

Introduction and Overview

Annual Review Workshop for SONGS Wetland Mitigation



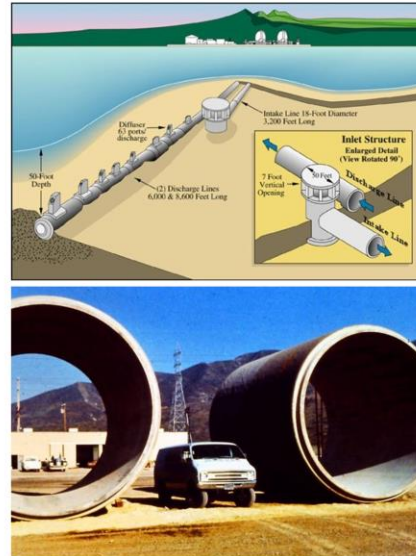
May 12, 2014

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

Wetland Mitigation Linked to the Adverse Effects of the SONGS Cooling Water System

(San Onofre Nuclear Generating Station = SONGS)

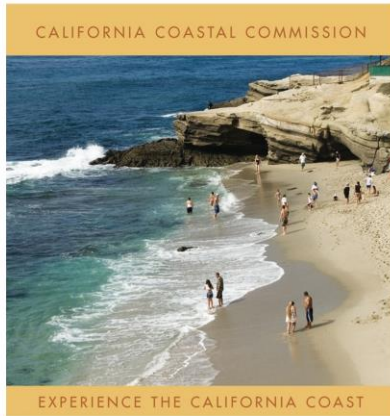
- **SONGS reactors are cooled by a single pass seawater system.**
- **Units 2 and 3 have separate intake lines located in about 30 feet of water offshore of the power plant.**
- **Power plant heated cooling water and turbulence kills fish eggs, larvae and small immature fish.**
- **SONGS operations projected to cause substantial reductions in populations of adult nearshore fish in the Southern California Bight.**



- Some background is important for understanding the purpose and rationale for the SONGS wetland mitigation project.
- The SONGS reactors are cooled by a single pass seawater system.
- Units 2 and 3 have separate intake lines that are located in about 30 feet of water offshore of the power plant
- The water is elevated 19 deg F above ambient in the plant and then discharged through an extensive diffuser system designed to dissipate the heat.
- Power plant heated cooling water kills fish eggs, larvae and small immature fish; these losses are projected to cause substantial reductions in populations of adult fish in the Southern California Bight.
- Construction of Units 2 and 3 was found to be consistent with the Coastal Act only if these significant adverse impacts to fish would be mitigated.

The California Coastal Act Requires Mitigation of SONGS Marine Impacts

California Coastal Commission (CCC) responsible
for implementing the Coastal Act



As mitigation for the impacts to larval and juvenile fish caused by SONGS the CCC required SCE to:

- **Create or substantially restore a minimum of 150 acres of wetlands, excluding buffer zone and upland transition area.**
- **Provide funding for scientific oversight and monitoring of the restoration project that is *independent* of SCE.**

- The California Coastal Act requires the mitigation of SONGS marine impacts.
- Enforcement of the Coastal Act resides with the California Coastal Commission (CCC).
- As mitigation for the impacts to larval and juvenile fish caused by SONGS the CCC required SCE to:
 - Create or substantially restore a minimum of 150 acres of wetlands, excluding buffer zone and upland transition area.
 - Provide funding for scientific oversight and monitoring of the restoration project that is *independent* of SCE.

Key Elements of the SONGS Wetland Mitigation Project

- **Out-of-kind compensation for in-plant losses of larval and juvenile fish caused by the operation of SONGS Units 2 & 3.**
- **Physical and biological standards were established to evaluate the performance of the wetland restoration project.**
- **One year of mitigation credit is given for each year that the San Dieguito Wetlands Restoration Project meets the performance standards.**
- **Fulfillment of the SONGS wetland mitigation requirement occurs when the number of years of mitigation credit accrued by the San Dieguito Wetlands Restoration Project equals the total years of operation of SONGS Units 2 & 3, including the decommissioning period to the extent that there is continuing discharge of cooling water.**

- To summarize key elements of the SONGS Wetland Mitigation Project:
- The mitigation project is out-of-kind compensation for in-plant losses of larval and juvenile fish caused by the operation of SONGS Units 2 & 3.
- Physical and biological standards were established to evaluate the performance of the wetland restoration project to ensure that the restored wetland provides ecosystem functions that are similar to relatively undisturbed tidal wetlands in the region.
- One year of mitigation credit is given for each year that the San Dieguito Wetlands Restoration Project meets the performance standards.
- Fulfillment of the SONGS wetland mitigation requirement occurs when the number of years of mitigation credit accrued by the San Dieguito Wetlands Restoration Project equals the total years of operation of SONGS Units 2 & 3, including the decommissioning period to the extent that there is continuing discharge of cooling water.
- Independent monitoring of project performance is done by university scientists from UCSB who report to the CCC and not SCE.

Current Status of SONGS Units 2 & 3

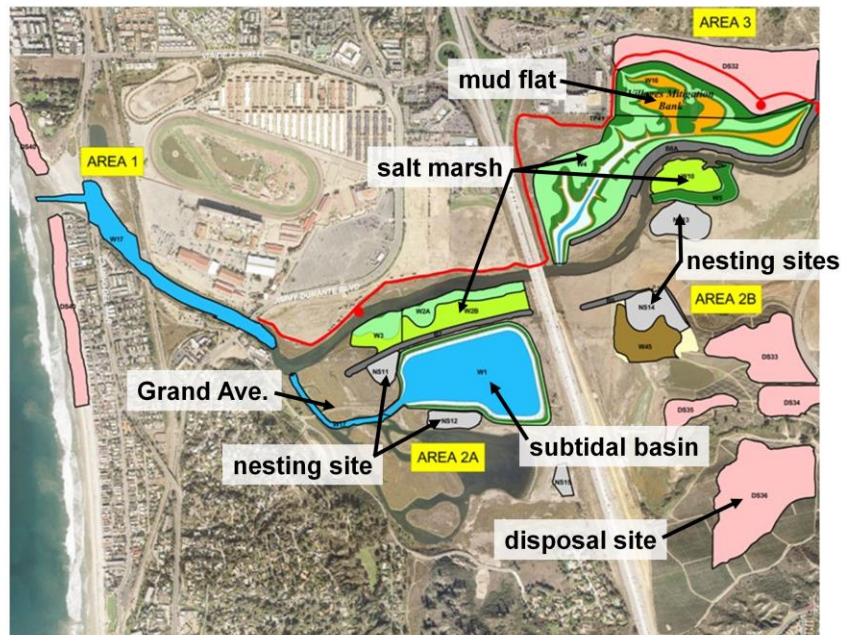
- **January 2012 – Power generation suspended**
- **June 7, 2013 – Decision to shutdown**
- **July 22, 2013 – Certification of permanent cessation of power operations**
- **Operating license modified to “possession only”**
 - **No longer authorized to operate the reactors or place fuel in reactors**
- **Since the shutdown, the flow in each unit has been reduced to about 49 million gallons per day or roughly 4% of the normal operating flow.**

- The operations of SONGS Units 2 & 3 were suspended in January 2012 due to premature wear of replacement steam generators.
- SCE made the decision to shutdown the plant in early June, 2013.
- The operating license has been modified to “possession only” and they are no longer authorized to operate the reactors.
- Since the shutdown, the flow in each unit has been reduced to about 49 million gallons per day or roughly 4% of the normal operating flow.
- Marine impacts caused by SONGS cooling water system are thus expectedly much less under the current flow conditions.



- This map shows the locations of SONGS, the impact site, the San Dieguito Lagoon, site of the San Dieguito Wetlands Restoration Project, and 3 wetlands that are used as reference sites to evaluate the performance of the restoration project: Carpinteria Salt Marsh, Mugu Lagoon, and Tijuana Estuary.

San Dieguito Wetlands Restoration Design



Source: Final Restoration Plan for San Dieguito Wetlands

- This slide shows the design plan view of the restoration project that was approved by the CCC.
- For reference, this is the Del Mar Racetrack, San Dieguito River and inlet to the Pacific Ocean, and I5 Freeway.
- The project included excavation and grading to tidal elevations capable of supporting tidal salt marsh, indicated by shades of green, mudflat, indicated by the light brown, and subtidal habitats, indicated by blue.
- In addition, 4 nesting sites, shown in gray, were constructed, which are not part of the SONGS mitigation requirement.
- The areas in pink are disposal sites that received the majority of the 2.2 million cubic yards of material excavated during construction of the wetland.
- The yellow boxes that indicate Areas 1, 2a, 2b, and 3 pertain to the staging of construction activities.

Construction Timeline

Start date **September 2006**

Project Task **Completion Date**

Construction of:

W1	Jan 2008
W4/W16 & W5/W10	Dec 2008
W2/W3	
Initial grading	Feb 2008
Tidal creeks	Nov 2010
Re-grading	Mar 2014

Berms	Feb 2009
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Additional wetland (Grand Ave)	Feb 2011
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Planting:

W1	Jan 2009, Nov 2011
W4/W16 & W5/W10	Feb 2009, Nov 2011
W2/W3	Nov 2009

Final inlet dredging	September 2011
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- This slide summarizes the construction timeline.
- Construction began in September of 2006.
- Wetland construction was organized by area and module -- most excavation and grading was completed by 2008, with the addition of tidal creeks in W2/3 completed in November 2010, and re-grading of this area to lower elevations in March 2014.
- Planting of salt marsh plants, including cordgrass, *Spartina* in the low marsh was completed in 2011.
- Final inlet channel dredging was completed in September 2011.
- We've completed the second year of performance monitoring, which is what we will be talking about today.

San Dieguito Lagoon before excavation and grading (2003)



- This slide shows a satellite view of the project site before excavation and grading.
- You can see the San Dieguito River and adjoining ruderal upland, including the site of an old WWII airfield, and old agricultural fields.
- You can also see a portion of a basin that was constructed in the 1980's termed the Fish and Game Basin.

San Dieguito Lagoon after excavation and grading (2013)



- During construction, the ruderal areas and old agricultural fields were excavated and graded to create the planned intertidal and subtidal wetland habitats of the restoration project.

Monitoring of Wetland Performance

- **Annual monitoring required to evaluate physical and biological performance standards provided in SONGS permit.**
- **Monitoring tracks ecosystem development and identifies adaptive management opportunities pertaining to physical and biological functioning of wetland.**
- **Independent monitoring is conducted by scientists from UCSB with advice from a Science Advisory Panel.**



- Following construction, annual monitoring is required to evaluate the physical and biological performance standards provided in the SONGS coastal development permit.
- Monitoring also tracks ecosystem development and identifies adaptive management opportunities pertaining to the physical and biological functioning of the wetland.
- Independent monitoring is conducted by scientists from UCSB with advice from a Science Advisory Panel.

Update on Status of San Dieguito Wetlands Restoration

- **Biological resources**
- **Adaptive management & on-going management tasks**
- **Key findings for 2013**



**View of constructed habitat
(March 2013)**

- Turn to a brief overview of the status of the San Dieguito Wetlands Restoration, including the biological resources, adaptive management and on-going management tasks, and key findings for 2013.

Salt Marsh Vegetation Current Status

- A high cover of marsh vegetation is characteristic of relatively undisturbed, natural tidal wetlands in region.
- San Dieguito Wetlands Restoration entailed excavation and grading of 92 acres to tidal elevations capable of supporting salt marsh vegetation.
- Development of vegetation has varied throughout the wetland and is least developed in areas graded to higher tidal elevations.

Mugu Lagoon



San Dieguito Wetlands



- A high cover of salt marsh vegetation is characteristic of relatively undisturbed, natural tidal wetlands in the region, for example, Mugu Lagoon, one of the reference sites.
- San Dieguito Wetlands Restoration entailed excavation and grading of 92 acres to tidal elevations capable of supporting salt marsh vegetation.
 - Pickleweed (*Salicornia virginica*) and other species are expected to become established in the mid and high marsh through natural colonization and a planting program.
 - Cordgrass (*Spartina foliosa*) is expected to become established in low marsh and several thousand plants were planted at lower tidal elevations throughout the wetland.
- Development of vegetation has varied throughout the wetland, and is least developed in areas graded to higher tidal elevations.

Salt Marsh Vegetation - Cordgrass

Current Status



- Cordgrass is important nesting habitat for the Federally listed endangered Light-footed Clapper Rail.
- Latest planting was in November 2009.
- For the first couple of years following planting, cordgrass performed poorly, but since then establishment has been more promising, with the development in larger patches with a canopy architecture similar to that found in Tijuana estuary.

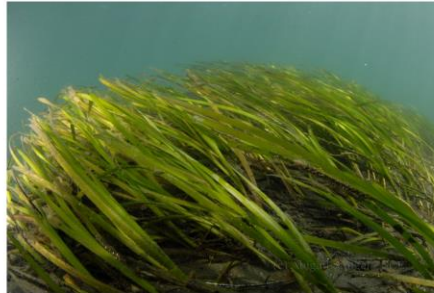
Salt Marsh Vegetation Adaptive Management

- Salt marsh vegetation has underperformed in portions of the restoration site.
- Monitoring has identified high tidal elevation and poor drainage as the cause of sparse vegetation.
- SCE has re-graded some of these areas lower to increase tidal inundation and improve drainage.

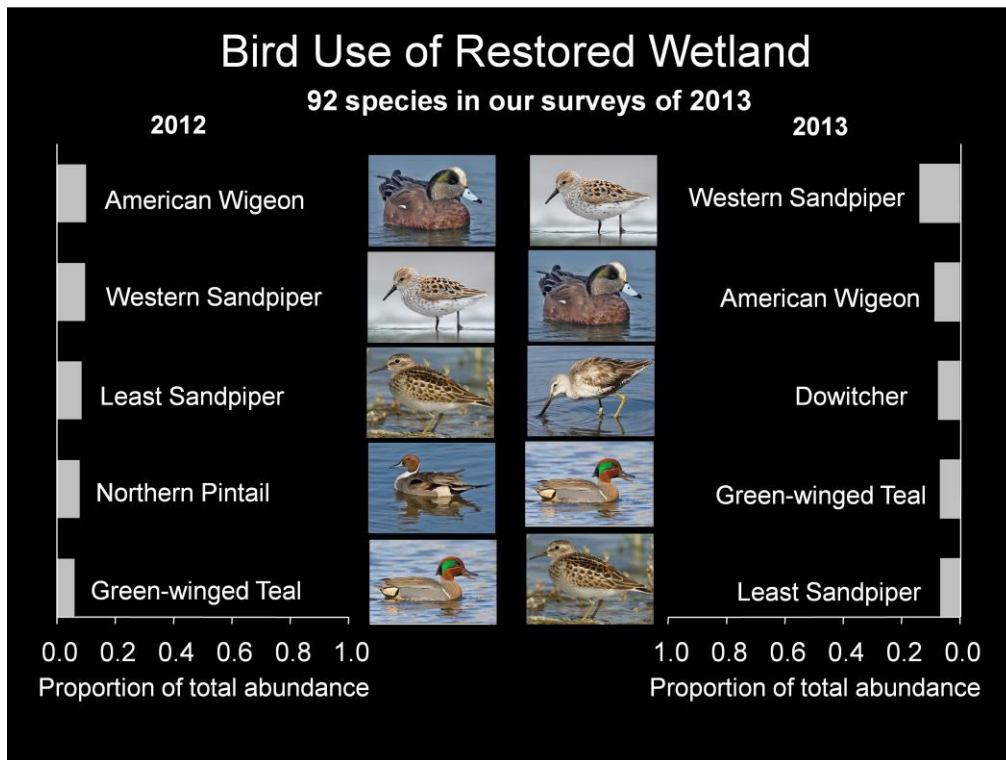


- However, vegetation has under performed in some portions of the restoration site, most noticeably on the west side of the freeway.
- In the top photo, taken in March 2013, you can see vegetation, pickleweed, that has colonized lower elevations, while the higher elevations are bare.
- Monitoring has identified high tidal elevation and poor drainage as the cause of sparse vegetation in this area
- SCE has been aware of this problem, and the area on the west side of the freeway was re-graded this March to lower tidal elevations and improve drainage, which should lead to the establishment of vegetation.

Restored wetland is providing habitat for invertebrates, fish, birds & eel grass



- In the second year of monitoring, the restored wetland is continuing to provide habitat for a diverse array of invertebrates, fish, and birds, and well as for eelgrass.



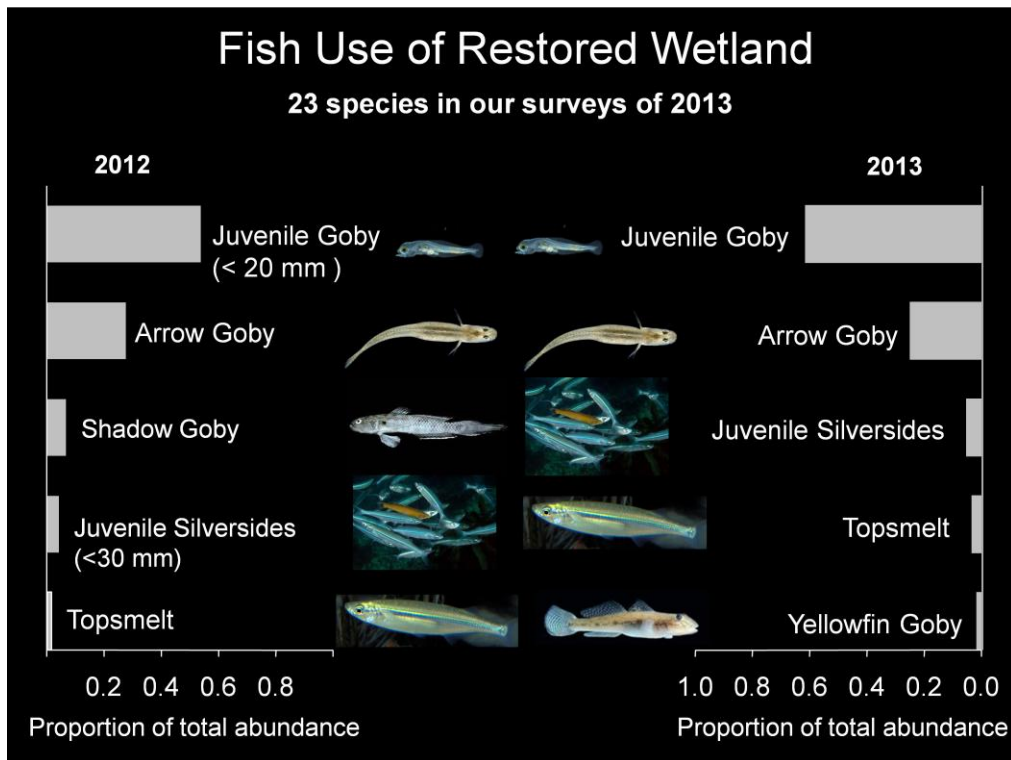
- During our surveys in 2013 we recorded 92 species of birds.
- 4 of the top 5 species in terms of abundance in 2013 were also the most abundant in 2012 and included shorebirds, Western and Least Sandpipers and ducks, American Wigeon and Green-winged Teal.

Bird Use of Restored Wetland

Examples of Other Sampled Species



- Examples of other sampled species are shown here and include Long billed Curlew and Common Egrets, found along the banks of tidal creeks and channels and on mudflats, the hooded merganser in the basin, the kingfisher on vegetation overlooking the basin, and Belding's Savannah Sparrow, which is a state listed endangered species, and red-winged blackbird in the vegetated marsh.



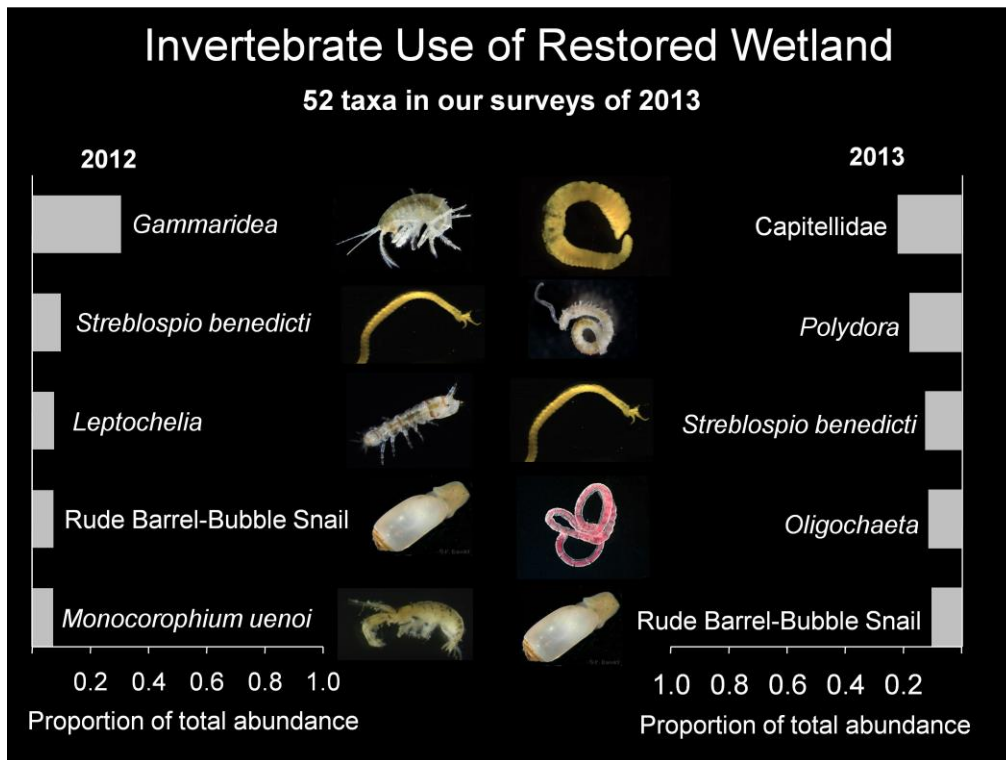
- During our surveys in 2013 we recorded 23 species of fish.
- Gobies were by far the most abundant of the fish sampled in the channels, basin, and tidal creeks of San Dieguito Wetlands in both 2012 and 2013.
- Gobies are small fish important in food chain support to larger fish and birds.
- Many of these gobies are so small that it is difficult to identify them to species in the field and thus are placed in the juvenile goby category.
- Topsmelt, members of the silverside family, which includes jacksmelt and grunion, were the next most abundant fish sampled.

Fish Use of Restored Wetland

Examples of Other Sampled Species



- Examples of some other species are shown here and include killifish, pipefish (get 3 species), staghorn sculpin, mudsuckers, diamond turbot and the round stingray (3 types of rays).



- During our surveys in 2013 we recorded 52 taxa of macroinvertebrates.
- Small worms and crustaceans were the most abundant of the invertebrates sampled in the channels, basin, and tidal creeks of San Dieguito Wetlands.
- Worms are typically found burrowed in the mud to a depth of a few centimeters.
- Other forms such as the small amphipod crustacean and bubble snail are found on the surface of the mud.
- These organisms are important in the food chain support of fish and birds.

Invertebrate Use of Restored Wetland

Examples of Other Sampled Taxa



- Examples of some other larger taxa that are found on the mud surface are shown here and include the California horn snail and the Bubble Snail, which feed on algae and the snail *Nassarius*, which is thought to be a scavenger.
- The remaining species are larger infauna, those forms that live in the sediment, and include the jackknife clam and ghost shrimp.

Eelgrass in Restored Wetland

- Eelgrass recruited to inlet channel and entrance to the W1 basin prior to the final inlet opening in September 2011.
- Eelgrass removed by final inlet channel construction transplanted to W1 in January 2011.
- Eelgrass covered ~80% of the bottom in W1 in 2012 and continues to cover most of the bottom in 2013.



- Eelgrass, which provides habitat for invertebrates and fish, recruited to the inlet channel and entrance to the basin, W1 prior to the final inlet opening in September 2011.
- Eelgrass removed by final inlet channel construction was transplanted to W1 in January 2011.
- There has been considerable recruitment of eelgrass.
- Eelgrass covered ~80% of the bottom of the W1 basin in 2012, and continues to cover most of the bottom in 2013.

On-going Management Tasks

Inlet Maintenance

- Inlet closure can adversely affect dissolved oxygen concentration.
- Partial blockage of the inlet by sand can affect drainage during low tides, leading to ponding.
- SCE has a maintenance plan to keep the inlet open to tidal exchange.
- Maintenance dredging of the inlet is scheduled for mid October 2014.

Inlet on April 23, 2014



- There are important on-going management tasks associated with ensuring that the restoration project is successful.
- One task concerns inlet maintenance.
- Inlet closure can adversely affect dissolved oxygen concentration in the lagoon and can lead to invertebrate and fish kills.
- Partial blockage of the inlet by sand can affect drainage during low tides, leading to ponding, and the death of cordgrass, which requires good tidal flushing and cannot tolerate continued submergence.
- SCE has an inlet maintenance plan that will keep the inlet open to avoid degradation in water quality, ponding, and loss of biological resources.
- Maintenance dredging of the inlet is scheduled for mid October 2014.

On-going Management Tasks

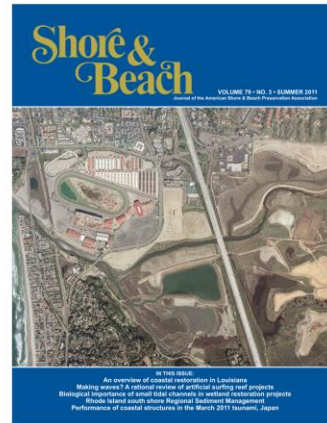
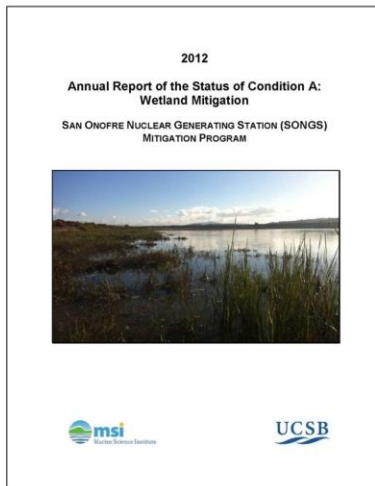
Non-native Species

- **Non-native species of plants are present around the edges of the restoration site.**
- **Some non-native species such as tamarisk tolerate high soil salinity and can move into the restoration site.**
- **SCE has an active weed abatement program to control weeds on the berms and disposal sites.**



- Another on-going management task is the control of non-native plants, which are present around the edges of the restoration site.
- Some non-native species such as tamarisk can tolerate high soil salinity and could move into the restoration site.
- Tamarisk has recruited into the restoration site, Steve immediately removed this specimen.
- SCE has an active weed abatement program to control weeds on the berms.

Broader benefits of monitoring



1. Provides information that helps guide future restoration efforts
2. Develops and refines sampling approaches
3. Contributes to an understanding of the natural history and ecology of coastal wetlands

- There are broader benefits of our monitoring program that extend beyond evaluating whether the restored wetland meets the performance standards provided in the SONGS permit.
- Our monitoring provides information that may help to guide future restoration efforts.
- It has lead to the development and refinement of sampling approaches
- Has is contributing to a better understanding of the natural history and ecology of wetland systems.

San Dieguito Wetlands Restoration Project Key Findings

- The restored San Dieguito Wetlands have been colonized by salt marsh vegetation, invertebrates, fish, and eelgrass.
- A large number of bird species continue to use the restored wetland.
- The restoration site is currently providing habitat for endangered and economically important species.
- Plant establishment continues to be highly variable within and across constructed wetland modules
- On-going management tasks important to wetland health include inlet maintenance and control of non-native species.



To summarize key findings during 2013:

- The restored San Dieguito Wetlands have been colonized by salt marsh vegetation, invertebrates, fish, and eelgrass.
- A large number of bird species continue to use the restored wetland.
- The restoration site is currently providing habitat for endangered and economically important species, such as Belding's Savannah Sparrow and California Halibut.
- Plant establishment has been highly variable within and across constructed wetland modules—colonization has been least successful at higher tidal elevations
- On-going management tasks important to wetland health include inlet maintenance and control of non-native species.