

Annual Public Workshop

San Onofre Nuclear Generating Station (SONGS) Artificial Reef Mitigation Project
Wednesday, April 5, 2023

Agenda

- | | |
|-------------|--|
| 1:30 – 1:45 | Introduction to SONGS reef mitigation – <i>Dan Reed, UCSB</i> |
| 1:45 – 2:30 | Results from the 2022 performance monitoring of the Wheeler North Reef – <i>Kat Beheshti, UCSB</i> |
| 2:30 - 2:45 | Questions and comments on performance monitoring results |
| 2:45 – 3:00 | Plans for reduced monitoring of Wheeler North Reef – <i>Rachel Smith, UCSB</i> |
| 3:00 - ?? | Questions, comments and general discussion |

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



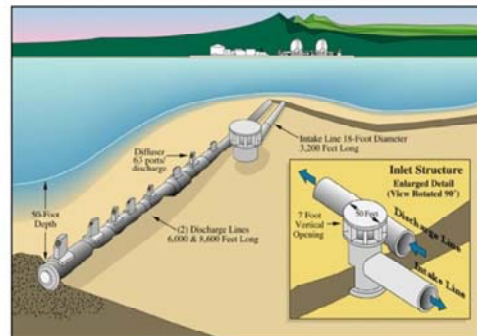
- Welcome to the Annual Public Workshop for the San Onofre Nuclear Generating Station Artificial Reef Mitigation project
- We begin with a brief overview of the history and objectives of the SONGS reef mitigation project, which is one component of a comprehensive mitigation program that is designed to offset damages to living marine resources caused by the operations of SONGS units 2 & 3
- The other major component of the mitigation program is wetland restoration project that is being done at San Dieguito Lagoon.
- A separate workshop will be held May 3, 2023 in Del Mar, CA to review the status and findings of the wetland restoration project.

SONGS generators cooled by a single pass seawater system

(San Onofre Nuclear Generating Station = SONGS)



The nuclear reactors of SONGS units 2 and 3 are cooled by seawater that is taken in by large intake pipes and discharged back to the ocean via two diffuser lines



- The operations of SONGS Units 2 and 3 relied on a single-pass seawater cooling system to cool their nuclear reactors
- Each unit has its own cooling system that includes an intake located in about 30 feet of water about 0.6 miles offshore of the power plant and an 18' diameter intake line that delivers seawater to the unit
- The volume of water taken in each day by these two intake lines when Units 2 and 3 were fully operational was about 2.4 billion gallons, which is equivalent to the volume of water in a cube that covers one square mile and 12 feet deep
- The seawater was elevated 19° F above ambient as it circulated through the plant, and then it was delivered back to the ocean through separate discharge lines that extended 6,000 and 8,000 feet offshore
- The last 2,500 feet of each discharge line is equipped with 63 diffuser ports that are designed to rapidly mix the cooling water with the surrounding seawater

Reef mitigation linked to the adverse effects of the SONGS cooling water discharge

Results from studies conducted from 1976-1987 by the Marine Review Committee determined that a turbidity plume associated with SONGS diffusers was the cause of a substantial reduction in size of the San Onofre kelp forest



- The SONGS artificial reef mitigation project is linked to the adverse effects of the SONGS seawater cooling system on the San Onofre kelp forest, which is located directly offshore of the power plant
- The Marine Review Committee was commissioned by the California Coastal Commission to conduct extensive studies from the mid 1970s –1980s to determine the extent of the impacts associated with the SONGS seawater cooling system
- One of the impacts identified by these studies was that the mixing of the discharged cooling water with the surrounding seawater resulted in the formation of a turbid plume that caused a substantial reduction in area of the San Onofre kelp forest located offshore of the power plant

The California Coastal Act Requires Mitigation of Marine Impacts

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



To mitigate for the impacts to the San Onofre kelp forest caused by SONGS the CCC required SCE to:

1. Construct an artificial reef large enough to support at least 28 tons of fish and 150 acres of kelp forest habitat to compensate for losses of kelp and kelp bed fish, invertebrates, and algae.
2. Provide funding for scientific oversight and monitoring of the mitigation project that is *independent* of SCE.

- The California Coastal Act requires mitigation for impacts to the marine environment such as those caused by SONGS
- Implementation of the Coastal Act resides with the California Coastal Commission (CCC)
- The CCC is responsible for ensuring that the adverse impacts to the marine environment caused by SONGS are adequately mitigated
- As mitigation for the impacts to the San Onofre kelp forest caused by SONGS the CCC required SCE to:
 - (1) Construct an artificial reef that is large enough to support 28 tons of reef fish and 150 acres of kelp forest habitat to compensate for losses of kelp and kelp bed fish, invertebrates and algae
 - (2) Provide funding for scientific oversight and monitoring of mitigation projects that is *independent* of SCE
- Independent monitoring is done by a team of marine scientists at UCSB who report directly to the CCC

SONGS Mitigation Monitoring team

Project Investigators



Mark Page
Research Biologist



Dan Reed
Research Biologist



Steve Schroeter
Research Biologist



Kathryn M. Behrke
Assistant Researcher



Rachel Smith
Assistant Researcher



Mark A. Steele
Assistant Professor

Scientific Staff



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Research Associate in Wetland Ecology



Lindsey Chamberlain
Research Associate in Reef Ecology



Lee Harkness
Research Associate in Reef and Wetland Ecology



Justin Hines
Research Associate in Wetland Ecology



Russell Johnston
Research Associate in Wetland Ecology



Margaret Tule
Research Associate in Reef and Wetland Ecology



Pamela Winkler
Data Scientist



David Huang
County Director of Computing and Research



Andrew Drexler
Wetland Field Research Supervisor

Science Advisory Panel



Richard Ambrose
Professor and Director



Peter Raimondi
Professor and Chair



Russell J. Schmitt
Professor of Marine Biology

- The UCSB team charged with evaluating the artificial reef and mitigation projects consists of six project investigators that oversee various elements of the two projects and report to the Coastal Commission, and a scientific staff who collect and process the monitoring data used to evaluate the performance of the reef and wetland mitigation projects
- The project is guided by a Science Advisory Panel or SAP consisting of Drs. Rich Ambrose (UCLA), Pete Raimondi (UCSC), and Russ Schmitt (UCSB) who meet with us on a regular basis and provide advice on the monitoring program

Project Objective

Replace the marine resources that were damaged or lost in the San Onofre kelp forest due to the operations of SONGS Units 2 & 3

Approach

1. Design an artificial reef in sandy habitat that is:
 - Low-relief with topography & depth similar to the San Onofre kelp forest
 - Located near SONGS, but outside the influence of its discharge
2. Construct the artificial reef in two phases :
 - a small (25 acre) short-term (5 y) experimental phase to test different reef materials and designs
 - A large (> 150 acres) long-term (>30 y) mitigation phase to replace the kelp forest resources lost at San Onofre
3. Monitor the artificial reef to measure its success based on performance standards developed to ensure that project objective is met
4. Impose corrective measures to remediate the artificial reef if it fails to meet the performance standards
5. End project monitoring and oversight after mitigation requirement is met

The objective of the project is to replace the marine resources that were damaged or lost in the San Onofre kelp forest due to the operations of SONGS Units 2 & 3.

- While Units 2 and 3 are no longer producing energy, damages to the San Onofre kelp forest occurred throughout the 32 years that they were operating
- Consequently, the SONGS artificial reef project is designed to mitigate for damages to kelp forest habitat that accrued over 32 years

The project involves a 5-step approach that includes:

1. Designing a reef that is similar to the natural reef at San Onofre that was impacted by SONGS
2. Construct the reef in two phases in which the first phase consists of a short-term experiment that tests different reef designs to inform the design of larger second phase that is intended to replace the kelp forest resources lost at San Onofre
3. Monitoring to measure the performance of the reef in meeting its objectives
4. Imposing corrective measures to remediate the artificial reef if it fails to meet performance requirements
5. End the monitoring and oversight after the mitigation requirement is met

Artificial Reef Construction and Design



- This map provides a general overview of the project site and shows the locations of the two phases of the artificial reef
- Construction of Phase 1 was completed in October 1999 and consisted of 56 modules (shown as dark pink squares) that tested different bottom coverages of quarry rock and rubble concrete in a random block design that totaled 25 acres
- Information obtained from the 5-years of monitoring the Phase 1 reef was used to guide the design of the Phase 2 reef
- Phase 2 was completed in September 2008 and consisted of 18 irregularly shaped polygons (shown in green) of low relief quarry rock which totaled 150 acres
- The Phase 1 and Phase 2 reefs combined to form a 175-acre artificial reef complex, which SCE named after Wheeler North, a famous kelp forest ecologist
- The overarching goal of the 175-acre Wheeler North Reef was to mitigate for the kelp forest losses caused by SONGS

Common marine life at Wheeler North Reef

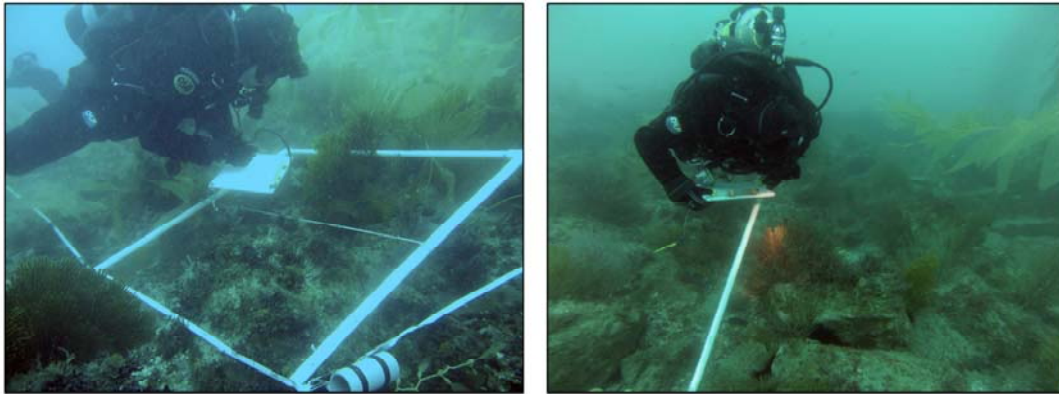


These underwater images taken from the Wheeler North Reef show some of the charismatic species that have colonized Wheeler North Reef, including:

- High densities of economically and ecologically important species such as spiny lobster, kelp bass, barred sand bass and giant kelp
- Ecologically protected species such as the giant sea bass

Need for remediation

Monitoring results showed that the 175-acre Wheeler North Reef was too small to consistently meet the performance standards for fish standing stock and giant kelp area



The CCC required SCE to **remediate** the Wheeler North Reef by adding up to 210 new acres of low-relief reef
(referred to as the Phase 3)

- Performance monitoring of the Wheeler North Reef began in 2009
- Although results from monitoring showed that the Wheeler North Reef was performing similar to natural reefs in the region, they also showed that its 175-acre footprint was too small to consistently meet the performance standards requiring it to sustain a fish standing stock of 28 tons and 150 acres of medium-to-high density giant kelp
- As a result, in 2016 the CCC required SCE to remediate the Wheeler North Reef by adding up to 210 new acres of low-relief reef (referred to as the Phase 3 expansion reef)



- Phase 3 expansion in this map is shown as the 20 white irregular shaped polygons
- A portion of it was built inshore of the southern end of the Phase 1 & 2 reefs and the remainder built along a 4 km (2.5 mile) stretch of coast north of the Phase 1 & 2 reef
- Construction of Phase 3 was completed in July 2020
- The 20 polygons comprised 198 acres of low relief boulder reef similar in design to the Phase 2 reef
- The phase 3 expansion increased the area of Wheeler North Reef to 373 acres of low relief reef with ~ 45% cover of rock

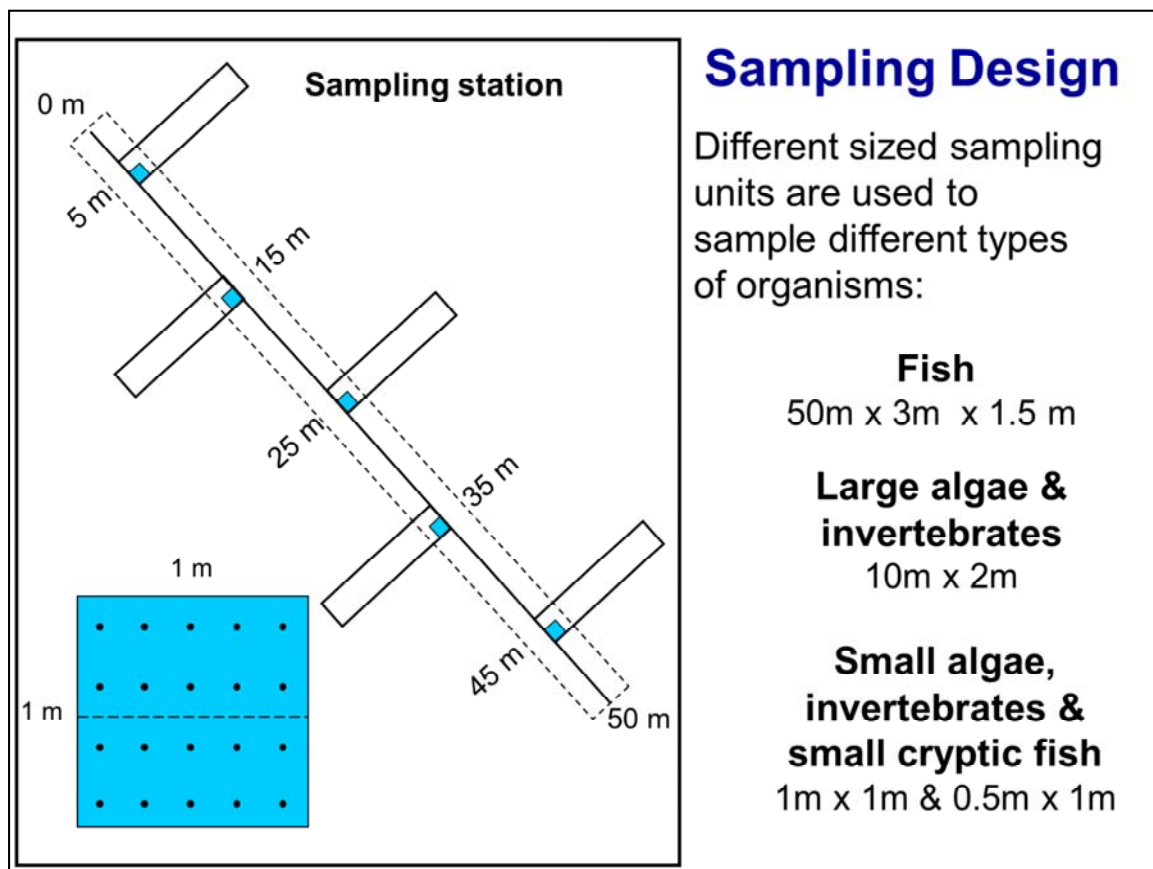
Performance Monitoring



Purpose: to determine whether the Wheeler North Reef is meeting the required project goals

Sampling Design

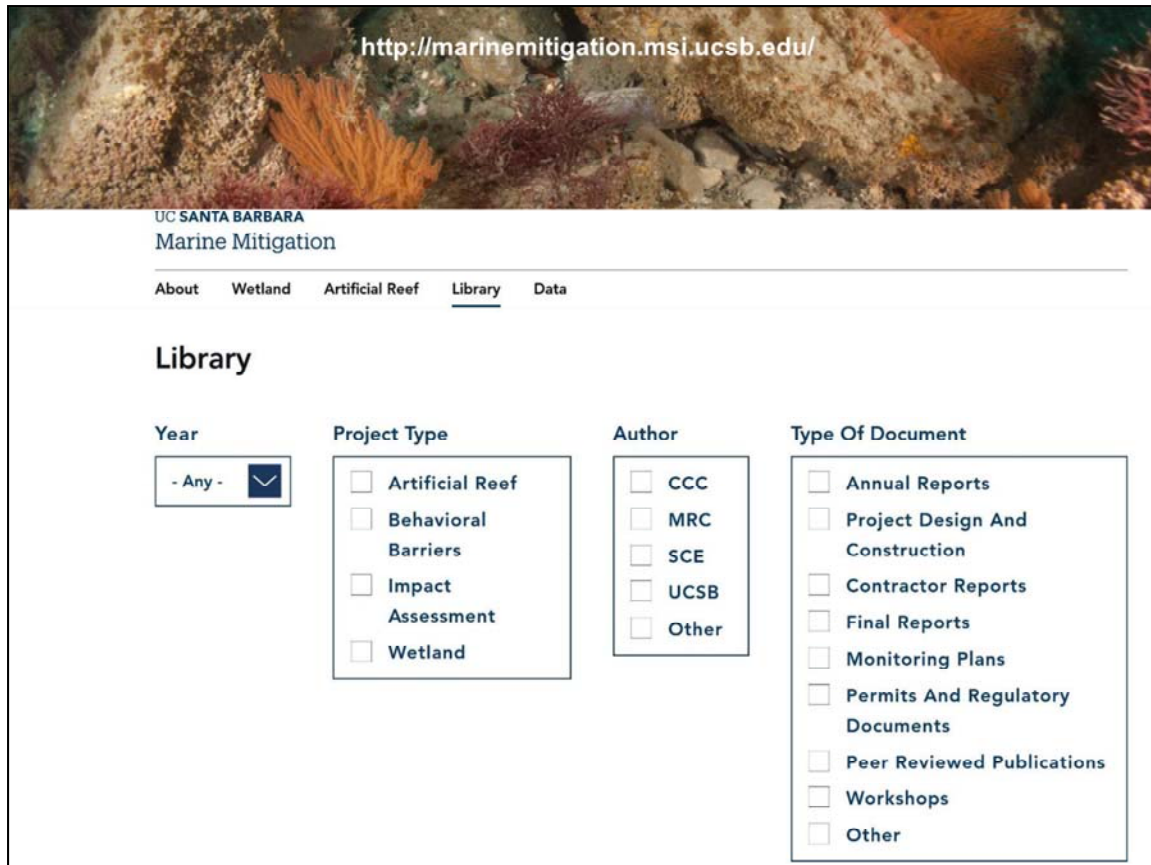
- 151 sampling stations (50m x 20m) broadly distributed across all three phases of Wheeler North Reef
- A total of 12 stations for Phase 1, 80 for Phase 2, and 59 for Phase 3
- Each station defined by a differential GPS coordinate and a compass heading
- Each station sampled once per year in summer/autumn



- This is a schematic diagram of a sampling station at the Wheeler North Reef, which is the same as that used to sample the natural reefs used for reference
- Different sized sampling units are used to sample different performance variables
- Fish are sampled in 50 m x 3 m band transects outlined with the dotted line, which extends 1.5 m off the bottom
- Adult giant kelp > 1 m tall, large understory algae, and large mobile invertebrates are counted in the five 10 m x 2 m bands positioned perpendicular to the main transect at 10 m intervals
- The % cover of invertebrates, algae and substrate is estimated using a grid of 20 points in the five 1 m x 1 m quadrats shown in blue
- Smaller mobile invertebrates and small cryptic fish are counted either in 1 m x 1 m or 1 m x 0.5 m quadrats depending on their size and abundance



- Additional information about the project can be found on the UCSB SONGS Mitigation Monitoring website
- The website contains useful content on the history of SONGS coastal impacts, the rationale and requirements for SONGS mitigation, and descriptions and status of the artificial reef and wetland mitigation projects



- The website also has a library of project related documents that includes the workshop presentations, annual reports, construction reports and various regulatory documents
- The library can be browsed by year, project type, author and type of document to assist users in finding what they are looking for

University of California, Santa Barbara

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Marine Mitigation

About Wetland Artificial Reef Library Data

Data

Habitats
☒ Artificial Reef
☐ Wetland

Dataset Type
☐ Performance Standard
☐ Survey

Data Category
☐ Algae
☐ Birds
☐ Fish
☐ Habitats
☐ Invertebrates
☐ Tidal Prism
☐ Vegetation
☐ Water Quality

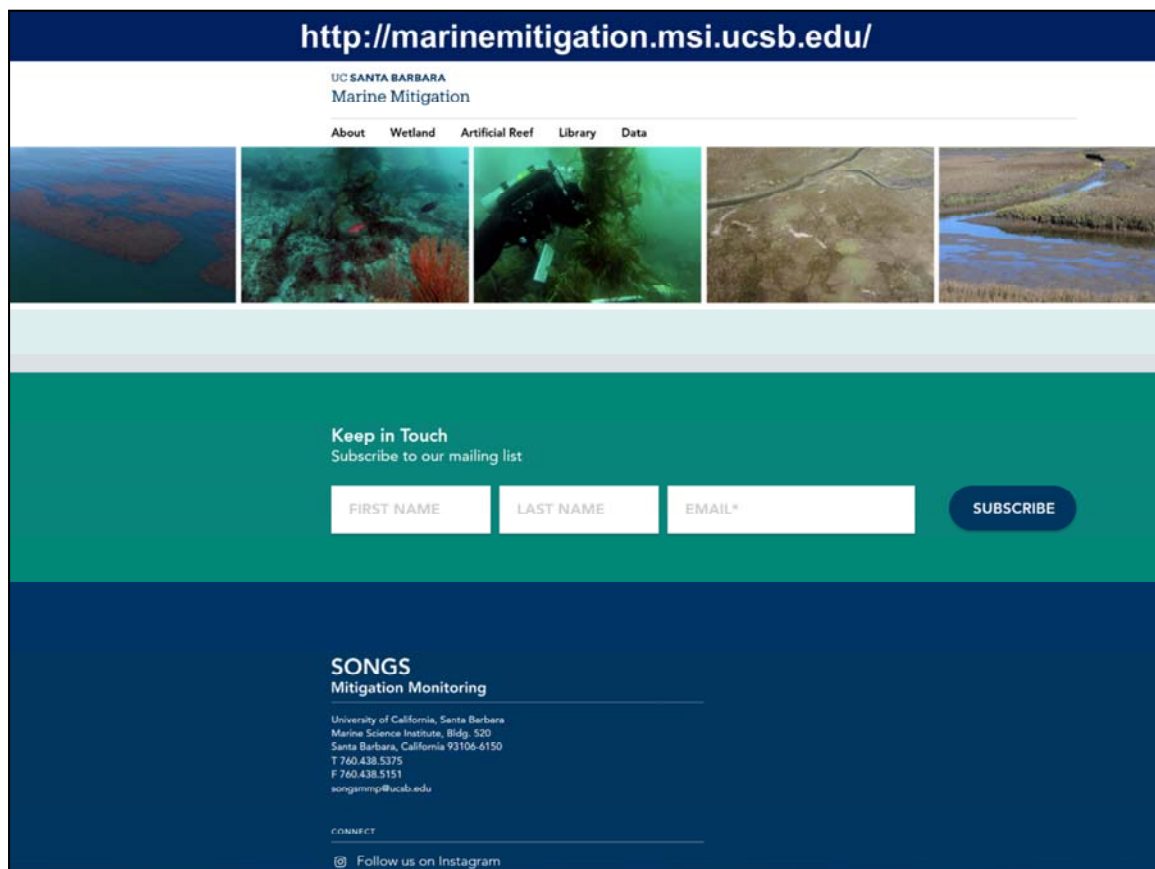
Species

APPLY

[UCSB SONGS Reef Survey - Algae and Invertebrate Abundance](#)
Dataset Type: Survey

[UCSB SONGS Reef Survey - Benthic Biota and Substrate Cover](#)
Dataset Type: Survey

- Importantly, all of the project's monitoring data are publically available through the data portal of the U.S. National Science Foundation's Environmental Data Initiative, which can be easily accessed through the UCSB SONGS Mitigation Monitoring Website



- Lastly, on the homepage of the website you can subscribe to our mailing list, follow us on Instagram or contact us by phone or email

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