

Performance Evaluation of the San Dieguito Wetlands Restoration Project

Annual Review Workshop for SONGS Wetland Mitigation



May 2, 2022

SONGS Mitigation Monitoring Project

Marine Science Institute, University of California Santa Barbara

This presentation focuses on:

- The results of the tenth year of performance monitoring of the San Dieguito Wetlands Restoration Project, and
- Our evaluation of the progress of the restoration project towards meeting the performance standards required for successful mitigation.

Types of Performance Standards

1. Absolute Standards: Measured only in the San Dieguito Wetlands.

(e.g., area of wetland habitats shall not vary by more than 10%)

2. Relative Standards: Measured against natural wetlands that serve as reference sites.

(e.g., the densities and number of species of birds shall be similar to that of natural wetlands in the region)

- Two types of standards are used to assess the performance of the restoration project.
- The first type, absolute standards, are evaluated only in San Dieguito Wetlands.
- For example, the area of wetland habitats shall not vary by more than 10% from the planned areas in the Final Restoration Plan.
- The second type are relative standards.
- These standards are measured in San Dieguito Wetlands and evaluated against natural wetlands in the region that serve as reference sites.
- For example, the densities and number of species of birds in San Dieguito Wetlands shall be similar to that of natural wetlands in the region.

Absolute Performance Standards

Requirement

The San Dieguito Wetlands Restoration must meet each absolute performance standard for that year to count towards mitigation credit.

Method of Evaluation

The evaluation of each absolute performance standard is based on the value for the current year.

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Absolute Performance Standards for San Dieguito Wetlands Restoration Project



Tidal Prism



Habitat Areas



Topography

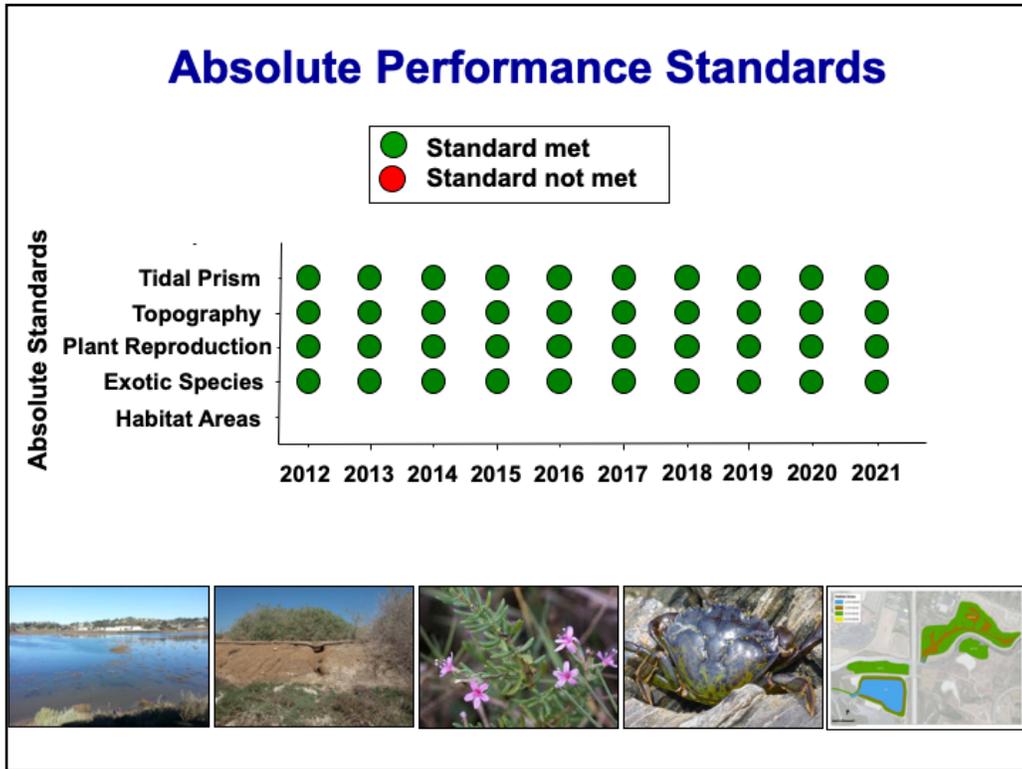


Plant Reproduction



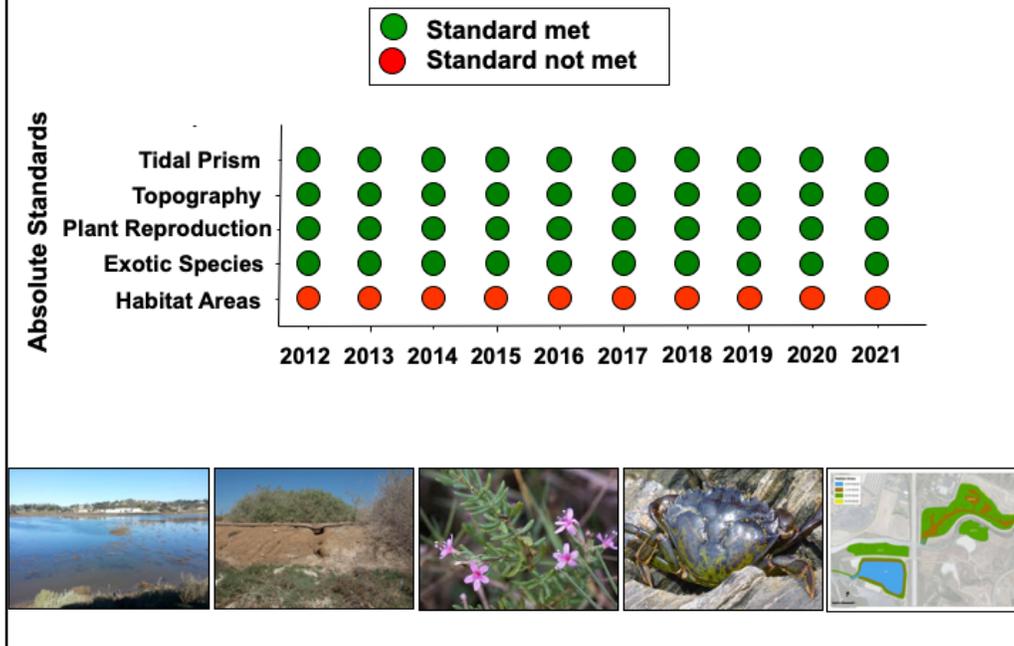
Exotic Species

- Absolute performance standards for the San Dieguito Wetlands Restoration Project pertain to tidal prism, habitat areas, topography, plant reproduction, and exotic species.
- The tidal prism is the volume of water exchanged in an estuary between the low and high tide levels.
- It is an important metric of tidal flushing, inundation of marsh habitat, and inlet stability and the standard specifies that the tidal prism shall be maintained.
- Habitat areas standard specifies that area of wetland habitats shall not vary by more than 10% from the planned areas in the Final Restoration Plan.
- The standard for topography requires that the wetland not undergo major topographic degradation, such as excessive erosion or sedimentation.
- Plant reproductive success requires that certain plant species have demonstrated reproduction (i.e. seed set) at least once in three years.
- The last absolute performance standard pertains to exotic species.
- It requires that the important functions of the wetland shall not be impaired by exotic species.
- Exotic species can have negative impacts on wetland functioning, for example by altering food webs or the physical structure of habitats.



- This slide summarizes whether a particular absolute standard was met during each of the last 10 years.
- A green dot indicates that the standard was met for a particular year, and a red dot will indicate that the standard was not met.
- You can see that the SDW has met 4 of 5 of the absolute standards the past 10 years, which includes the standards for tidal prism, topography, plant reproduction, and exotic species.

Absolute Performance Standards



- SDW has not yet met the Habitat Areas standard.
- We will now take a closer look at the results for the Habitat Areas standard.

Performance Standard: Habitat Areas

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



Planned acres :

Salt marsh:	green	92.6 acres
Mudflat:	brown	24.9 acres
Subtidal:	blue	32.0 acres

Vegetated salt marsh inundated at high tide at San Dieguito Wetlands

- Taking a look at the Habitat Areas standard in more detail, this standard specifies that the areas (as acres) of the different habitats shall not vary by more than 10% from the areas indicated in the final restoration plan.
- This performance standard is designed to preserve the mix of habitats provided in the Final Restoration Plan and guard against large scale conversions of one habitat type to another, for example of vegetated marsh to mudflat or vice versa.
- Panel on the left shows the planned locations of salt marsh (green), mudflat (brown), and subtidal (blue) habitats as provided in the Final Plan for the restoration project as well as the planned acres for the different habitats.

Assessment of Subtidal & Mudflat Habitat

Classified as Subtidal Habitat if:

- Continuously submerged

Classified as Mudflat Habitat if:

- Intertidal and $\leq 3.5'$ NGVD
- $< 5\%$ cover of vegetation (mudflats are defined as intertidal and unvegetated)



- Now, I'll provide a brief overview of the criteria used to classify each habitat type, starting first with subtidal and moving up in tidal elevation...
- Habitat is classified as Subtidal if:
 - Continuously submerged
- Habitat is classified as Mudflat if:
 - Intertidal and $\leq 3.5'$ NGVD with $< 5\%$ cover of vegetation (mudflats are defined as intertidal and unvegetated)

Assessment of Salt Marsh Habitat

Classified as Salt Marsh if:

- Intertidal and $\leq 4.5'$ NGVD
- $\geq 30\%$ cover of vegetation evaluated using aerial imagery

Vegetation cover evaluated under the Relative Standards



Salt Marsh Habitat in San Dieguito Wetlands

Classified as "Other" if:

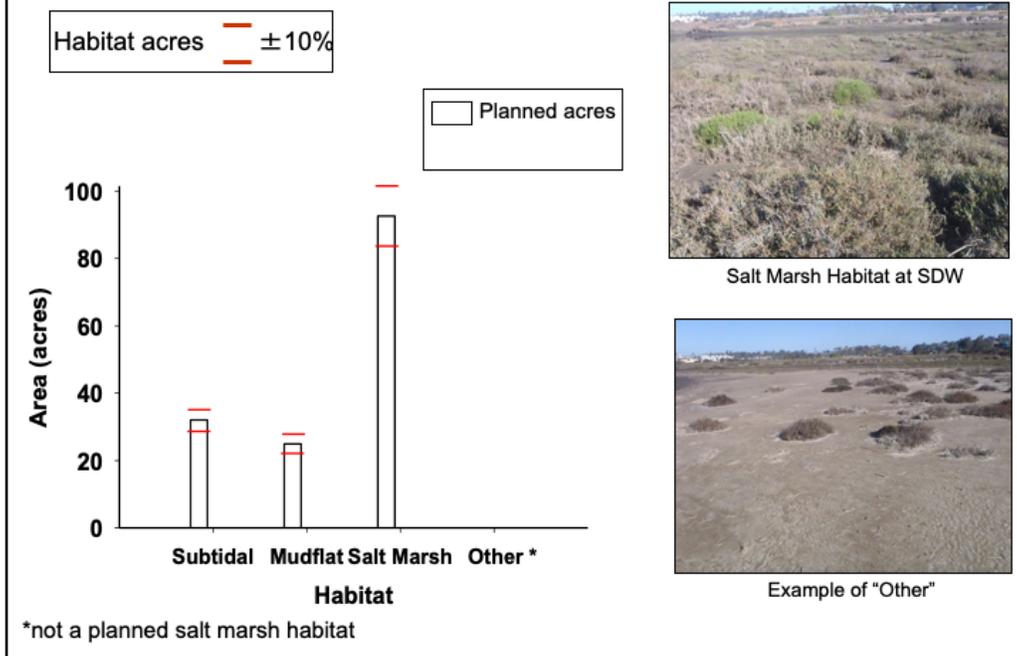
- Intertidal and $\leq 4.5'$ NGVD
- $< 30\%$ cover of vegetation evaluated using aerial imagery



Insufficient cover to be assessed as Salt Marsh

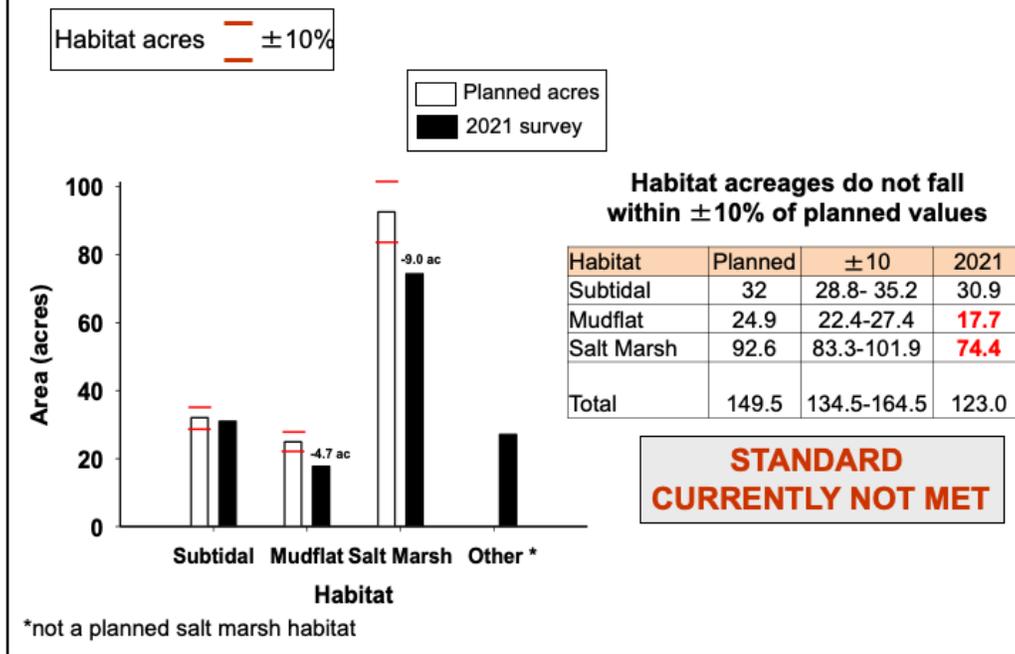
- Habitat is classified as Salt Marsh if:
- Intertidal and $\leq 4.5'$ NGVD and at least 30% cover of vegetation evaluated within 10 x 10 m grids using aerial imagery
- There is a standard that pertains specifically to vegetation cover that is evaluated under the Relative Standards
- Finally, there is the habitat area cover of "Other" which is not a planned habitat type and is not included in the Final Restoration Plan but was defined after monitoring began. Habitat is classified as "Other" if intertidal and $\leq 4.5'$ NGVD with less than 30% cover of vegetation

Performance Standard: Habitat Areas

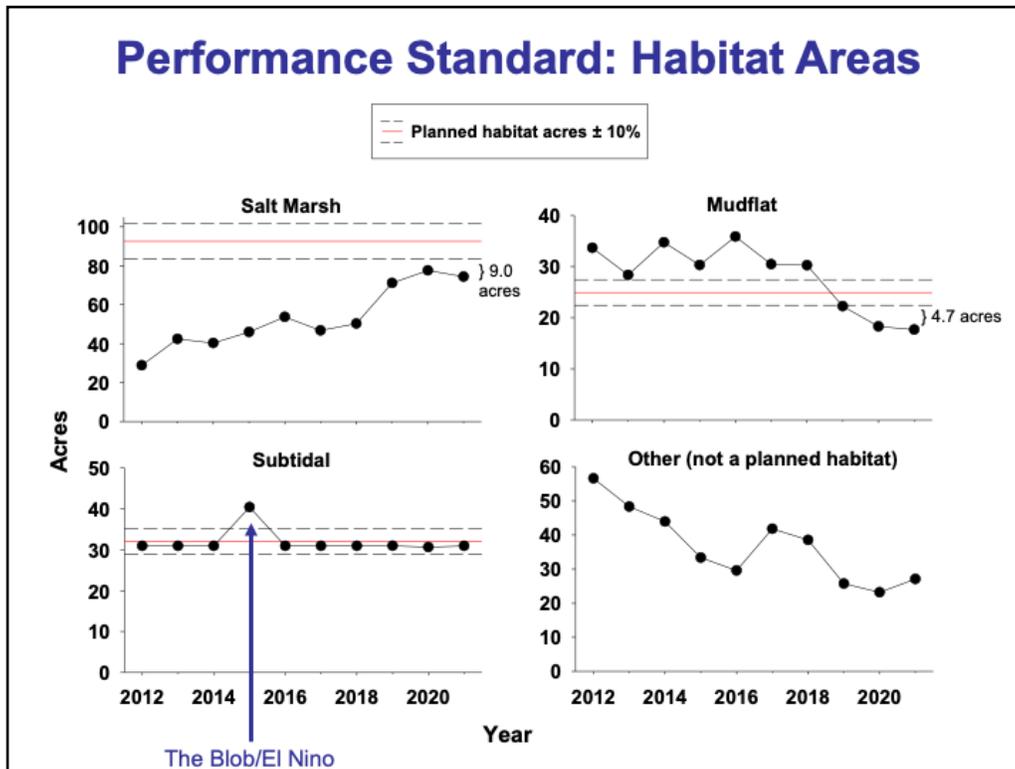


- This figure shows the planned area in acres of subtidal, mudflat, and salt marsh habitat and plus or minus 10% of those areas indicated by the red lines.
- The photos show an example of salt marsh habitat and an example of “other”, which is not a planned habitat, as I mentioned earlier.
- These areas are too sparsely vegetated to be assessed as salt marsh and have too much vegetation or too high in elevation to be considered mudflat.

Performance Standard: Habitat Areas



- The solid bars indicate the acreages determined in our 2021 survey.
- While the area of subtidal habitat in 2021 was within 10% of the planned acreage, the areas of mudflat and tidal salt marsh were both less than 10% of the designed acreages.
- Salt marsh acreage in 2021 was 74.4 acres, about 9 acres below the minimum required 83.3 acres.
- Mudflat was 17.7 acres, 4.7 acres below the 22.4 minimum required acres.
- As a result, the performance standard for habitat areas is currently not met.



- Taking a look at the trend in habitat acres over time, we can see that the increase in acres of salt marsh has been promising, despite a slight decline last year, the area of salt marsh has been approaching the minimum required acres of this habitat.
- The pronounced increase from 2018 to 2019 was likely due to heavy rains that we had during this period that facilitated the growth of marsh plants.
- The area of subtidal habitat was within 10% of the planned acreage in 2021, we also wanted to point out that this increase in subtidal acres in 2015 was a consequence of the warm water event, known as “The Blob” and the El Nino, which elevated sea levels in that year thereby increasing the acres of subtidal habitat.
- Moving on to mudflat, the area of mudflat has been decreasing, and is lower than the planned acreage and the minimum required area, of 22.4 acres.
- The figure on the lower right shows a slight increase in the “other” category in 2021, not a planned habitat.

Types of Performance Standards

2. *Relative Standards*: Must be similar to natural wetlands that serve as reference sites.

(e.g., the density and number of species of birds must be similar to that of natural wetlands in the region.)

Method of Evaluation

The evaluation of each relative standard in any given year is based on an average calculated from data collected at San Dieguito Wetlands and the reference wetlands for that year and for the previous three years.

- The second type of performance standards are relative standards, evaluated against natural wetlands in the region that are used as a reference sites.
- The evaluation of each relative standard in any given year is based on an average calculated from data collected at San Dieguito Wetlands and the reference wetlands for that year and for the previous three years.

What counts as similar in the context of assessing the performance of the San Dieguito Wetlands Restoration Project?

Definition: The 4-year running average for a relative performance standard at San Dieguito Wetlands must be *equal to or better than* that value for the lowest performing reference wetland for that standard.

Rationale:

- To be successful, the San Dieguito Wetlands Restoration must provide resource values *similar* to those of natural wetlands in the region.
- A running average rather than the value for the current year better accounts for natural fluctuations over time.

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Reference Wetlands

46 sites evaluated

Criteria for inclusion of a wetland as a reference site are provided in the SONGS Permit.

Reference wetlands shall be:

- Relatively undisturbed
- Tidal
- Located in Southern California Bight



- The criteria for inclusion of a wetland as a reference site is provided in the SONGS permit.
- These criteria are that the reference wetland be relatively undisturbed, tidal, and located in the Southern California Bight.
- 46 wetlands in the region were evaluated as possible reference sites, and Carpinteria Salt Marsh, Mugu Lagoon, and Tijuana Estuary were selected as best meeting the criteria provided in the SONGS permit.

Relative Performance Standards

1. Water Quality
2. Bird Density
3. Bird Species Richness
4. Fish Density – Main Channel (MC)
5. Fish Species Richness – MC
6. Fish Density – Tidal Creek (TC)
7. Fish Species Richness – TC
8. Invertebrate Density – MC
9. Invertebrate Species Richness – MC
10. Invertebrate Density – TC
11. Invertebrate Species Richness –TC
12. Vegetation Cover
13. Algal Cover
14. Spartina Canopy Architecture
15. Food Chain Support



- Shown here are the 15 relative performance standards used to evaluate the success of the San Dieguito Wetlands Restoration Project.

Relative Performance Standards

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- The first standard is a physical standard that pertains to water quality.

Relative Performance Standards

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15. Food Chain Support



- The next 10 standards pertain to biological communities, the densities and species richness of birds, fish, and invertebrates.
- In the case of fish and invertebrates, the densities and species richness of these groups are evaluated in two habitats, main channel and tidal creek.

Relative Performance Standards

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15. Food Chain Support



- There are three standards that pertain to vegetation and algae.

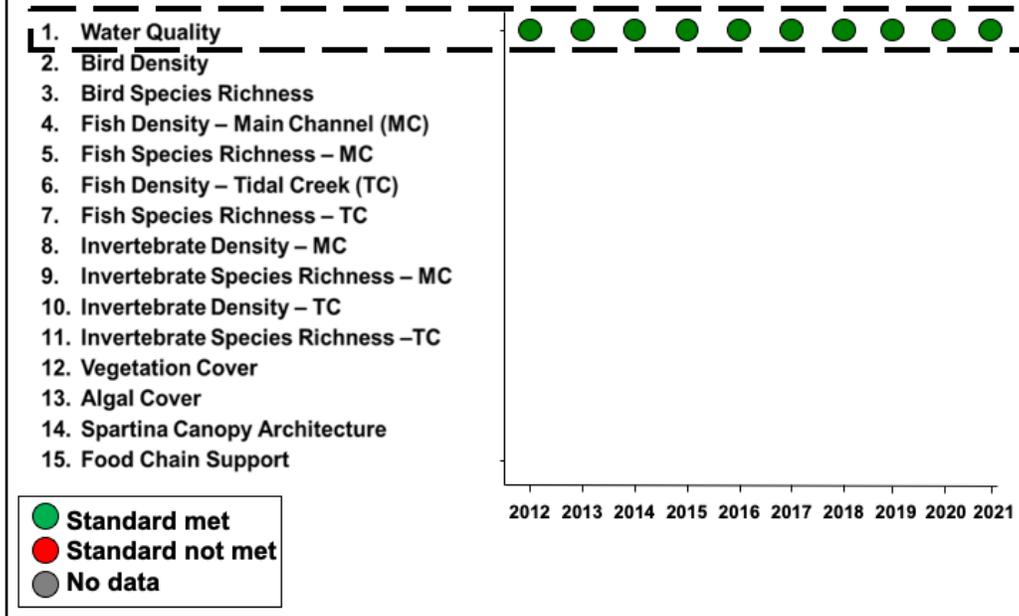
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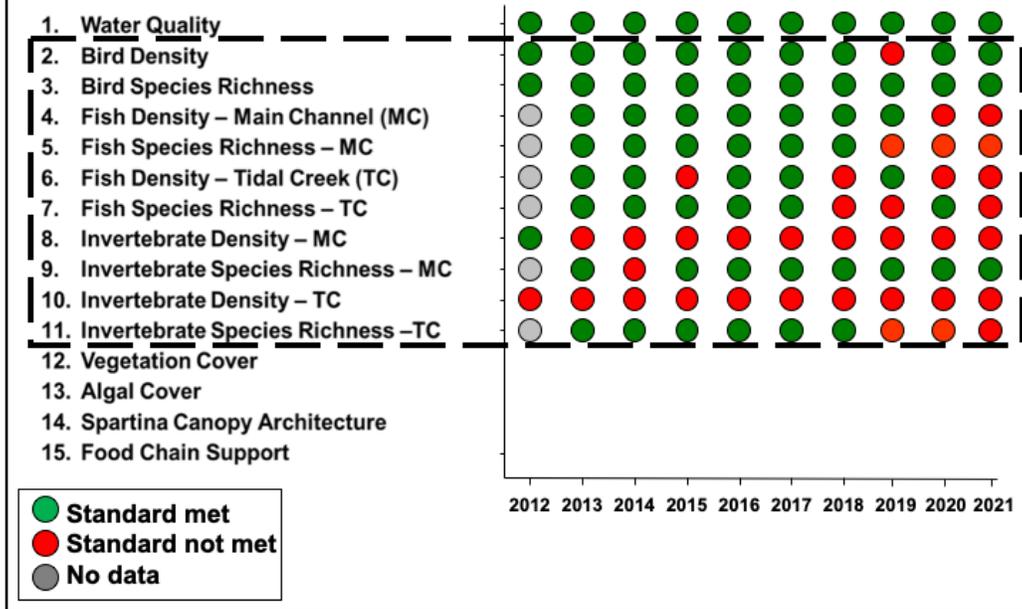
- And lastly a standard that pertains to the food chain support function as evaluated by the density of feeding birds.

Relative Performance Standards San Dieguito Wetlands Restoration Project



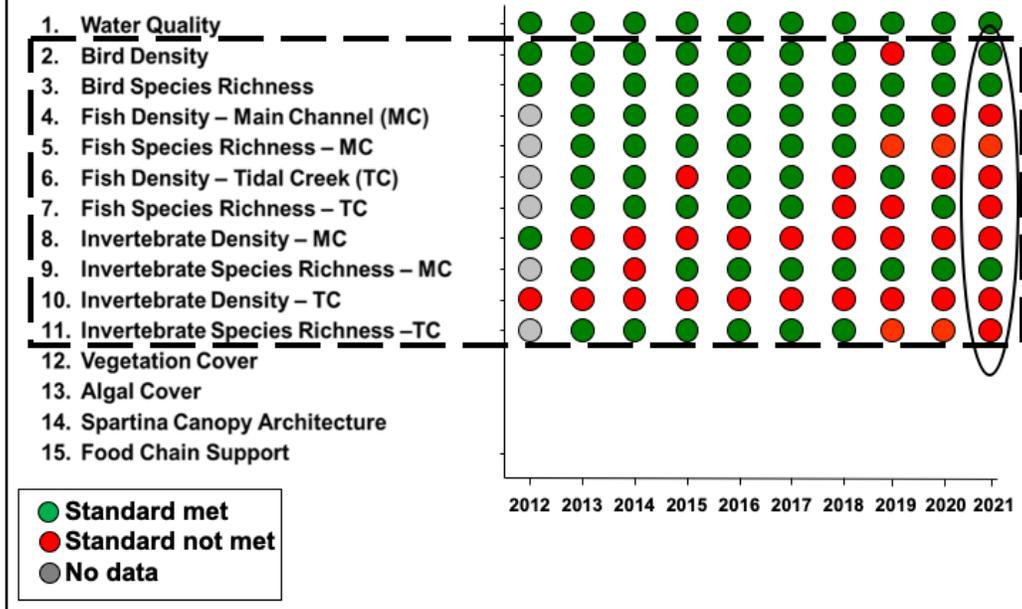
- The following slides will summarize whether a particular relative standard was met during each of the last 10 years.
- A green dot indicates that the standard was met for a particular year, and a red dot indicates that the standard was not met.
- This slide summarizes the results for water quality.
- Because of its importance to estuarine health, dissolved oxygen concentration is the water quality variable used to evaluate this standard.
- We assess DO by comparing the mean number of hours of continuous hypoxia, DO values <3 mg/l between San Dieguito Wetlands and the reference wetlands.
- If mean number of consecutive hours of continuous hypoxia is significantly higher in the San Dieguito Wetlands than in the reference wetland with the highest value, then San Dieguito Wetlands fails to meet the standard.
- The values for sequential hours of hypoxia at San Dieguito has been similar to the reference wetlands for the past 10 years and the standard is currently met.

Relative Performance Standards San Dieguito Wetlands Restoration Project



- We are now moving onto the performance standards for biological communities, which includes standards for birds, fish, and macroinvertebrates.
- These are relative standards that pertain to both the densities and numbers of species of these groups.
- The performance standard for biological communities requires that the total densities and number of species of birds, fish, and macroinvertebrates shall be similar to the densities and number of species in similar habitats in the reference wetlands.

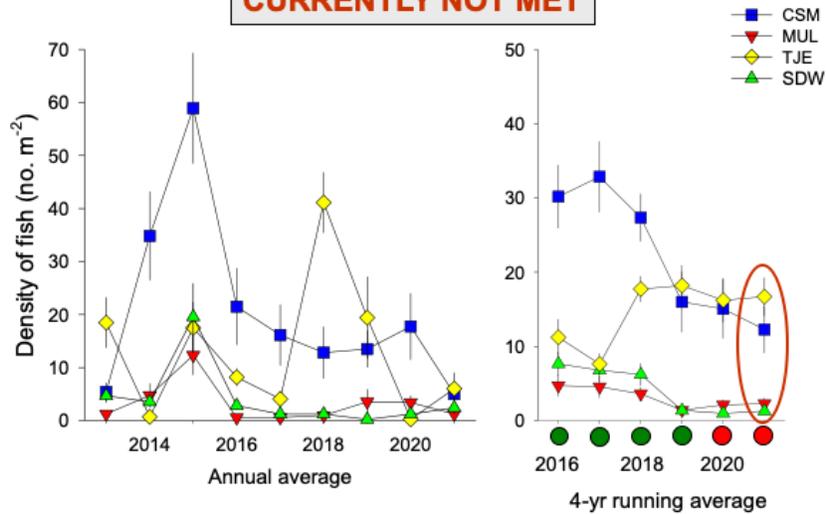
Relative Performance Standards San Dieguito Wetlands Restoration Project



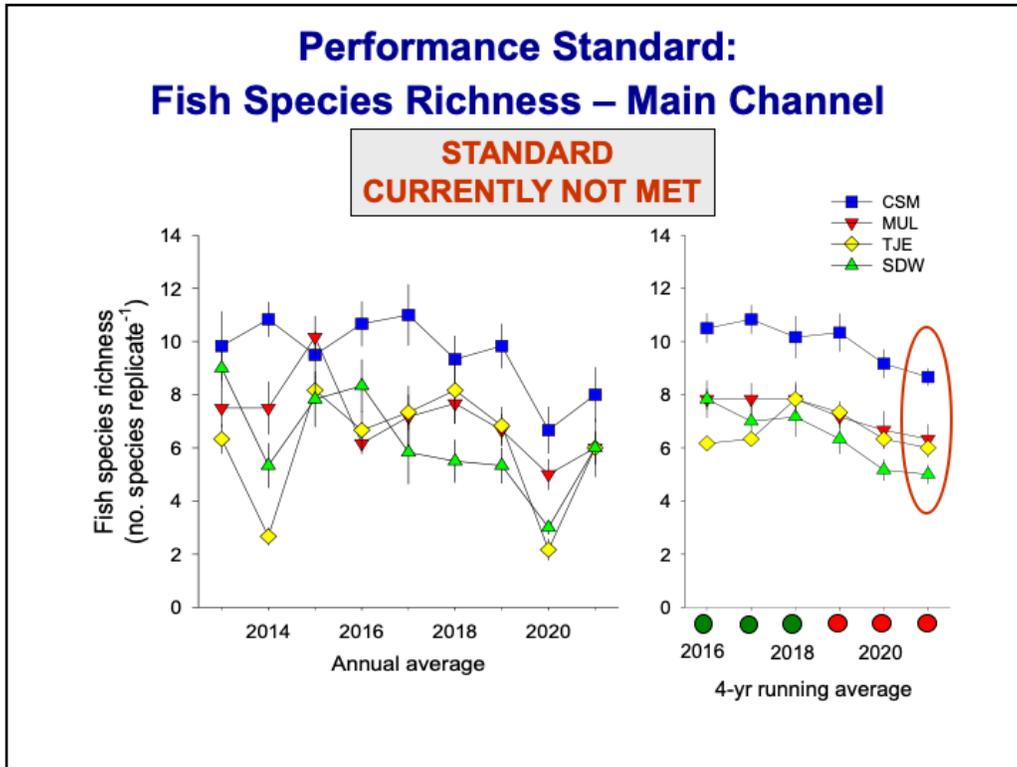
- You can see by the number of red dots for 2021 that there were six biological standards were not met in 2021, the same number as not met in 2020 and 2019.
- Standards not met include those that pertain to fish density and species richness in main channel and tidal creek, and invertebrate density in main channel and tidal creek habitat.
- We'll now take a look at the results for the standards that were not met in more detail.

Performance Standard: Fish Density – Main Channel

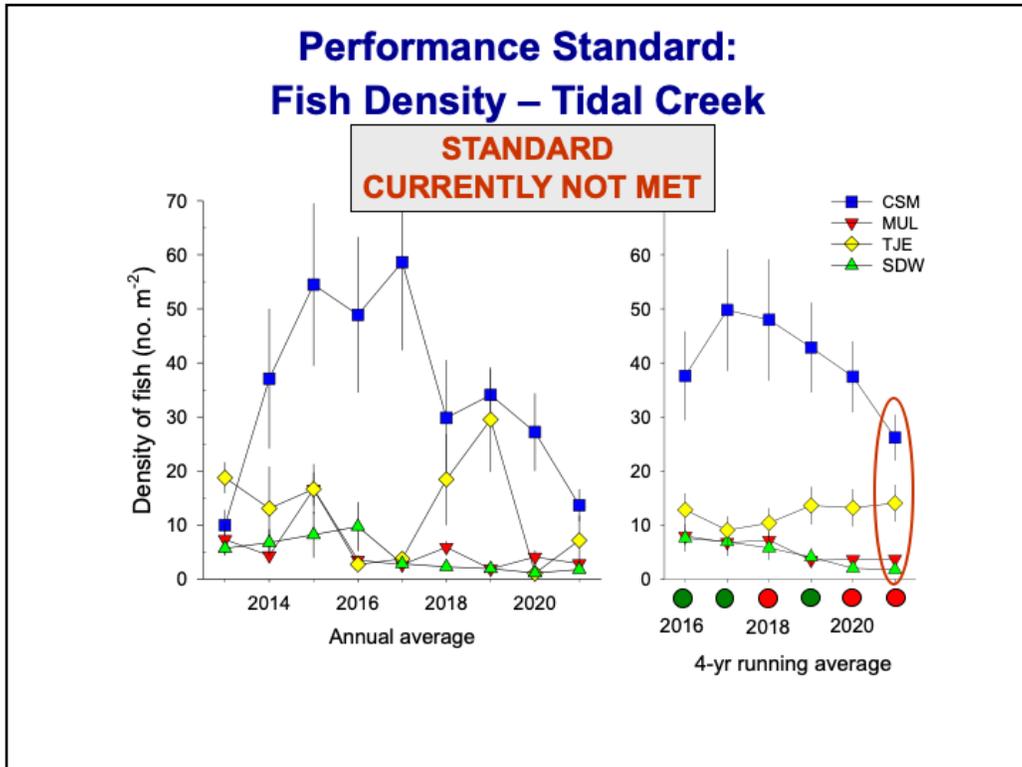
**STANDARD
CURRENTLY NOT MET**



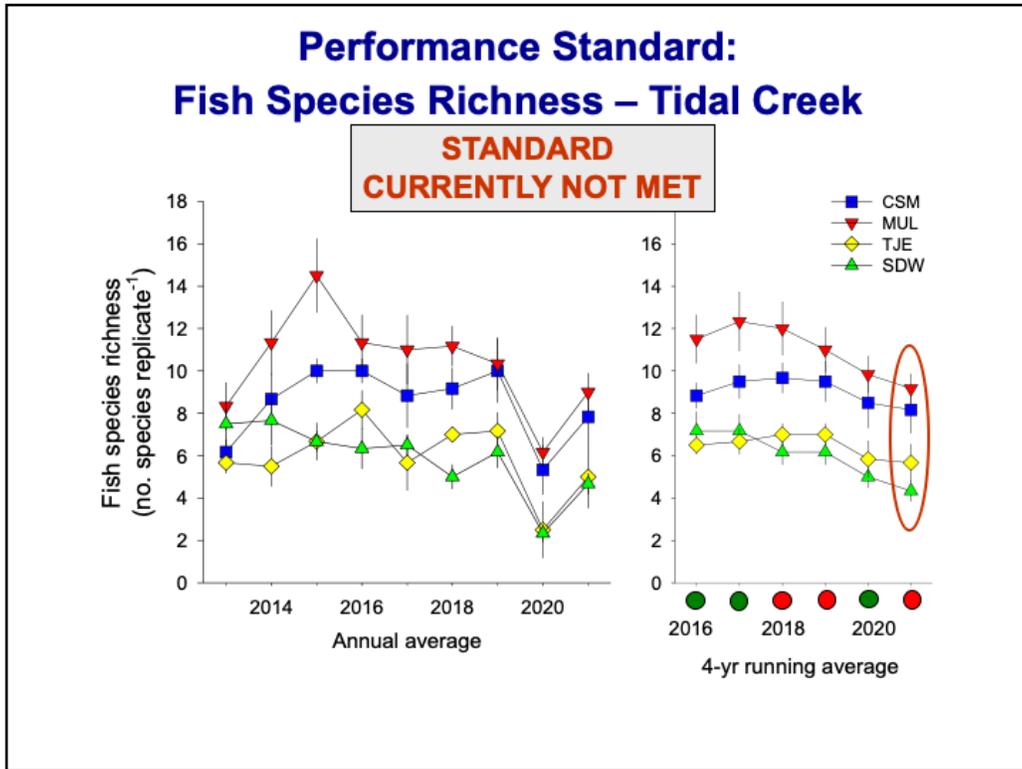
- Fish density in main channel habitat was a standard that had been met up to 2020, but there has been a decline in the running averages, from 2016 to 2020.
- In 2021, the 4 year running average was not similar to the lowest performing reference site, Mugu Lagoon, and consequently, this standard is not currently met.



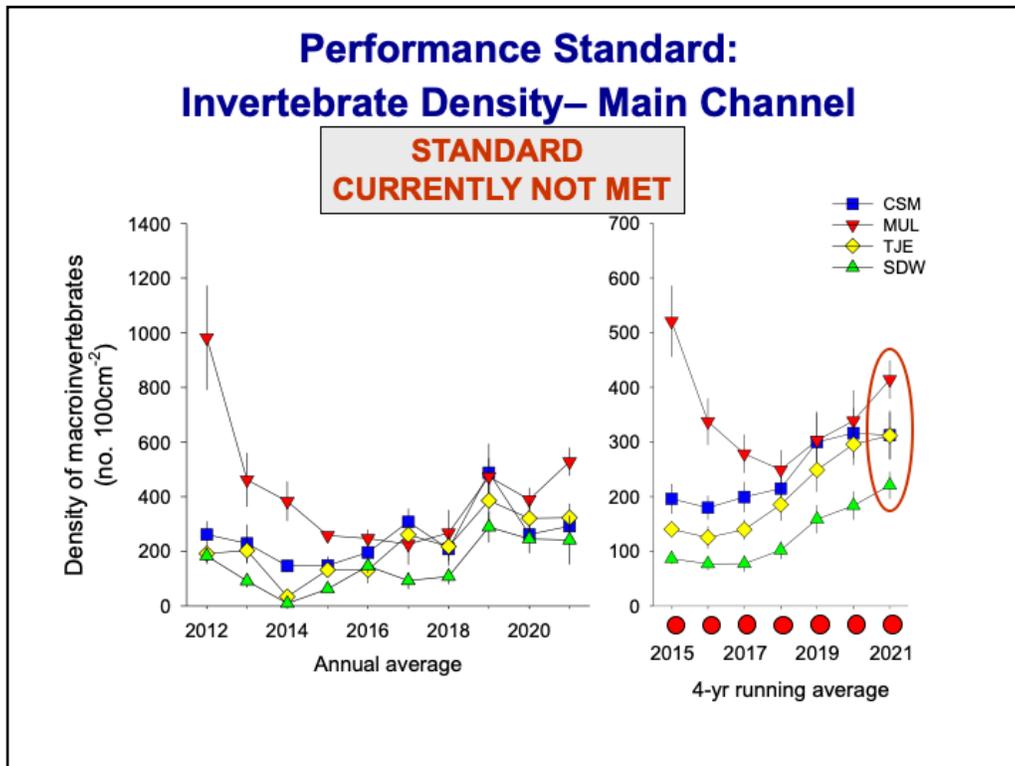
- A relative standard that was not met in 2019, and again in 2020 and 2021 is fish species richness in main channel habitat.
- The annual average for richness was higher or the same as the lowest performing reference site in 2020 and 2021.
- The reduced sampling due to COVID in 2020 may have affected annual values, but we anticipate the trends shown here were little affected since the reduced sampling was applied across all wetlands.
- Looking at the 4 year running averages, richness had declined in all the wetlands from 2018 to 2021 though in SDW there has been a steeper decline such that the 4 year running average in SDW remains below Tijuana Estuary, the lowest performing reference site.
- Consequently, this standard is not currently met.



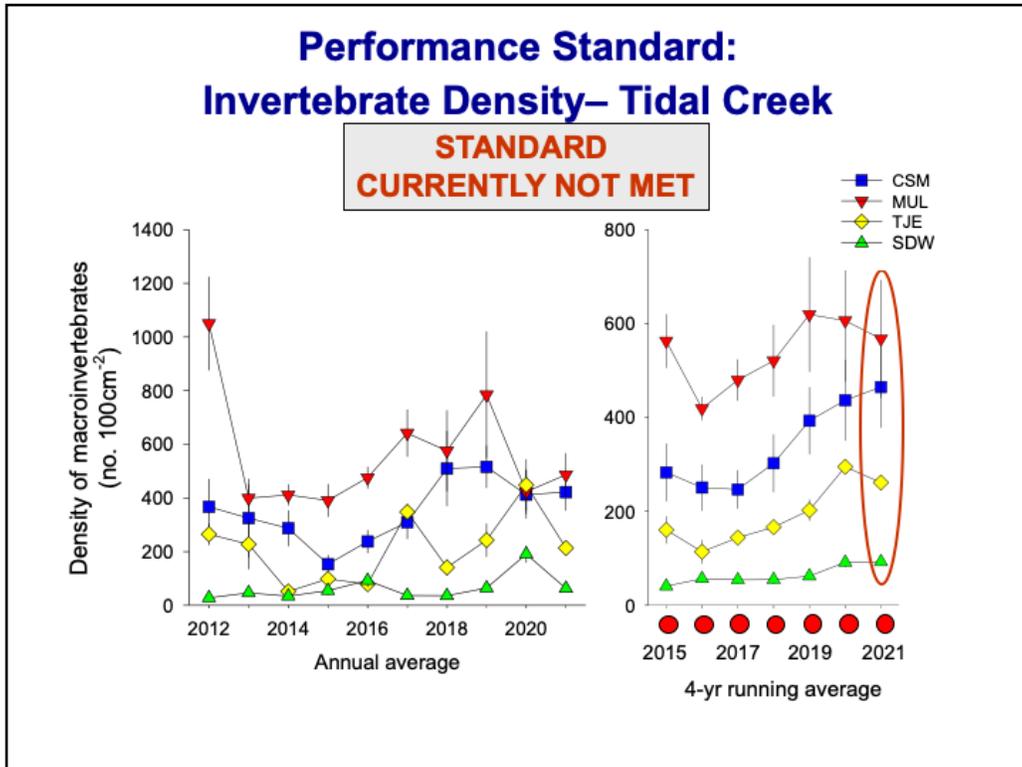
- San Dieguito Wetlands has met this standard intermittently over the past 10 years.
- There has been a general decline in the running averages for fish density in tidal creeks over time.
- Running average values at Mugu Lagoon have also declined, but not as much.
- Since the 4 year running average at San Dieguito in 2021 was lower than Mugu Lagoon, the lowest performing reference site, this standard is not currently met.



- San Dieguito Wetlands has also intermittently met this standard over the past 10 years.
- Last year, the standard was met, but it was not met the previous two years.
- The annual values for richness have been comparable between San Dieguito Wetlands and Tijuana Estuary the past couple of years.
- However, since the 4 year running average at San Dieguito in 2021 was lower than Tijuana Estuary, the lowest performing reference site, this standard is not currently met.



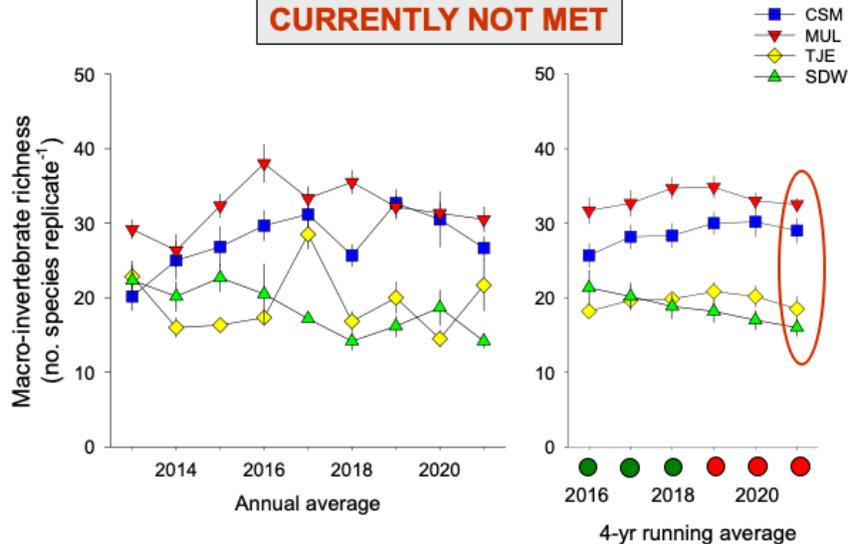
- Moving on to the densities of macro-invertebrates.
- This slide shows densities as mean number per 100 cm², in the main channel habitat.
- The annual value in San Dieguito Wetlands has generally been lower than the value in the lowest performing reference wetland over the past few years.
- This is reflected in the running average for San Dieguito Wetlands, which has been consistently lower than the reference wetland with the lowest value, which is Tijuana Estuary.
- It is interesting that the running average for all the wetlands has increased from 2018 to 2021.
- However, the running average at San Dieguito Wetlands has continued to be well below the lowest performing reference sites and as a result this standard is currently not met.



- This slide shows the results for macro-invertebrate density in tidal creek habitat.
- Looking at the annual average on the left, we see that the annual values for SDW have generally been well below the reference sites.
- This is reflected in the running average which continued to remain well below the lowest performing reference site in 2021 and as a result this standard is not currently met.

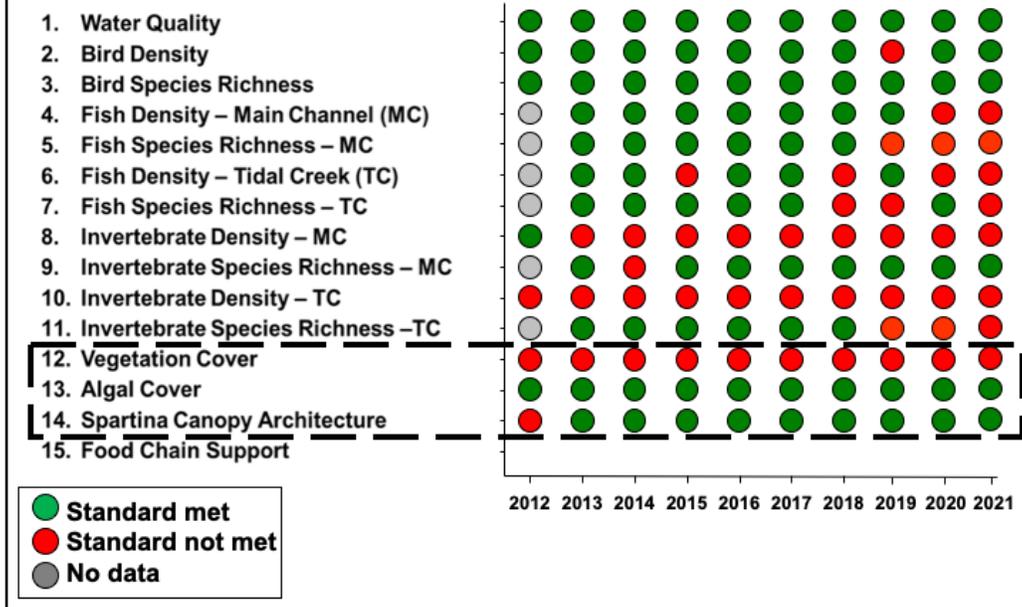
Performance Standard: Invertebrate Species Richness– Tidal Creek

**STANDARD
CURRENTLY NOT MET**



- This slide shows the results for macro-invertebrate species richness in tidal creek habitat.
- Looking at the annual average on the left, we see that the annual values for SDW have been declining since 2016.
- This standard was met from 2013 through 2018. In the past few years, the annual average at SDW has been below that of the lowest performing reference wetland, TJE (with the exception of 2020). In 2021, invertebrate species richness in tidal creek habitat increased at TJE and decreased at SDW, relative to 2020 values. As a result, this standard is currently not met.

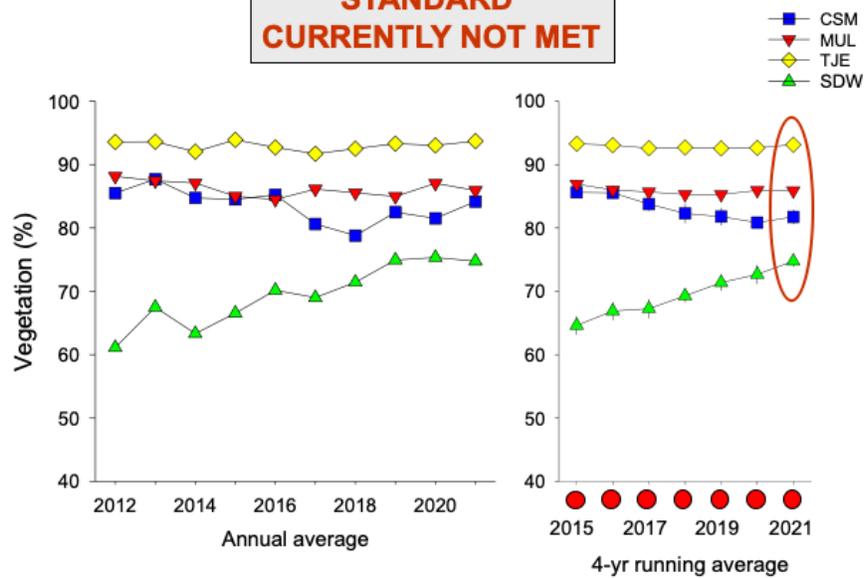
Relative Performance Standards San Dieguito Wetlands Restoration Project



- The next 3 standards pertain to the percent cover of vegetation, algae, and to Spartina canopy architecture.
- Vegetation cover in salt marsh habitat is determined from aerial imagery that is also used to evaluate habitat areas.
- San Dieguito Wetlands has yet to the standard for cover of vegetation.
- The performance standard for algae is designed to monitor the development of unusually dense mats of filamentous green macroalgae in the restoration site that have the potential to interfere with wetland functioning by smothering benthic invertebrates and inhibiting bird feeding on mudflats. Decomposing mats of algae can also adversely affect water quality. The standard for Algal cover is met in San Dieguito if it is not significantly higher in the reference wetland with the highest coverage of algae. San Dieguito has met this standard in all 10 years of monitoring.
- The standard for Spartina canopy architecture requires that the proportion of stems over 3 feet tall shall not be lower in the San Dieguito wetland than in the reference wetland with the lowest proportion. The rationale for this standard is that areas with Spartina stems 3 feet or longer are required nesting habitat for the endangered Ridgeway Rail. In practice this comparison has only been made between San Dieguito and the Tijuana estuary the only two wetlands with sufficient Spartina stands to evaluate this standard. San Dieguito has passed this standard from 2013 to the present.

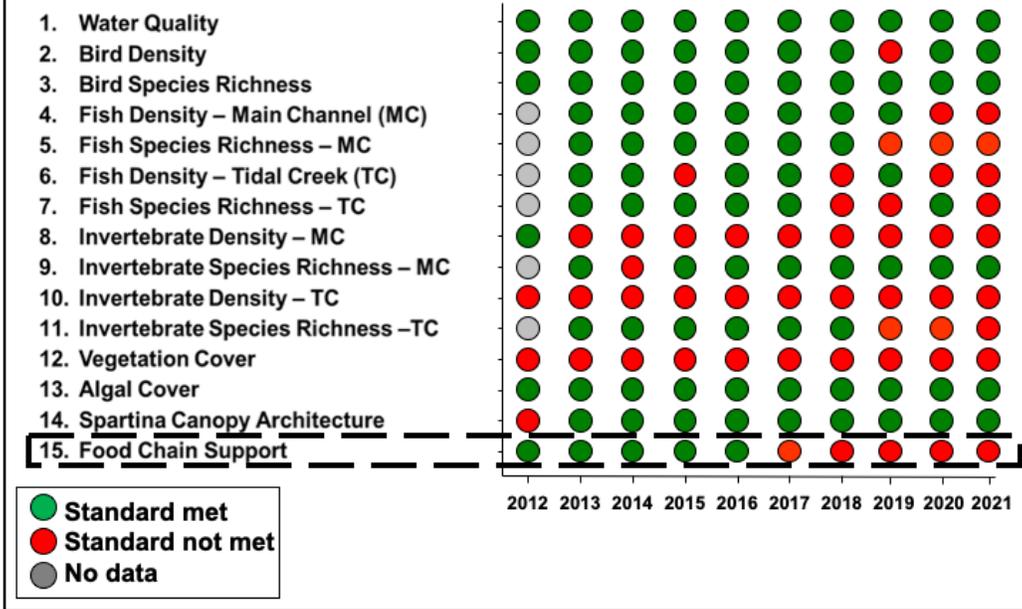
Performance Standard: Vegetation

**STANDARD
CURRENTLY NOT MET**

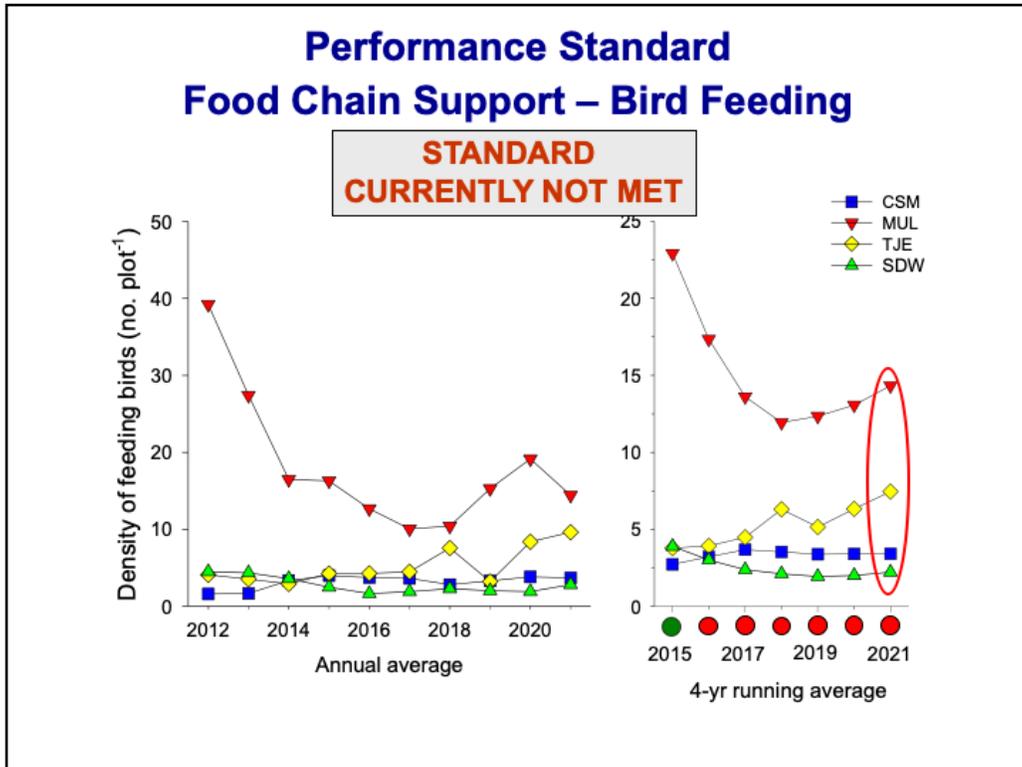


- Taking a look at the annual data for vegetation cover in salt marsh habitat in more detail, vegetation cover has been generally increasing, but cover changed little from 2019-2021.
- The running average has continued to increase, but cover has not yet filled in to the point where it is similar to the reference wetlands.
- Mark will speak about experiments underway to inform SCE's planting program in the third talk, and Setal Prabhu from SCE will speak about the on-going planting program in the last talk.

Relative Performance Standards San Diegoquito Wetlands Restoration Project



- The last standard pertains to food chain support as measured by the density of feeding birds.
- This standard was met from 2012 through 2016, but has not been not met the past five years, including 2021.



- Taking a closer look at the data, food chain support has been consistently highest at Mugu lagoon
- At San Dieguito the running average in density of feeding birds declined from 2016 to 2018 relative to Carpinteria Salt Marsh and has remained lower than Carpinteria Salt Marsh, the lowest performing reference site.
- Since food chain support in San Dieguito was lower than in Carpinteria Salt marsh, the lowest performing reference wetland in 2021, this standard is currently not met.

Relative Performance Standards

Requirement

The San Dieguito Wetlands Restoration must meet at least the same proportion of relative standards as the lowest performing reference wetland in a given year for that year to count towards mitigation credit.

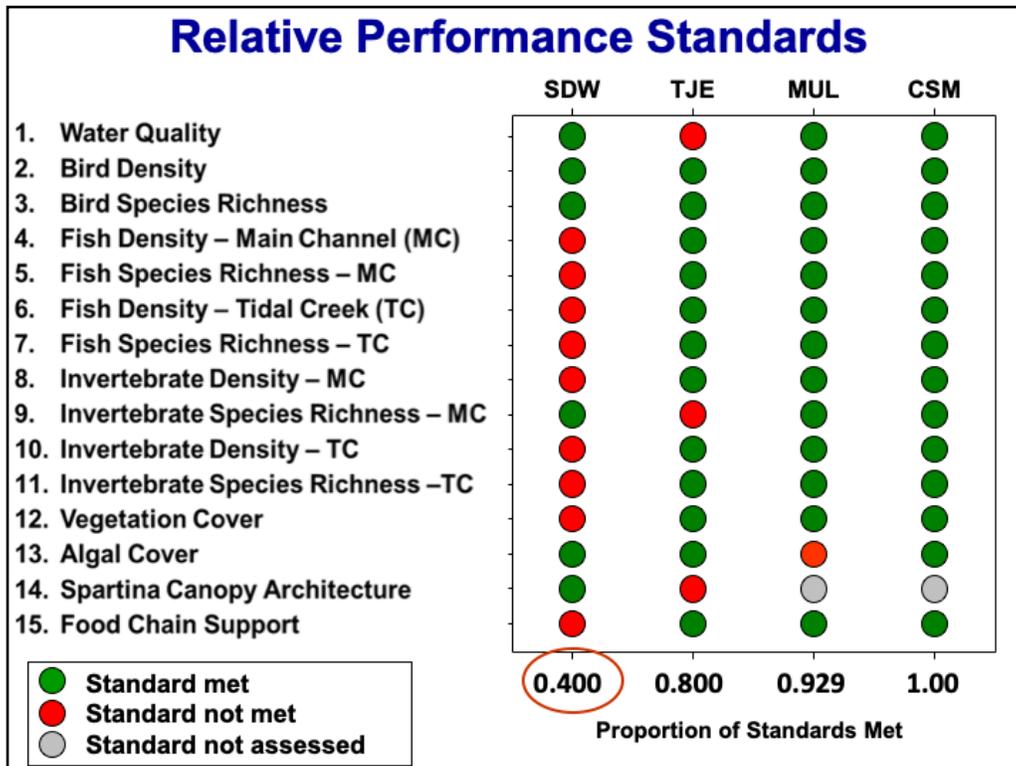
Method of Evaluation

San Dieguito Wetlands and the reference wetlands are evaluated with respect to whether or not they meet each relative standard and the proportion of relative standards met by each wetland is computed and compared.

Rationale

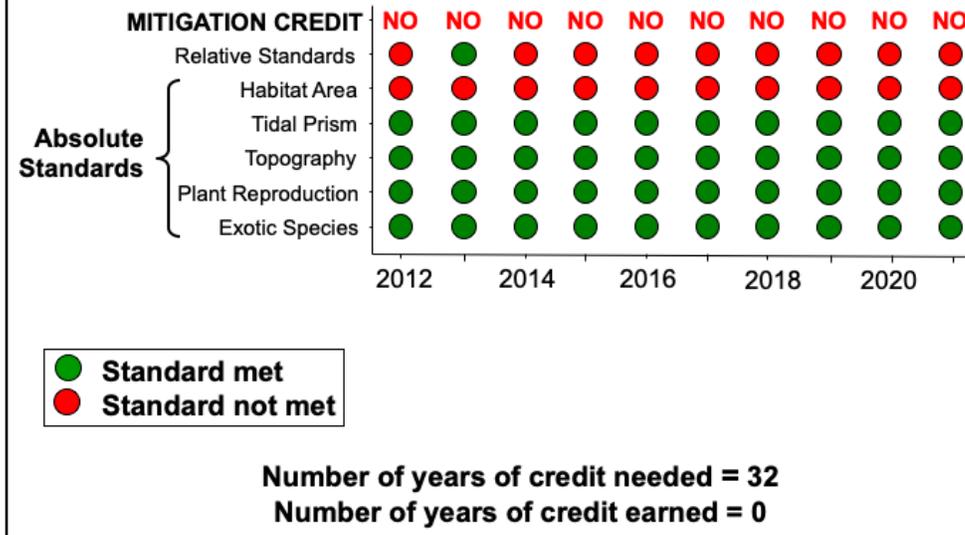
Requiring the San Dieguito Wetlands Restoration to meet at least the same proportion of relative standards as the lowest performing reference wetland achieves the desired mitigation goal of being similar to natural wetlands without requiring the restoration to outperform the reference wetlands.

- Reviewing requirements for the Relative Standards-
- The San Dieguito Wetlands Restoration must meet at least the same proportion of relative standards as the lowest performing reference wetland in a given year for that year to count towards mitigation credit.
- San Dieguito Wetlands and the reference wetlands are evaluated with respect to whether or not they meet each relative standard and the proportion of relative standards met by each wetland is computed and compared.
- Requiring the San Dieguito Wetlands Restoration to meet at least the same proportion of relative standards as the lowest performing reference wetland achieves the desired mitigation goal of being similar to natural wetlands without requiring the restoration to outperform the reference wetlands.



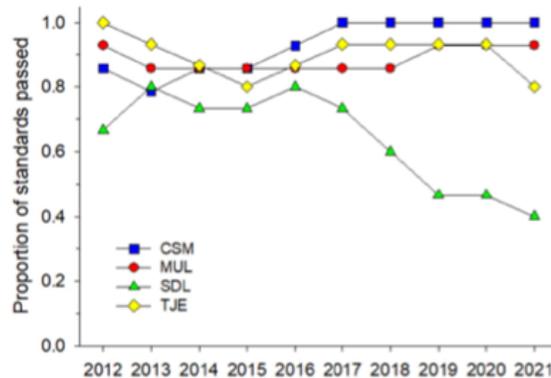
- This table provides a summary assessment of the relative performance standards for 2021 using the running averages.
- A green dot indicates that the performance variable at a particular wetland is similar to the other wetlands.
- A red dot indicates that the performance variable at a particular wetland was not similar to the other wetlands
- Gray dot – performance variable not measured in a particular wetland.
- Carpinteria Salt Marsh met all of relative standards while Mugu Lagoon failed one.
- Tijuana Estuary failed three, water quality, invertebrate species richness in main channel and Spartina canopy architecture.
- San Dieguito Wetlands met 7 of 15 or 47% of the 15 standards.
- Since the proportion of standards met by San Dieguito Wetlands was below the reference wetlands, it did not meet the relative standard requirement for 2021.

Mitigation Credit San Dieguito Wetlands Restoration Project



- Taking a look at mitigation credit, in order to receive mitigation credit for a given year, the wetland restoration project must meet all of the Absolute Standards and as many of the Relative Standards as the worst performing reference wetland.
- So far, the San Dieguito Wetlands has yet to meet the Habitat Areas Absolute Standard due to slow vegetation development.
- The project has also failed to meet the Relative Standard requirement due to slow rate of vegetation development, and low densities and species richness of invertebrates and fish in one or both of main channel and tidal creek habitats.
- As a result, the project has not yet satisfied the performance success criteria in the SONGS permit and has not yet received mitigation credit.
- In the next talk, Mark will discuss in more detail the status of the vegetation and salt marsh habitat as well as invertebrate density and species richness in Tidal Creek and Main Channel Habitat, and some analyses to identify mechanisms behind the underperformance of invertebrates.

Underperformance of relative standards in San Dieguito Wetlands



Per the coastal development permit (CDP 6-81-330A), if the goals or standards are not achieved, the CCC Executive Director shall prescribe remedial measures to be implemented by the permittee, SCE.

We are beginning to evaluate potential remediation options, but must first focus on understanding the reasons why the wetland is not meeting certain performance standards.

- To review the overall performance of the SDW with respect to the relative standards
- There was a progressive decline in the proportion of standards met in San Dieguito Wetlands relative to the reference wetlands beginning in 2017 and the proportion of relative standards met has been declining since 2016.
- There is language in the SONGS permit that pertains to the responsibility of the permittee to meet the performance standards and the prescription of remedial measures should the standards not be met.
- **We are beginning to evaluate potential remediation options, but must first focus on understanding the reasons why the wetland is not meeting certain performance standards.**

Agenda

Annual Public Workshop

San Onofre Nuclear Generating Station Wetland Mitigation Project

May 2, 2022

- 1:30 – 1:40** Introduction and Overview – *Steve Schroeter, UCSB*
- 1:40 – 2:20** Performance of the San Dieguito Wetlands Restoration Project – *Kat Beheshti, UCSB*
- 2:20 – 2:50** Salt Marsh Vegetation and Biological Standards: Status Update – *Mark Page, UCSB*
- 2:50 – 3:00** SCE planting program – *Setal Prabhu, SCE*
- 3:00 – ?** General Discussion

For more information go to: <http://marinemitigation.msi.ucsb.edu/>

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