Prey percent cover raw data from predator removal experiment following seastar wasting disease from coastal Oregon, 2015

Website: https://www.bco-dmo.org/dataset/653966
Data Type: experimental
Version:
Version Date: 2016-08-12

Project
» Testing the rocky intertidal community consequences of the decimation of purple sea star populations along the Oregon coast by sea star wasting disease (Sea star wasting)

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

Contributors	Affiliation	Role
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Dataset Description

Data are from experiment measuring sessile community structure with and without whelk and Leptasterias predators following SSWD. Experiment was run at two sites from June 2014 to May 2015. Data here are from photographic analysis of prey community for 4 time points.

Related Reference:

Elizabeth B. Cerny-Chipman, Jenna M. Sullivan, and Bruce A. Menge. Whelk predators exhibit limited population responses and community effects following disease-driven declines of the keystone sea star *Pisaster ochraceus.* In Revision: MEPS.

Related Datasets:
Predator removals
Whelk size distributions: counts
Whelk size distributions: individuals
Whelk surveys

Methods & Sampling

Study system:
Our study included 4 sites along the Oregon coast: Strawberry Hill (44.250°N-124.115°W) and Yachats Beach (44.319°N-124.109°W), located on Cape Perpetua, and Fogarty Creek (44.837°N-124.0587°W) and Boiler Bay (44.832°N-124.061°W) located on Cape Foulweather (Fig.1). Cape Perpetua is a rocky headland adjacent to a wide continental shelf offshore that promotes retention of propagules such as larvae and phytoplankton (Menge et al. 2015). As a result, Cape Perpetua intertidal sites are characterized by high phytoplankton productivity and high recruitment of invertebrates (Menge et al. 1997, 2004, 2015). Cape Foulweather, in contrast, is characterized by a narrower offshore continental shelf, which leads to reduced retentiveness, lower invertebrate abundance, and high macrophyte abundance. Prior to the onset of SSWD, densities of P. ochraceus could be as high as 8 individuals m-2 at Cape Perpetua and 4 individuals m-2 at Cape Foulweather sites (Menge et al. 2016).

Subordinate predator removal experiment
To assess the effects of subordinate predators in the absence of the keystone, we conducted a factorial removal experiment at two intertidal sites located on Cape Perpetua, Oregon (Strawberry Hill and Yachats Beach, see Fig. 1). We predicted that whelk predators would affect establishment of the dominant mussel, Mytilus californianus, by consuming the mid-successional prey species that facilitate its recruitment. As such, we chose to follow prey dynamics from a mid-successional stage by placing plots where there was abundant cover of the mussel Mytilus trossulus and several barnacle species. This mid-successional community is where we expected to see the greatest effects of subordinate predators and the largest changes in community structure following SSWD. We originally examined the effects of two groups of subordinate predators, gastropod whelks Nucella canaliculata and N. ostrina (W) and the smaller sea star Leptasterias spp. (L), in a factorial design including four treatments: +W +L, -W+L, +W -L, and -W-L. However, Leptasterias spp. were rare in our plots, and treatments were combined to include control (+W) and whelk removal (–W) treatments only (see data analysis section below). It is important to note that our experiment tested the effects of subordinate predators at reduced P. ochraceus densities, rather than comparing their effects in the presence or absence of P. ochraceus.

We followed prey community structure over time at 5 replicate plots (10 when treatments were combined) within each site at the upper edge of the low zone. The main treatment plots were 0.25 m2 in size and corners were marked with stainless steel lag screws. Each main plot was surrounded by four additional subplots adjacent to each plot side that were meant to act as a buffer for the main plot. We monitored plots either bi-weekly or monthly as tides permitted from experimental initiation in June 2014 through May 2015. At each monitoring, we counted the total number of each subordinate predator species (N. canaliculata, N. ostrina, and Leptasterias spp.), as well as any less common predators, such as the whelk Nucella lamellosa, in all plots. When possible, we conducted a full monitoring with counts and removals of predators in the main plot, the four adjacent subplots, and in the corners between subplots. On some occasions, particularly during winter months with limited site access, we only monitored the main plots. All removal of whelks and Leptasterias spp. was conducted using forceps, and removed predators were relocated away from the plot area. In plots without removals, we mimicked the use of forceps in the plot while counting subordinate predators to limit the possibility that the physical action of predator removal would influence our results. Although SSWD caused declines in Pisaster ochraceus densities, it did not extirpate the species entirely from our sites. We recorded and relocated any P. ochraceus within each plot and any adult and juvenile P. ochraceus from a 3m radius around each plot.

Data Processing Description

Photo analysis of prey communities
We used photo analysis to follow changes in prey community structure across experimental treatments over time. At each monitoring point, we took a photograph of each plot including a quadrat to provide a grid for estimating cover of prey species. Photo analysis was conducted for four time points: June 2014, September 2014, February 2015, and May 2015. Percent cover of M. californianus and several groups of mid-successional prey species including M. trossulus and the barnacles Balanus glandula, Semibalanus cariosus, Chthamalus dalli, Pollicipes polymerus, and B. nubilus were visually estimated from the photographs as a metric of abundance (e.g. Dethier et al. 1993). Barnacle recruits were too small to be identified to species and were put into a single separate category. We also separately estimated the percent cover of Mytilus recruits, which were less than roughly 5 mm in length and were not identifiable to species. It is difficult to differentiate M. californianus and M. trossulus when individuals are small or in very high densities. As such, it is possible that some mussel individuals identified as adult M. trossulus were later identified as M. californianus if they developed clear morphological traits of M. californianus, though misidentification would be consistent across treatment.

Because other low zone organisms were likely to respond to variation in abundance of mussels and barnacles, we quantified the abundance of macrophyte algae, anemones (Anthopleura elegantissma and Anthopleura xanthogrammica) and sponges. Macrophytes were sorted into functional groups including crusts, turfy algae, and canopy-forming algae. Overall, the cover of macrophytes was low in our plots throughout the experiment. We also quantified the abundance of non-focal mobile invertebrates including sea urchins (Strongylocentrotus purpuratus), chitons (e.g., Katharina tunicata, Tonicella lineata, Mopalia spp.), and limpets (Lottia spp.).

BCO-DMO Processing:
- added conventional header with dataset name, PI name, version date
- renamed parameters to BCO-DMO standard
- reformatted date from m/d/yyyy to yyyymmdd
- replaced . in specific_cover_type column with nd (no data)

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Data Files

File
pcent_cover.csv (Comma Separated Values (.csv), 19.40 KB) MD5:f4a8ea755f10502df9278a77a942c5fd Primary data file for dataset ID 653966

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Parameters

Parameter	Description	Units
time_point	Standardized date reflecting time period for each site of observations. In YYYYMMDD format	year-month-day
direction	Direction of subplot relative to mainplot. Used to maintain consistent plot monitoring. M=main plot; N=north; E=east; S=south; W=west	unitless
photo_date	Date photograph used in analysis was taken in format YYYYMMDD	year-month-day
site	One of two experimental sites: SH=Strawberry Hill; YB=Yachats Beach	unitless
rep	Replicate number: 1-5	unitless
treatment	Treatment: C=control; W=Whelk removal; L=Leptasterias Removal; A=removal of both whelks & Leptasterias	unitless
plot	Unique ID for each experimental unit within each site (names are repeated across sites)	unitless
M_californianus	Percent cover of Mytilus californianus	percent

M_trossulus	Percent cover of Mytilus trossulus	percent
M_unidentified	Percent cover of indentified Mytilus spp.	percent
M_recruits	Percent cover of Mytilus recruits; species unidentified	percent
B_glandula	Percent cover of Balanus glandula	percent
S_cariosus	Percent cover of Semibalanus cariosus	percent
C_dalli	Percent cover of Chthamalus dalli	percent
P_polymerus	Percent cover of Pollicipes polymerus	percent
B_nubilus	Percent cover of Balanus nubilus	percent
barn_recruits	Percent cover of barnacle recruits; all species	percent
anemones	Percent cover of anemones (Anthopleura elegantissima and Anthopleura xanthogrammica)	percent
sponge	Percent cover of sponges; species unidentified	percent
canopy	Percent cover of macrophyte canopy (for canopy-forming species)	percent
turf	Percent cover of turf-forming algae	percent
crust	Percent cover of algal crusts	percent
sand	Percent cover of sand	percent
bare	Percent cover of bare rock	percent
free_space	Percent cover of total open space (sand + bare rock)	percent
vertical	Percent cover of plot that is vertical; and thus not counted. Final percent covers are adjusted to reflect any missing space in plots.	percent

bare_expected	Percent cover bare rock expected. Equal to 100% less all other primary cover values	percent
act_bare_vs_exp	Actual bare rock percent cover - expected	percent
chiton	Number of chitons in plot	individuals
limpets	Number of limpets within a 20 x 20 cm subplot. Subplot was chosen using a random number generator with values between 1 and 25	individuals
S_purpuratus	Number of Strongylocentrotus purpuratus	individuals
tot_mussels	Sum of percent cover of all mussel groups	percent
tot_barn	Sum of percent cover of all barnacle groups	percent
comments	Initials of researcher analyzing photo	unitless
investigator	Notes on picture quality or other issues	unitless

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Camera
Generic Instrument Description	All types of photographic equipment including stills, video, film and digital systems.

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Deployments

Menge_2014

Website	https://www.bco-dmo.org/deployment/653801
Platform	OSU
Start Date	2014-04-16
End Date	2015-07-17
Description	Benthic ecology before and after Seastar Wasting Disease infection.

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Project Information

Testing the rocky intertidal community consequences of the decimation of purple sea star populations along the Oregon coast by sea star wasting disease (Sea star wasting)

Website: http://www.eeb.ucsc.edu/pacificrockyintertidal/data-products/sea-star-wasting/

Coverage: Oregon coast

This study will investigate the ecological consequences of the decimation of sea star populations by wasting disease along the Oregon coast. Hallmarks of wasting disease are the formation of sores on the sea star that progress to cause loss of arms, and ultimately death of the animal. Wasting disease was reported in sea star populations including those of the purple sea star, Pisaster ochraceus, in British Columbia, Washington, and California as early as April 2013. In Oregon, wasting was first observed in April 2014, and by June 2014 rates of infection ranged up to 80%, and sea star abundance had declined. At that rate, many populations may disappear by the end of summer 2014. Prior research has shown that in the absence of the purple sea star, mid-shore mussel populations increase, and ultimately overgrow the sea weeds and invertebrates that occur low on the shore, reducing biodiversity. However, because disease events of this magnitude have never occurred along the entire coastline, it is unclear if the small-scale expansion of mussels observed previously will be a general result of this event. One possibility is that predators unaffected by wasting, such as whelks and crabs, will increase their predation effects and blunt the expected invasion of mussels to the low shore. The research in this project will evaluate this possibility by testing the role of these alternative predators. Broader Impacts include the training of undergraduate and graduate students, the involvement of coastal residents and the production of microdocumentaries and video to document the changing context of this ecosystem.

The research project is designed to test three hypotheses. First, that in the absence of Pisaster ochraceus, predation by whelks will increase in strength through increases in whelk abundance and in whelk size, and at least partially compensate for the absence of Pisaster. Second, the small sea star Leptasterias spp. will also expand its role as a predator through increased size and abundance, and expansion of its habitat beyond mussel beds. Although individuals of this sea star have been observed to suffer from wasting as well, the frequency so far appears low, and it seems likely this species may persist. Third, the crab Cancer productus, normally mostly a subtidal species, will expand its range into the intertidal and help to compensate for the loss of Pisaster. Tests of these hypotheses will include manual removal experiments (whelk removal, Leptasterias removal, removal of both and of neither), cage exclusion experiments (whelk exclusions), cage inclusion-exclusion experiments (Leptasterias inclusion, Leptasterias exclusion). Experiments will be replicated with appropriate controls, and done at multiple sites on the central Oregon coast that vary naturally in population abundances, rates of prey and predator recruitment, and oceanographic conditions. Results obtained under this unprecedented set of circumstances will deepen and expand our empirical understanding of the dynamics of an iconic ecosystem, and will help parameterize community models.

Additional Project Information: Sea Star Wasting Map

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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-1448913

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