Performance Evaluation of the San Dieguito Wetlands Restoration Project

2015 Monitoring Results

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

This presentation focuses on:

- The results of the fourth 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 against a fixed value and 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 measured against a fixed value and 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.

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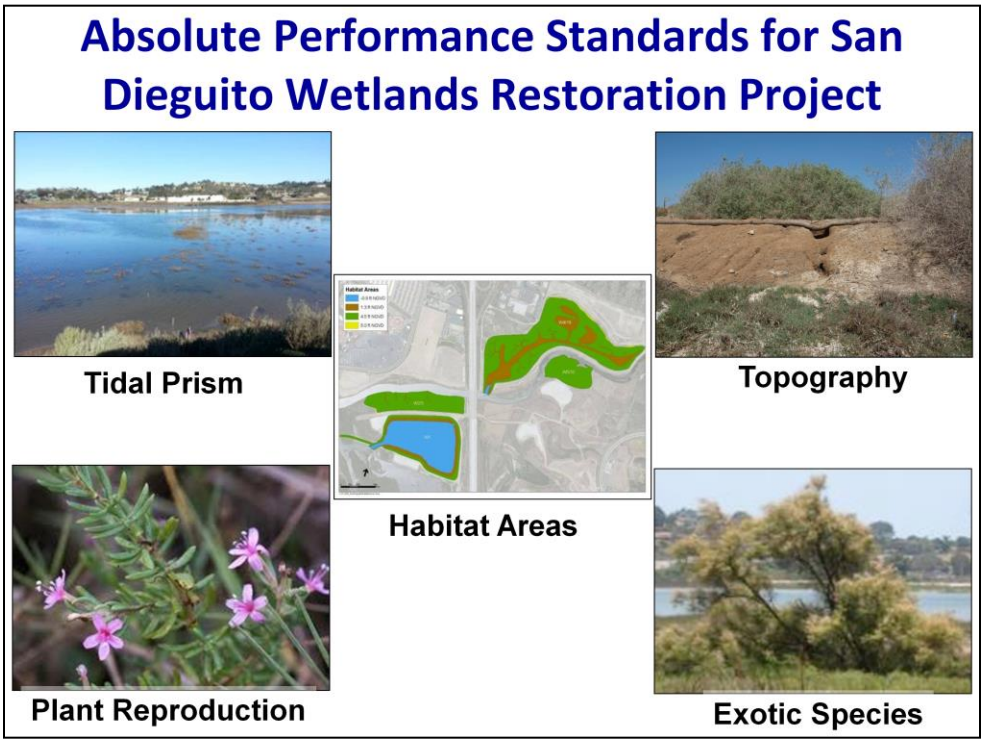


- Absolute performance standards for the San Dieguito Wetlands Restoration Project pertain to tidal prism, habitat areas, topography, plant reproduction, and exotic species.
- I will now go through the evaluation of each of the absolute standards for 2015.

Performance Standard: Tidal Prism

The designed tidal prism shall be maintained, and tidal flushing shall not be interrupted

Tidal prism: The volume of water exchanged in an estuary between the low and high tide levels.

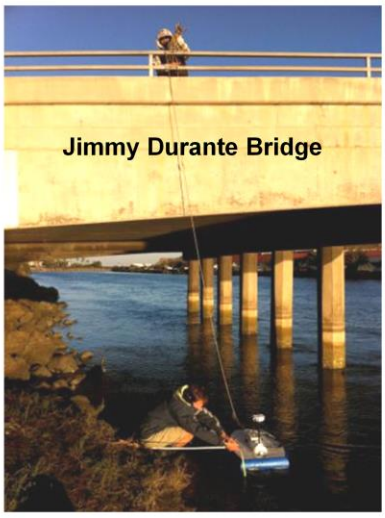
Why measure it? Metric of tidal flushing, inundation of marsh habitat, and inlet stability.

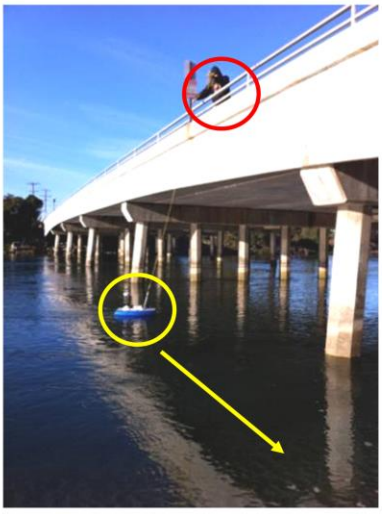
W4/16 – low tide

W4/16 – high tide

- Tidal prism as an absolute standard, is evaluated only within the San Dieguito Wetlands Restoration.
- This standard specifies that the designed tidal prism shall be maintained, and tidal flushing shall not be interrupted.
- 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.

Method of Assessing Tidal Prism



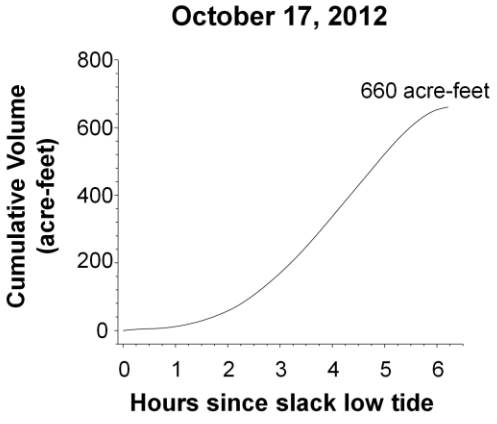


River Surveyor--Acoustic Doppler Current Profiler (ADCP)

- Tidal prism is assessed using a River Surveyor—a small acoustic doppler current profiler or ADCP that measures channel profile and volume of water flow.

Method of Assessing Tidal Prism

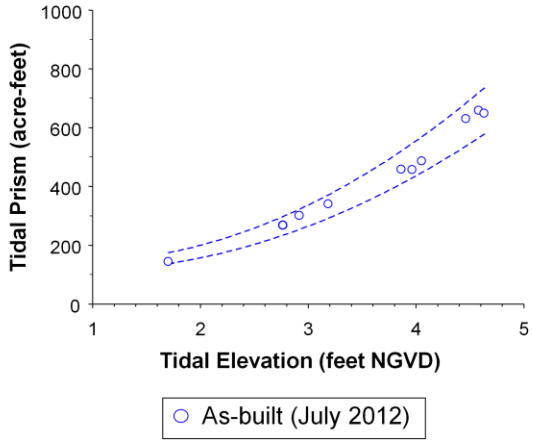
- **Measurements of flow volume are taken every 15 minutes during an incoming tide using the River Surveyor.**
- **Flow volume values are cumulated over the entire incoming tide to estimate prism.**



- Measurements of flow volume are taken every 15 minutes during an incoming tide using the River Surveyor.
- Flow volume values are cumulated over the entire incoming tide to estimate prism.

Performance Standard: Tidal Prism

- **An "as-built" prism was assessed over a range of high tides in July 2012.**
- **Tidal prism for the current year measured over a range of high tides is evaluated against the as built prism.**
- **Fitted line for the measured prism must fall within the blue dotted lines to ensure no more than a 10% shift in planned salt marsh habitat.**

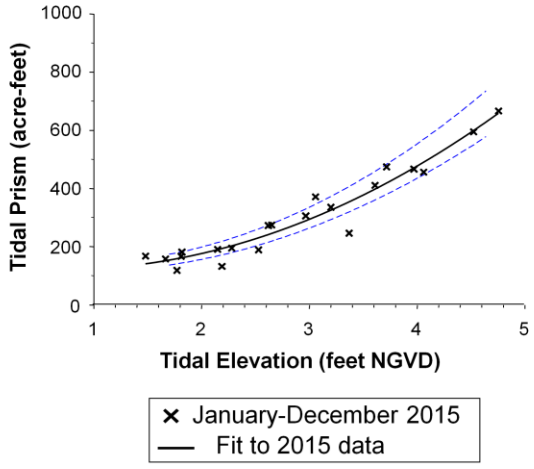


- An "as-built" prism was assessed over a range of high tides in July 2012.
- Tidal prism for the current year measured over a range of high tides is evaluated against the as built prism.
- Fitted line for the measured prism must fall within the blue dotted lines to ensure no more than a 10% shift in planned salt marsh habitat.

Performance Standard: Tidal Prism

- **Fitted line for measured tidal prism in 2015 falls within the blue dotted lines.**

STANDARD CURRENTLY MET



- The fitted line to the tidal prism data from January through December 2015 falls within the dashed blue lines, indicating that the tidal prism at the San Dieguito Wetlands was maintained in 2015.
- Points falling below the lower dotted blue line occurred when tidal flushing was impeded by a rock rip rap and turbidity curtain in place across the main inlet channel in November during construction at the railroad bridge.

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

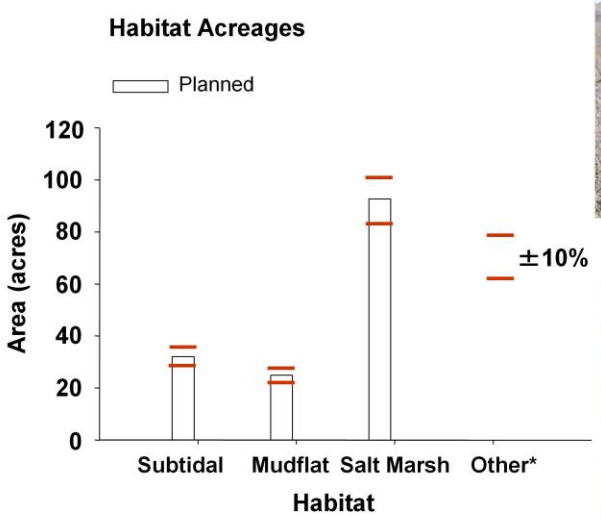
Vegetated salt marsh inundated at high tide at San Dieguito Wetlands

Planned acres :

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

- Habitat Areas 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 thus guard against large scale conversions of one habitat type to another, for example of vegetated marsh to mudflat.
- Panel on the left shows areas of planned 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.

Performance Standard: Habitat Areas

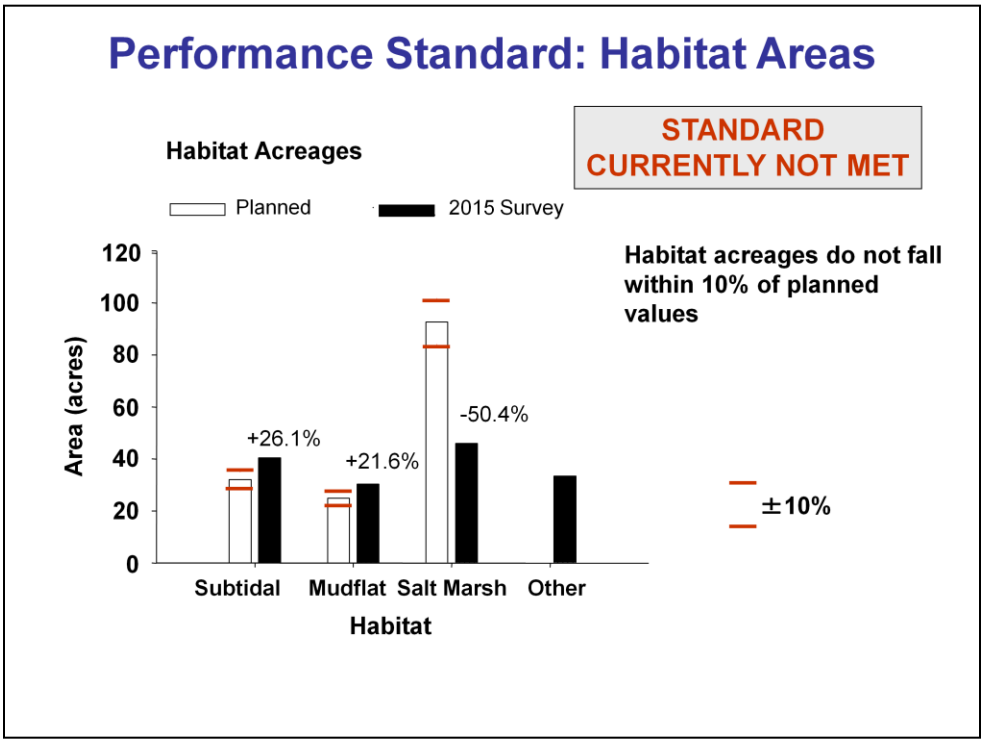


Salt Marsh Habitat at SDW

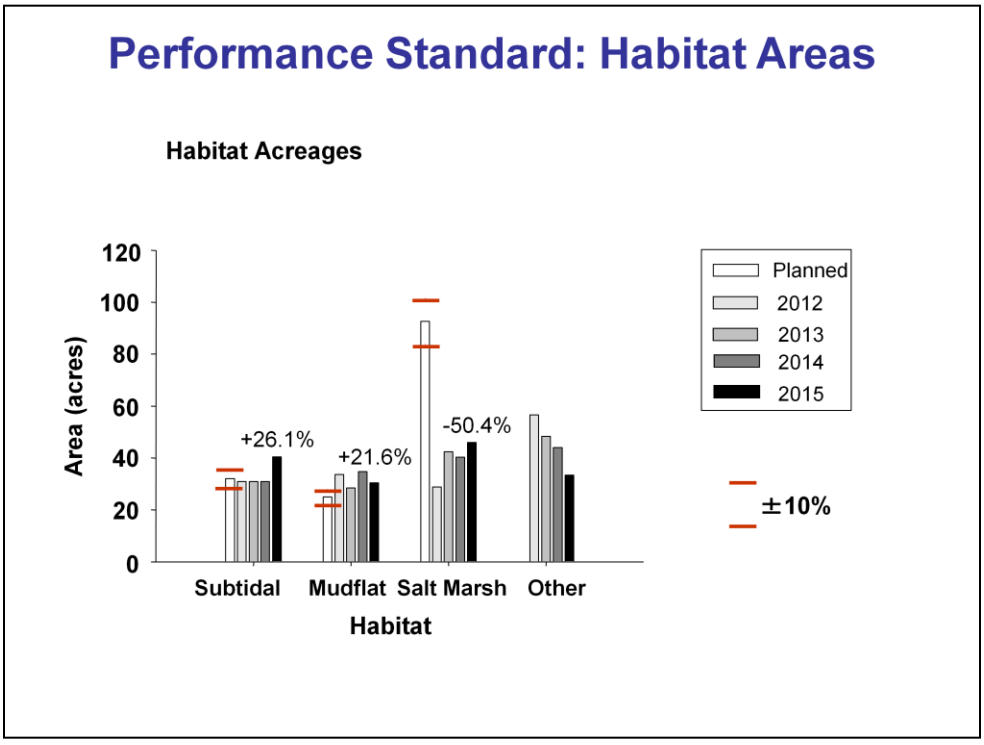
Example of "Other"

*not a planned salt marsh habitat

- The open bars on this slide show the planned acreages of subtidal, mudflat, and salt marsh habitat 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 2015 survey.
- The area for subtidal, mudflat, and salt marsh habitat measured in 2015 were not within ± 10% of the planned acreages.
- You can also see in particular an appreciable deficit in habitat assessed as salt marsh.
- About 33 acres were assessed as “Other” not assessed as one of the planned habitats provided in the Final Restoration Plan.
- As a result, the performance standard for habitat areas is currently not met.



- Although not yet meeting the standard for habitat areas, the monitoring results for 2015 are encouraging in that there has been an increase of about 5 acres classified as Salt Marsh habitat from 2014.
- The 10 acre increase in subtidal habitat could be due to overall higher sea levels that occurred in 2015 and to sand build-up at the inlet that prevented drainage during low tides. As Steve mentioned, the inlet was dredged this past November.

Performance Standard: Topography

The wetland shall not undergo major topographic degradation (such as excessive erosion or sedimentation)

Erosion of upland bordering the restoration following storm events

- Topography is another absolute performance standard.
- The standard for topography requires that the wetland not undergo major topographic degradation, such as excessive erosion or sedimentation.

Methods of Assessing Topography

- **The intent of the topography standard is to ensure that the expected functions of the wetland are not affected by excessive erosion or sedimentation.**
- **Survey data and field observations indicate that the wetland did not undergo major topographic degradation in 2015.**

Surveying elevations in the San Dieguito Wetland

STANDARD CURRENTLY MET

- The intent of the topography standard is to ensure that the expected functions of the wetland are not affected by excessive erosion or sedimentation.
- Survey data and field observations are used to determine whether the topography standard is met.
- The monitoring results for 2015 indicate that the wetland did not undergo major topographic degradation.

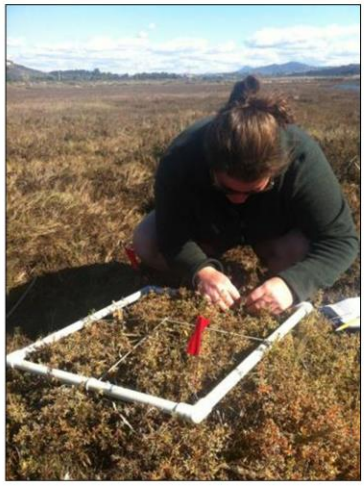
Performance Standard: Reproductive Success

Certain plant species, as specified in the work program, shall have demonstrated reproduction (i.e. seed set) at least once in three years

- Plant reproductive success, another absolute standard, requires that certain plant species, as specified in the work program, have demonstrated reproduction (i.e. seed set) at least once in three years.
- This slide shows pictures of 6 of the 7 plant species used to evaluate this standard: Alkali Heath, Salt Grass, Pickleweed, Marsh Jaumea, Spiney Rush, and Sea Lavender, not shown is Parish's Glasswort.
- These are the most common plant species in San Dieguito Wetlands and occupy a range of tidal elevations.

Methods of Assessing Plant Reproductive Success

- **Inspection of the 7 species for the setting of seed in summer-fall when seed set is greatest.**
- **Seed set identified using a sub-sample of mature flowers of each species distributed throughout the wetland.**



Collection of mature flowers

- To assess plant reproductive success, we inspect the 7 common species at sites throughout San Dieguito Wetlands for the setting of seed in summer-fall when seed set is greatest.
- Seed set is identified from a subsample of mature flowers of each species distributed throughout the wetland.

Performance Standard: Reproductive Success

	Seed Set	
Plant	2012	2015
Parish's Glasswort	✓	✓
Saltgrass	✓	✓
Alkali Heath	✓	✓
Marsh Jaumea	✓	✓
Spiny Rush	✓	✓
California Sea Lavender	✓	✓
Pickleweed	✓	✓

STANDARD CURRENTLY MET

- All 7 species produced seed in 2012 and 2015.
- Since the standard requires that the selected species have demonstrated reproduction (i.e. seed set) at least once in three years, the standard is met for 2015.
- We will keep assessing seed set yearly.

Performance Standard : Exotics

The important functions of the wetland shall not be impaired by exotic species

Exotic species can cause compositional and functional changes in estuarine ecosystems (e.g., alteration of food webs or physical structure of habitats).

- 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.
- To illustrate, the Asian mussel can occur in very dense mats that exclude native benthic organisms.
- This boring isopod burrows into channel banks and at high densities can enhance bank erosion and adversely affect topography

Methods used to Assess Exotics

- **Use monitoring data to assess the prevalence of exotic species.**
- **Conduct a special survey that covers as much of the wetland as possible that looks for exotic species once per year.**
- **If exotic species are prevalent**
  - **Conduct targeted studies to assess how the invader is affecting the functioning of the restored wetland.**
  - **Consult appropriate resource agencies regarding a plan of action to manage these species.**

- To evaluate this standard, the monitoring data are used to assess the prevalence of exotic species.
- A special survey is also conduced covering as much of the wetland as possible that looks for exotic species.
- If exotic species are prevalent, targeted studies may be done to assess how the invader is affecting the functioning of the restored wetland.
- Appropriate resource agencies will be contacted regarding a plan of action to manage these species.

Performance Standard : Exotics

The important functions of the wetland shall not be impaired by exotic species

Conclusion: No evidence that exotic species have impaired the important functions of San Dieguito Wetlands.

STANDARD CURRENTLY MET

- Although some relative performance standards for macroinvertebrates were not met, to be discussed when we get to the relative standards, there was no evidence from our sampling or the special survey that exotic species were responsible.
- Therefore, the performance standard for exotic species was met in 2015.

Types of Performance Standards

2. Relative Standards: Measured against 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.)

- The second type of performance standards are relative standards, evaluated against natural wetlands in the region that are used as a reference sites.

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

Definition: **The mean value for a relative performance standard at San Dieguito Wetlands must be *equal to* or *better than* the mean 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.

- The SONGS Coastal Development Permit envisioned a quantitative definition of "similar" for evaluating the performance of both the wetland and reef mitigation projects relative to reference sites, and it specified that the measure of similarity would be defined in the monitoring plans for these projects.
- After considerable discussion the definition for the measure of similarity that was chosen is that the mean value for a relative performance standard at the San Dieguito Wetlands must be *equal to or better than* the mean value for the lowest performing reference wetland for that standard.
- The rationale behind this definition is that the San Dieguito Wetlands should perform at least as well as the lowest performing natural wetland used as a reference site.

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

Requirement

- **The San Dieguito Wetlands Restoration must meet as many relative standards as the lowest performing reference wetland in a given year for that year to count towards mitigation credit.**
- **To meet a given standard the value at the restoration must be *similar* to values at the reference wetlands.**

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.**

Rationale

- **Requiring San Dieguito Wetlands Restoration to meet at least as many 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.**

- The requirement for the relative performance standards is that the San Dieguito Wetlands Restoration must meet as many of the relative standards as the lowest performing reference wetland in a given year for that year to count towards mitigation credit.
- To meet a given standard the value at the San Diegutio restoration must be *similar* to values at the reference wetlands.
- The evaluation of each relative standard in any given year is based on a four-year running average calculated from data collected at San Dieguito Wetlands and the reference wetlands for that year and the previous three years similar to the method used for reef mitigation project.
- Requiring San Dieguito Wetlands to meet at least as many 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.

Relative Performance Standards for the San Dieguito Wetlands Restoration Project

1. Water Quality
2. Bird Density
3. Bird Species Richness
4. Fish Density – Main Channels
5. Fish Species Richness – Main Channels
6. Fish Density – Tidal Creeks
7. Fish Species Richness – Tidal Creeks
8. Macro-invertebrate Density – Main Channels
9. Macro-invertebrate Species Richness – Main Channels
10. Macro-invertebrate Density – Tidal Creeks
11. Macro-invertebrate Species Richness – Tidal Creeks
12. Vegetation Cover
13. Algae Cover
14. *Spartina* canopy architecture*
15. Food chain support

* Evaluated relative to Tijuana Estuary only

- Shown here are the relative performance standards used to evaluate the success of the San Dieguito Wetlands Restoration Project.
- One of the relative standards, *Spartina* canopy architecture, has been evaluated only in comparison to Tijuana Estuary because *Spartina* is not present in Carpinteria Salt Marsh and until recently rare in Mugu Lagoon.
- What follows is a summary of the monitoring results as they pertain to each of these standards for 2015.

Performance Standard: Water Quality

Water quality variables shall be similar to reference wetlands

Dissolved oxygen concentration critically important to the health of estuarine biota

Closed and opened inlet at San Dieguito in 2002

- Water quality as a relative standard requires that water quality variables in the San Dieguito Wetlands shall be similar to the reference wetlands.
- Dissolved oxygen concentration is critically important to the health of estuarine organisms, whereas many estuarine species are tolerant of wide ranges of salinity and temperature.
- Dissolved oxygen concentration is very sensitive to inlet closure.
- As a result of it's importance to estuarine health, dissolved oxygen concentration is the water quality variable used to evaluate this standard.

Method of Assessing Dissolved Oxygen (DO) Concentration

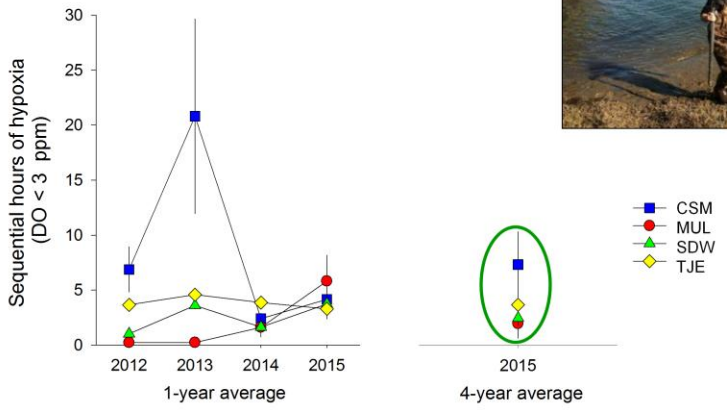
- **DO measured using dataloggers continuously deployed in SDW and reference wetlands.**
- **DO below 3 mg/l considered "hypoxic" and sustained values below this value are detrimental to estuarine biota.**
- **The mean number of consecutive hours spent below this value is calculated for each wetland.**
- **If mean number of consecutive hours DO < 3 mg/l is significantly higher in San Dieguito than the reference wetland with the highest value, San Dieguito fails to meet the standard.**

Checking dataloggers

- Dissolved oxygen concentration (DO) is measured in San Dieguito Wetlands and the reference wetlands using dataloggers.
- A DO value less than 3 mg/l is considered hypoxic and sustained values below 3 are potentially detrimental to estuarine biota.
- Therefore, one approach to assessing DO is to compare the mean number of hours of continuous hypoxia between San Dieguito Wetlands and the reference wetlands.
- If mean number of consecutive hours DO <3 mg/ 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.

Performance Standard: Water Quality (DO)
(Mean length of hypoxic events)

STANDARD CURRENTLY MET



- This slide shows the mean number of hours of continuous hypoxia at the San Dieguito Wetlands compared with the 3 reference wetlands from 2012 through 2015 and the four year running average, which is used to evaluate the standard.
- Again, this standard is evaluated by comparing values in San Dieguito to the reference wetland with the highest value of sequential hours of hypoxia.
- For the four year running average, the value for sequential hours of hypoxia at San Dieguito was similar to the reference wetlands and therefore San Dieguito Wetlands met the Water Quality standard for this period.

Performance Standard: Birds

Within 4 years of construction, the total densities and number of species of birds shall be similar to the densities and number of species in similar habitats in the reference wetlands

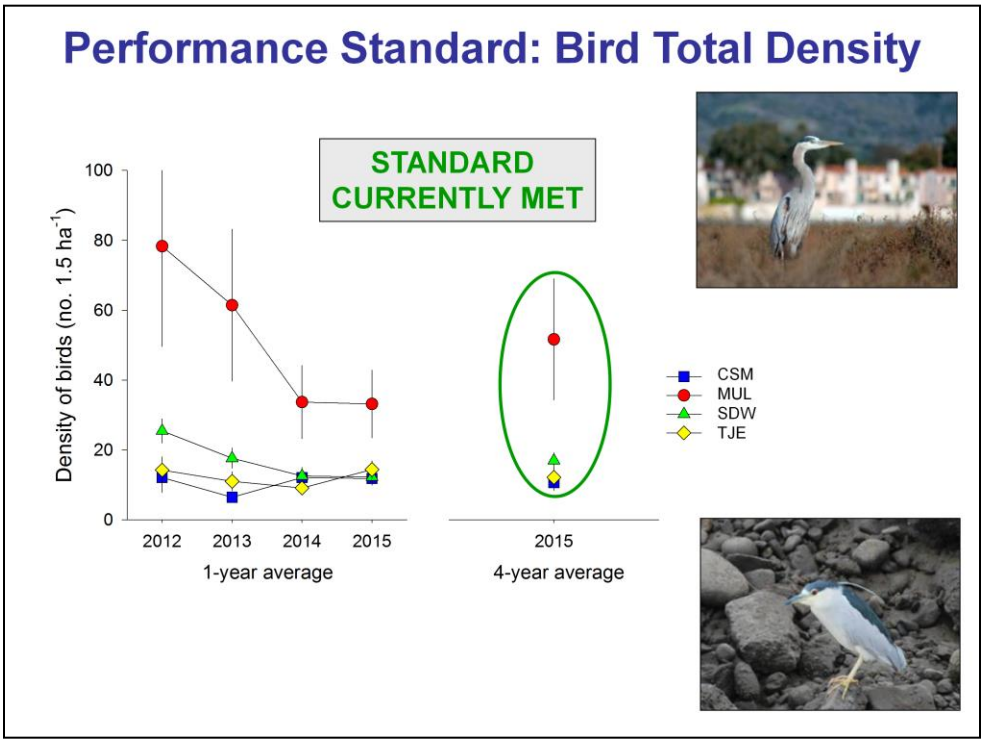
- We are now moving onto the performance standards for biological communities, which includes standards for birds, fish, and macroinvertebrates.
- These are relative standards that pertain both the densities and numbers of species of these groups.
- The performance standard for birds requires that within 4 years of construction, the total densities and number of species of birds shall be similar to the densities and number of species in similar habitats in the reference wetlands.

Method of Assessing the Density and Number of Species of Birds

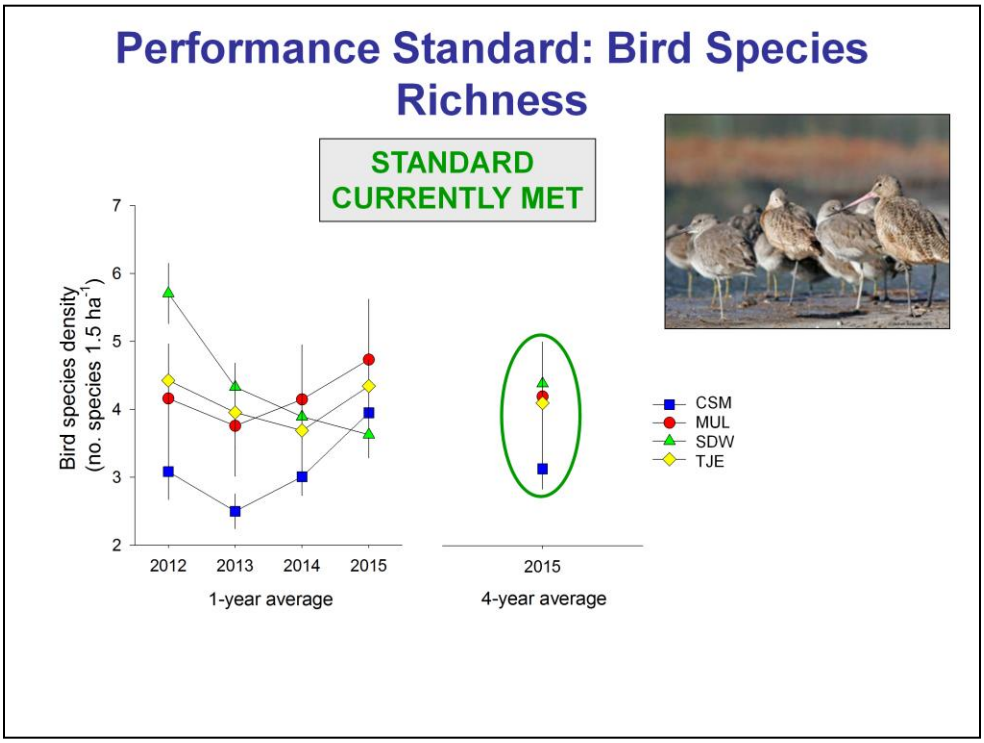
- **Birds counted and identified within 20-100 x 150 m plots spread throughout each wetland.**
- **Sampling observations made during 3 periods: January-February, April-May, and October-November.**
- **6 sampling surveys made in each wetland during each seasonal period.**
- **Comparison among wetlands based on average of the 18 survey dates using plots as replicates for each wetland.**

Bird sampling plots in restored habitat in San Dieguito Wetlands

- This slide summarizes the methods used to assess the density and number of species of birds in San Dieguito Wetlands and the reference wetlands.
- Birds are sampled within 20-100 x 150 m plots spread throughout the wetlands.
- Sampling observations are made during 3 periods: January-February, April-May, and October-November.
- Six sampling surveys are made in each wetland during each seasonal period.
- The comparison among wetlands is based on the average of the 18 survey dates using plots as replicates for each wetland.



- This slide compares bird total density, as mean number per sample plot of 1.5 hectare, in San Dieguito Wetlands to Carpinteria Salt Marsh, Mugu Lagoon and Tijuana Estuary annually for 2012 through 2015 and the 4 year running average.
- For the four year running average, Mugu Lagoon had the highest bird density, but bird density in San Dieguito Wetlands was higher than the wetland with the lowest value over this period.
- Therefore, the standard for bird density in San Dieguito currently met.



- This slide compares bird species richness, as mean number of species per hectare, in San Dieguito Wetlands to the three reference wetlands.
- For the four year running average, San Dieguito Wetlands had higher bird species richness than the reference wetland with the lowest value.
- Therefore, the standard for bird species richness in San Dieguito Wetlands is currently met.

Performance Standard: Fish

Within 4 years of construction, the total densities and number of species of fish shall be similar to the densities and number of species in similar habitats in the reference wetlands

- The relative performance standard for fish requires that within 4 years of construction, the total densities and number of species of fish shall be similar to the densities and number of species in similar habitats in the reference wetlands.

Sampling Design for Fish

- **San Dieguito Wetlands and the 3 reference wetlands are sampled in the late summer-early fall.**
- **6 tidal creeks & 6 sections of main channel/basin are sampled in each wetland.**
- **The sampled creeks or sections of main channel/basin are treated as replicates.**
- **Tidal creeks and main channels assessed separately.**

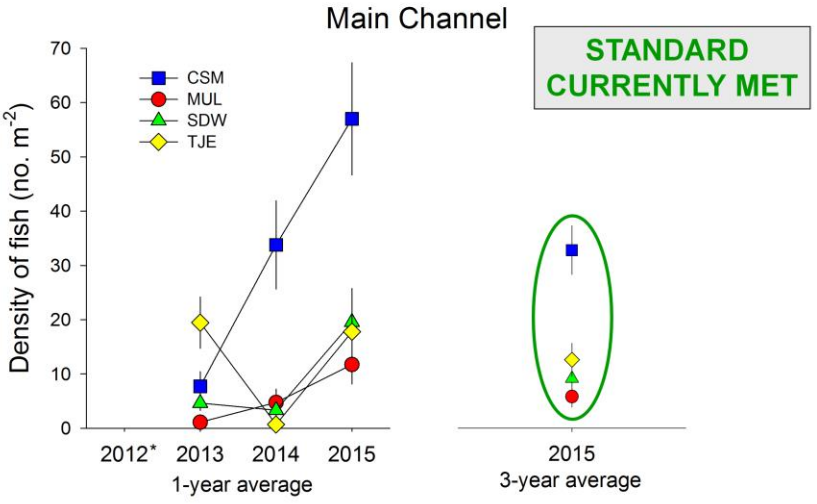
- This slide summarizes the general sampling design for fish.
- This general design is also used for macro-invertebrates.
- San Dieguito Wetlands and the 3 reference wetlands are sampled in late summer-fall.
- Six tidal creeks and 6 sections of main channel/basin are sampled in each wetland.
- The creeks or sections of main channel/basin that are sampled are treated as replicates.
- Because tidal creeks and main channels differ in width, water depth, hydrology, and thus the likelihood that they will support different assemblages of fish and macroinvertebrates, tidal creeks and main channels are assessed separately.

Methods of Assessing the Density and Species Richness of Wetland Fish

- **Two methods are used: enclosure traps and blocked beach seines.**
- **Densities and species richness of fish are calculated for each creek or section of main channel/basin.**
- **Density and species richness values averaged across the 6 creeks or 6 sections of main channel/basin are used to compare wetlands.**

- This slide provides the methods of assessing the density and species richness of wetland fish.
- Two methods are used: enclosure traps (for gobies and other comparably sized fish) and blocked beach seines (larger fish).
- The densities and species richness of fish are computed for each sampled creek or section of main channel/basin.
- These density and species richness values are averaged across the 6 creeks or 6 sections of main channel/basin and used to compare wetlands.

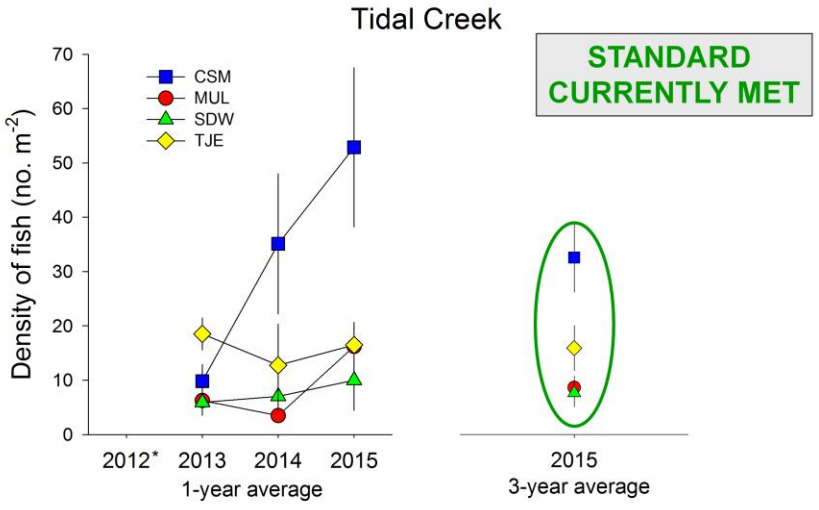
Performance Standard: Fish Total Density



*2012 enclosure samples only

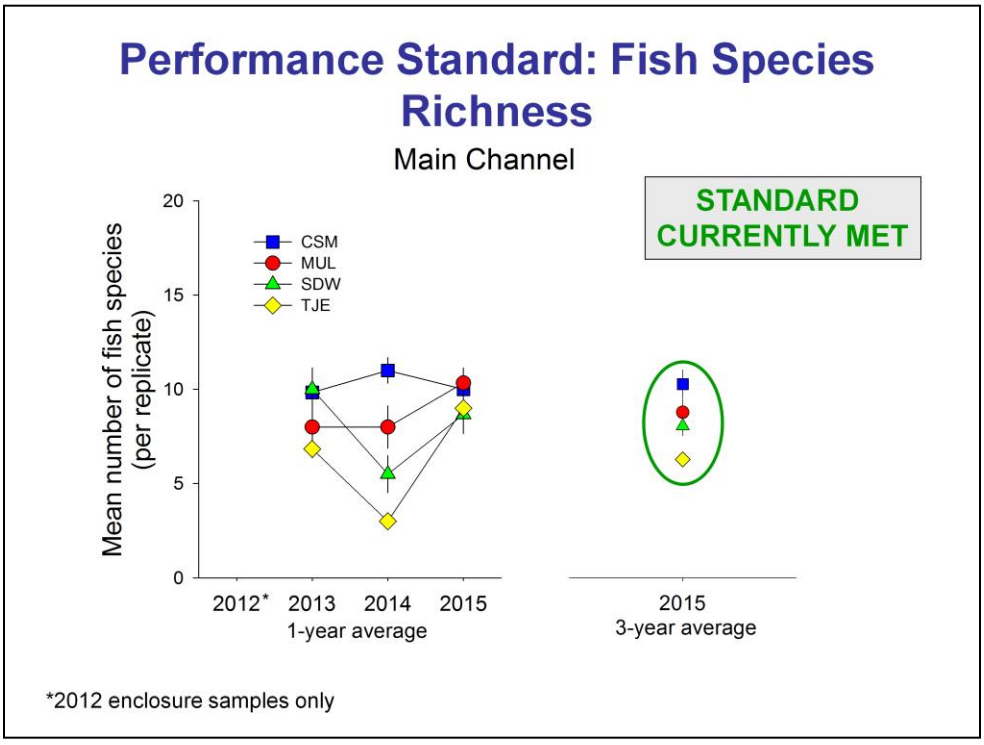
- This slide shows the monitoring results for fish total density as mean number per m2 for Main Channel habitat.
- Clapper Rail nesting in Tijuana Estuary prevented sampling using seines in 2012.
- However, we were able to sample using enclosure traps and seines in Tijuana Estuary in 2013 through 2015.
- As a result only data from 2013 through 2015 and a 3 year running average are presented.
- For the 3 year running average, fish density in main channel habitat in San Dieguito Wetlands was not significantly lower than the lowest reference wetland.
- Therefore, the standard for fish density in main channel habitat is currently met.

Performance Standard: Fish Total Density

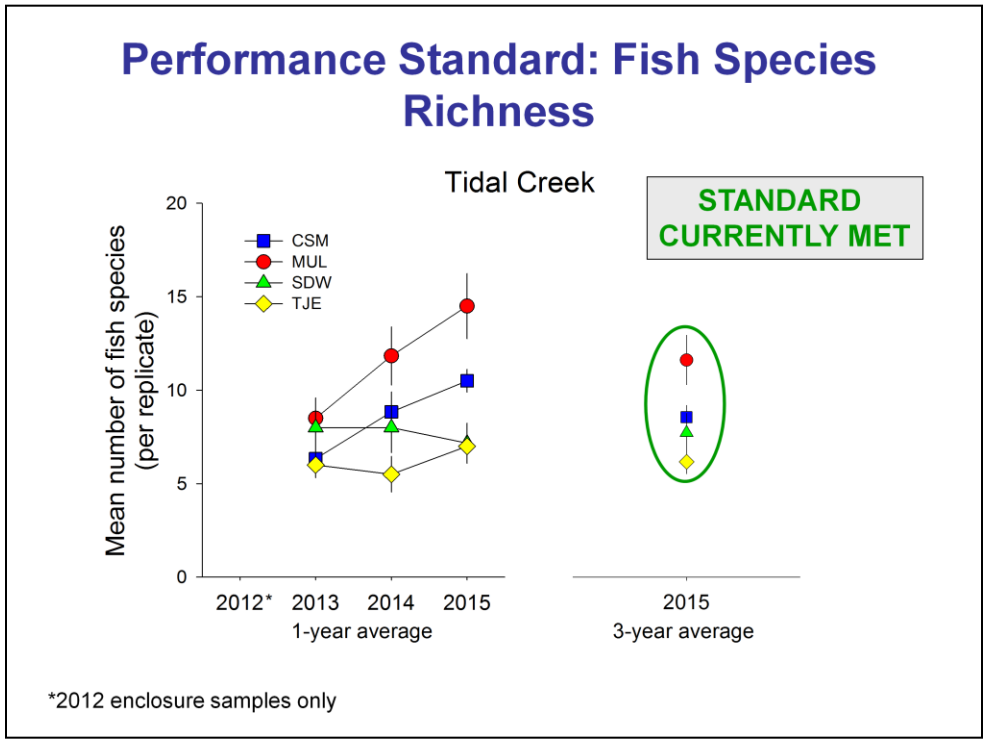


*2012 enclosure samples only

- This slide shows the annual monitoring results for fish total density as mean number per m2 for Tidal Creek habitat.
- Again, we were able to sample using enclosure traps and seines in Tijuana Estuary in 2013 through 2015.
- For the 3 year running average, fish density in tidal creek habitat in San Dieguito Wetlands was not significantly lower than the lowest reference wetland.
- Therefore, the standard for fish density in tidal creek habitat is currently met.



- This slide shows the annual monitoring results and 3 year running average for fish species richness, as mean number of species per main channel replicate.
- Looking at the running average, fish species richness in main channel in San Dieguito Wetlands was not significantly lower than the lowest performing reference wetland.
- Therefore, the restored wetland currently meets the standard for fish species richness in main channel habitat.



- This slide shows the annual monitoring results and 3 year running average for fish species richness in tidal creek habitat, as mean number of species per tidal creek replicate.
- Looking at the running average, fish species richness for tidal creeks in San Dieguito Wetlands was not significantly lower than the lowest performing reference wetland.
- Therefore, the restored wetland currently meets the standard for fish species richness in tidal creek habitat.

Performance Standard: Macroinvertebrates

Within 4 years of construction, the total densities and number of species of macroinvertebrates shall be similar to the densities and number of species in similar habitats in the reference wetlands

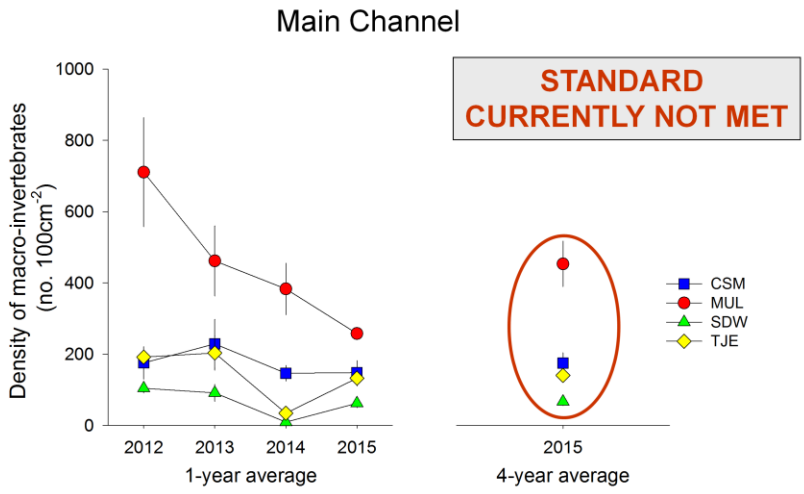
- The relative performance standard for macroinvertebrates requires that within 4 years of construction, the total densities and number of species of macroinvertebrates shall be similar to the densities and number of species in similar habitats in the reference wetlands.

Methods of Assessing the Density and Species Richness of Wetland Macroinvertebrates

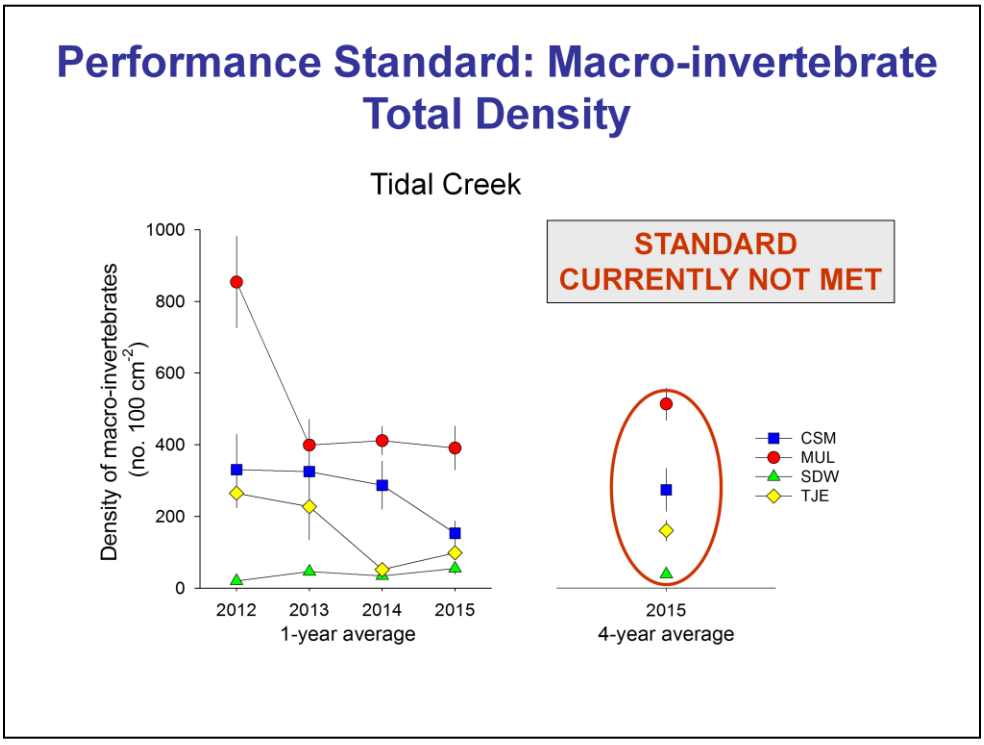
- **Three sampling methods: small and large cores for infauna. Epifauna counted in quadrats.**
- **Densities and species richness of macro-invertebrates are calculated for each tidal creek or section of main channel/basin.**
- **Density and species richness values averaged across the 6 creeks or 6 sections of main channel/basin used to compare wetlands.**

- Three sampling methods are used to sample macroinvertebrates: small (3.5 cm diameter) and large (10 cm diameter) cores are used to sample small and large infauna, respectively. Epifauna also counted in 25 cm x 25 cm quadrats.
- The densities and species richness of macro-invertebrates are calculated for each creek or section of main channel/basin.
- Density and species richness values are averaged across the 6 creeks or 6 sections of main channel/basin and used to compare wetlands.

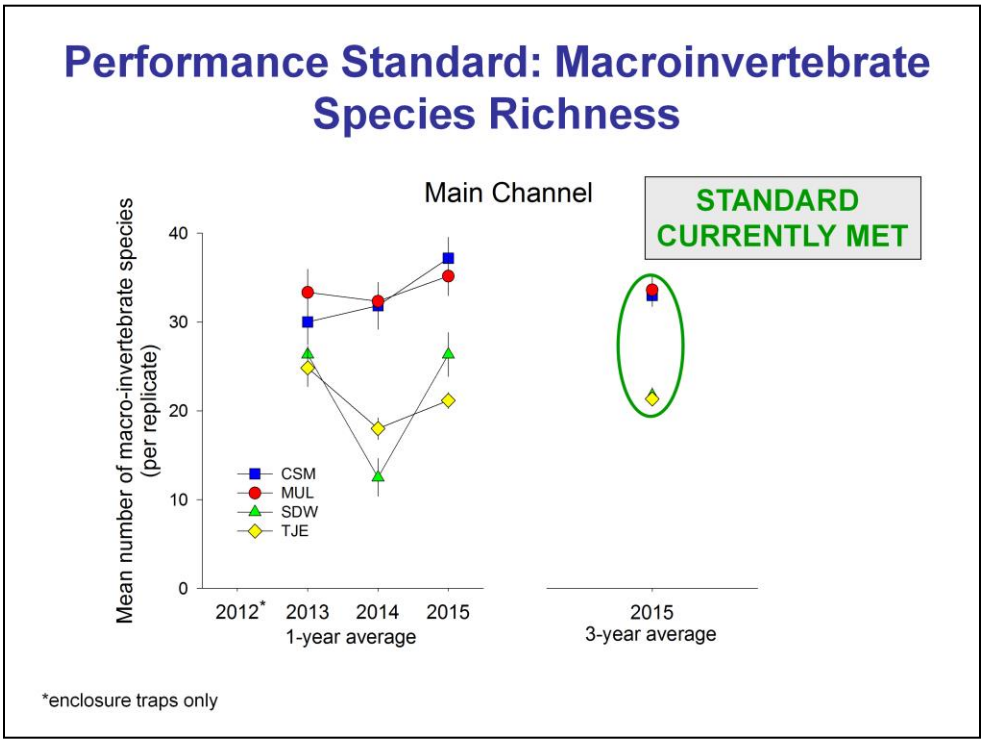
Performance Standard: Macro-invertebrate Total Density



- This slide shows the monitoring results for macroinvertebrate total density, as mean number per 100 cm2, in main channel habitat.
- The four year running average of density of invertebrates was lower at San Dieguito than in the lowest performing reference wetland for main channels and thus is not similar to the reference wetlands.
- Therefore, the performance standard for macroinvertebrate density in the main channels of San Dieguito Wetlands is currently not met.

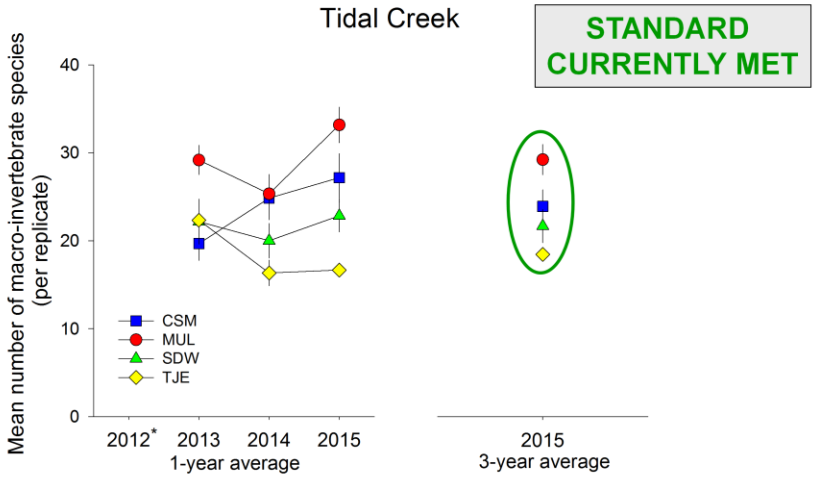


- This slide shows the monitoring results for macroinvertebrate total density in tidal creek habitat.
- The four year running average of density of invertebrates was lower in San Dieguito than in the lowest performing reference wetland for tidal creeks and thus is not similar to the reference wetlands.
- Therefore, the performance standard for macroinvertebrate density in the tidal creeks of San Dieguito Wetlands is currently not met.



- This slide shows the monitoring results for macroinvertebrate species richness, as mean number of macroinvertebrate species per section of main channel habitat.
- The three year running average of species richness of invertebrates is presented here because larger invertebrates captured during seining sampling for fish are used to compute species richness and seining was not conducted in 2012 because of Clapper Rail nesting.
- The three year running average for species richness of macroinvertebrates at San Dieguito was not different than the lowest performing reference wetland for main channel.
- Therefore, the performance standard for macroinvertebrate species richness in main channel habitat of San Dieguito Wetlands is currently met.

Performance Standard: Macroinvertebrate Species Richness



*enclosure traps only

- This slide shows the monitoring results for macroinvertebrate species richness in tidal creeks.
- Again, the three year running average of species richness of invertebrates is presented here because seine sampling, used together with core sampling to compute species richness, was not conducted in 2012.
- The three year running average for species richness of macroinvertebrates in tidal creek habitat at San Dieguito was higher than the lowest performing reference wetland.
- Therefore, the performance standard for macroinvertebrate species richness in tidal creek habitat of San Dieguito Wetlands is currently met.

Performance Standard: Vegetation

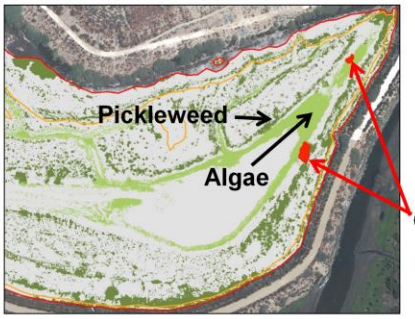
The proportion of total vegetation cover and open space in the marsh shall be similar to those proportions found in the reference sites. The percent cover of algae shall be similar to the percent cover found in the reference wetlands

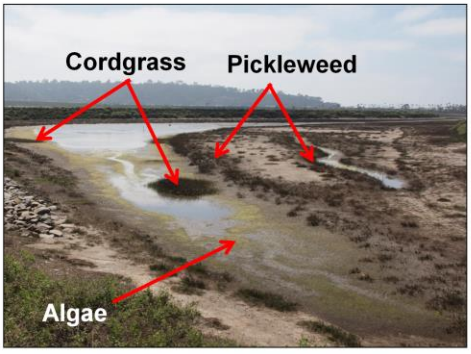
San Dieguito Wetlands (W5)
March 2016

- The performance standard for vegetation also a relative standard, requires that the proportion of total vegetation cover and open space in the marsh shall be similar to those proportions found in the reference sites. The percent cover of algae shall be similar to the percent cover found in the reference wetlands.

Methods of Assessing the Cover of Vegetation and Algae

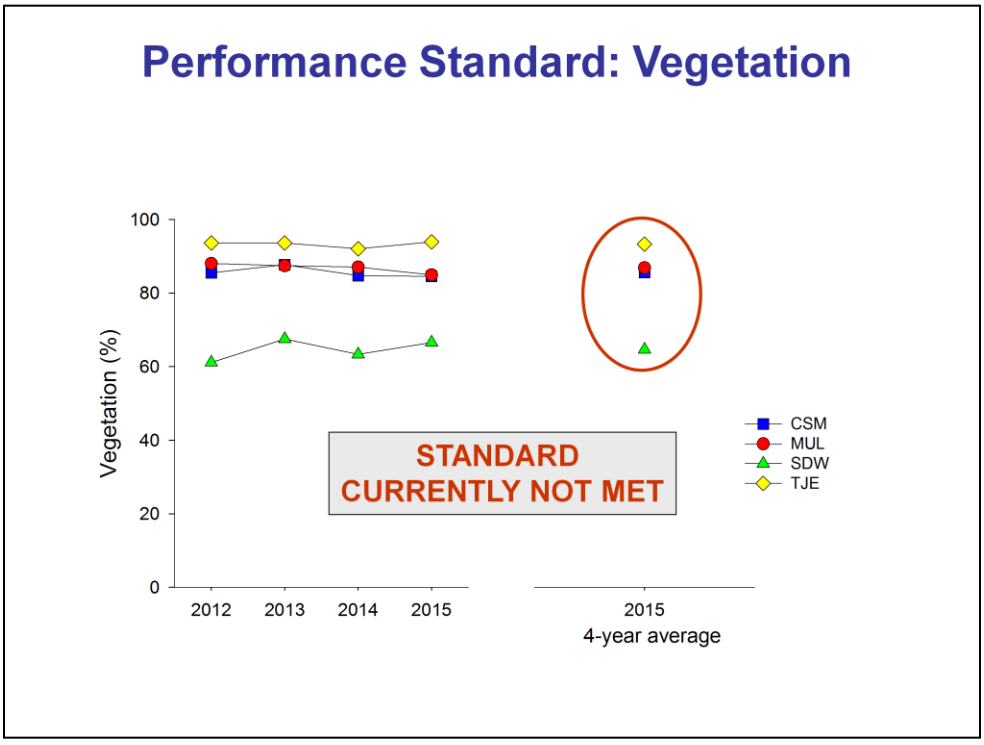
- **Estimates of percent cover of vegetation and algae are made using aerial images taken in late May-early June.**
- **Wetland wide cover estimates of vegetation and algae are compared among wetlands.**



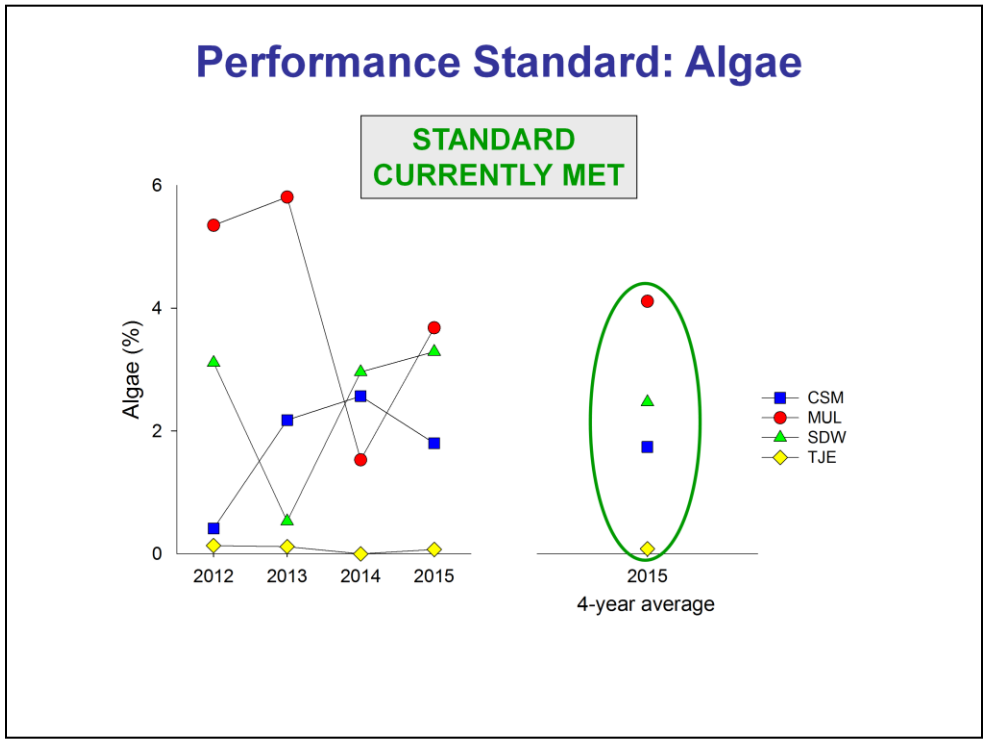


Salt marsh vegetation and algae in San Dieguito Wetlands (W16)
March 2016

- Estimates of percent cover of vegetation and algae in San Dieguito Wetlands and the reference wetlands are made using aerial imagery taken in the late spring or summer.
- Wetland wide estimates of vegetation and algal cover are compared between San Dieguito Wetlands and the reference wetlands.



- This slide compares the cover of vegetation in the San Dieguito Wetlands to the reference wetlands.
- Although vegetation is colonizing the restored wetland and is more widely distributed, it has not yet filled in to the point where we see an increase in cover.
- The four year running average of cover of vegetation was lower at San Dieguito compared with the lowest performing reference wetland and thus is not yet similar to the reference wetlands.
- Therefore, this relative standard for Vegetation is currently not met.



- This slide compares the cover of macroalgae in San Dieguito Wetlands to macroalgal cover in the reference wetlands.
- A high cover of macroalgae can indicate eutrophic conditions or poor tidal circulation and can be detrimental to estuarine health.
- For this standard, we evaluate algal cover relative to the reference wetlands with the highest of cover of macroalgae, since excessive cover may be detrimental.
- For the four year running average, macroalgal cover in San Dieguito Wetlands was lower than the value in the reference wetland with the highest cover.
- Therefore, the relative standard for Algae is currently met.

Performance Standard: *Spartina* Canopy Architecture

The restored wetland shall have a canopy architecture that is similar in distribution to the reference sites, with an equivalent proportion of stems over 3 feet tall

- Spartina was planted throughout the restoration site to provide habitat for the light foot clapper rail, now Ridge's Rail and other species.
- The performance standard for Spartina specifies that the restored wetland shall have a canopy architecture that is similar in distribution to the reference sites, with an equivalent proportion of stems over 3 feet tall.
- This standard is only evaluated relative to Tijuana Estuary because as mentioned earlier Spartina is absent in Carpinteria Salt Marsh and was rare in Mugu Lagoon.

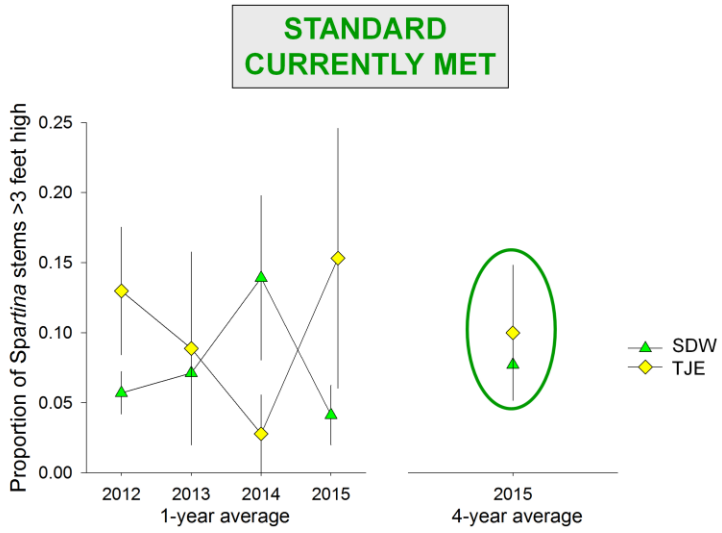
Method of Assessing *Spartina* Canopy Architecture

- **Four patches of *Spartina* sampled in San Dieguito Wetlands & Tijuana Estuary.**
- **Maximum heights (excluding flowering stalks) of all stems in 10 0.1 m^2 quadrats placed in each patch were recorded.**
- **Mean proportion of stems >3 feet tall, calculated using patches as replicates, is compared between wetlands.**

Assessing *Spartina* canopy

- This slide summarizes the method of assessing Spartina canopy architecture which is identical to the methods developed by Zedler, 1993 that are currently in use in the Tijuana Estuary.
- Four patches of *Spartina* at least 20 m in extent are sampled in San Dieguito Wetlands and Tijuana Estuary.
- *Spartina* sampled in 0.1 m2 quadrats placed every 2 m along a 20 m long transect in each patch.
- Maximum heights (excluding flowering stalks) of all stems present in the quadrat were recorded.
- The mean proportion of stems >3 feet (91 cm) tall, calculated using patches as replicates, is compared between wetlands.

Standard: *Spartina* Canopy Architecture



- This slide compares the mean proportion of stems >3 feet tall in San Dieguito Wetlands than to Tijuana Estuary.
- There is quite a bit of variability in these data—we believe that the decline in the height of stems in San Dieguito was due to the increased inundation of Spartina as a result of higher water levels in the wetland.
- Nevertheless, the four running average of mean proportion of stems >3 feet (or 91 cm) tall was similar between San Dieguito Wetlands and Tijuana Estuary.
- Therefore, this relative standard for Spartina canopy architecture is currently met.

Performance Standard: Food Chain Support

The food chain support provided to birds shall be similar to that provided by the reference sites, as determined by feeding activity of the birds

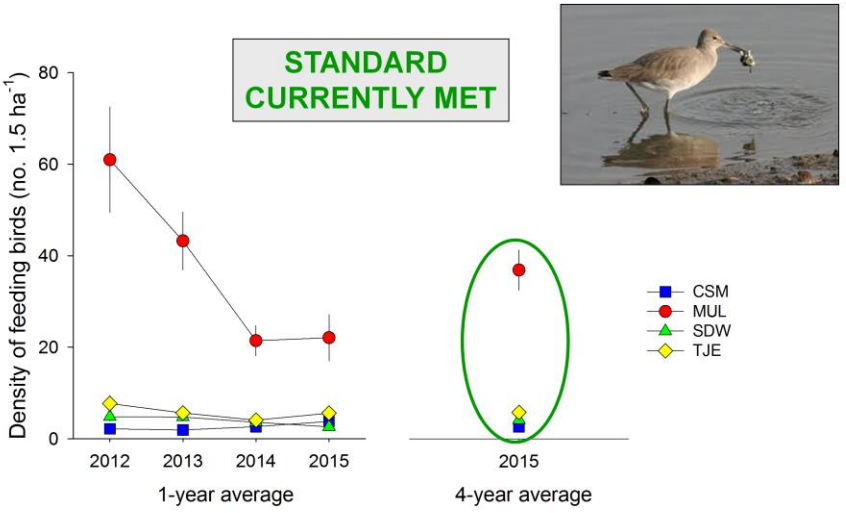
- Food chain support is one of the more important functions of coastal wetlands.
- This standard specifies that the food chain support provided to birds shall be similar to that provided by the reference sites, as determined by feeding activity of the birds.

Methods Used to Assess Food Chain Support

- **Evaluated at the same time that birds are sampled to determine density and species richness.**
- **Density of feeding birds in each of selected plots consists of average across the 18 survey dates.**
- **Mean densities of feeding birds in San Dieguito Wetlands are compared to densities at the reference wetlands.**

- This standard is evaluated during the period that birds are sampled to determine density and species richness.
- A bird is recorded as feeding if one feeding attempt is made over a five minute time interval.
- The density of feeding birds in each of the selected plots consists of the average across the 18 survey dates.
- Mean densities of feeding birds computed across plots in the restored wetland is compared to that of the reference wetlands.

Performance Standard: Food Chain Support



- This slide compares the feeding activity of birds as mean number of feeding birds per plot between San Dieguito Wetlands and the reference wetlands.
- Mugu consistently had the highest density of feeding birds.
- However, the four year running average of feeding activity was not significantly lower at San Dieguito compared with the reference wetlands.
- Therefore, the relative standard for Food Chain Support is currently met.

Summary of Assessment for Absolute Standards

ABSOLUTE STANDARDS	2015
1. Habitat Areas	NO
2. Tidal Prism	YES
3. Topography	YES
4. Plant Repoductive Success	YES
5. Exotic Species	YES
NUMBER OF ABSOLUTE STANDARDS MET	4

The San Dieguito Wetlands Restoration met 4 of the 5 absolute standards in 2015

- To review, this slide shows a summary evaluation of the absolute performance standards for 2015.
- The San Dieguito Wetlands Restoration met 4 of the 5 absolute standards in 2015. The restoration did not meet the requirement of the Habitat Areas standard.

Summary Assessment for Relative Standards 2015

	RELATIVE STANDARDS	SDW	TJE	MUL	CSM
		4 year*	4 year	4 year	4 year
1	Water Quality	YES	YES	YES	YES
2	Bird Density	YES	YES	YES	YES
3	Bird Species Richness	YES	YES	YES	NO
4	Fish Density - Main Channels	YES	YES	NO	YES
5	Fish Species Richness - Main Channels	YES	NO	YES	YES
6	Fish Density - Tidal Creeks	YES	YES	YES	YES
7	Fish Species Richnes - Tidal Creeks	YES	YES	YES	YES
8	Macro-invertebrate Density - Main Channels	NO	YES	YES	YES
9	Macro-invertebrate Species Richness - Main Channels	YES	YES	YES	YES
10	Macro-invertebrate Density - Tidal Creeks	NO	YES	YES	YES
11	Macro-invertebrate Species Richness - Tidal Creeks	YES	YES	YES	YES
12	Vegetation Cover	NO	YES	YES	YES
13	Algae Cover	YES	YES	NO	YES
14	Food Chain Support - Bird Feeding	YES	YES	YES	NO
15	Spartina Canopy Architecture**	YES	YES		
	PROPORTION OF RELATIVE STANDARDS MET	0.800	0.933	0.857	0.857

*shaded cells are 3 yr running averages

**SDW compared to TJE only

The San Dieguito Wetlands Restoration received a lower proportion of "YES" than the lowest performing reference wetlands (MUL, CSM) in 2015

- This table provides a summary assessment of the relative performance standards for 2015 using the 4 year running average.
- For standards in which only 3 years of data are available, the 3 year running average is used.
- "Yes" indicates that the performance variable at a particular wetland is similar to the other wetlands.
- Comparing the running averages, Tijuana was the best performing wetland with a higher proportion of standards met than the other wetlands.
- San Dieguito Wetlands received a lower proportion of "YES" than Mugu Lagoon and Carpinteria Salt Marsh, the reference sites with the lowest proportion of "YES"
- Therefore, San Dieguito Wetlands did not meet the relative standards for 2015.
- The SONGS permit also has special requirements for the Biological Communities standards, those standards that pertain to birds, fish, and macroinvertebrates.

Summary Assessment for Biological Community Standards 2015

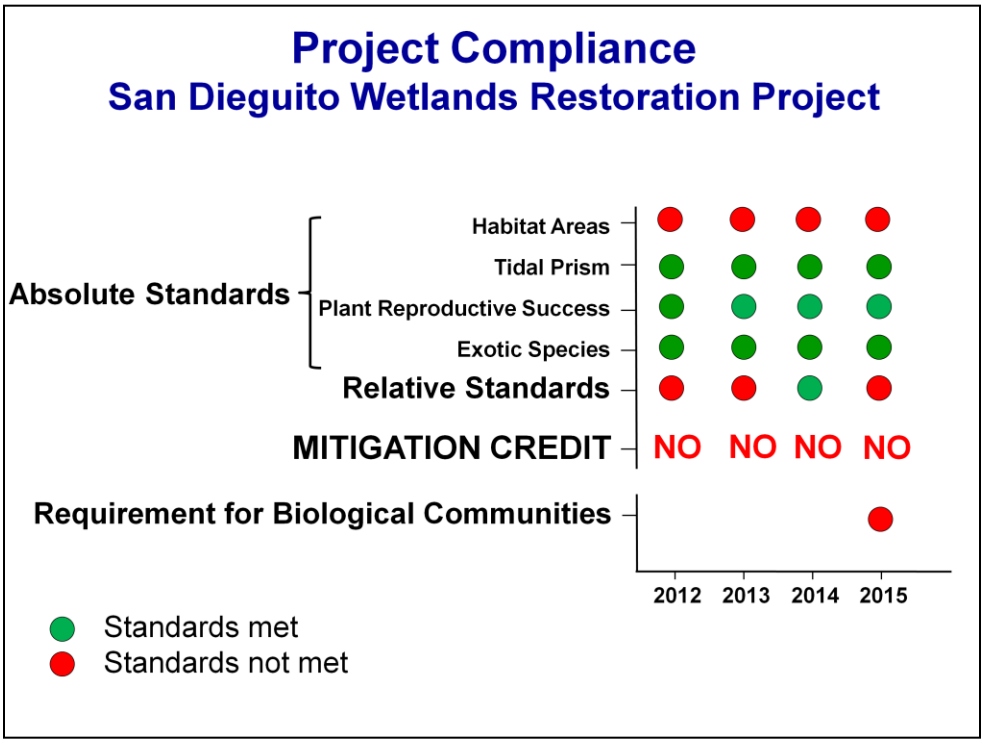
Biological Communities. Within 4 years of construction, the total densities and number of species of birds, fish, and macro-invertebrates shall be similar to the densities and number of species in similar habitats in the reference wetlands.

BIOLOGICAL COMMUNITY STANDARDS	SDW	TJE	MUL	CSM
	4 year*	4 year	4 year	4 year
Bird Density	YES	YES	YES	YES
Bird Species Richness	YES	YES	YES	NO
Fish Density - Main Channels	YES	YES	NO	YES
Fish Species Richness - Main Channels	YES	NO	YES	YES
Fish Density - Tidal Creeks	YES	YES	YES	YES
Fish Species Richnes - Tidal Creeks	YES	YES	YES	YES
Macro-invertebrate Density - Main Channels	NO	YES	YES	YES
Macro-invertebrate Species Richness - Main Channels	YES	YES	YES	YES
Macro-invertebrate Density - Tidal Creeks	NO	YES	YES	YES
Macro-invertebrate Species Richness - Tidal Creeks	YES	YES	YES	YES
PROPORTION OF BIOLOGICAL COMMUNITY STANDARDS MET	0.800	0.900	0.900	0.900

* Shaded cells are 3-year running averages

The San Dieguito Wetlands Restoration received a lower proportion of "YES" than the reference wetlands in 2015

- This table provides a summary assessment of the relative performance standards that pertain to Biological Communities for 2015.
- Within 4 years of construction, the total densities and number of species of fish, macroinvertebrates and birds shall be similar to the densities and number of species in similar habitats in the reference wetlands.
- These standards are evaluated as a subset of the relative performance standards—the San Dieguito Wetlands must perform at least as well as the worst performing reference wetland.
- Again, a "Yes" indicates that performance variable at a particular wetland is similar to the other wetlands.
- The gray shaded areas indicate those standards for which 3 year running averages are used.
- Comparing the running averages, San Dieguito Wetlands received a lower proportion of "YES" than the reference wetlands.
- This was due to the under performance of invertebrate density in the main channels and tidal creeks compared to the reference wetlands.
- Therefore, San Dieguito Wetlands has not yet met the requirement that the standards for Biological Communities be met in 4 years.



- 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, primarily due to slow vegetation development.
- In addition, the project has failed to meet the Relative Standard requirement in 3 out of 4 years, and the Biological Communities requirement, due to the underperformance of macro-invertebrate densities in tidal creeks and main channels relative to the reference wetlands.
- While there are many encouraging signs that the wetland in providing habitat and food chain support for wetland plants and animals, it has not yet satisfied the performance success criteria in the SONGS permit and has not yet received mitigation credit.

On-going Activities and Future Plans for 2016

- **Continue performance monitoring as required by the SONGS Permit.**
- **Analyze existing data to examine reasons for the underperformance of macro-invertebrate densities and vegetation cover.**
- **Consult with CCC staff and SCE regarding next steps to address the under performance of macro-invertebrate densities and vegetation cover to bring the project into compliance with the SONGS permit.**

- On-going activities and future plans moving forward include continue performance monitoring in 2016 as required by the SONGS permit.
- Analyze existing data to assist in discussions pertaining to the reasons for the underperformance of macro-invertebrate densities and vegetation cover.
- Consult with Coastal Commission staff and SCE regarding next steps to address the under performance of vegetation cover and invertebrate densities to bring the project into compliance with the SONGS permit.