Performance Evaluation of the San Dieguito Wetlands Restoration Project

Annual Review Workshop for SONGS Wetland Mitigation

June 18, 2020

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

This presentation focuses on:

- The results of the eighth 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%.
- The second type are relative standards.
- These standards are evaluated against natural wetlands in the region that serve as reference sites.
- For example, the densities and number of species of birds in San Dieguto Wetlands shall be similar to that of natural wetlands in the region.

Absolute Performance Standards

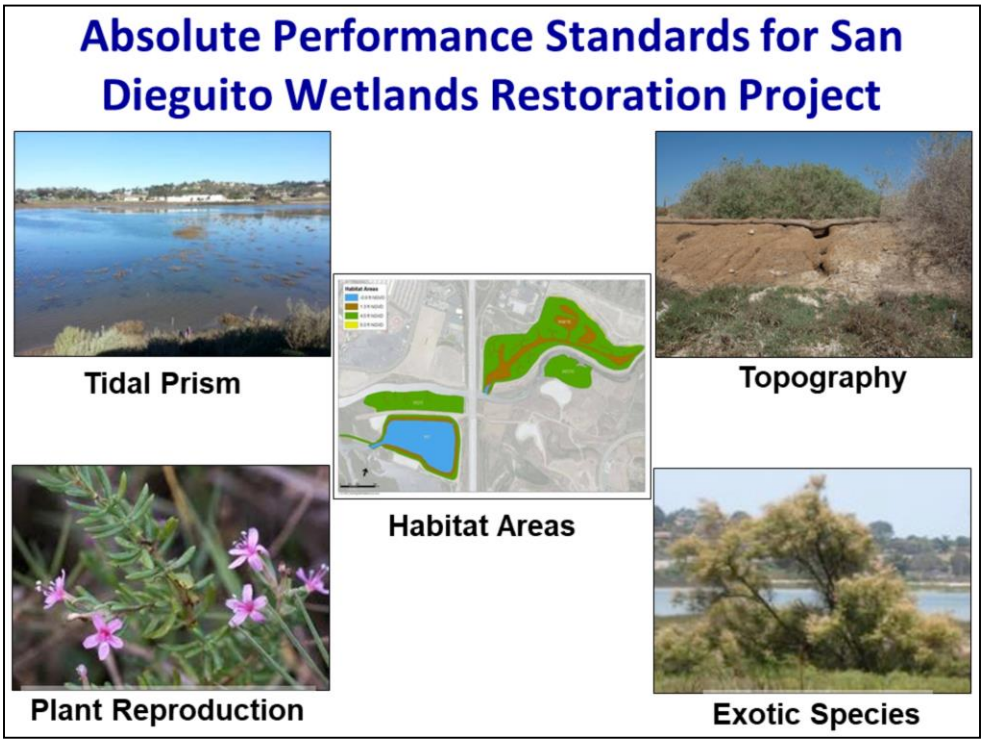
Requirement

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

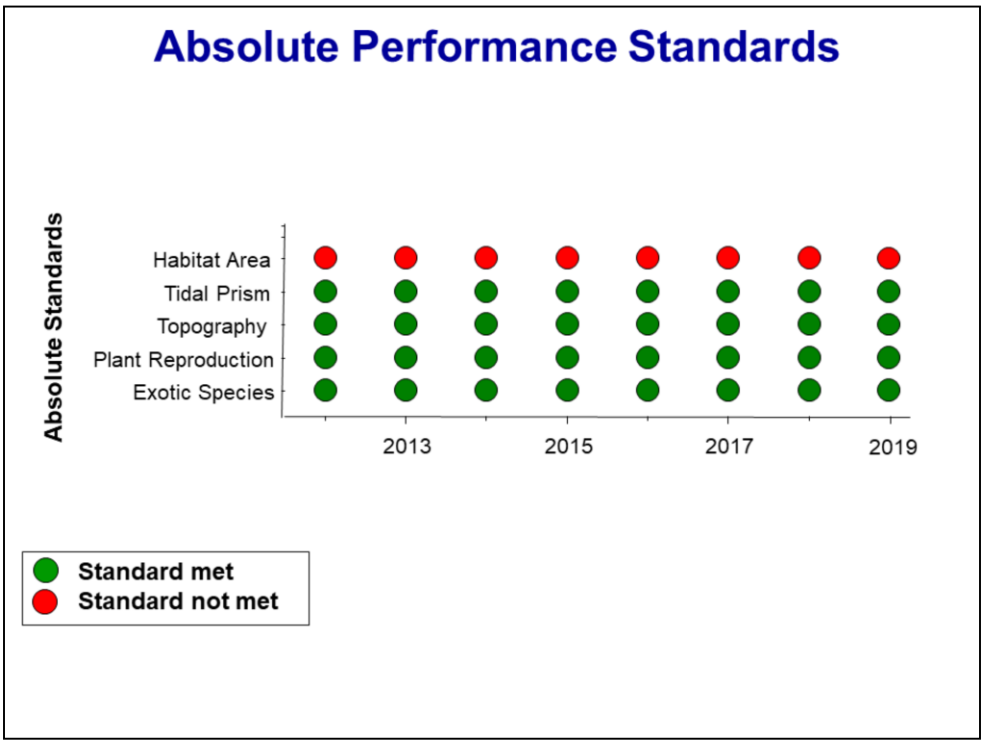
Method of Evaluation

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

- The San Dieguito Wetlands Restoration must meet each absolute performance standard for that year to count towards mitigation credit.
- The evaluation of each absolute performance standard is based on the value for the current year.



- 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 8 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 all of the absolute standards the past eight years except 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 Salt Marsh Habitat

Habitat assessed as Salt Marsh if:

- **Intertidal and ≤4.5' NGVD**
- **≥30% cover of vegetation evaluated using aerial imagery**

Vegetation cover evaluated under the Relative Standards

Salt Marsh Habitat in San Dieguito Wetlands

Insufficient cover of vegetation for Salt Marsh

- Taking a look at the criteria that are used in assessing habitat areas—
- Habitat assessed as Salt Marsh if:
- Intertidal and ≤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

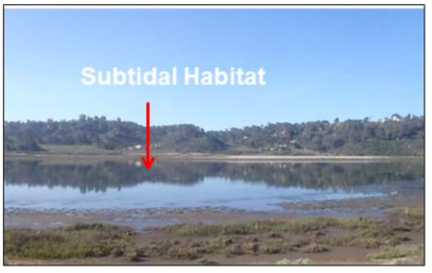
Assessment of Mudflat & Subtidal Habitat

Assessed as Mudflat Habitat if:

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

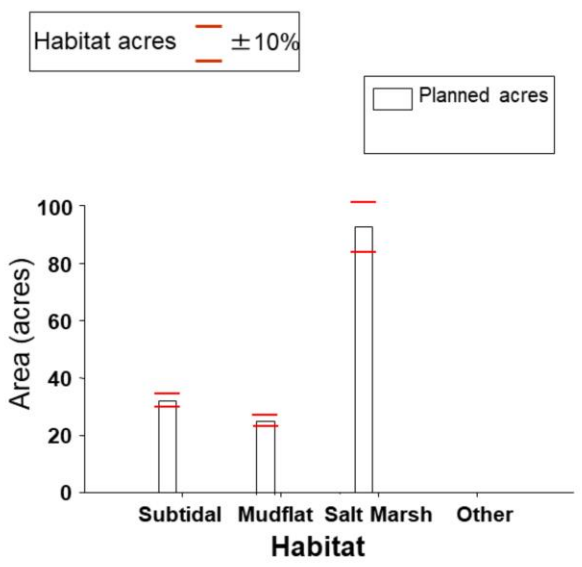
Assessed as Subtidal Habitat if:

- **Continuously submerged**



- Habitat is assessed as Mudflat if:
- Intertidal and ≤3.5' NGVD with <5% cover of vegetation (mudflats are defined as intertidal and unvegetated)
- Habitat is assessed as Subtidal if:
- Continuously submerged

Performance Standard: Habitat Areas

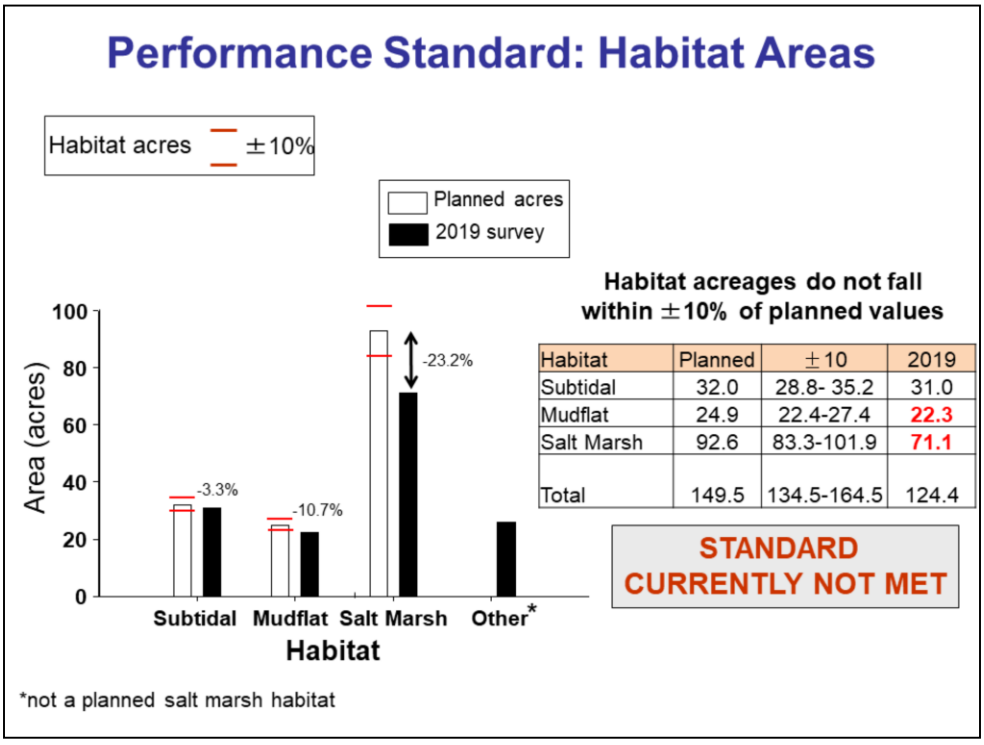


*not a planned salt marsh habitat

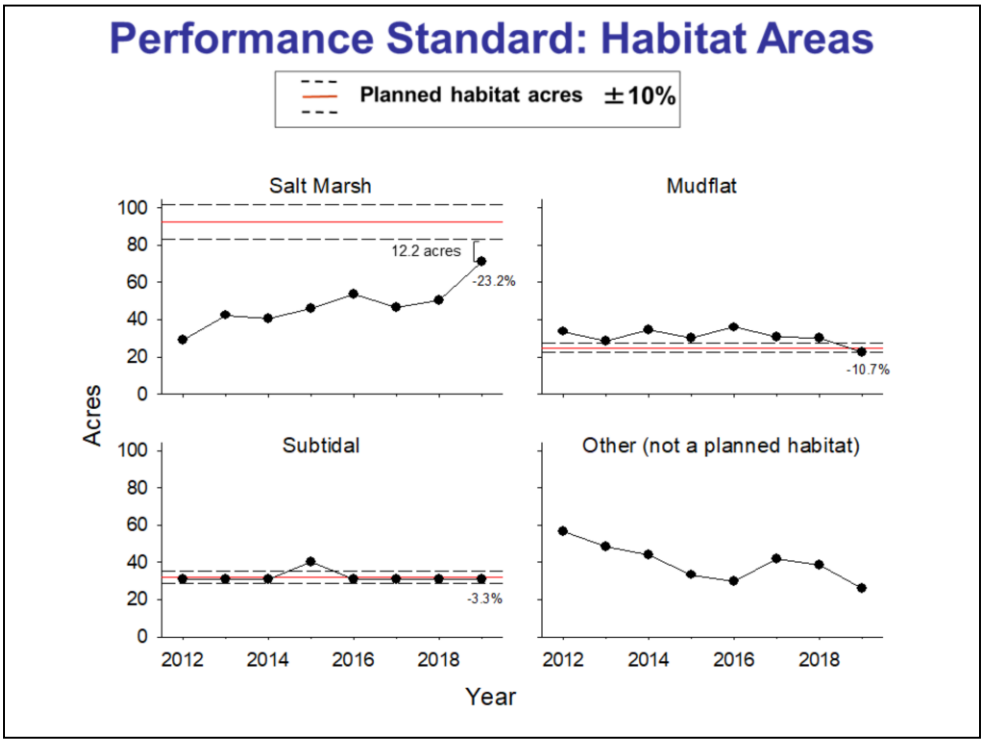
Salt Marsh Habitat at SDW

Example of “Other”

- The open bars on this slide show the planned acreages of subtidal, mudflat, and salt marsh habitat, plus or minus 10% of these values, as well as an example of salt marsh habitat in the restored wetland with a high cover of vegetation.
- Also shown is a category that we term “other”, which is not a planned habitat.
- These are areas with insufficient cover of vegetation to be assessed salt marsh and too much vegetation and/or too high intertidally to be assessed as “mudflat”.



- The solid bars indicate the acreages determined in our 2019 survey.
- While the area of subtidal habitat was within 10% of the planned acreage in 2019, the area of mudflat was slightly less than 10%, and there was a deficit of salt marsh habitat, which was also not within ± 10% of the planned acreages. Salt marsh acreage in 2019 was about 71 acres, about 12 acres below the lower 10% limit of the designed acreage.
- As a result, the performance standard for habitat areas is currently not met.



- This slide shows the trend over time in acres of habitat categories and the Other category.
- The red line shows the planned acreage in the Restoration Plan and dashed lines indicate values plus or minus 10 % that value.
- There has been a slow but general increase in salt marsh habitat since 2012, and a more pronounced increase from 2018 to 2019, which is encouraging.
- Also encouraging is the decrease in Other in 2019, which reflects the filling in of vegetation, particularly at lower elevations.
- One trend that we need to keep an eye on is the decrease in mudflat such that the acres of mudflat are now slightly below 10% of the planned acres.
- This is due in part to the encroachment of Spartina in the low marsh into areas that are planned mudflat.

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.

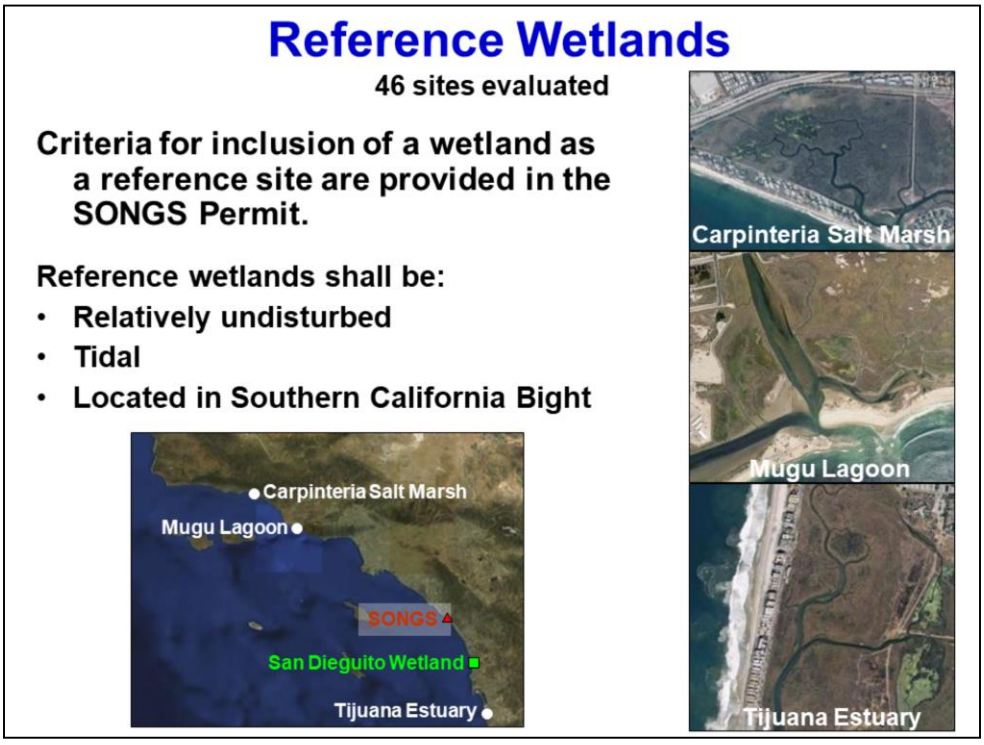
What counts as similar in the context of assessing the performance of the San Dieguito Wetlands Restoration Project?

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.**

- *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.



- 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 – MC
5. Fish Species Richness – MC
6. Fish Density – 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

MC=Main Channel, TC=Tidal Creek

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

Relative Performance Standards

1. Water Quality
2. Bird Density
3. Bird Species Richness
4. Fish Density – MC
5. Fish Species Richness – MC
6. Fish Density – 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

MC=Main Channel, TC=Tidal Creek

- The first standard pertains to water quality, a physical factor.

Relative Performance Standards

1. Water Quality
2. Bird Density
3. Bird Species Richness
4. Fish Density – MC
5. Fish Species Richness – MC
6. Fish Density – 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

MC=Main Channel, TC=Tidal Creek

- Standards 2-11 pertain to biological communities of birds, fish, and invertebrates.

Relative Performance Standards

1. Water Quality
2. Bird Density
3. Bird Species Richness
4. Fish Density – MC
5. Fish Species Richness – MC
6. Fish Density – 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

MC=Main Channel, TC=Tidal Creek

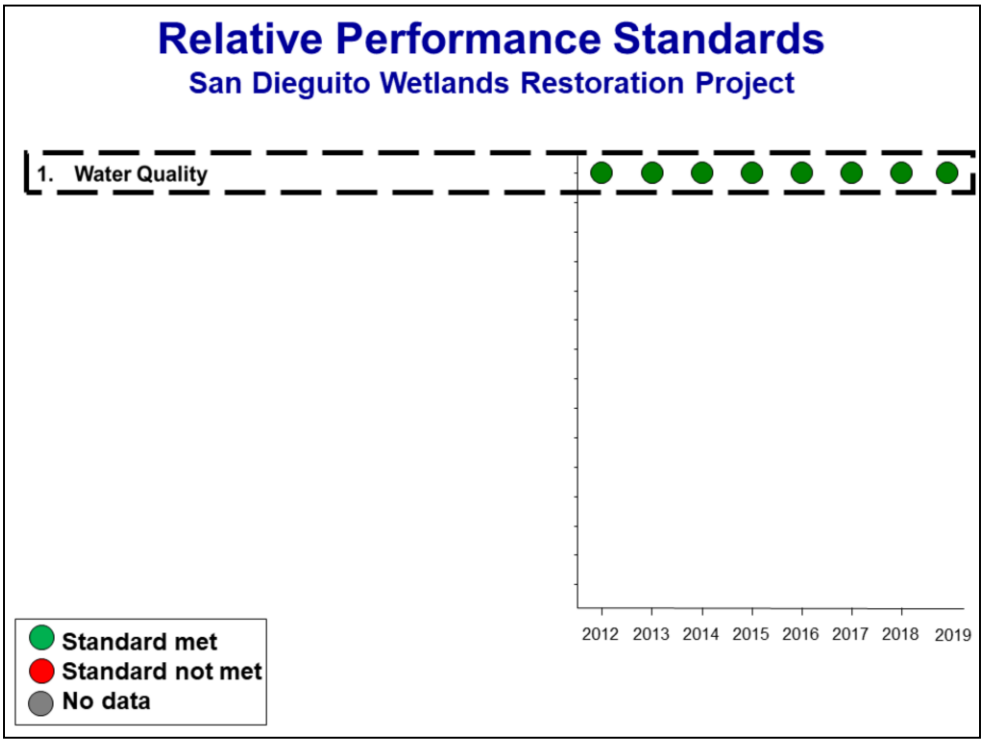
- Standards 12-14 pertain to the cover of vegetation and algae and Spartina canopy architecture.

Relative Performance Standards

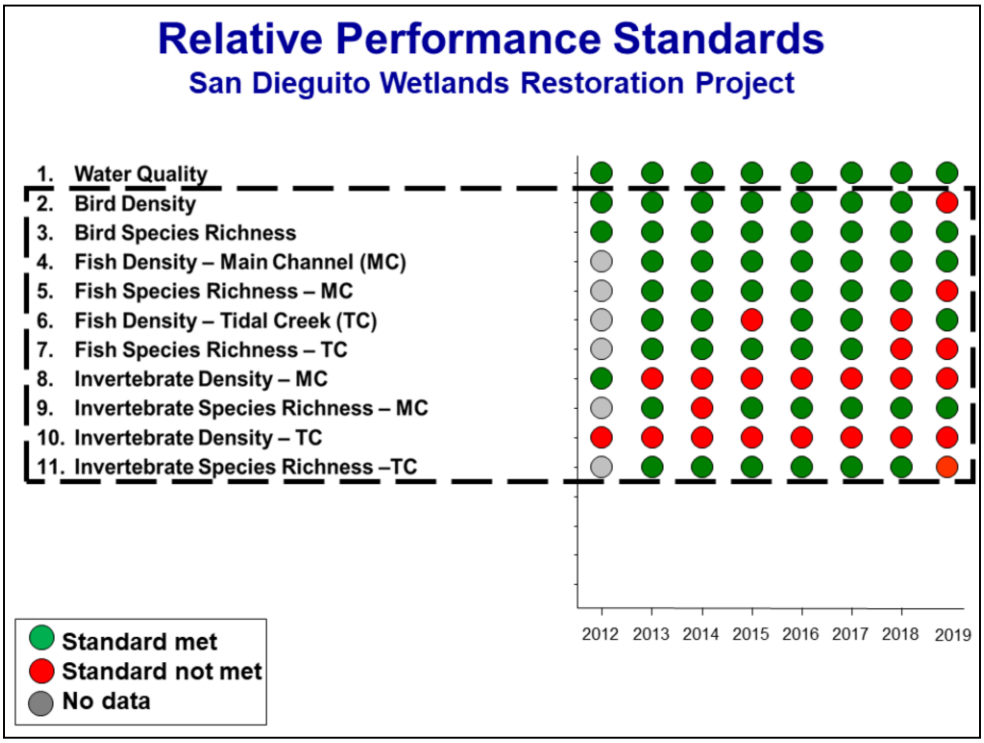
1. Water Quality
2. Bird Density
3. Bird Species Richness
4. Fish Density – MC
5. Fish Species Richness – MC
6. Fish Density – TC
7. Fish Species Richness – TC
8. Invertebrate Density – MC
9. Invertebrate Species Richness – MC
10. Invertebrate Density – TC
11. Invertebrate Species Richness –TC
12. Vegetation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

MC=Main Channel, TC=Tidal Creek

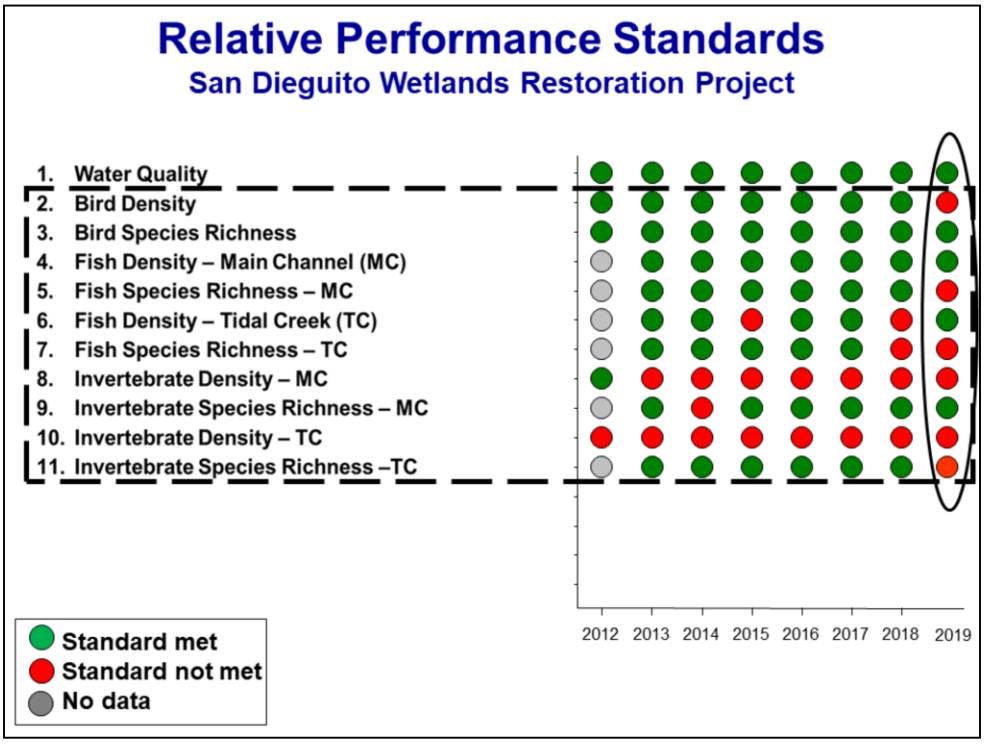
- The last standard pertains to food chain support provided by the wetland to birds.



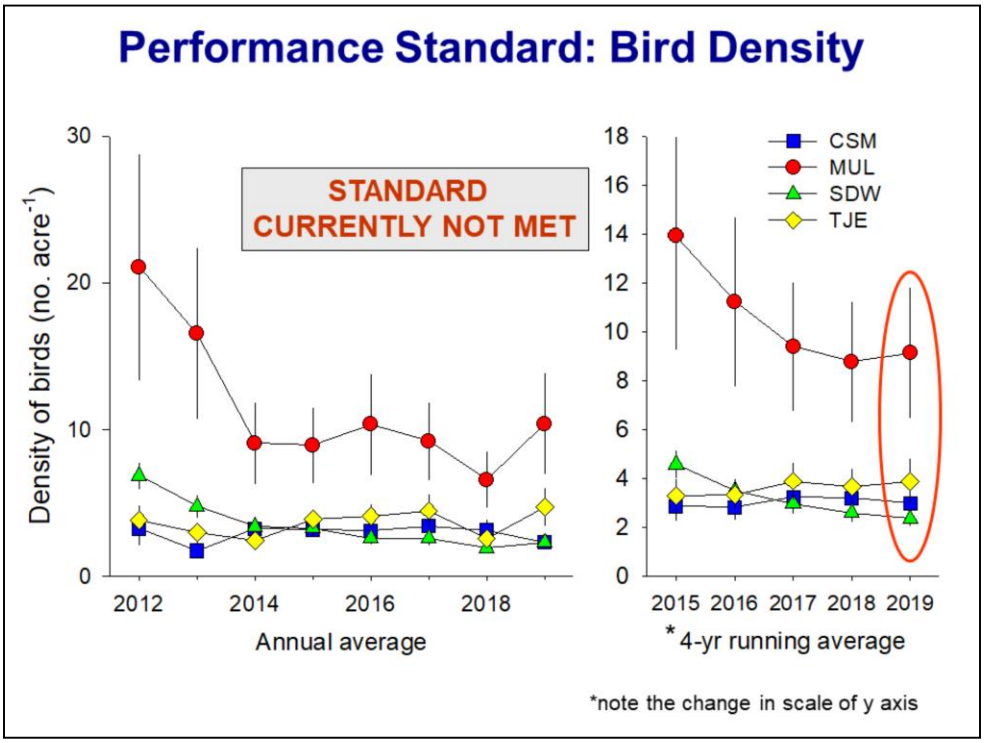
- The following slides will summarize whether a particular relative standard was met during each of the last 8 years.
- A green dot indicates that the standard was met for a particular year, and a red dot will indicate that the standard was not met.
- This slide summarizes the results for water quality.
- As a result of it's 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 8 years and the standard is currently met.



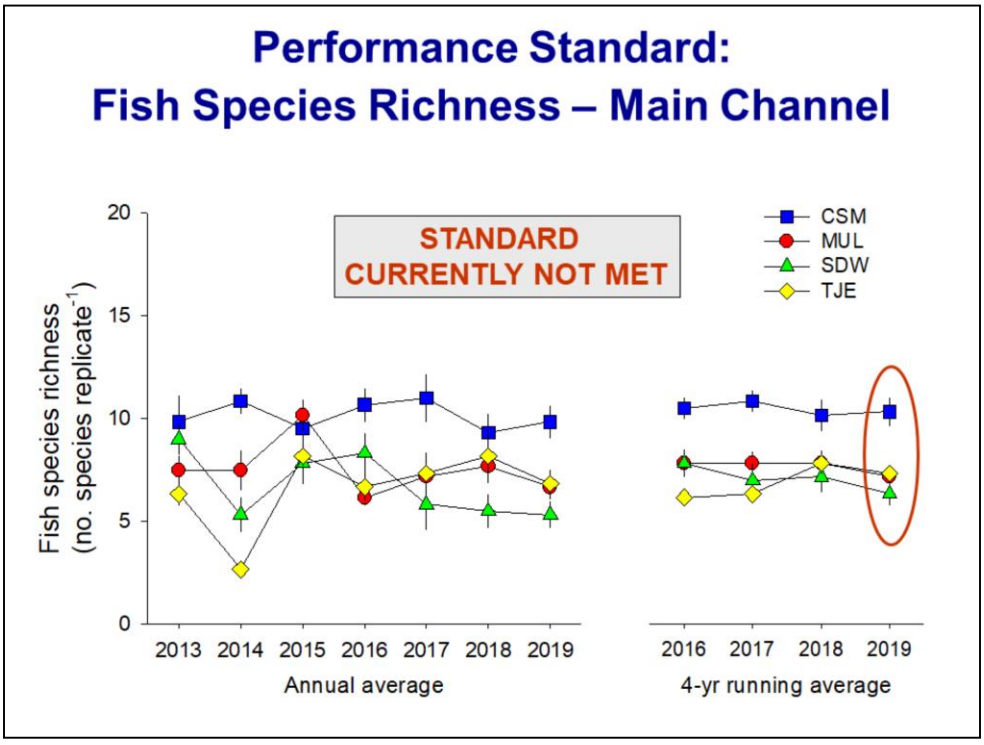
- We are now moving onto the performance standards for biological communities, which includes standards for birds, fish, and macroinvertebrates.
- These are relative standards that pertain both the densities and numbers of species of these groups.
- The performance standard for biological communities 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.



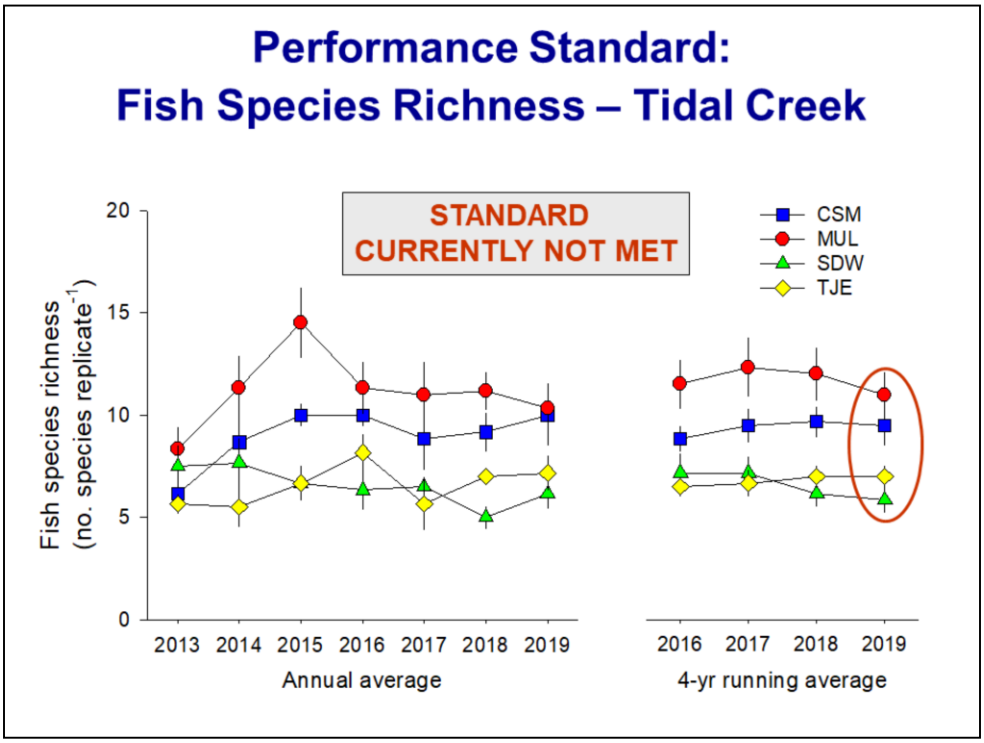
- You can see by the number of red dots for 2019 that there were six biological standards were not met in 2019, three of which were met in 2018.
- Standards not met include bird density, fish species richness in tidal creek and main channel, invertebrate density in main channel and tidal creek habitat and invertebrate species richness in tidal creek habitat.
- We'll now take a look at the results for the standards that were not met in more detail.



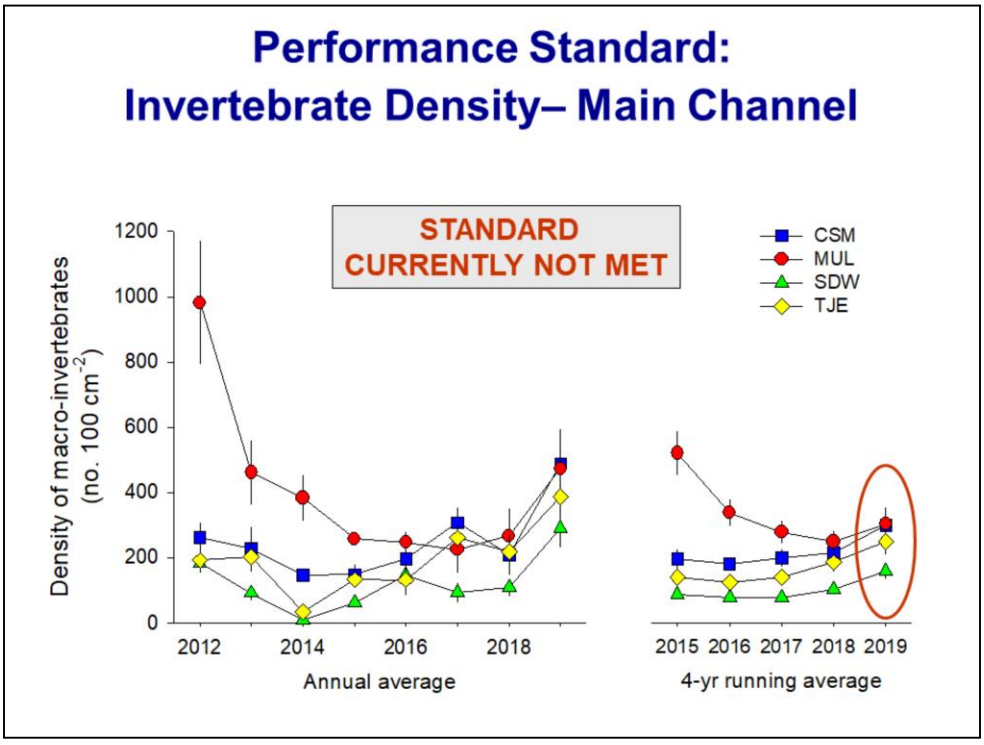
- This slide shows the annual average on the left and running averages on the right used to evaluate bird density as mean number of birds per acre.
- Note the differences in y axis scale between the two figures to better see differences among wetlands for the running averages.
- Looking at the running average, we see that there has been a general decline in this the value for SDW.
- In 2018, this standard was met, but in 2019, the running average has fallen below the lowest performing reference wetland and is no longer similar to the reference wetlands.
- As a result this standard is not currently met.



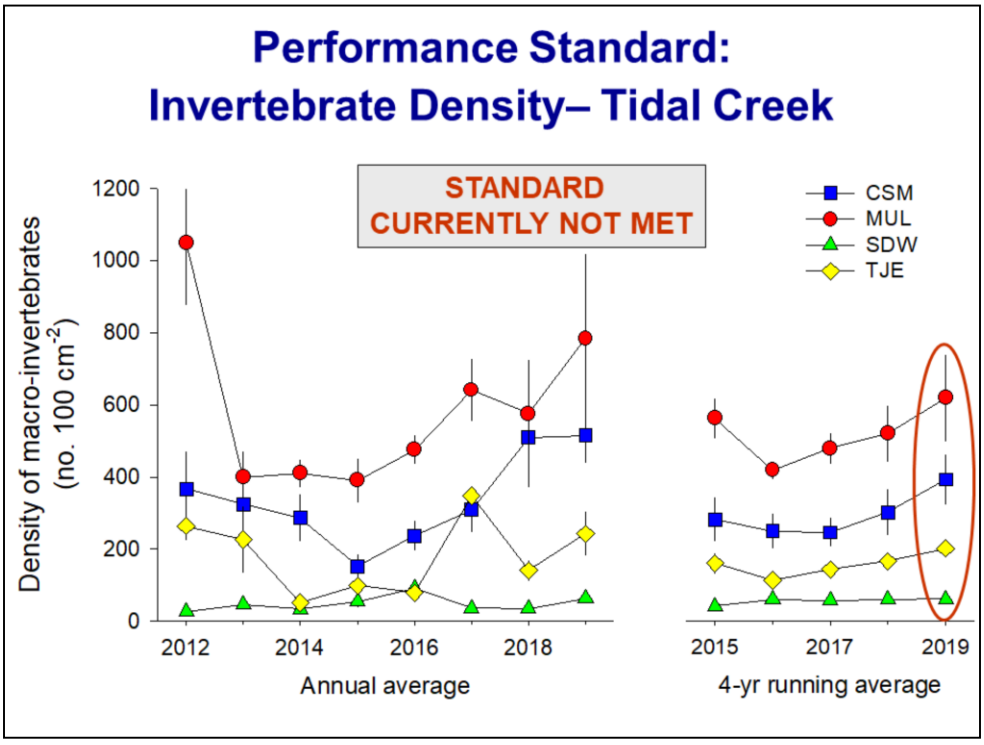
- Another relative standard that was met in 2018, but not met in 2019 is fish species richness in main channel habitat.
- Looking at the annual values, richness declined from 2016 to 2017 and has remained below the reference sites.
- The 4 year running average is not similar to the lowest performing reference site and as a result this standard is not currently met.



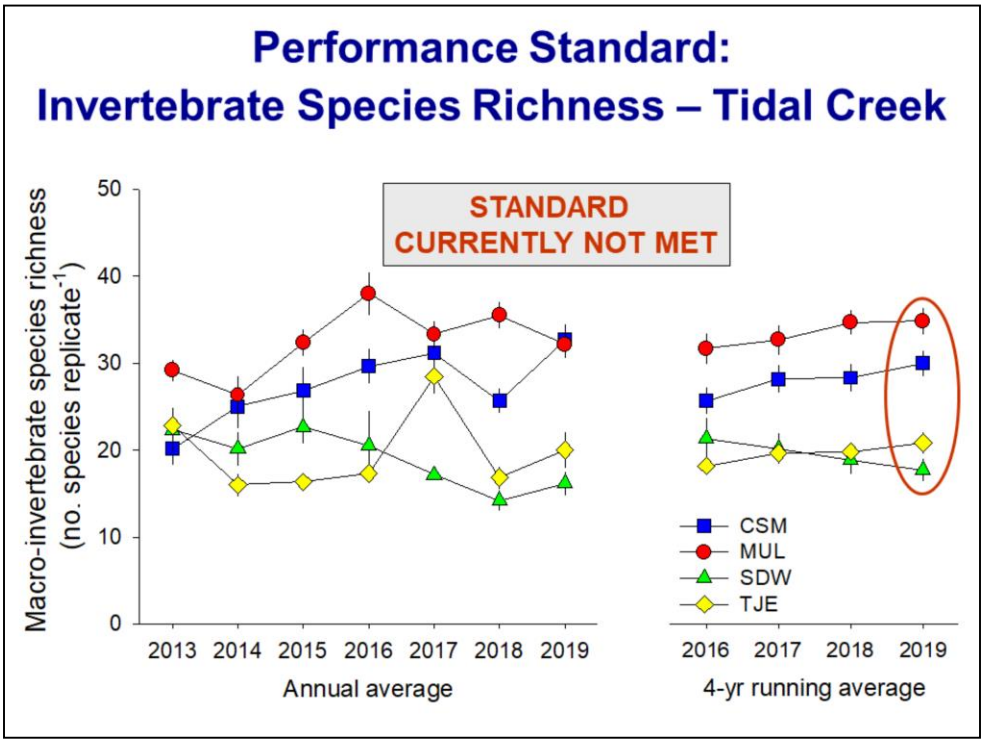
- Taking a look at the species richness of fish in tidal creeks.
- There has been a decline in the running average for fish species richness in tidal creeks.
- Running averages in the reference wetlands have remained relatively constant.
- As was the case for fish species richness in main channels, the 4 year running average of fish species richness in tidal creeks was lowest in SDW in 2019 and as a result this standard was not met in 2019.



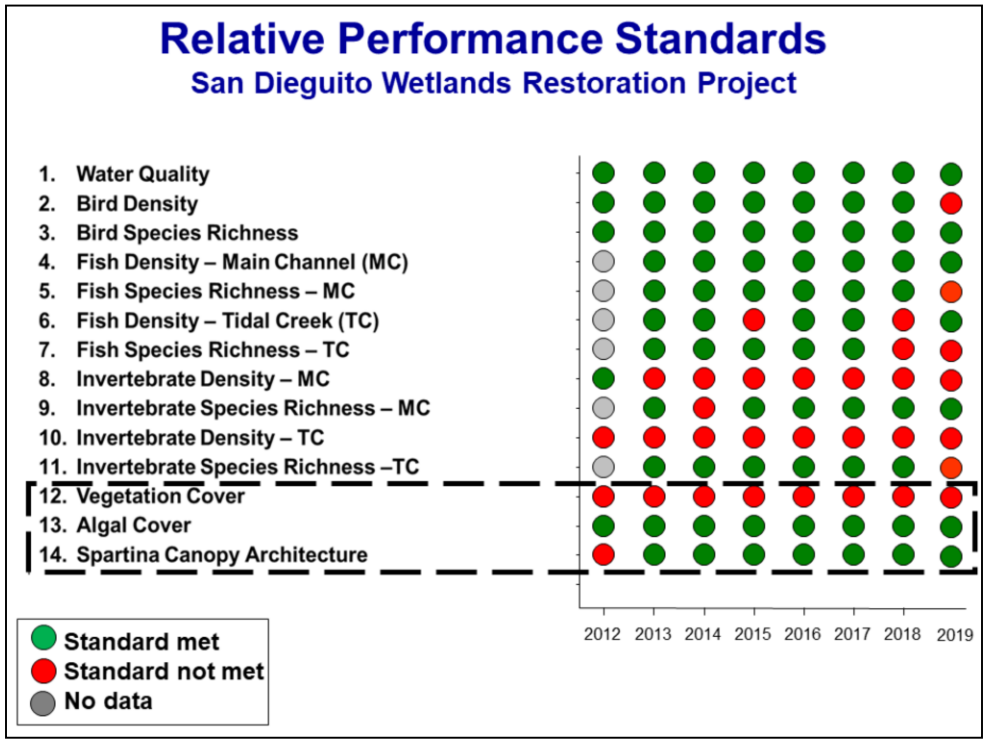
- Moving on to the densities of macro-invertebrates.
- This slide shows both the annual averages and the running averages which are used to evaluate macro-invertebrate density, as mean number per 100 cm2, in the main channel habitat.
- The running average in SDW has been consistently lower than the reference wetland with the lowest value, which has been Tijuana Estuary.
- This year the running average has continued to be well below the lowest performing reference site and as a result this standard is currently not met.



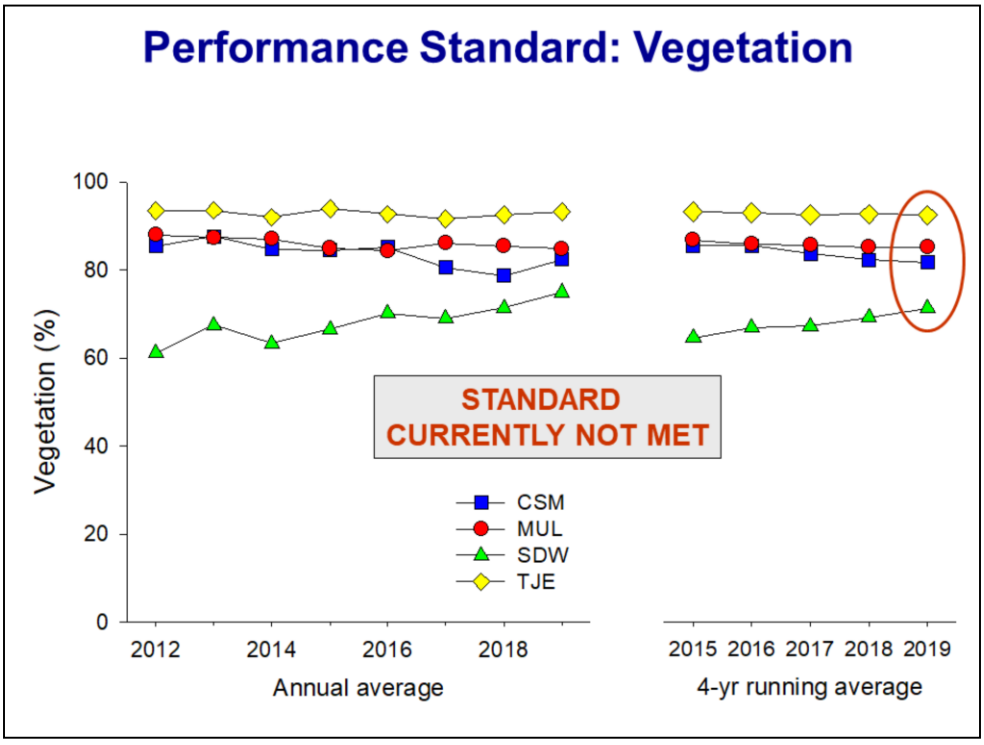
- This slide shows the results macro-invertebrate density in tidal creek habitat.
- Looking at the annual average on the left, we see that the value for SDW declined in 2017 and remained at about the same level for the past 3 years.
- The running average for invertebrate densities in tidal creek habitat remains below the lowest performing reference site in 2019 and as a result this standard is not currently met.



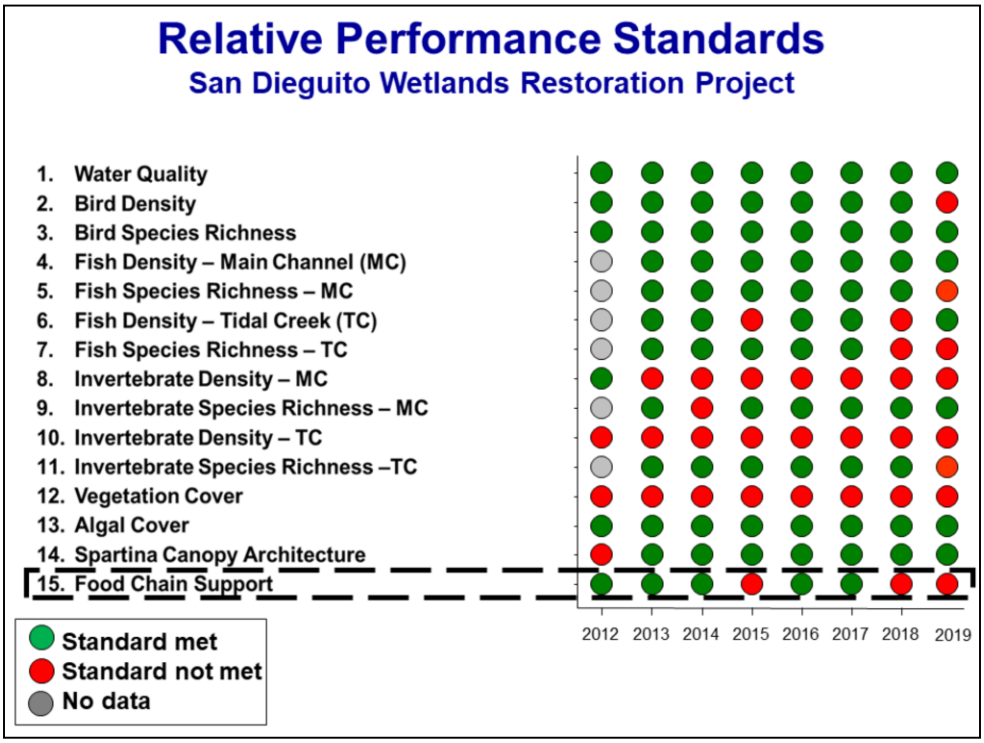
- This slide shows the results for macro-invertebrate species richness in tidal creek habitat.
- This standard was met in 2018, but there has been a general decline and the running average was below the lowest performing reference site in 2019.
- As a result this standard is not currently met.



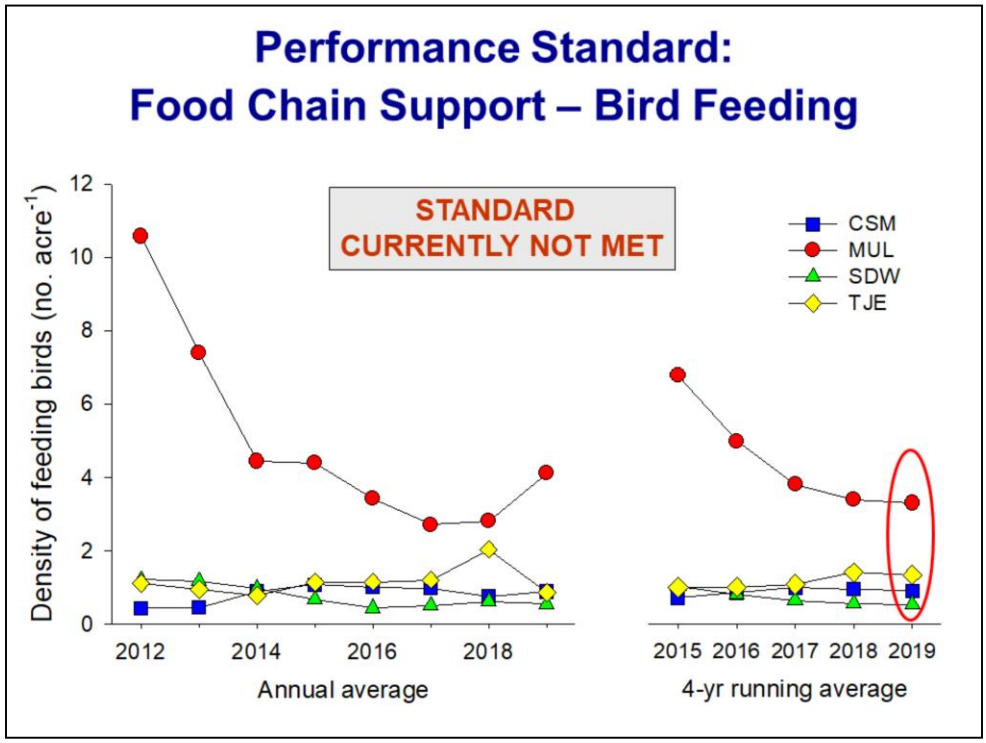
- The next 3 standards pertain to the percent cover of vegetation, algae, and to Spartina canopy architecture.
- Vegetation cover in salt marsh habitat is determined from aerial imagery that is also used to evaluate habitat areas.
- SDW has yet to the standard for cover of vegetation.
- The performance standard for algae is designed to monitor the development of unusually dense mats of filamentous green macroalgae in the restoration site. Thick mats of algae have the potential to interfere with wetland structure and function 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 algal cover is not significantly higher than the reference wetland with the highest coverage of algae. San Dieguito has met this standard in all 8 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 Ridgway 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.



- Taking a look at the data for vegetation cover in salt marsh habitat in more detail, this slide shows the annual average on the left and the running average, used to evaluate the standard, on the right for cover of vegetation in the San Dieguito Wetlands compared to the reference wetlands.
- Vegetation has colonized the restored wetland and is increasing in cover on a promising trajectory, but it has not yet filled in to the point where the running average of cover is similar to the reference wetlands.
- Steve will speak more about on-going activities to increase vegetation cover in SDW in the next talk.



- The last standard pertains to food chain support as measured by the density of feeding birds.
- This standard was met 5 of the previous 7 years, but has not been not met the past two years.



- Food chain support has been consistently highest at Mugu lagoon
- At San Dieguito the running average had been similar to the reference wetlands, but lower than the reference wetlands that last two years.
- Since food chain support in San Dieguito was lower than in Carpinteria Salt marsh, the lowest performing wetland in 2019, this standard was not met for 2019.

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.

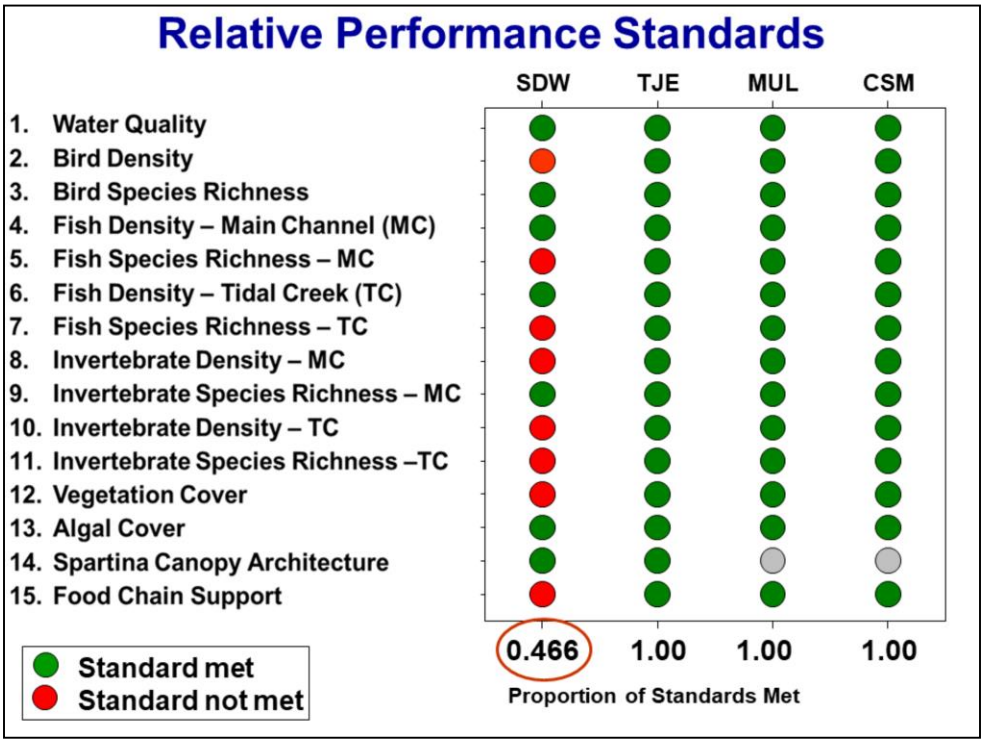
Method of Evaluation

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.

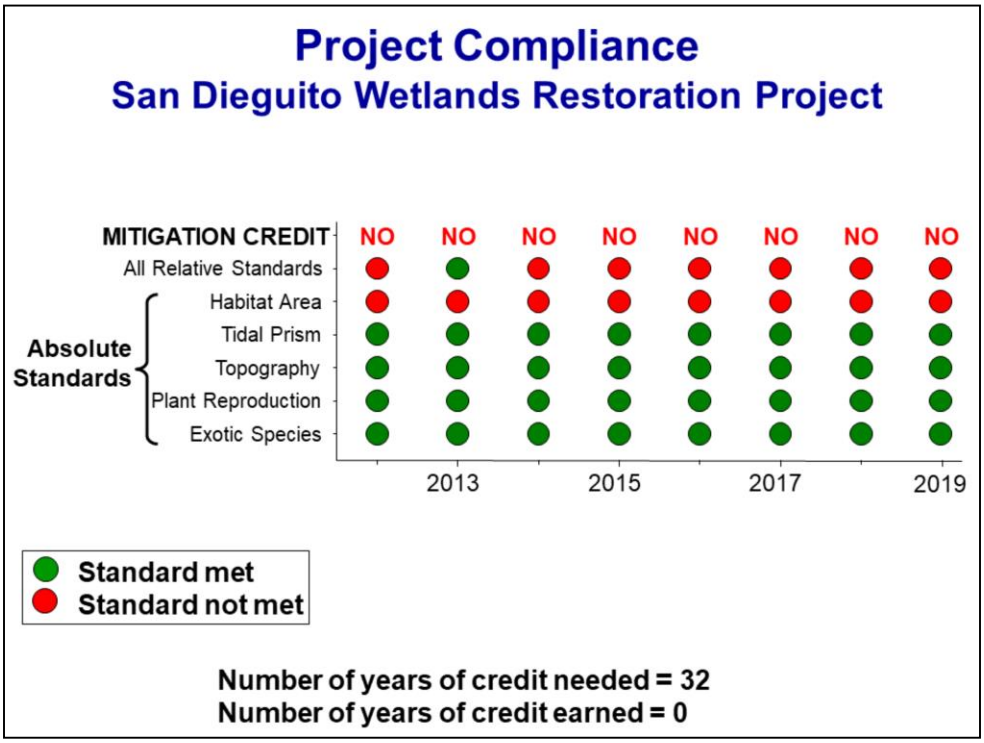
Rationale

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 2019 using the running averages.
- A green circle indicates that the performance variable at a particular wetland is similar to the other wetlands.
- A red circle indicates that the performance variable at a particular wetland was not similar to the other wetlands
- Gray– performance variable not measured in a particular wetland.
- Comparing the running averages, 2019 was a very good year for the reference wetlands—all met the same proportion of relative standards.
- San Dieguito Wetlands only met 7 of 15 standards or 47%.
- Therefore, San Dieguito Wetlands did not meet the relative standards for 2019.



- Taking a look at project compliance, 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 SDW 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, low densities of invertebrates in tidal creek and main channel, and low densities and species richness of fish.
- 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, Steve will discuss in more detail the status of the vegetation and salt marsh habitat, the on-going planting program, and status and plans to examine the underperformance of biological communities.