Monitoring the Rocky Intertidal Habitat With Citizen Science

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BACKGROUND AND MOTIVATION

The rocky intertidal habitat creates a dynamic boundary between the terrestrial and marine environments. Even slight fluctuations in species assemblages can indicate environmental changes on either side of the tideline. Understanding natural processes, species distributions, and species abundances is critical for creating useful and adaptable management plans, as well as determining the impacts of coastal disturbances. In California, this type of baseline information is especially important as the extraction and transport of oil and gas along the coast increases the possibility of a spill or other impacts to coastal resources.

Citizen science, the involvement of volunteers in scientific monitoring, is a growing trend for informing resource agencies. A citizen science (CS) program can complement the existing professional monitoring conducted by the Bureau of Ocean Energy Management (BOEM), the agency responsible for managing energy production in federal waters. This program can bolster data collection, and also help to meet federal obligations for incorporating citizen science into ocean stewardship initiatives. Perpetuating the long-term dataset that BOEM and its partners in the Multi-Agency Rocky Intertidal Network (MARINe) have created is imperative as coastal resources face increased pressure from energy demands, climate change, and sea level rise.

PROJECT OBJECTIVES

- Produce a ***replicable*** citizen science monitoring protocol for the rocky intertidal habitat that yields ***accurate*** volunteer-collected data.
- Provide users with a tool to detect ecological changes and to empower environmentally-minded groups to monitor their local coastal resources.

PROJECT ACHIEVEMENTS

- Protocol achieves accurate volunteer-collected data to detect ecological changes in the intertidal habitat.
- With the field guide, a volunteer Site Leader, and a smartphone, as few as 4 citizen scientists can survey a site using the protocol.

CITIZEN SCIENCE PROTOCOL COMPONENTS

Transect

Measure the percent cover of a biological category.
Set-up: Three 10m transect tapes set between fixed bolts.
Task: One category identified every 10cm (100 points total).

Photoplot

Measure the percent cover of a biological category.
Set-up: Five uniform quadrats placed on permanent bolts.
Task: Use smartphone to photograph quadrats.

Species of Concern Search

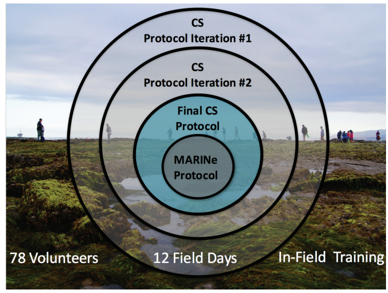
Search for an organism with a specified ecological significance not measured by other protocol components.
Task: 30 minute search within the site boundaries. Measure and record the size of the organism.

Site Survey

Record qualitative characteristics of the site with photos and observations at designated areas marked with cones.
Task: 1) Record general site observations. 2) Take photo from an elevated area. 3) Take 360^{0} photos of site.

CREATING AND REFINING A CITIZEN SCIENCE PROTOCOL

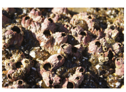
Field-testing of the CS Protocol evaluated volunteer data collection at a site monitored by MARINe. Volunteer accuracy increased as each protocol iteration was refined. All volunteer-collected data were compared to data collected by professionals.



Citizen science categories were chosen based on abundance, importance, and ease of identification.

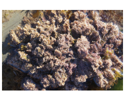
Feather Boa. This brown algae is sensitive to desiccation and poor water quality. However, if recruitment is successful, rapid recovery has been documented due to its fast growth rate.

Mussels. Extensive mussel beds along the Pacific coast are integral to the intertidal habitat because water and materials trapped between mussels provide food and shelter to other organisms.



Barnacles. Barnacles are sensitive to disturbances, such as oil spills, but historically have rebounded quickly due to their high spawning rates.

Gooseneck Barnacles. Stalked barnacles are resistant to desiccation and can withstand high wave action. Accessible populations have been harvested for human consumption.

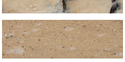


Seaweed. This general category was created to specifically prevent the misidentification of Red Turf Algae. Algae can be misidentified at different life stages.

Anemones. These densely-spaced organisms are resistant to disturbances from shifting sands and are not known to be unusually sensitive to oil spills.

Sea Lettuce. Presence of this green algae can be correlated with disturbance. It can be used as an indicator species of high levels of pollution.

Surfgrass. This marine plant provides an important nursery habitat for juvenile fish and invertebrates. It also increases water clarity and traps sediments, preventing erosion.

Non-biological: Rock, Sand, and Unknown. Scoring these categories in the field is important to understand environmental dynamics (Rock and Sand) and data quality (Unknown).

LESSONS LEARNED

Data Flow

- **Smartphone Technology.** This protocol relied on the use of smartphones for cameras and online spreadsheets. In the field and after collection, data were input and accessed in the Google Drive. This process minimized the time required for data entry.
- **Crowdsourcing.** An online crowdsourcing platform was distributed via social media and produced results in a short time frame with minimal resources.

Accuracy

- **Field Guide.** Each protocol component and an identification key of the citizen science categories were outlined in the field guide. Volunteers used the guide during each sampling event.
- **Standardized Briefings.** A key factor in increasing accuracy was providing all volunteers with the same protocol instructions, via the field guide, regardless of the time or date of data collection.
- **Repeat Volunteers.** The utilization of this protocol does not require a lengthy training. Ideally, an organized, environmentally-minded group of volunteers could “adopt” a site for regular surveys.
- **Site Leader.** A Site Leader acted as a liaison between citizen scientists and the end user of the collected data. Duties included setting up the site for surveying, aiding in data collection, and orienting volunteers to the protocol.
- **Minimize Task Loading.** Tests of this protocol showed that volunteer accuracy increased when briefings of protocol components occurred immediately before volunteers collected data.

ACCURACY RESULTS OF PHOTOPLOT

Photoplot is the only component not scored in the field due to tidal time constraints. Therefore, photo quality must be high for accurate scoring on a computer.

Citizen science photoplot pictures, taken with smartphones, were scored for quality based on the following criteria:

- Entire quadrat is evenly shaded
- Entire quadrat is visible
- Minimal space outside the perimeter of the quadrat
- Photograph taken from a "bird's eye view"
- Photograph is focused

The quality of CS photos was sufficient for MARINe professionals to score the percent cover of California mussels (*Mytilus californianus*). Photos were also scored by citizen scientists via a crowdsourcing platform.

Guidelines that contributed to this accuracy included:

- Using an umbrella to homogenize the light inside the quadrat
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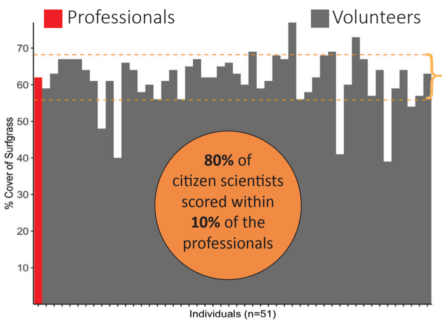
ACCURACY RESULTS OF TRANSECT



Transect data collected by volunteers were compared to that of professionals. Three different scenarios were used to measure citizen science accuracy (within 5%, 10%, and 15% of professional scores). Accuracy results were evaluated using statistical analyses and qualitative comparisons.

The majority of volunteers collected data within a 10% accuracy range of professionals.

Guidelines that contributed to this accuracy included:

- Standardized scoring for areas of sand and pools of water along the transect.
- Requiring citizen scientists to practice the transect protocol, including category identification, on a transect line prior to collecting data.
- In addition to the citizen science categories, an Unknown category was included to prevent misidentifications and to account for organisms not included in the protocol.

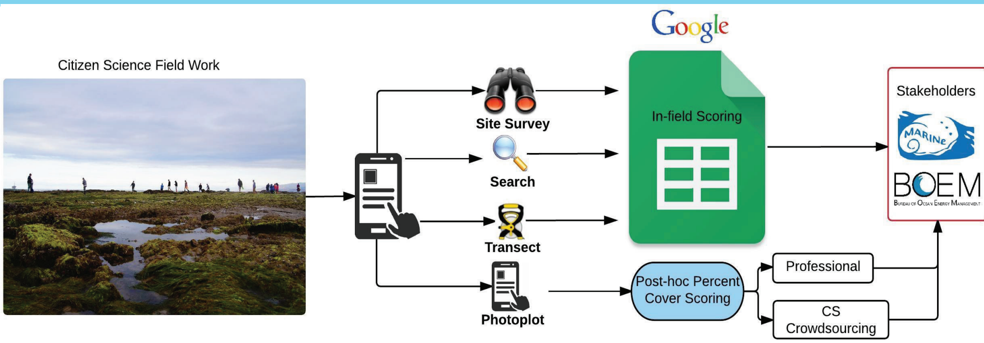
SPECIES OF CONCERN SEARCH

A search for a "species of concern" was included in the protocol. For this project, Ochre Star (*Pisaster ochraceus*) was chosen due its recent population declines. Volunteers enjoyed exploring the site while searching for sea stars. When found, sea stars were measured and recorded in the Google Sheets app.

SITE SURVEY

This component creates a holistic understanding of the surveyed site. This information can be important to future Site Leaders, volunteers, and stakeholders. Information can be used to create site maps and compare non-biological characterictics of sites over time.

DATA FLOW



CROWDSOURCING

Score mussel presence or absence at each crosshair

One of the most time consuming aspects of biological monitoring is data analysis. A project goal was to accurately crowdsource the data analysis of photoplots. Crowdsourcing offers a low-maintenance way to analyze photographic data.

Crowdsourcing Results from Mussel Photoplot

CS: **53%** Mussel Cover

Professional: **49%** Mussel Cover

Age: 27 - 70 years

123 respondents from seven different countries

Though 50% of respondents go to the ocean monthly or less, they were able to produce accurate results!

ACKNOWLEDGEMENTS: We would like to thank the following people for generously offering their time and guidance throughout the duration of this project: John Melack, Lisa Gilbane, Sara Guiltinan, Mary Elaine Helix, Carol Blanchette, Jessie Altstatt, Steve Lee, and Owen Liu. We would like to express our deepest gratitude to the 78 citizen scientists who volunteered their time. This project could not have been done without their dedication and support.

Check out our website:

http://intertidalteam.weebly.com/bren.html

SCAN ME!

Spring 2016

Pictures by Aaron Howard
Transect Icon: Pocketdemo

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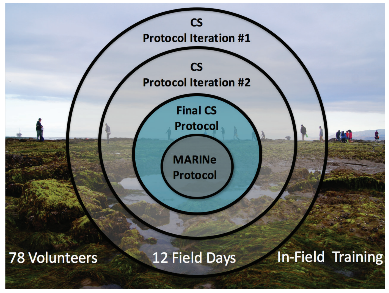

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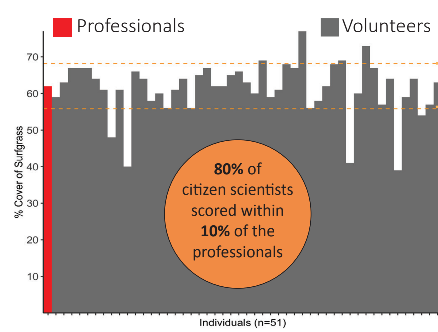

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