VT_MusselDensities

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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)
» LTREB: Testing tipping points in a model rocky intertidal meta-ecosystem – Climate-change, increasing variances, and response mechanisms (LTREB Intertidal Tipping Points)

Programs
» Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO)
» Long Term Research in Environmental Biology (LTREB)

Contributors	Affiliation	Role
Menge, Bruce A.	Oregon State University (OSU)	Principal Investigator
Gouhier, Tarik C.	Northeastern University	Co-Principal Investigator
Gravem, Sarah	Oregon State University (OSU)	Co-Principal Investigator
Raimondi, Peter T.	University of California-San Diego (UCSD)	Co-Principal Investigator
York, Amber D.	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Densities of mussel recruits along replicated vertical transects at multiple Oregon and California sites

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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.

LTREB: Testing tipping points in a model rocky intertidal meta-ecosystem – Climate-change, increasing variances, and response mechanisms (LTREB Intertidal Tipping Points)

Coverage: West coast of North America

NSF abstract:

In recent decades, ocean ecosystems, long thought to be immune to change, have undergone disruptions to their structure, diversity, and geographic range, yet the actual underlying reasons for such changes in oceanic biota are often unclear. Coastal intertidal zones (i.e., the shore between high and low tides) have long served as important ecological model systems because of advantages in accessibility and ease of observation, occupancy by easily studied and manipulated organisms of relatively short lifespans, and exposure to often severe environmental conditions. This research will address the stability of a well-known rocky shore system along the Oregon and California coasts. Prior long-term research indicates that, although casual observation

suggests these systems are stable, in fact, they may be on the cusp of shifting into another state, losing iconic organisms like mussels and sea stars, and becoming dominated by seaweeds. These changes might be comparable to losing trees and large predators from terrestrial systems. This study would result in the training of undergraduates and graduate students, including individuals from under-represented groups. Additionally, this study would include outreach to the general public.

The researchers will focus particularly on impacts of increasing and more variable warming on community recovery. For example, climate oscillations (e.g., El Niño), coastal upwelling, and particularly temperature have all changed in recent decades in ways leading to increased stress on intertidal biota. In apparent response, coastal ecosystems evidently have become less productive, organismal performance (growth, reproduction) has declined, and key dynamical processes (species interactions) have weakened. The new research will pursue these strong hints of an impending “tipping point” by (1) continuing the projects that led to the insights of increasing instability, (2) adding new projects that will pinpoint ecological changes, and (3) expanding the region of work to include locations in California. Research will assess whether or not sea stars recover from wasting disease, experimentally test if species interactions are indeed weakening, quantify the annual inputs of new prey and changes in abundance, diversity, stability, and resilience of intertidal communities, and document changes in the physical environment. Using field observations and experiments, the research will provide insight into impacts of environmental change, particularly warming, on the future of coastal ecosystems, and more generally, into possible future states of Earth’s ecosystems. Using these data, we will test the hypothesis that direct and indirect effects of climate change are driving, or may drive these systems into new, alternative states.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

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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.

Long Term Research in Environmental Biology (LTREB)

Website: https://www.nsf.gov/funding/opportunities/ltreb-long-term-research-environmental-biology

Long Term Research in Environmental Biology (LTREB)

Supports research for a period of 10 years or longer to generate an extended time series of data with a focus on evolutionary biology, ecology and ecosystem science.

Synopsis
The Long Term Research in Environmental Biology (LTREB) Program supports the generation of extended time series of data to address important questions in evolutionary biology, ecology, and ecosystem science. Research areas include, but are not limited to, the effects of natural selection or other evolutionary processes on populations, communities, or ecosystems; the effects of interspecific interactions that vary over time and space; population or community dynamics for organisms that have extended life spans and long turnover times; feedbacks between ecological and evolutionary processes; pools of materials such as nutrients in soils that turn over at intermediate to longer time scales; and external forcing functions such as climatic cycles that operate over long return intervals.

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Funding

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