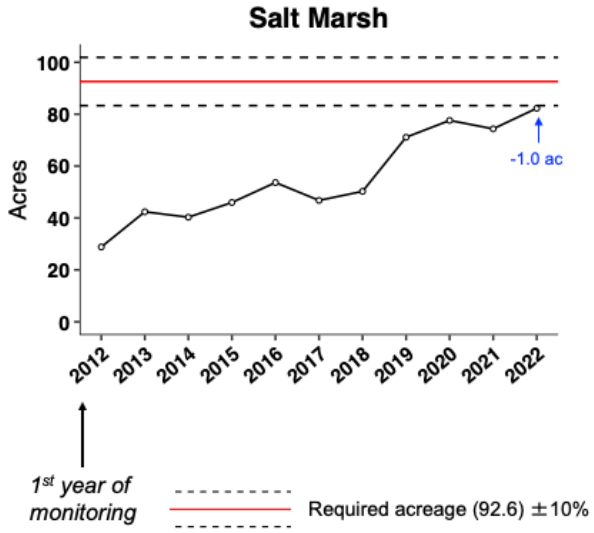
Standards that have consistently underperformed in San Dieguito Wetlands



- Both the absolute standard for Habitat Areas and the relative standard for Vegetation Cover have yet to be met.
- 2015 is the first year we have a four year running average for the evaluation of the vegetation cover standard, which is why the circles are unfilled until 2015.

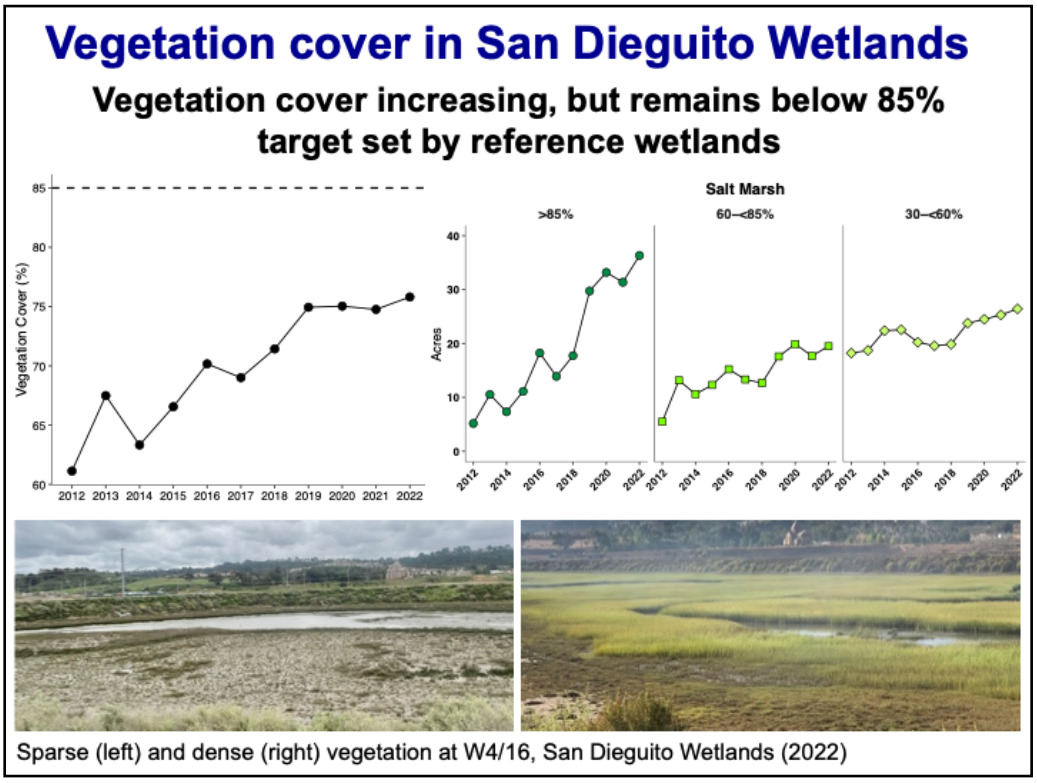
Salt Marsh Habitat

Changes in acres of salt marsh habitat over time



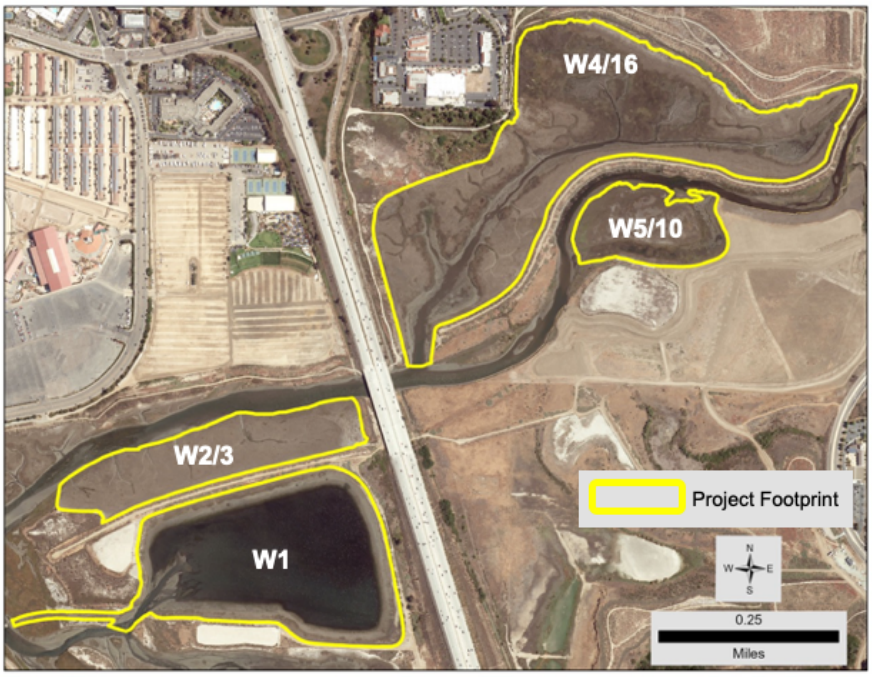
San Dieguito Wetlands, W2/3

- This slide reviews the change in area (measured in acres) of salt marsh habitat over time.
- The planned acres of salt marsh habitat is shown by the red line at 92.6 acres with +/-10% of that value indicated by the dashed lines.
- Substantial progress has been made in vegetation development since 2018 and the wetland is short only 1.02 acres from meeting the minimum required salt marsh area of 83.3 acres.

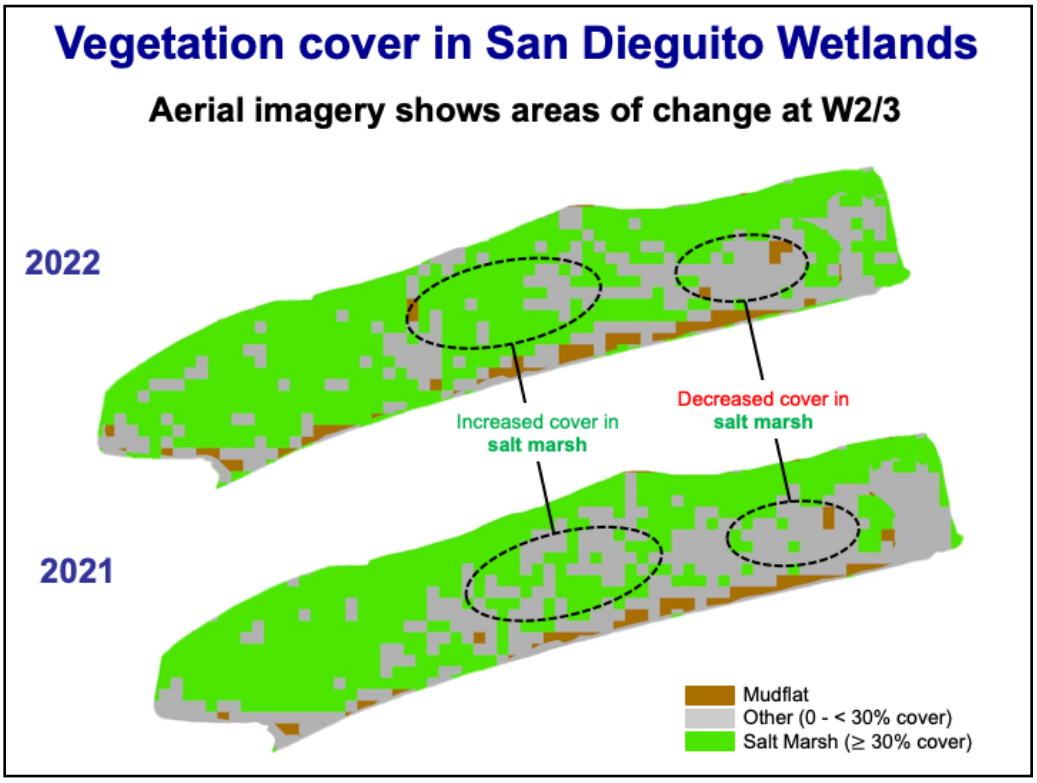


- Pivoting now to vegetation cover, here we show the vegetation cover at San Dieguito from 2012 to 2022. This figure only considers salt marsh habitat, meaning marsh with cover greater than 30%.
- We see that cover is increasing but remains short of the 85% target (indicated by the dashed line in the top figure) set by reference wetlands.
- Now if we look at the time series for salt marsh acres by cover bin, shown on the right, we see that cover >85% has been increasing at a faster pace (+35 acres) than 60 to <85% (+14 acres), which started at a similar acreage in 2012.
- Cover in the 30 to <60% bin has increased as well but at a slower rate, having gained 8 acres over the last 11 years.
- Overall, we are close to meeting both targets for salt marsh acreage and vegetation cover.

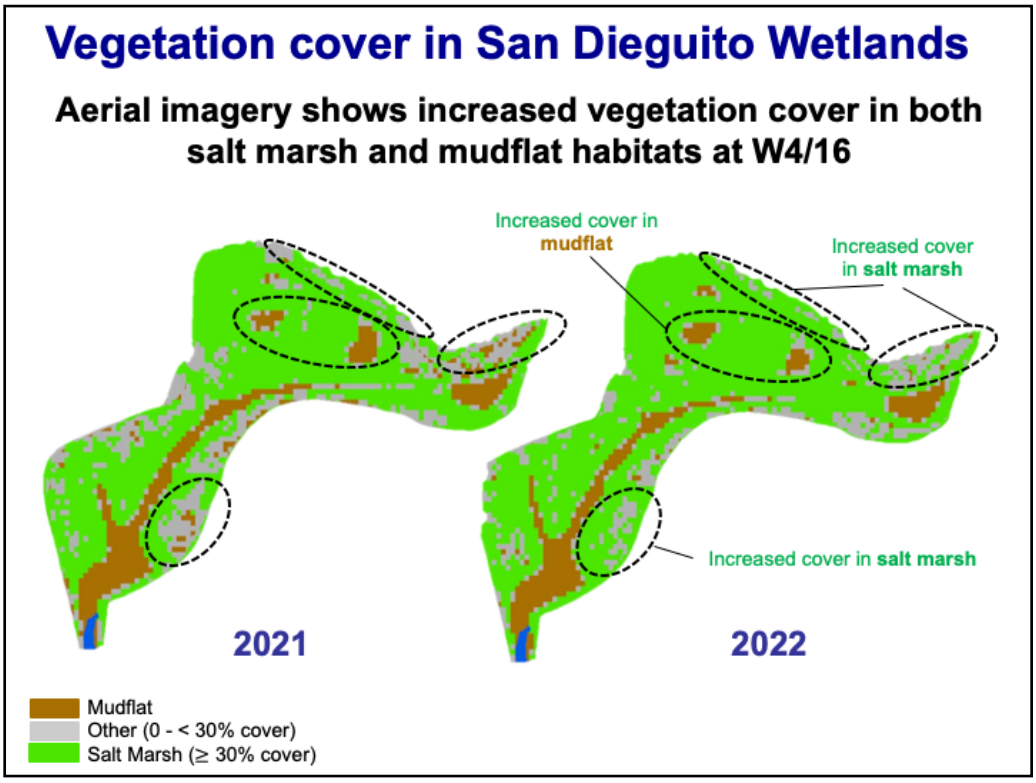
What are the cover patterns at the module level?



- Evaluation of the habitat areas and vegetation cover standards is done wetland-wide, but looking at individual modules within the restoration project is useful for identifying areas with persistently low cover, and areas where cover has increased from year to year.
- The next two slides look at the vegetation cover, broken down by the habitat type for W2/3 and W4/16.
- As Rachel mentioned in the previous talk, these habitat categories are mudflat, salt marsh, and other.

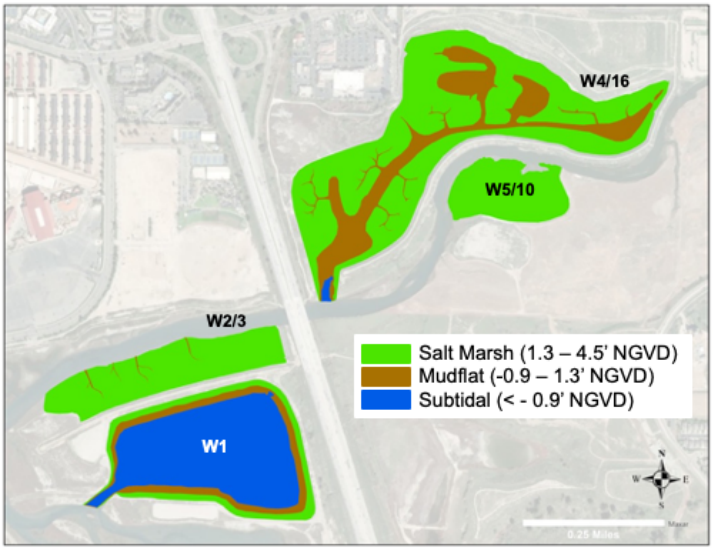


- Here we are showing the aerial imagery from 2021 (on bottom) and 2022 (on top) for the W2/3 module. Each grid is 10 x 10 m and classified as either mudflat, other, or salt marsh.
- We can see areas where vegetation cover has increased in areas that were previously classified as “other”, not a planned habitat.
- Though we did observe some loss of salt marsh in portions of the module.



- This slide shows W4/16, one of the modules east of the I-5 freeway, with 2021 shown on the left and 2022 on the right.
- Similar to W2/3, we see areas of increased cover at W4/16, with increase in cover in the northeastern portions of the module as well as is in the southern areas of the module.
- This increase in cover is reflected in the conversion of mudflat and other to salt marsh.
- We also see this increase in cover in what was designed as mudflat habitat.

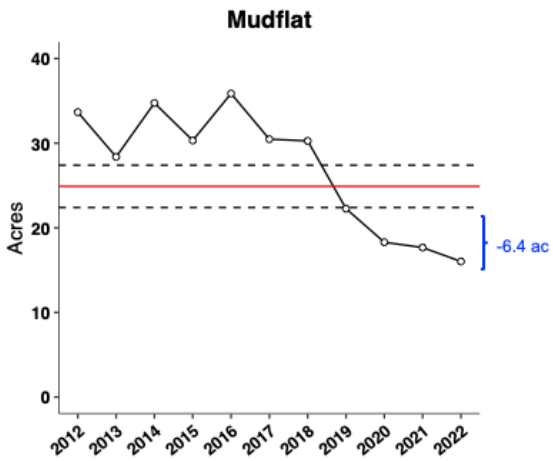
Loss of Planned Mudflat



Habitat	Planned Acres
Mudflat	24.9 ac.

However, this increase in salt marsh has come in part at the expense of mudflat habitat, which was planned to occupy 24.9 acres of the restored wetland

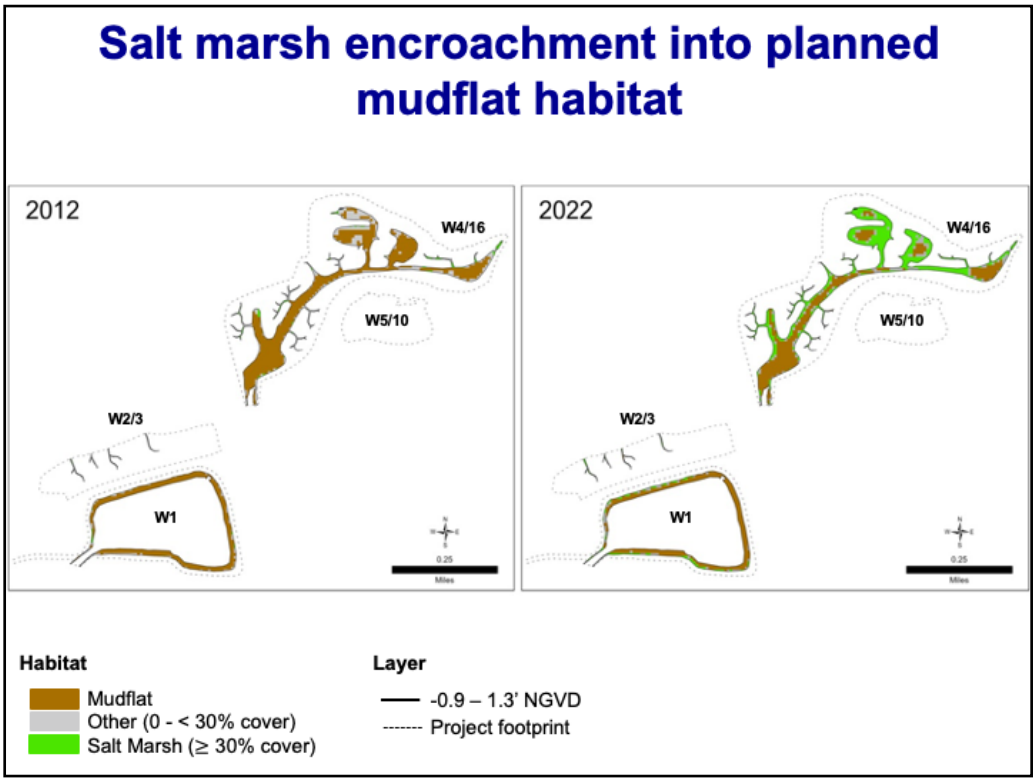
Declining trend in mudflat habitat at San Dieguito Wetlands



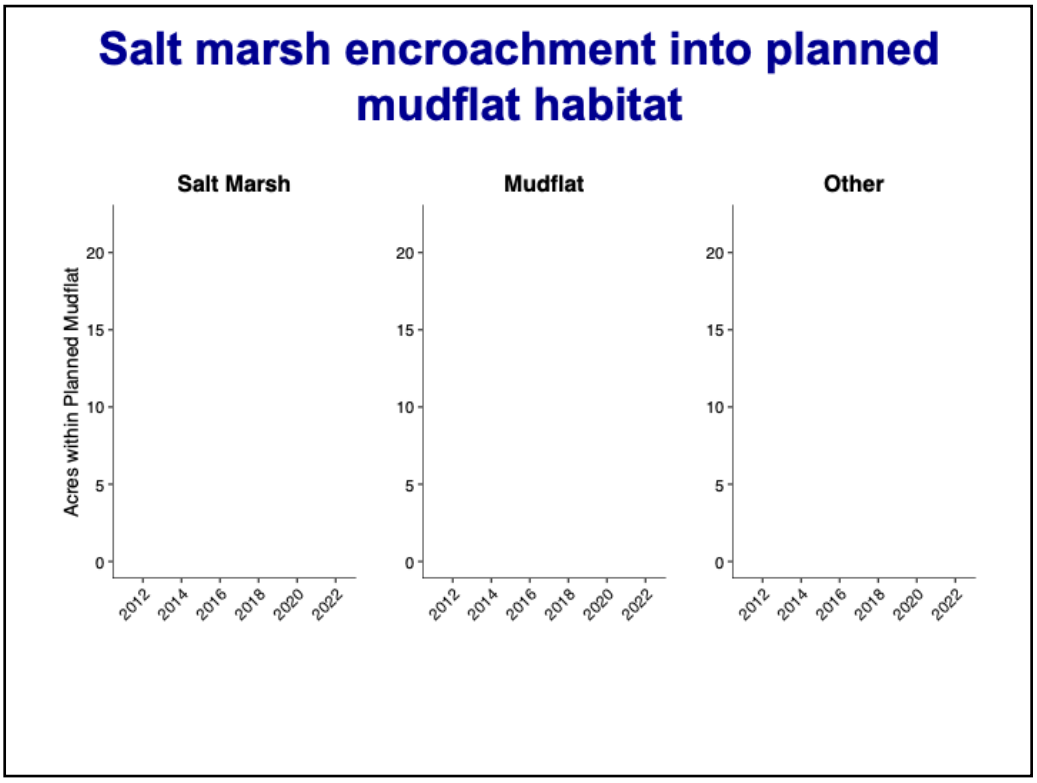
San Dieguito Wetlands, W4 mudflat (2022)

How many mudflat acres are lost due to salt marsh encroachment?

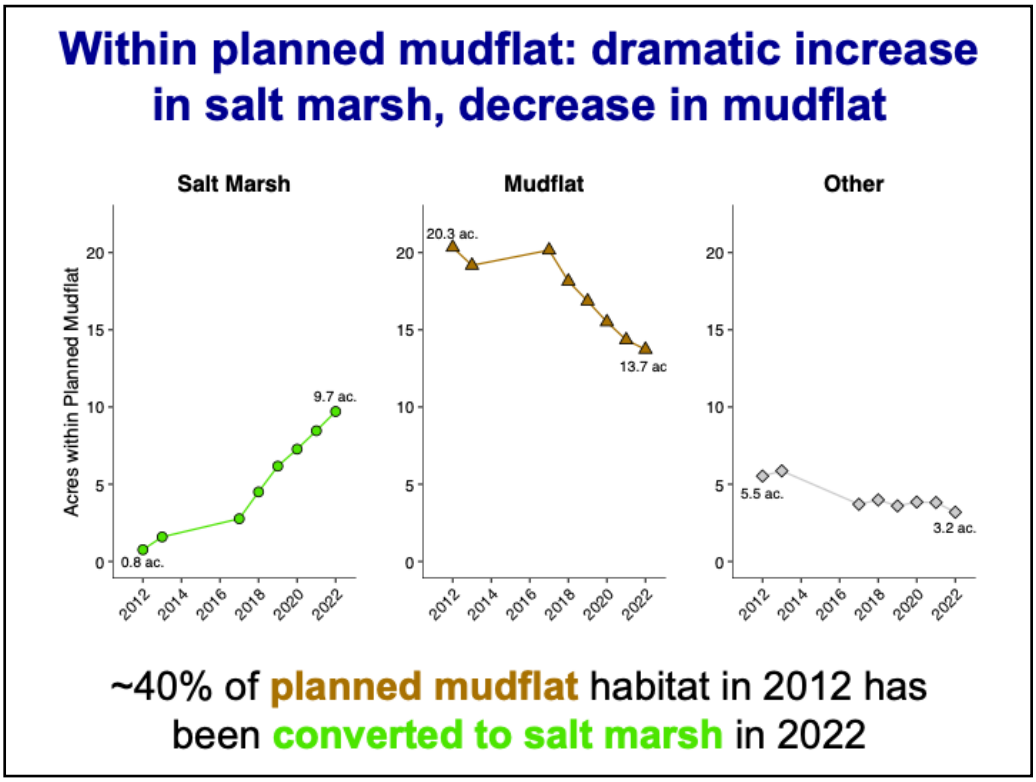
- As Rachel mentioned in the Performance Talk, we have seen a decline in mudflat habitat at San Dieguito Wetlands in recent years.
- As of 2022, we are -6.4 acres short of meeting the minimum mudflat acres (20.16) required by the Habitat Areas Standard.
- The photo on the right, taken from well within one of San Dieguito's mudflats, shows the encroachment of low marsh species, mainly *Spartina foliosa*, into mudflat habitat.
- Given these trends, we asked—how many mudflat acres are lost due to salt marsh encroachment?
- To begin to answer this question, we will focus the remainder of the presentation on the planned mudflat area as indicated in the Final Restoration Plan, which I showed on the previous slide.



- To orient you to these maps, we've outlined the project footprint for the various modules by dotted line. The area of focus for this analysis is the planned mudflat habitat which ranges in elevation from – 0.9 to 1.3' NGVD.
- Shown on the left we see that mudflat makes most of the planned mudflat area in 2012.
- On the right, we see that area planned as mudflat has converted to salt marsh over the eleven year period
- Much of the salt marsh encroachment into planned mudflat habitat is *Spartina foliosa* and we've also seen *Spartina* move into the constructed tidal creeks which are used to evaluate the fish and invertebrate performance standards, which Mark will go into more detail on in the talk to follow.



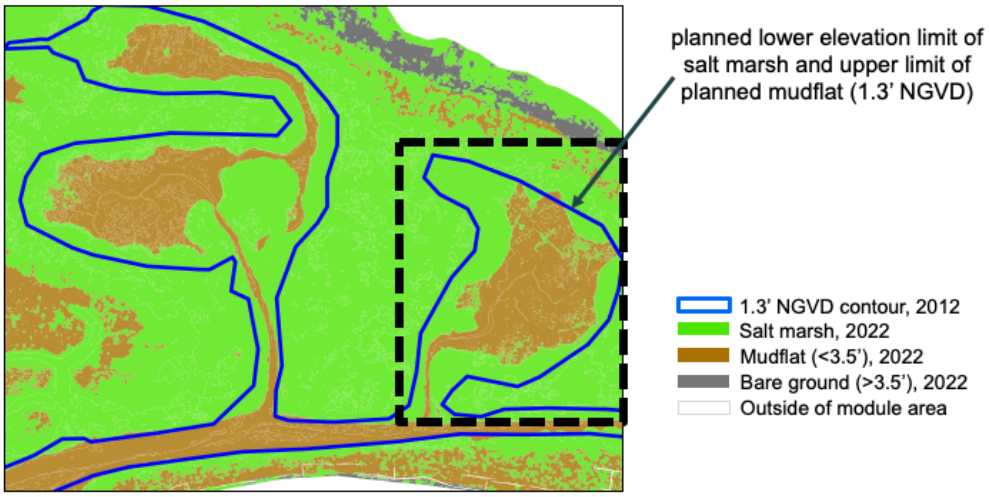
- This figure will show from left to right--the conversion of acres of planned mudflat to salt marsh, acres remaining of planned mudflat, and other over the longer term, from 2012 to 2022.



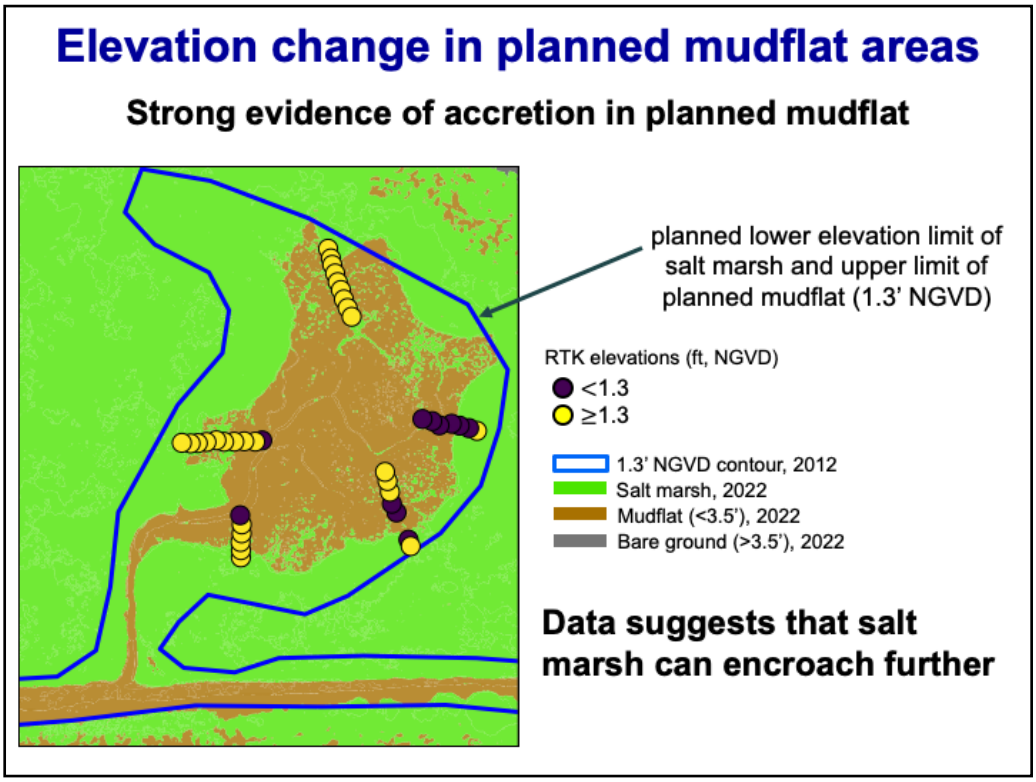
- Starting on the left, you can see that what we classify as salt marsh, i.e., greater than or equal to 30% cover of vegetation has increased in planned mudflat and now occupies 9.7 acres of former mudflat.
- Moving now to the middle figure, we see a concurrent loss in acres of mudflat from 20.3 acres to 13.7 acres.
- Lastly, the 2.3 acre decrease in other, which was within the area of planned mudflat was also converted to salt marsh, further contributing to the loss of mudflat.
- Together, ~40% of planned mudflat habitat in 2012 has been converted to salt marsh in 2022

Investigating potential drivers of mudflat loss

Topographic changes may facilitate habitat transition

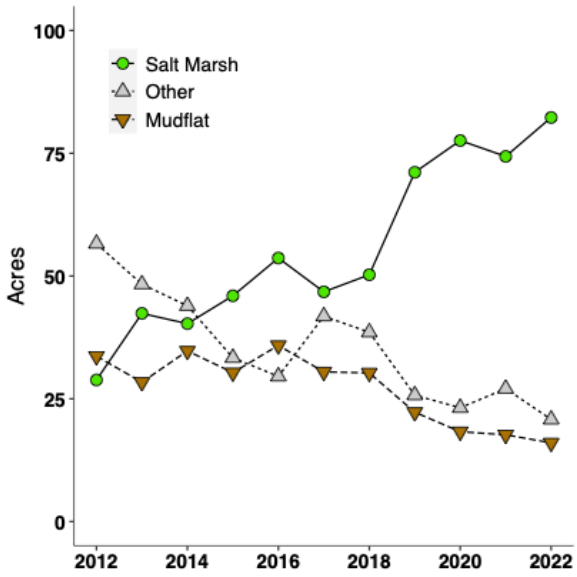


- To investigate the potential drivers of mudflat loss, we conducted RTK surveys this past fall to evaluate whether the elevation inside the 1.3' contour (shown in blue) has changed, potentially facilitating the observed habitat transition from mudflat to salt marsh.
- We conducted these surveys at multiple mudflats within the lagoon but for the sake of time will focus on only one—shown here in the black box.



- In analyzing the data from this mudflat, we see strong evidence of elevation change within the planned mudflat area.
- Our RTK survey was designed to capture 2-3 points within the vegetation (shown in green) that bordered the mudflat (shown in brown), followed by a series of points along a transect that extended into the mudflat area.
- The RTK points, measured in feet, NGVD are indicated by the circles and color coded to indicate their coarse elevation category. Points below 1.3' NGVD are shown in dark purple and points at or above 1.3' NGVD in yellow.
- We see that majority of the survey points are above the 1.3' NGVD value (yellow), providing evidence of topographic change.
- These results also suggest that the salt marsh can encroach further into the mudflat area, as majority of the area surveyed was above the planned lower elevation limit of salt marsh.
- I'd like to point out that a good deal of this vegetation, shown in green, is *Spartina foliosa*, though other species like *Salicornia pacifica* and *Jaumea carnosa* are also common in dense patches within the area surveyed.

Increase in salt marsh at the cost of mudflat



San Dieguito Wetlands (W4/16)
Mudflat with **salt marsh encroachment**

- To review, we've seen an increase in salt marsh acres since construction and are now about 1 acre short of meeting the minimum required acres, per the Final Restoration Plan.
- This trend is driven by increases in vegetation cover wetland-wide. This pattern is driven, in part, by the conversion of "other" to salt marsh. But also, the encroachment of salt marsh into planned mudflat habitat which has driven the decline in mudflat acres in recent years.

Understanding drivers of unplanned changes in habitats to inform management

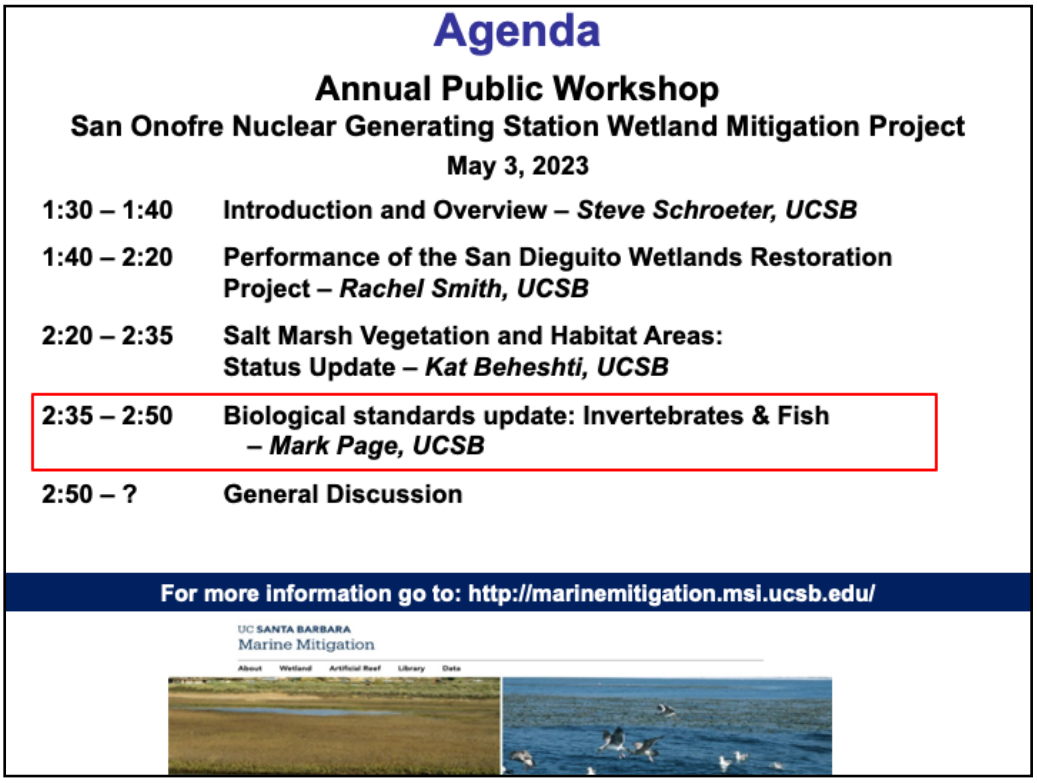
Ongoing studies:

- Evaluating potential topographic changes at multiple spatial scales and habitats (mudflat, salt marsh)
  - RTK surveys, a Digital Elevation Model (DEM) and additional contour surveys in 2023
- Determining the relationship between elevation and *Spartina* distribution at San Dieguito and other wetlands in the region

Next steps:

- Consult with geomorphologist/hydrologist on potential mechanisms driving observed trends

- Given these results, we are conducting follow-up studies to understand the drivers of these unplanned changes in habitats to inform potential remediation.
- To supplement existing survey data collected to evaluate potential topographic changes at multiple spatial scales and across habitat types, we plan analyze data collected in 2023 from additional RTK surveys, a DEM, and additional contour surveys.
- Because much of the salt marsh encroachment into mudflat habitat is driven by *Spartina foliosa*, we will continue a study evaluating the relationship between elevation and *Spartina* distribution at San Dieguito and other wetland in the region.
- In terms of next steps, we plan to consult with a geomorphologist/hydrologist on the potential mechanisms driving the trends we are observing.
- While my talk has focused exclusively on the potential implications of topographic change on the habitat areas and vegetation cover standards…



- Dr. Mark Page will now provide an update on the ongoing investigations aimed at better understanding the underperformance of fish and invertebrate standards at San Dieguito Wetlands and the potential impact of topography on these standards.