Database of oyster mortality based on body size treatment

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Project
» CAREER: Linking genetic diversity, population density, and disease prevalence in seagrass and oyster ecosystems (Seagrass and Oyster Ecosystems)

Contributors	Affiliation	Role
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Abstract
Database of oyster mortality based on body size treatment

Table of Contents

Coverage

Spatial Extent: **Lat**:-33.83883 **Lon**:151.25458
Temporal Extent: 2015-11-17 - 2016-01-15

Dataset Description

These data were used in the analyses presented in Gribben, P.E., M.J. Bishop, W.A. O'Connor, D.J. Bradley, and A.R. Hughes. Intraspecific diversity in prey body size influences survivorship through density mediated changes in predation. Ecosphere. Accepted.

Acquisition Description

We utilised 10-month old oysters, spawned under the breeding program at the Port Stephens Fisheries Institute (PSFI) in January 2015 and subsequently grown out on nearby oyster leases, to establish three phenotypic treatments with respect to size. The phenotypes were Small (mean size ± SE; 18.88 ± 0.17 mm shell length), Medium (32.23 ±0.21 mm shell length) and Large (39.04 ± 0.32 mm shell length), with each phenotype receiving at least 100 oysters from each of the same 16 family lines to produce treatments of comparable genetic diversity.

Oysters were manipulated on concrete tiles that were deployed at a mid-intertidal elevation along the eastern shoreline of Chowder Bay, Sydney Harbour, Australia (33°50'19.80"S, 151°15'16.50"E).

Oyster phenotypic diversity (3 levels; 1, 2 or 3 size classes/tile) and predator access (2 levels: small mesh cages and large mesh cages) were manipulated in a fully orthogonal experiment on concrete tiles, measuring 30cm (length) x 30cm (width) x 4cm (height). The large mesh was 2.5 cm in diameter. The small mesh was 1.5 cm in diameter. In total we had 14 treatments: small and large mesh cages containing small, medium and large oysters on their own, all pairwise combinations, and all three phenotypes together. There were five replicates per treatment, giving a total of 70 tiles.

Oysters were glued to concrete tiles using a 2-part epoxy adhesive (Megapoxy HT, Permatech), with the various body sizes haphazardly interspersed on tiles assigned to receive multiple phenotypes. There was a 3 cm margin with no oysters around each plate. No oysters died from this process.

Prior to caging of tiles, each was photographed (with a scale bar included) to determine the initial size of all oysters and the position on each tile of the various size classes. We used maximum shell length along the anterior–posterior axis as our measure of body size

Tiles were then enclosed within a box cage consisting of stainless steel mesh of the assigned size. The tiles were not affixed to the mesh cage but sat on the bottom of it. The mesh extended 10 cm above the surface of the tile. Mesh was secured on the underside of the tile with cable ties.

Tiles were placed in Chowder Bay at the mid intertidal elevation at which oysters naturally occur on 17th November 2015. Tiles were interspersed with respect to treatment, separated by

at least 0.5 m and wedged between boulders to minimise flipping by waves. The tiles were sampled at 1 week and after 8 weeks (15 Jan 2016). At 1 week, three tiles were flipped by wave action but no damage to oysters or cages were observed, so these were righted and secured in new positions between boulders. No other flipping or damage to tiles was recorded at the end of the experiment.

Processing Description

The tiles were sampled at 1 week and after 8 weeks (15 Jan 2016). At 1 week, three tiles were flipped by wave action but no damage to oysters or cages were observed, so these were righted and secured in new positions between boulders. No other flipping or damage to tiles was recorded at the end of the experiment.

The effects of different types of predators were inferred from shell damage observed to dead oysters. At the end of the study, dead oysters were recorded as drilled, crushed, valve removed or intact (two valves present and undamaged). In no instance were both valves of an oyster missing.

BCO-DMO processing notes:

- Adjusted the column headers to comply with the database requirements

[table of contents | back to top]

Parameters

Parameter	Description	Units
Plate_density	Descriptor of the density of the experimental plate: Full (24 oysters per plate); Half (12 oysters per plate); Third (8 oysters per plate)	unitless
Plate_replicate	Unique identifier for replicate plates within a given treatment	unitless
Cage_mesh_size	Descriptor of the mesh size used to surround each experimental plate: Small Mesh or Large Mesh	unitless
Oyster_size_treatment	Size treatment for the experimental plate: S (small oysters only); M (medium oysters only); L (large oysters only); SM (mix of small and medium oysters); SL (mix of small and large oysters); ML (mix of medium and large oysters); SML (mix of small, medium, and large oysters)	unitless
Individual_oyster_size	Size class of each individual oyster on the experimental plate	unitless
Individual_mortality	Binomial code for the mortality of each individual oyster on the experimental plate: 0 (Alive) or 1 (Dead)	unitless
Mode_of_mortality	Category for the mode of mortality of each individual oyster: U (unknown); M (missing valve); D (drilled by a predator); C (crushed by a predator)	unitless

[table of contents | back to top]

Project Information

CAREER: Linking genetic diversity, population density, and disease prevalence in seagrass and oyster ecosystems (Seagrass and Oyster Ecosystems)

Coverage: Coastal New England

NSF Award Abstract: Disease outbreaks in the ocean are increasing, causing losses of ecologically important marine species, but the factors contributing to these outbreaks are not well understood. This 5-year CAREER project will study disease prevalence and intensity in two marine foundation species - the seagrass Zostera marina and the Eastern oyster Crassostrea virginica. More specifically, host-disease relationships will be explored to understand how genetic diversity and population density of the host species impacts disease transmission and risk. This work will pair large-scale experimental restorations and smaller-

scale field experiments to examine disease-host relationships across multiple spatial scales. Comparisons of patterns and mechanisms across the two coastal systems will provide an important first step towards identifying generalities in the diversity-density-disease relationship. To enhance the broader impacts and utility of this work, the experiments will be conducted in collaboration with restoration practitioners and guided by knowledge ascertained from key stakeholder groups. The project will support the development of an early career female researcher and multiple graduate and undergraduate students. Students will be trained in state-of-the-art molecular techniques to quantify oyster and seagrass parasites. Key findings from the surveys and experimental work will be incorporated into undergraduate courses focused on Conservation Biology, Marine Biology, and Disease Ecology. Finally, students in these courses will help develop social-ecological surveys and mutual learning games to stimulate knowledge transfer with stakeholders through a series of workshops. The relationship between host genetic diversity and disease dynamics is complex. In some cases, known as a dilution effect, diversity reduces disease transmission and risk. However, the opposite relationship, known as the amplification effect, can also occur when diversity increases the risk of infection. Even if diversity directly reduces disease risk, simultaneous positive effects of diversity on host density could lead to amplification by increasing disease transmission between infected and uninfected individuals. Large-scale field restorations of seagrasses (Zostera marina) and oysters (Crassostrea virginica) will be utilized to test the effects of host genetic diversity on host population density and disease prevalence/intensity. Additional field experiments independently manipulating host genetic diversity and density will examine the mechanisms leading to dilution or amplification. Conducting similar manipulations in two marine foundation species - one a clonal plant and the other a non-clonal animal - will help identify commonalities in the diversity-density-disease relationship. Further, collaborations among project scientists, students, and stakeholders will enhance interdisciplinary training and help facilitate the exchange of information to improve management and restoration efforts. As part of these efforts, targeted surveys will be used to document the perceptions and attitudes of managers and restoration practitioners regarding genetic diversity and its role in ecological resilience and restoration.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1652320
Australian Research Council (ARC)	FT140100322

[table of contents | back to top]