

Annual Public Workshop
San Onofre Nuclear Generating Station (SONGS) Artificial Reef Mitigation Project
Monday, April 8, 2024

Agenda

- 1:30 – 1:45** **Introduction to SONGS reef mitigation – *Dan Reed, UCSB***
- 1:45 – 2:30** **Results from the 2023 performance monitoring of the Wheeler North Reef – *Rachel Smith, UCSB***
- 2:30 - 2:45** **Questions and comments on performance monitoring results**
- 2:45 – 3:00** **Lessons learned from 25 years of monitoring Wheeler North Reef
*Kat Beheshti, UCSB***
- 3:00 - ??** **Questions, comments and general discussion**

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



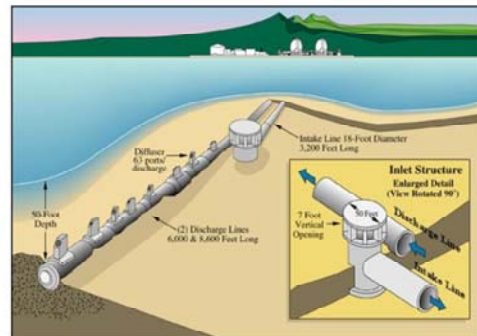
- Welcome to the Annual Public Workshop for the San Onofre Nuclear Generating Station Artificial Reef Mitigation project
- We begin with a brief overview of the history and objectives of the SONGS reef mitigation project, which is one component of a comprehensive mitigation program that is designed to 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 9, 2024 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)



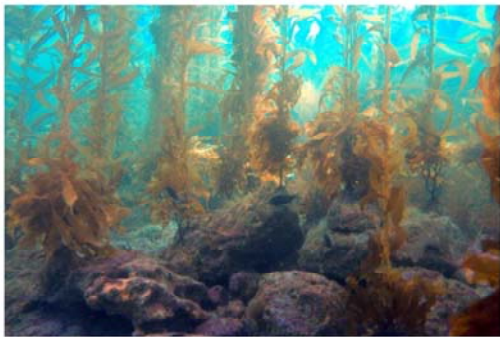
The nuclear reactors of SONGS units 2 and 3 are cooled by seawater that is taken in by large intake pipes and discharged back to the ocean via two diffuser lines



- 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 amount of seawater 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 for Units 2 and 3 that extended 6,000 and 8,000 feet offshore, respectively
- 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 aimed at determining the extent of the coastal marine 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



Scientific Staff



Science Advisory Panel



- 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 an artificial reef that is similar to the natural reef at San Onofre that was impacted by SONGS
2. Constructing the artificial 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 the artificial reef to measure its success based on performance standards developed to ensure that project objective is met.
 - These standards include absolute standards measured at Wheeler North Reef only that are based on the size of the impact at the San Onofre kelp forest, and relative standards that require Wheeler North Reef to be similar to natural reference reefs.
4. Imposing corrective measures to remediate the artificial reef if it fails to meet performance requirements
5. Ending the monitoring and oversight after the mitigation requirement is met

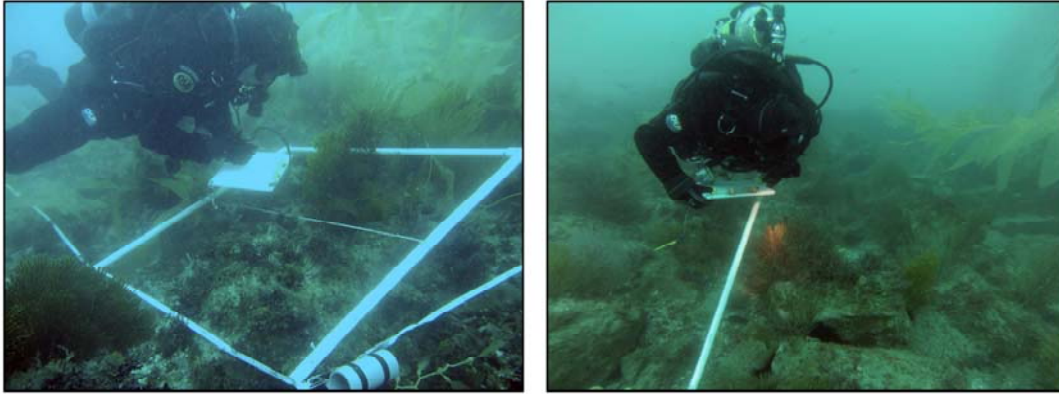
Artificial Reef Construction and Design



- 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

Need for remediation

Seven years of monitoring 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



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 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 adult 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 is shown in this map 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

Method for assigning mitigation credit for the performance of Wheeler North Reef was revised with reef expansion



The artificial reef(s) shall sustain 150 acres of medium-to-high density giant kelp



The standing stock of fish at the mitigation reef shall be at least 28 tons

Original method of evaluation

- The absolute performance standards for giant kelp area and fish standing stock must both be met in a given year for Wheeler North Reef to receive mitigation credit for that year

Revised method of evaluation

- Adult giant kelp acreage and fish standing stock at Wheeler North Reef are measured each year and each is summed over time until they reach a cumulative total equivalent to the annual target (150 kelp acres or 28 fish tons) x the number of years of SONGS operations (= 32 years)
- Accumulation of kelp acreage and fish standing stock began in 2019

- The method for assigning mitigation credit for the absolute performance standards for giant kelp area and fish standing stock were revised with the Phase 3 reef expansion
- These standards require Wheeler North Reef to sustain 150 acres of medium-to-high density giant kelp and 28 tons of reef fish standing stock.
- The intent was that the Wheeler North Reef sustain 150 acres of medium-to-high density giant kelp and 28 tons of fish for a period of time equivalent to the operating life of SONGS
- Originally, Wheeler North Reef was required to meet both of these standards in a given year for it to receive mitigation credit for that year.
- This meant that it did not get any mitigation credit irrespective of whether it sustained 0 acres of kelp or 149 acres of kelp, or 0 tons of fish or 27 tons of fish.
- With the expansion of Wheeler North Reef to 373 acres the Commission changed this requirement to allow Wheeler North Reef to accumulate credit for kelp acreage and fish standing stock over time
- In this way mitigation credit for these two performance standards is summed over time until the accumulated credit for each performance standard reaches a total value equivalent to the annual target (which is 150 acres for kelp and 28 tons for fish) x the number of years of SONGS operations which the CCC determined to be 32 years
- The CCC determined that the accumulation of kelp acreage and fish standing stock would begin in 2019.

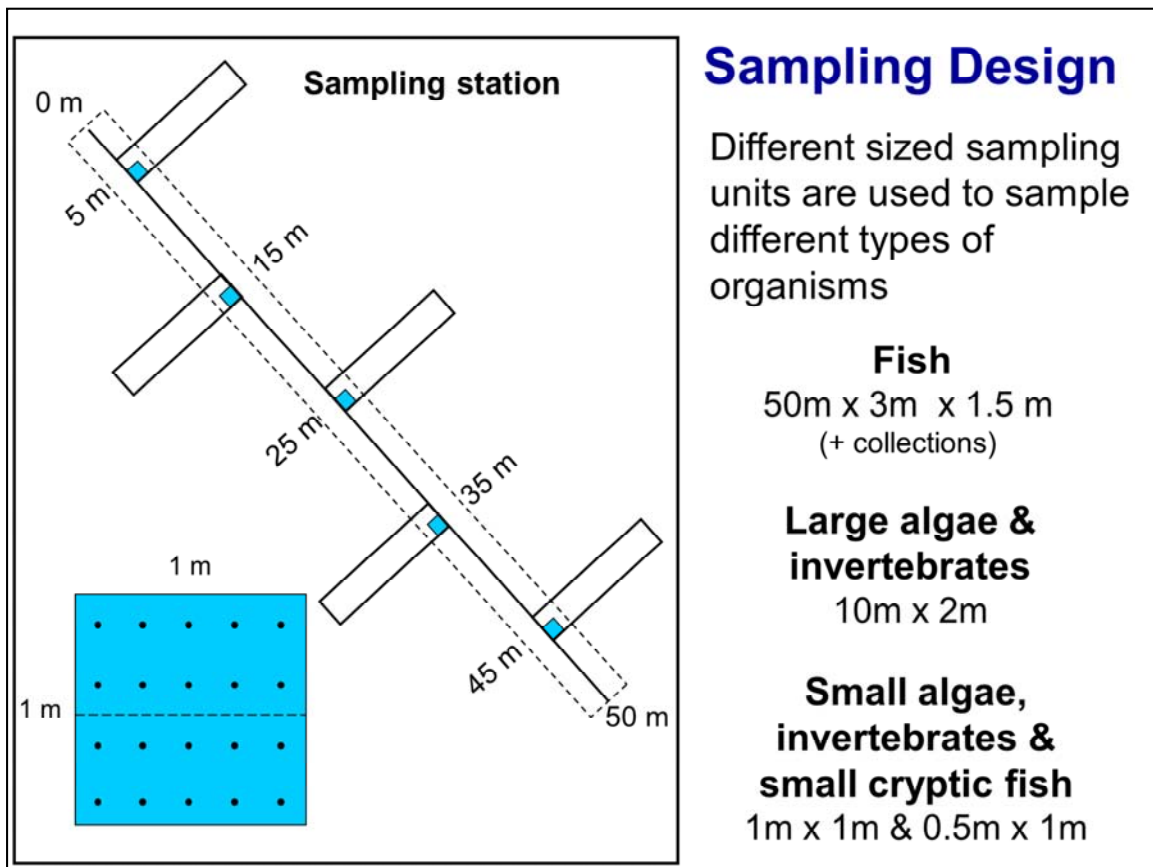
Performance Monitoring



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

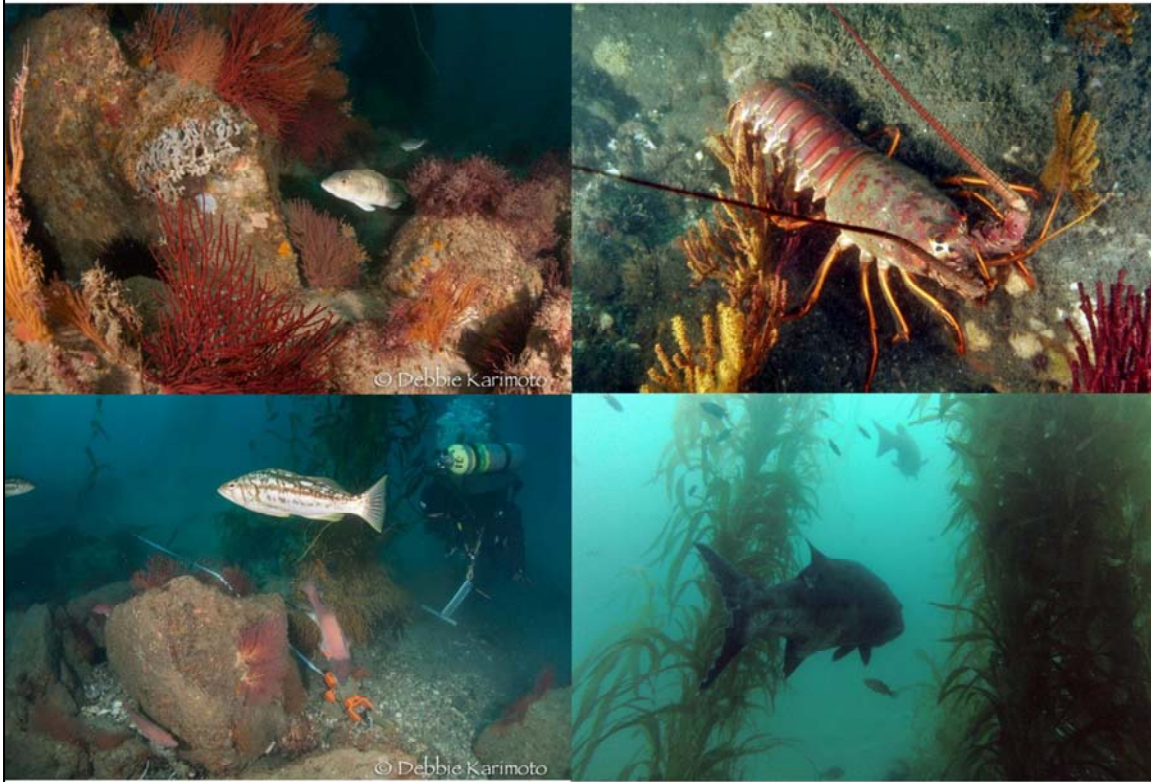
Sampling Design

- 151 sampling stations (50 m x 20 m) broadly distributed across all three phases of Wheeler North Reef
 - n = 12 Phase 1, n = 80 Phase 2, n = 59 Phase 3
- 82 sampling stations at two reference reefs
- 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 and the two natural reefs used as reference
- Different sized sampling units are used to sample different performance standards
- Fish are counted and sized in 50 m x 3 m band transects outlined with the dotted line, which extends 1.5 m off the bottom.
 - In addition to transect sampling fish are collected broadly across all three reefs for the purpose of evaluating their growth, reproduction and feeding
- 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

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

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University of California, Santa Barbara



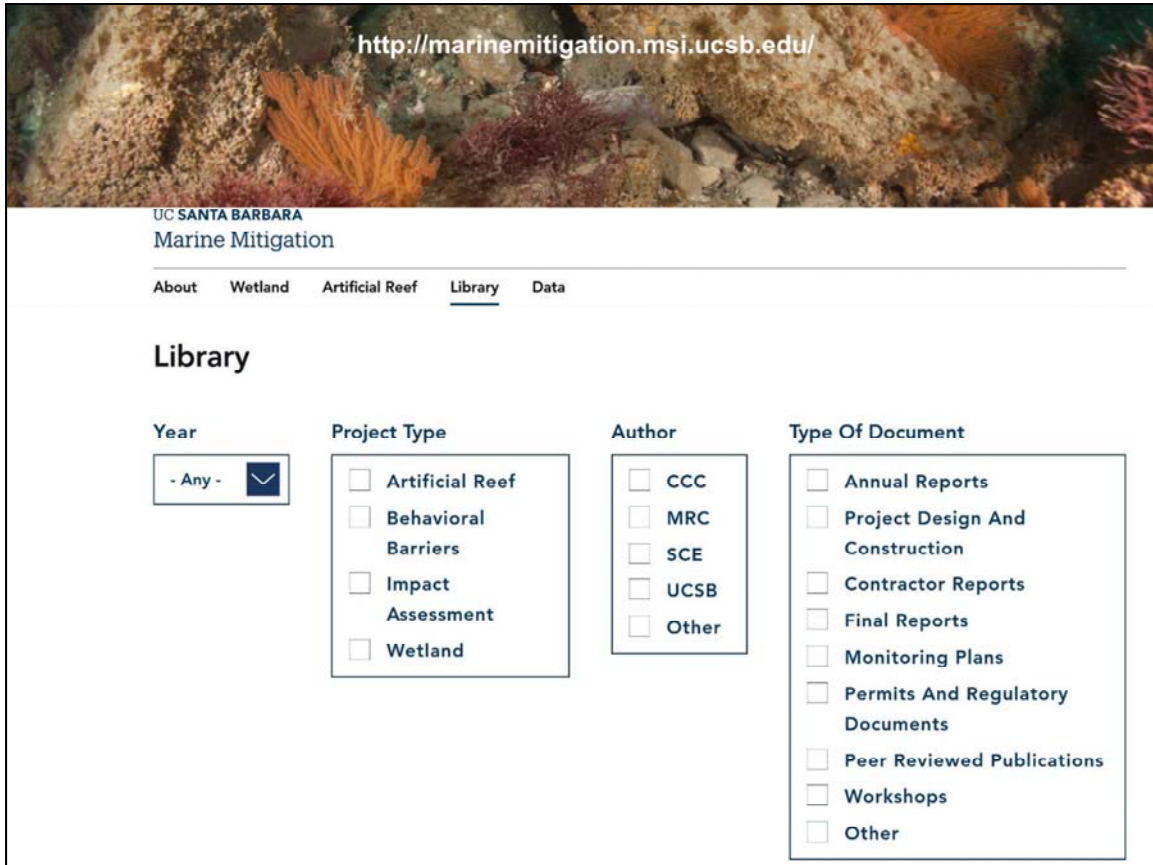
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About Wetland Artificial Reef Library Data

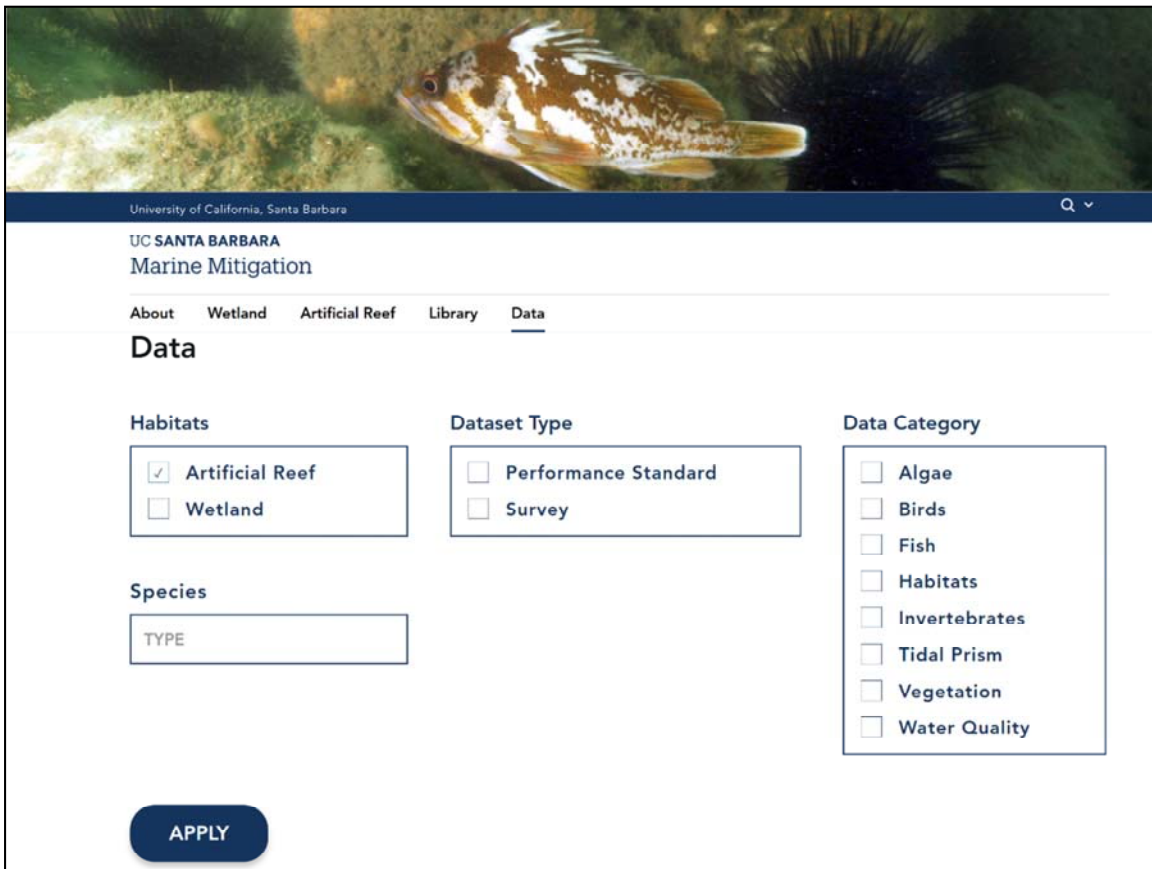


UCSB SONGS Mitigation Monitoring

- 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




- 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

<http://marinemitigation.msi.ucsb.edu/>

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