Quadrat sampling information along the Northern Central California coast from 2017 to 2021

Website: https://www.bco-dmo.org/dataset/751634
Data Type: Other Field Results
Version: 3
Version Date: 2024-02-29

Project
» Collaborative Proposal: Selection and Genetic Succession in the Intertidal -- Population Genomics of Pisaster ochraceus During a Wasting Disease Outbreak and its Aftermath (PoGOMO)

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Abstract
Quadrat sampling information collected concurrently with habitat complexity photos along the Northern Central California coast from 2017 to 2021.

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Coverage

Location: Northern Central California coast, ~36–39 N
Spatial Extent: **N**:38.9165 **E**:-120.672 **S**:35.1522 **W**:-123.715
Temporal Extent: 2017-12-02 - 2021-07-25

Dataset Description

This page serves data for only the "Quadrat data" dataset. See "Related Datasets" section for access to the other data types mentioned in the study data description below and the Methods & Sampling section. Study data description: Abundances and sizes of target invertebrates in quadrat surveys; photos of habitat complexity and a subset of specimens; and GPS coordinates of quadrats.

Methods & Sampling

Sampling and analytical procedures for habitat complexity photos and related datasets:

At each site, we sampled two rocky intertidal areas (usually one on either side of a beach or headland and separated by approximately 100 meters) during low tide (usually less than -0.8 feet), using quadrats to estimate abundances of Pisaster ochraceus, Cryptochiton stelleri, Leptasterias sp., and Henricia pumila. We exhaustively searched 20–32 one-meter square quadrats per site (i.e. 10–16 per

each of 2 areas), recording GPS waypoint, time, and abundances and sizes of the target species for each quadrat. Each quadrat was photographed. Quadrat locations were selected by first finding one of the target habitat types—surf grass, low-zone red algae, coralline turf, cobble or boulder field, or urchin pools with pits either empty or occupied—selecting a starting point haphazardly, and then using a random numbers table (range of 1–10 meters) to choose remaining quadrat locations. All quadrats and specimens were georeferenced using a Garmin C60X GPS (±3 m precision). The accuracy of the GPS in meters at the time the waypoint was recorded can be found in column "GPS_Accuracy" of the "Quadrat data" dataset. Tissues samples are preserved in 95% Ethanol and stored at -20 degrees C. A subset of tissue samples are also preserved in RNA Later and stored at -20 degrees C (as indicated in the "Quadrat data" dataset).

Data Processing Description

Data were transcribed from field notes, error-checked, and verified that tissue collections matched up to notes.

BCO-DMO Curation Notes

BCO-DMO Data Manager Processing Notes:
* Data submitted in 75 Excel files (e.g. Quadrat_181221_MCM_Area1_LMS.xlsx) with sheets named "QuadratData" was exported as csv and imported into the BCO-DMO data system. All data concatenated into one table.
* Parameters (column names) renamed to comply with BCO-DMO naming conventions. See https://www.bco-dmo.org/page/bco-dmo-data-processing-conventions
* Date format converted to ISO 8601 date format yyyy-mm-dd
* Time format converted to ISO 8601 time format HH:MM
* DateTime (UTC) column added in ISO 8601 format yyyy-mm-ddTHH:MMZ from local dates and times "Start_Time" and "Date" in US/Pacific Time to form column "Quadrat_Start_DateTime_UTC."
* Commas in "Person" and "Site" changed to semicolons to support csv export from the BCO-DMO data system.
* Column with blank values "End_Time" was removed from the dataset.
* Columns named "Area" renamed to Quadrat_Area and Area_Number (see parameter descriptions).
* lat and lon columns for the waypoints added to this the dataset from the "GPS waypoints" data using the waypoint ID, date, and area number to join the data tables.

Data version 2 replaced data version 1 on 2022-02-01.
* Data version 2 adds additional data from 2019-2020. Processed the same way as v1.
* value "?" in Start_Time and GPS_Accuracy changed to missing data value. Note added to the Quadrat_Notes column "Start time unknown" and "GPS accuracy unknown" respectively.

Datset version 3 adds data for 2020-2021
* Dataset imported the same way as v1 and v2. lat lon was added from related "GPS waypoints" version 3.

Problem Description

For 2018-12-21 and 2019-07-06:
Strongylocentrotus purpuratus were only counted in the first quadrant (0.25 x 0.25m) of each quadrat (1m2), so the total search area for that species is one quarter that of other species and so the density should be calculated accordingly.

For 2020-2021: Strongylocentrotus purpuratus were not counted or measured this field year.

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Data Files

File
751634_v3_quadrat-data.csv (Comma Separated Values (.csv), 1.22 MB) MD5:ffc4b9c6c79ed5b4fef179628016c36c Primary data file for dataset ID 751634, version 3

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Related Datasets

IsRelatedTo

Dawson, M. N., Schiebelhut, L. (2025) **GPS waypoints for habitat complexity photos collected along the Northern Central California coast from 2017 to 2021.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 3) Version Date 2024-02-29 doi:10.26008/1912/bco-dmo.750667.3 [view at BCO-DMO]
Relationship Description: These data were collected concurrently.

Dawson, M. N., Schiebelhut, L. (2025) **Habitat complexity photos collected along the Northern Central California coast from 2017 to 2021.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 3) Version Date 2024-02-29 doi:10.26008/1912/bco-dmo.751642.3 [view at BCO-DMO]
Relationship Description: These data were collected concurrently. These data were collected concurrently. Photo names in "Habitat Complexity Photos" dataset will match to the Quadrat_Photo listed in this "Quadrat data" dataset.

Dawson, M. N., Schiebelhut, L. (2025) **Quadrat species counts and measurements along the Northern Central California coast from 2017 to 2021.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 3) Version Date 2025-05-12 doi:10.26008/1912/bco-dmo.751650.3 [view at BCO-DMO]
Relationship Description: These data were collected concurrently.

Dawson, M. N., Schiebelhut, L. (2025) **Site list for habitat complexity photos and related datasets sampled along the Northern Central California coast from 2017 and 2021.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 3) Version Date 2024-02-29 doi:10.26008/1912/bco-dmo.751658.3 [view at BCO-DMO]
Relationship Description: These data were collected concurrently.

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Parameters

Parameter	Description	Units
Date	Date the survey was conducted in ISO 8601 format.	unitless
Site_Code	The 3 letter code for the survey location	unitless
Area_Number	Area number (1 or 2) within the site	unitless
Sector	One of four 0.25m^2 quadrants within a full quadrat; the first is 'NL" and is the sector at which the Waypoint is recorded; an additional 3 sectors are layed out linearly side-by-side, named 'FL', 'FFL', and 'FFFL'; together 4 sectors make up 1m^2 quadrat unless otherwise noted	unitless

Quadrat_Waypoint	The waypoint number logged for a particular GPS Name, Date, Site, and Area; corresponds to "wpt_ID" in the "GPS waypoints" dataset. The quadrat itself is 1 square meter made up of 4 0.25m^2 quadrants (4 sectors)	unitless
lat	Latitude (accuracy ±3m unless otherwise stated in Quadrat data)	decimal degrees
lon	Longitude (accuracy ±3m unless otherwise stated in Quadrat data)	decimal degrees
Quadrat_Area	Area of the sector	square meters (m^2)
GPS_Name	GPS Name (e.g. MNDGPS1). Assigned name to distinguish GPS units	unitless
Site	The name of the survey location	unitless
Start_Time	The time (local US/Pacific time zone) the search begin within a particular quadrat	unitless
Quadrat_Notes	Extra notes about quadrats (e.g. description of other; other observations).	unitless
Most_common_substrate	The most common substrate in the quadrat sector	unitless
Second_most_common_substrate	The second most common substrate in the quadrat sector	unitless
Quadrat_Photo	The name of the photo taken of this quadrat sector. (See "Habitat complexity photos" Dataset for accees to the images)	unitless
GPS_Accuracy	The accuracy of the GPS in meters at the time the waypoint was recorded (+- m)	meters (m)
Person	The person or people doing the quadrat survey (full name).	unitless
Quadrat_Start_DateTime_UTC	The DateTime (UTC) the search begin within a particular quadrat in ISO 8601 format YYYY-MM-DDThh:mmZ.	unitless

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Camera
Dataset-specific Description	The vast majority of images were taken on a Panasonic DMC-FT5 or Panasonic DMC-ST4, some were taken from an iPhone.
Generic Instrument Description	All types of photographic equipment including stills, video, film and digital systems.

Dataset-specific Instrument Name	Garmin C60X GPS
Generic Instrument Name	GPS receiver
Dataset-specific Description	Garmin C60X GPS (±3 m precision)
Generic Instrument Description	Acquires satellite signals and tracks your location. This term has been deprecated. Use instead: https://www.bco-dmo.org/instrument/560

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Project Information

Collaborative Proposal: Selection and Genetic Succession in the Intertidal -- Population Genomics of Pisaster ochraceus During a Wasting Disease Outbreak and its Aftermath (PoGOMO)

Coverage: Northeastern Pacific (32–60 ºN), particularly northern Central California (35–40 ºN)

NSF abstract:

This project seeks to understand the outcomes of predator-disease dynamics by exploring a recent pandemic that decimated 90% of ochre sea stars (Pisaster ochraceus) in the eastern North Pacific in 2013. The research team will explore how recovery may depend upon often difficult-to-see processes such as the interplay of migration and natural selection in marine species. While the population of sea stars is currently rebounding due to several years of unusually high recruitment, the sea star wasting disease continues to persist at low levels. This project aims to determine the genetic consequences of the pandemic and subsequent recovery. The team will determine whether the majority of susceptible sea stars have died and identify possible refuges where susceptible sea stars survived. They will examine the potential for heritable variation in resistance to this disease in order to assess whether the new recruits are tolerant or susceptible to wasting. Resolving these issues will enable predictions about the trajectory of their recovery and the potential responses to future large scale disease outbreaks. Research findings will be shared with resource managers and scientists at a collaborative workshop that will focus on state-of-the-art methods to advance research on marine diseases. The public will have the opportunity to learn more about sea star wasting disease through a partnership with the UCSC Seymour Marine Discovery Center and can track the incidence of disease using an online interactive map available at www.seastarwasting.org. Results will be incorporated into professional development for teachers with CalTeach and adapted for teaching materials up to college-level. This project will train diverse early career scientists - undergraduates, graduates, and a postdoctoral scholar - in integration of ecological and genomic methods.

Understanding the consequences of large-scale pandemics in the broader contexts of geographic heterogeneity and chronic changes in ocean pH and temperature is an emerging contemporary issue. This project employs long-term characterization of population dynamics and genetic consequences of a sea star wasting disease (SSWD) outbreak, which caused median 90% mortality in Pisaster ochraceus populations in the northeastern Pacific, to estimate potential long-term consequences for the species. While the largest recorded influx of new recruits occurred in 2014-2016, it is unknown where they originated from, whether recruits and surviving adults remained susceptible to the disease, which persisted at low levels, and for how long these dynamics might continue. This long-term dataset provides a unique opportunity for exploring the

short and long term repercussions of such large-scale disease outbreaks and the population dynamics that they precipitate. This project builds on long-term field studies of wild populations to describe host population dynamics, the disease, and genomic diversity. The goal is to discover genetic variation associated with SSWD and to dissociate that variation from population genomic effects attributable to abiotic environmental variation. Objectives are: (1) Census P. ochraceus at 24 sites throughout its range to describe population dynamics, the prevalence of SSWD, and measure abiotic variables. (2) Conduct laboratory experiments coupled with RNAseq analyses to determine loci differentially regulated during exposure to SSWD, temperature, salinity, and pCO2 anomalies. (3) Map ddRAD, RNAseq, and candidate loci under selection to a P. ochraceus genome. (4) Conduct range-wide population genomic analyses for 3 years to assess genetic (SNP) variation among wild-caught specimens with, versus without, SSWD across a geographic mosaic of abiotic variation. (5) Explore links between SSWD and candidate loci, such as EF1A. These analyses will describe the immediate genomic consequences of the disease outbreak, the population dynamics that the outbreak set in motion, and the interplay of factors and mechanisms - such as disease, temperature, migration, selection - that affected these changes. The results will advance understanding of general processes and interactions that shape population genomic structure in coastal ecosystems, providing resources to inform future research and applications in design of management strategies for coastal living resources.

Proposal abstract

Extreme disturbances are expected to increase in frequency and intensity with climate change; their consequences for marine species will depend upon the often enigmatic interplay of dispersal and selection (and drift). This project seeks to understand the population and genomic consequences of a decimating epizootic of the sea star *Pisaster ochraceus*. Existing collections, which immediately preceded and followed the outbreak and documented >90% mortality of adults and massive subsequent recruitment, will be coupled with continuing annual surveys and population genomic, transcriptomic, and candidate locus analyses. The project aims to determine the extent to which this disease outbreak may (or may not) lead to long-term changes in the frequencies of alleles associated with survival of SSWD.

Understanding the consequences of large perturbations set against a backdrop of geographic heterogeneity and gradual environmental change is an emerging contemporary issue. It requires long-term characterization of population dynamics, genetic consequences, and future implications. In 2013, sea star wasting disease (SSWD) swept through *P. ochraceus* populations in the northeastern Pacific. We captured this epizootic in long-term ecological-genetic studies, which documented median 90% mortality coast-wide (site-specific rates 51–96%). In the aftermath of the initial outbreak, we quantified the largest influx of new recruitments on record. The disease currently persists at low-levels among surviving populations, and recruitment continues to be above average. Given heterogeneity in the environment and in mortality rates, and because 2013 recruits may have been spawned by adults pre-outbreak, but 2014-to-current recruits are progeny of adults that survived, the genomic consequences of the outbreak and the implications for future population and disease dynamics are uncertain.

This project builds on long-term field studies of wild populations of *P. ochraceus* to describe population dynamics, the disease, and genomic diversity. Goals are to discover genetic variation associated with SSWD and to dissociate that variation from population genomic effects attributable to abiotic environmental variation. Objectives are: (1) Census *P. ochraceus* at 24 sites throughout its range to describe population dynamics, the prevalence of SSWD, and measure abiotic variables. (2) Conduct laboratory experiments coupled with RNAseq analyses to determine loci differentially regulated during exposure to SSWD, temperature, salinity, and pCO2 anomalies. (3) Map ddRAD, RNAseq, and candidate loci under selection to a *P. ochraceus* genome. (4) Conduct range-wide population genomic analyses for 3 years, including intensive study of a focal region, in which we will assess genetic (RAD) variation among wild-caught specimens with versus without SSWD and experiencing the geographic mosaic of abiotic variation. (5) Explore links between SSWD and candidate loci, such as EF1A.

Preliminary results are consistent with an association between SSWD, very high mortality (90%), and differential susceptibility of *P. ochraceus* linked to variation in ddRAD markers, expression of RNAseq loci, and overdominance at a candidate locus (EF1A). RAD analyses show site-specific differences between *P. ochraceus* adults despite high gene flow, and while intertidal juveniles and adults were selected by SSWD in 2013, the subsequent pulse of new recruits was most genetically similar to the pre-outbreak population. The consequences of the SSWD outbreak are still unfurling in a dynamic eco-evolutionary landscape.

Research mentoring

This project trains a postdoc, 3 graduate students, >= 6 undergraduates. The postdoc and graduates will be cross-trained in field, lab, and genomics. Undergraduates will participate in field and laboratory research, have opportunities for internships, and be involved in outreach activities addressing environmental change. UCM and UCSC are designated Hispanic Serving Institutions. Teaching. Collaboration with the CalTeach program at UC

Merced, lab research experience for high school students at Cornell, and an interactive web-based instructional exercise at UCSC will draw upon the iconic natures of *Pisaster*, the rocky intertidal, and keystone predators in education, policy, and management, interweaving project outcomes. Public understanding. Outreach efforts will target general public and marine resource managers using a website and interactive map for tracking sea star wasting (www.seastarwasting.org). Scientific understanding. An end-of-project workshop will host several groups working on different aspects of SSWD and its consequences.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1737381

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