

Project Objectives

The objective of this project was to develop a monitoring protocol with a *replicable* methodology for *accurate* volunteer-based data collection in the rocky intertidal habitat. The protocol provides a tool to:

- Collect data by volunteers that can identify changes at intertidal sites.
- Empower environmentally-minded groups to monitor their coastal resources.

Rocky Intertidal Habitat

Organisms that live in the rocky intertidal habitat are adapted to survive in a dynamic environment. They must endure wave action when submerged and withstand exposure to air during low tides. However, these organisms are vulnerable to natural and anthropogenic disturbances such as:

- Disease outbreak, extreme storm events
- Temperature and pH anomalies
- Oil spills, shoreline development, urban runoff



Coal Oil Point Reserve, Southern California

Professional Monitoring

The Multi-Agency Rocky Intertidal Network (MARINe) monitors the rocky intertidal habitat along the west coast of North America. MARINe's long-term monitoring provides a critical dataset that informs policy and resource management decisions. These data have advised population recovery efforts, and helped agencies, like BOEM, assess damages from oil spills. With adjustments to the selected species categories, this citizen science protocol can be applied to other MARINe monitoring zones.



MARINe monitoring zones
Image: Multi-Agency Rocky Intertidal Network

Citizen Science

Citizen Science: The collection or analysis of data by volunteers in collaboration with professional scientists.

Citizen science projects bolster scientific data collection and connect the general public with the scientific community. Data quality is a concern with citizen science, highlighting the need for protocols that yield accurate data.

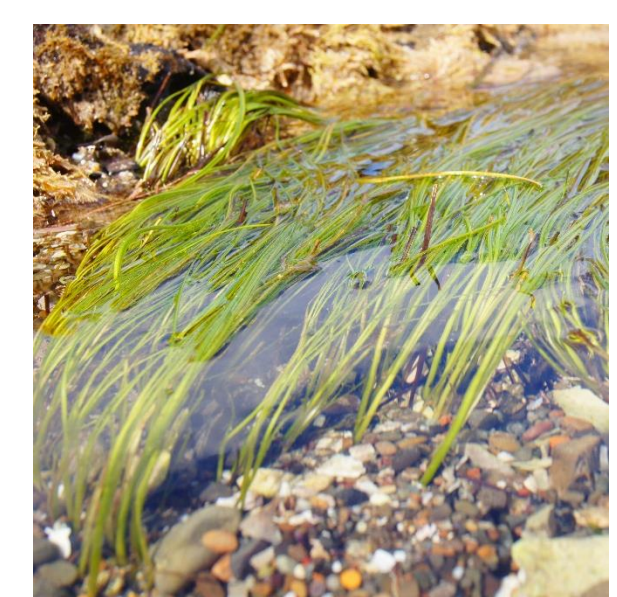
The Obama Administration has ordered federal agencies to incorporate ocean stewardship initiatives using citizen science and crowdsourcing in future federal research programs¹. This project can help BOEM and MARINe meet this obligation by expanding data collection opportunities through a strong and accurate citizen science program. Additional monitoring opportunities can strengthen the MARINe database in a way that is credible and low-cost.

Selection of Biological Categories

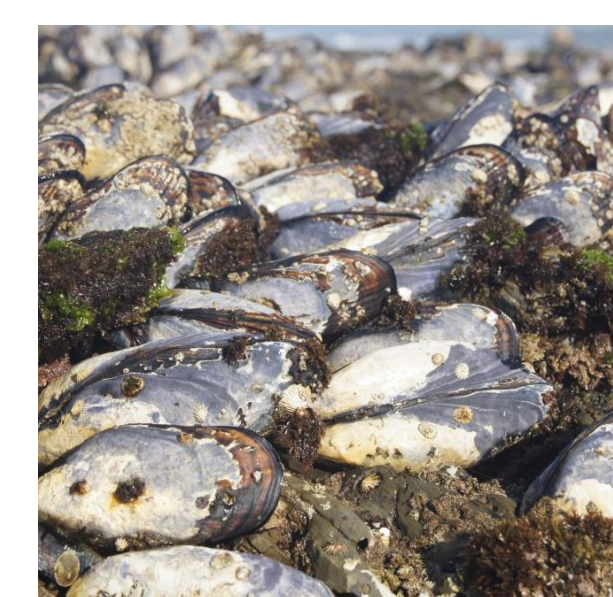
The selection of categories to be monitored by citizen scientists was based on the following criteria:

- Abundance
- Ecological and human significance
- Easily identifiable by non-professionals

Ecological data from Coal Oil Point and Carpinteria State Beach were considered for this project. In addition to Rock, Sand, and Unknown, the following biological categories were selected:



Surfgrass
Phyllospadix spp.



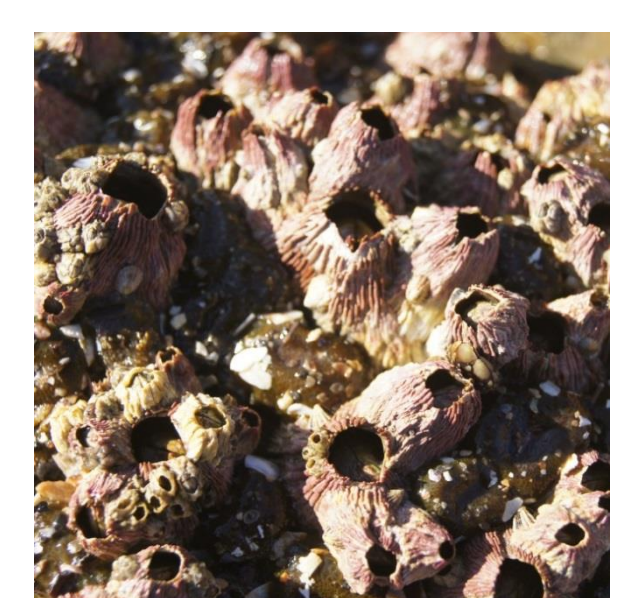
Mussel
Mytilus californianus



Anemone
Anthopleura spp.



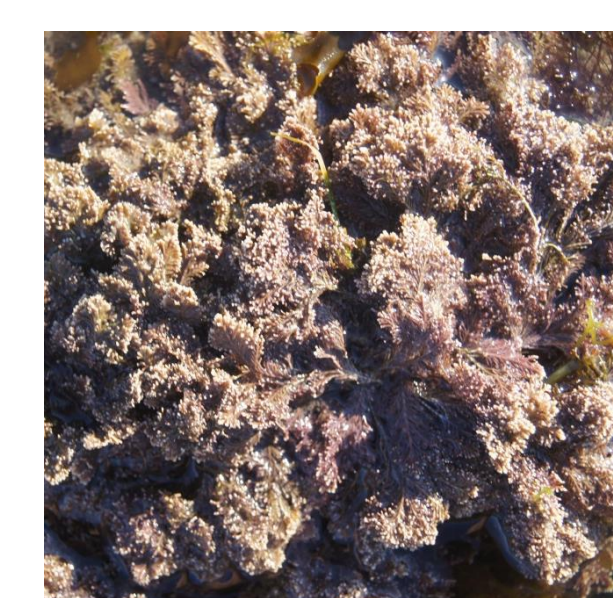
Sea Lettuce
Ulva spp.



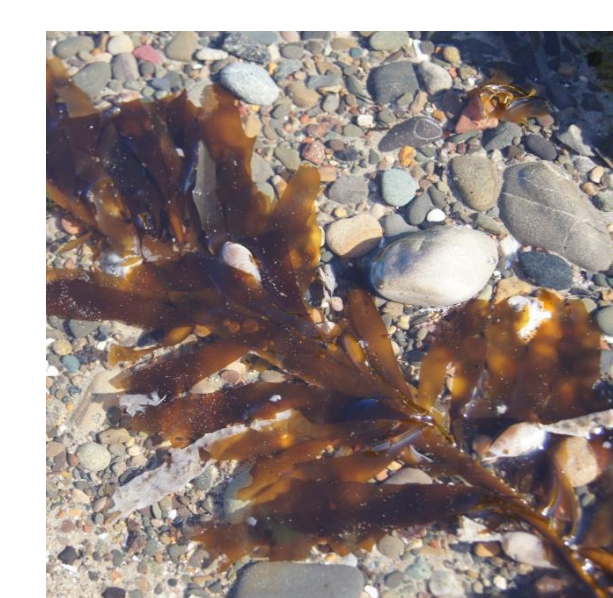
Acorn Barnacle
Chthamalus spp. /
Balanus glandula



Gooseneck Barnacle
Pollicipes polymerus



Seaweed
Corallina spp.



Feather Boa
Egregia menziesii

Citizen Science Monitoring Protocol

Transect

Goal: Measure the percent cover of a target category.



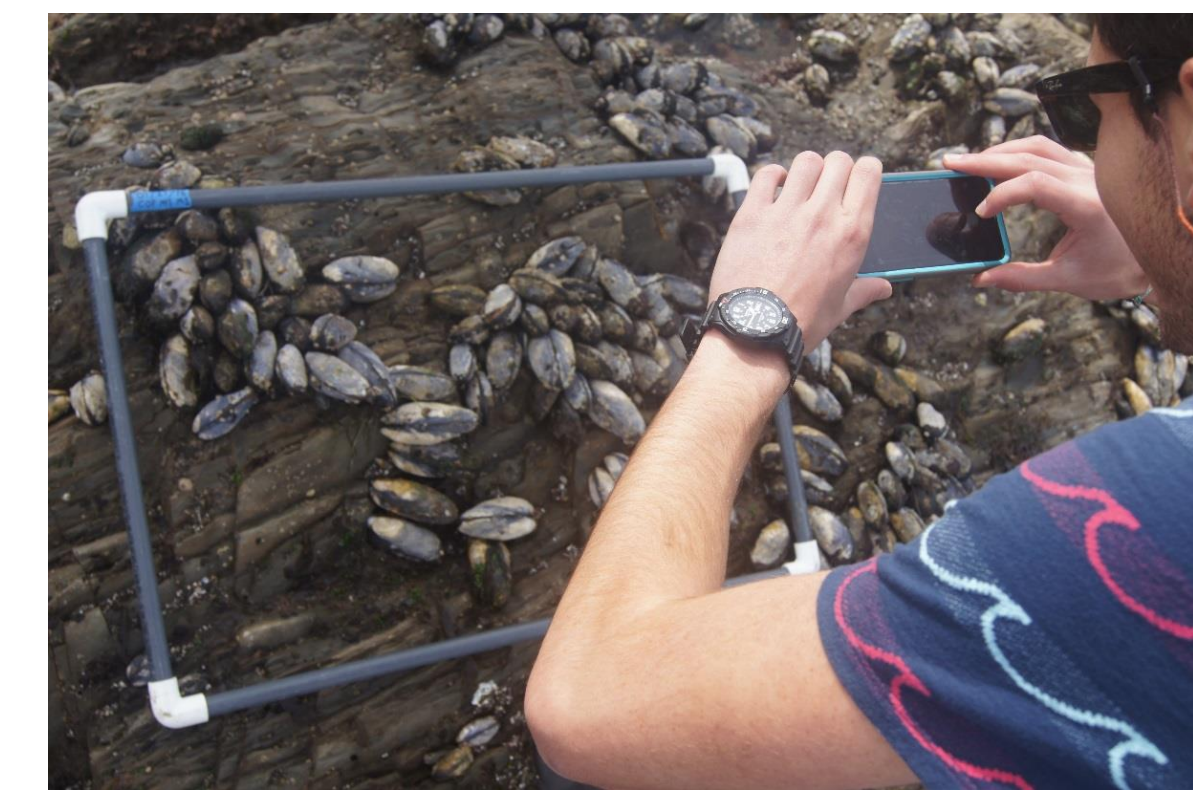
Citizen scientists record species categories along three 10m transect lines set between permanent bolts.



Categories are recorded every 10cm along the transect for a total of 100 points for each transect.

Photoplot

Goal: Measure the percent cover of a densely-spaced target category.



Volunteers use their smartphones to photograph five 50cm x 75cm quadrats set on permanent bolts marking the photoplot boundary.



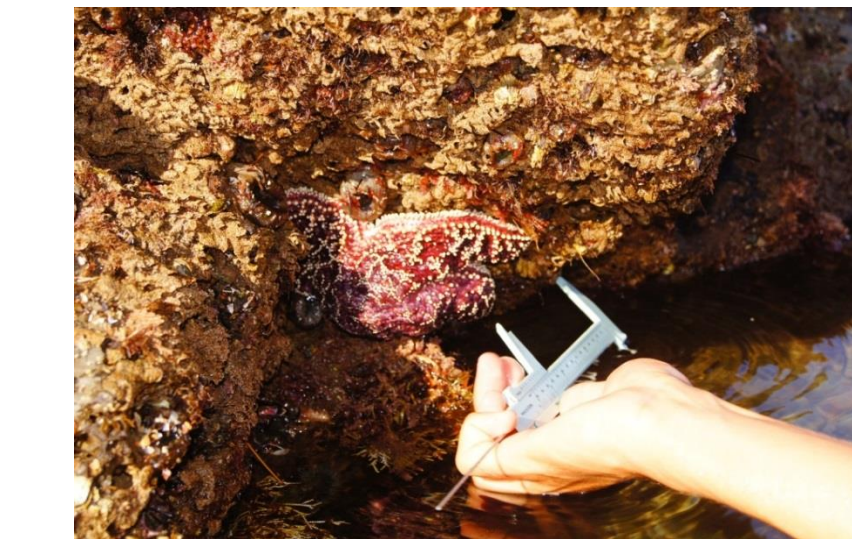
Smartphone technology allows volunteers to take high-quality photos that can be scored later.

Species of Concern Search

Goal: Search for an organism with a specific ecological significance.

The species of concern can be invasive, rare, or in decline, and may vary for each site.

Citizen scientists conduct a 30 minute search within the site boundaries and use calipers to measure the size of the organism.



Site Survey

Goal: Record conditions of the site with photos and observations.

- General survey recording weather, tide, debris, etc.
- Photo taken from an elevated area
- 8 photos taken from a fixed point to capture a 360° view of the surrounding area



Field Guide

The field guide is an essential tool that leads citizen scientists through the four protocol components, and includes the following information:

- Site map
- Standardized briefing for the Site Leader
- Instruction for data entry
- Step-by-step instructions for each component
- Photos of the biological categories
- Examples of acceptable photoplot pictures

The field guide is imperative to ensure accuracy in data collection by citizen scientists.



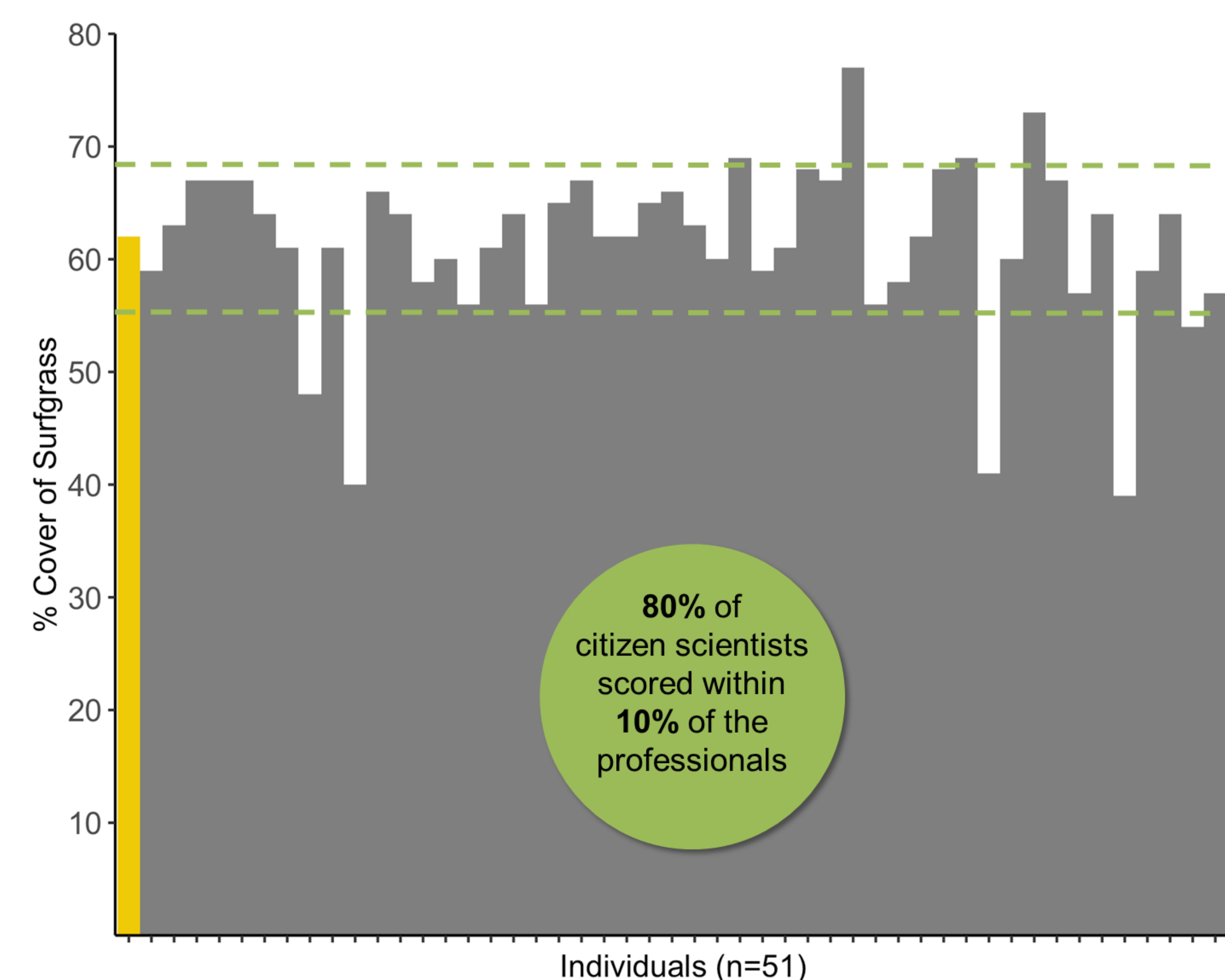
Citizen Science Results

Transect data collected by volunteers were compared to that of professionals. Three range scenarios were used to measure citizen science accuracy.

- 47%** of citizen scientists scored within **5%** of the professional mean score
- 80%** of citizen scientists scored within **10%** of the professional mean score
- 88%** of citizen scientists scored within **15%** of the professional mean score

A statistical analysis showed that there was no significant difference between citizen scientists' scores and the mean scores of the professionals ($W=581.5$, $n=51$, $p=0.95$).

Citizen science can detect major changes in the rocky intertidal habitat.



Percent cover of Surfgrass at Coal Oil Point. Grey bars represent data collected by citizen scientists (n=51). Gold bar represents the mean value of data collected by three professional scientists. Dashed lines mark the 10% range from the professional mean.

Implementation

Data Flow Recommendations

Crowdsourcing

Citizen scientists from around the world can score the photoplot pictures online to determine the percent cover of an organism.

Smartphone Technology

This protocol can be integrated into an existing or customized citizen science or biological monitoring app for real time, in-field data input.

Field Survey Recommendations

Assign a Site Leader

The Site Leader coordinates volunteers and manages the survey event.

Standardized Briefings

Standardization prevents data from being skewed by intertidal dynamics.

Repeat Volunteers

Accuracy improved when volunteers completed the protocol a second time.

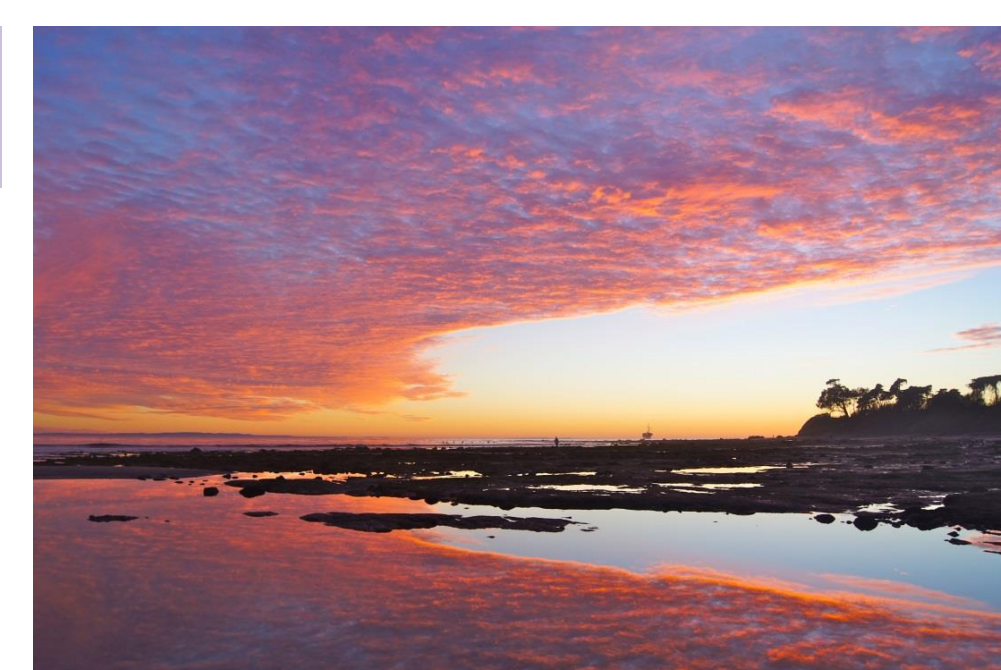
Minimize Task Loading

Accuracy improved when volunteers were trained right before performing a task.

Acknowledgements

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Visit our website for more information: <http://www2.bren.ucsb.edu/~intertidal/>



REFERENCE:
¹ Exec. Order No. 13547, 3 C.F.R. (2010). Stewardship of the Ocean, Our Coasts, and the Great Lakes. Secretarial Order No. 3289, Amendment No. 1. (2009). Addressing the Impacts of Climate Change on America's Water, Land, and Other Natural and Cultural Resources.

PHOTOGRAPHS:
All photos by
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