Predation Rate By Sea Stars on Mussels

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Project
» Collaborative Research: Mechanisms of resistance and resilience to system-wide loss of a keystone predator in an iconic intertidal community (Keystone Species Loss)

Program
» Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO)

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Abstract
Time series of outplanted mussel patches left exposed or unexposed to predation by the sea star Pisaster ochraceus.

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Methods & Sampling

PREDATION RATE - OREGON
PISCO Intertidal
Location: Oregon and California rocky intertidal

Oregon State University

Project Duration May 2017 - 2020

Purpose: The purpose of this experiment is to study the rate of predation on mussels in the low intertidal.

Number of sites: 7 (Fogarty Creek, Boiler Bay, Yachats Beach, Strawberry Hill, Cape Blanco**, Port Orford Heads, Rocky Point) **at CB full cage reps double as annual Mussel Growth

Annual experiment schedule: April: Project is restarted, new mussels are deployed

May: Vexar plots are domed

June: Vexar removed and cages are installed

June-March: Monitoring plots

Number of replications per site: 5

Number of treatments per replicate: 2 (Fence Control, Cage)

Installation Supplies:

- Black vexar mesh,
- Plastic washers,
- Stainless lag screws,
- Plastic anchors,
- Stainless steel mesh cages and fences,

Monitoring Supplies

- Datasheet,
- Pencil,
- Oil pastels

Setup in Field:

Collect 500 mussels from the midzone at each site on the day of deployment. Mussels should be about 5-6cm long.

Clear any mussels and organisms remaining from the past year in the plots. The mussels transplanted to the cleared plots and secured to the rocks using Vexar mesh. Dome the vexar mesh over the mussels, giving the mussels 1-2 inches of space between them and the mesh. Doming can be done after 2 weeks to a month after initial deployment to promote byssal thread attachment.

Remove the vexar from the plots a month after it has been domed. Once the Vexar is removed from each plot, install the stainless steel cages and fences around the mussels. Add colored zipties to the Cages and Control Fences to distinguish between each replicate number (Red =1, Orange =2, Yellow =3, Green =4, Blue =5).

Monitoring:

Pred Rate is monitored at each visit, or as often as possible. Count mussels within each treatment and record the number of alive and dead individuals. Use oil pastels to mark the individuals counted within each fence and cage to keep track of which have been counted and which have not.

In June, July, and August the number of sea stars within a 1 meter radius around each plot is counted and recorded in the notes section of the datasheet. Some sea stars will be double counted if treatments are close together, this is normal and will not affect analysis.

Pisaster and *Nucella* spp. should be removed from the cage plots, but not recorded. The monitoring of Pred Rate at a site will be terminated when the mussels from all fence plots are gone.

Instruments:

Rock Hammer Drill: Amazon – Bosch – 11536VSR

https://www.amazon.com/Factory-Reconditioned-Bosch-11536VSR-RT-Lithium-Ion-SDS-Plus/dp/B000PDFXAO/ref=sr_1_1?ie=UTF8&qid=1520283121&sr=8-1&keywords=Bosch+11536VSR

Lags and anchors: McMaster Carr

https://www.mcmaster.com/#stainless-steel-lag-screws/=1br8j6w – item number 92351A558

Polyethylene Conical Screw Anchor, No. 14-16 item number: 97068A140

Mesh, Plastic "Vexar": Memphis Net and Twine http://www.memphisnet.net/ (888)674-7638

Black: 1/4 or ½ in. Mesh, Wind and Sand Fence, Standard Product ID: PN3

Data Processing Description

All data were input to microsoft excel.

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Parameters

Parameters for this dataset have not yet been identified

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Project Information

Collaborative Research: Mechanisms of resistance and resilience to system-wide loss of a keystone predator in an iconic intertidal community (Keystone Species Loss)

Website: http://pacificrockyintertidal.org

Coverage: Temperate west coast of North America

This project is affiliated with the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) and Multi-Agency Rocky Intertidal Network (MARINe).

NSF abstract:

Diseases that compromise the health of predators can lead to large, abrupt and sometimes unexpected changes in the structure of ecosystems. This project will combine field surveys, manipulative experiments and mathematical models to both understand and predict the ecosystem-level effects of the unprecedented sea star wasting disease (SSWD) outbreak that devastated populations of Pisaster ochraceus, a critical predator, across the West Coast of the United States. Specifically, the project will determine (1) the ecological and environmental factors that promote vs. compromise the resilience of intertidal ecosystems to sea star wasting disease, (2) document the pace and extent of recovery from this major disturbance across the West Coast of the United States, and (3) identify hotspots of resilience to sea star wasting disease that may serve as important conservation targets to preserve these iconic ecosystems. The research will address important societal needs by cross-training undergraduate and graduate students in disease ecology, marine biology, mathematical modeling and biostatistics. Students from underrepresented groups will be recruited broadly from West Coast states. Each summer, four undergraduate students will be trained in rocky intertidal field research techniques. SSWD-focused modules will be developed and used in ecology courses at each institution to emphasize the importance of quantitative and interdisciplinary training for addressing important questions in biology. Graduate students will work with the Oregon Migrant Leadership Institute (OMLI) for migrant workers and their children to create workshops for students about SSWD. The PIs will continue interacting with the media and public groups, and will expand outreach activities through The Nature Conservancy and CoastWatch-sponsored workshops for high school teachers interested in involving students in sea star monitoring to ensure that the results of this project are disseminated beyond traditional academic circles. Finally, a series of model-based interactive web modules will be created as part of this project to illustrate the ecosystem-level effects of sea star wasting disease to the broader public. The studies on this model system will lead to a better understanding of how other ecosystems may resist or be vulnerable to human activities (e.g., fishing, hunting and habitat destruction) that asymmetrically influence top predators.

Diseases that threaten the health of predators can reduce their top-down influence and thus lead to significant changes in ecosystem structure. In 2013-15, sea star wasting disease (SSWD) devastated populations of Pisaster ochraceus, the original keystone predator, along the west coast of North America in one of the most extensive marine disease events ever recorded. This project will leverage this unprecedented outbreak to test and extend keystone predation theory by documenting and explaining the temporal pace, geographical extent, and spatiotemporal co-occurrence of ecosystem recovery from SSWD. The disease event also provides an opportunity to test the resistance and resilience of a well-studied ecosystem at an unprecedented scale. At each of 14 sites, the investigators will quantify processes that underlie potential resistance of the system to loss of sea stars (prey recruitment and colonization, mussel growth, predation intensity, facilitative interactions

among sessile organisms, and the effect of alternative predators). In the latter experiments, the PIs will conduct caging exclusion experiments to test the effects of both larger (e.g., birds) and smaller (e.g., whelks) alternative predators on prey recolonization of cleared plots. The investigators will also conduct a novel set of experiments to manipulate factors affecting facilitation of mussels by barnacles and turf-forming algae. All these empirical studies will be used to parameterize modeling efforts that will explore the longer-term and larger-scale implications of these processes, both for this system and for other ecosystems. Specifically, the PIs will fit a novel spatially-explicit metacommunity model to the empirical data in order to determine the relative importance of intraspecific and interspecific resistance vs. resilience mechanisms for the recovery of intertidal ecosystems following a historical, coastal-scale SSWD disturbance.

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Program Information

Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO)

Website: http://www.piscoweb.org/

Coverage: West coast of North America from Mexico to Alaska

The Partnership for Interdisciplinary Studies of Coastal Oceans is a long-term ecosystem research and monitoring program established with the goals of:

- understanding dynamics of the coastal ocean ecosystem along the U.S. west coast
- sharing that knowledge so ocean managers and policy makers can make science based decisions regarding coastal and marine stewardship
- producing a new generation of scientists trained in interdisciplinary collaborative approaches

Over the last 10 years, PISCO has successfully built a unique research program that combines complementary disciplines to answer critical environmental questions and inform management and policy. Activities are conducted at the latitudinal scale of the California Current Large Marine Ecosystem along the west coast of North America, but anchored around the dynamics of coastal, hardbottom habitats and the oceanography of the nearshore ocean – among the most productive and diverse components of this ecosystem. The program integrates studies of changes in the ocean environment through ecological monitoring and experiments. Scientists examine the causes and consequences of ecosystem changes over spatial scales that are the most relevant to marine species and management, but largely unstudied elsewhere.

Findings are linked to solutions through a growing portfolio of tools for policy and management decisions. The time from scientific discovery to policy change is greatly reduced by coordinated, efficient links between scientists and key decision makers.

Core elements of PISCO are:

- Interdisciplinary ecosystem science
- Data archiving and sharing
- Outreach to public and decision-making user groups
- Interdisciplinary training
- Coordination of distributed research team

Established in 1999 with funding from The David and Lucile Packard Foundation, PISCO is led by scientists from core campuses Oregon State University (OSU); Stanford University's Hopkins Marine Station; University of California, Santa Cruz (UCSC); and University of California, Santa Barbara (UCSB). Collaborators from other institutions also contribute to leadership and development of PISCO programs. As of 2005, core PISCO activities are funded by collaborative grants from The David and Lucile Packard Foundation and the Gordon and Betty Moore Foundation. Core support, along with additional funding from diverse public and private sources, make this unique partnership possible.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1735743
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