The effect of relatedness and density on survival and growth of Bugula neritina in the Gulf of Mexico, Florida from October to December 2021.

Website: https://www.bco-dmo.org/dataset/968839
Data Type: experimental
Version: 1
Version Date: 2025-07-16

Project
» Consequences of kin structure in benthic marine systems (Marine kin structure)

Contributors	Affiliation	Role
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Abstract
In the Gulf of Mexico, Florida, we performed a series of field experiments using an experimentally tractable species (the bryozoan Bugula neritina) to test the hypothesis that the density, spatial arrangement, and genetic relatedness of neighbours differentially affect survival, growth, reproduction, paternity, and sperm dispersal. We manipulated the density and relatedness of neighbours and found that increased density reduced survival but not growth rate, and that there was no effect of relatedness on survival, growth, or fecundity, in contrast to previous studies. We also manipulated the distances to the nearest neighbour and used genetic markers to assign paternity within known mother–offspring groups to estimate how proximity affects mating success. Distance to the nearest neighbour did not affect the number of settlers produced, the paternity share, or the degree of multiple paternity. Overall, larger than expected sperm dispersal led to high multiple paternity, regardless of the distance to the nearest neighbour.

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Coverage

Location: Gulf of Mexico, Florida, USA
Spatial Extent: **Lat**:29.828333 **Lon**:-84.580806
Temporal Extent: 2021-10 - 2021-12

Methods & Sampling

Experiment 1: the effect of relatedness and density on survival and growth.

The first experiment ran from October to December 2021. There were 10 density treatments (ranging from 2 to 20 individuals per dish in increments of 2) crossed with two relatedness treatments (related or unrelated). Overall, there were 25 maternal families. In the “related” treatment, 10 of these maternal families were used, where each of the 10 density treatments comprised offspring from a different maternal family (i.e., density = 2 is two offspring from family A, density = 4 is four offspring from family B, and so to where density = 20 is 20 offspring from family J). In the “unrelated” treatment, each of the 10 density treatments comprised one offspring randomly chosen from one of the 25 maternal families, such that the 10 maternal families in the related treatment were also used in the unrelated treatments, plus an additional 15 maternal families to achieve the desired density. Within each dish, individual colonies were randomly assigned to a position in a 3 × 4 cm grid on a Petri dish lid. The distance between grid points was 1 cm. Petri dishes were randomly assigned to PVC poles, spaced 1 m apart and arranged in a 4 × 5 grid. After 7 days in the field, individuals were collected and transported back to the lab, where survival (present or absent) and size (number of zooids) were measured under a dissecting scope. Individuals were returned to the field the following day. Individuals were left in the field for another 7 days, at which point they were collected, transported back to the lab, and measured for survival and size.

BCO-DMO Processing Description

* adjusted field names to comply with database requirements
* added sampling latitude and longitude to data itself

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Data Files

File
968839_v1_experiment1.csv (Comma Separated Values (.csv), 39.74 KB) MD5:2ffba1a7fdd4f72a75b3a21cc0dffe85 Primary data file for dataset ID 968839, version 1

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Related Publications

Barnes, D. K., & Burgess, S. C. (2024). Fitness consequences of marine larval dispersal: the role of neighbourhood density, arrangement, and genetic relatedness on survival, growth, reproduction, and paternity in a sessile invertebrate. Journal of Evolutionary Biology. https://doi.org/10.1093/jeb/voae125
Results

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Related Datasets

IsRelatedTo

Scott Burgess. (2024). *scottcburgess/neigborhood-effects-on-dispersal-fitness: neigborhood-effects-on-dispersal-fitness* (Version v1.0) [Computer software]. Zenodo. https://doi.org/10.5281/ZENODO.13821158 https://doi.org/10.5281/zenodo.13821158

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Parameters

Parameter	Description	Units
Latitude	Sampling latitude, south is negative	decimal degrees
Longitude	Sampling longitude, west is negative	decimal degrees
Unique_ID	Unique identifier for each F1 colony out planted to the field	unitless
Mother_colony	Mother identifier for each F1 colony out planted to the field.	unitless
Density	Number of colonies per replicate (within a 1.5 x 3 inch grid on a petri dish lid; ranges from 2 to 20 colonies in increments of 2)	unitless
Relatedness	Non=Non-related, F1 colonies from different mothers; Sib=Siblings, F1 colonies from the same mother	unitless
Grid_position	Numbers correspond to specific positions of colonies on the grid of the petri dish lid. 1 though 5 on top row right to left, 6 through 10 on second row right to left, 11 through 15 on third row right to left, and 16 through 20 on bottom row right to left.	unitless
X	X coordinate on the grid, 1-5	unitless
Y	Y coordinate on the grid, 1-4	unitless
Inside_outside	Relative position on the grid, positions 1-5, 6, 10, 11, 15, and 16-20 are considered outside, others are inside.	unitless
Date	Date of data collection	unitless
Age_days	Age of F1 focal colonies; days since settlement	unitless
Bifurcations	Number of bifurcations on the focal colony counting longest chain	unitless
Zooids	Number of zooids on the focal colony counted under the microscope	unitless
Survival	1=survived, 0=died	unitless

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Project Information

Consequences of kin structure in benthic marine systems (Marine kin structure)

Coverage: Gulf of Mexico

NSF Award Abstract:
In marine systems, the production, dispersal, and recruitment of larvae are crucial processes that rebuild depleted adult stocks, facilitate changes in species geographic ranges, and modify the potential for adaptation under environmental stress. Traditionally, the tiny larvae of bottom-associated adults were thought to disperse far from their parents and from each other, making interactions among kin improbable. However, emerging evidence is challenging this view: larval dispersal does not always disrupt kin associations at settlement, and a large fraction of invertebrate diversity on the seafloor contains species in which most larvae disperse short distances. Limited dispersal increases the potential for interactions among kin, which has important consequences for individual fitness across many generations, and therefore the productivity of populations and the potential for adaptation. But when these consequences occur, and how exactly they manifest, remains largely unexplained. The key challenge now is to explain and predict when kin associations are likely to occur, and when they are likely to have positive or negative ecological consequences. Therefore, the key questions addressed by this research are: 1) how and when do kin associations arise and persist, and 2) what are the consequences of living with kin for survival, growth, and reproduction. This concept-driven research combines genomic approaches with experimental approaches in lab and field settings using an experimentally-tractable and representative invertebrate species. The project trains and mentors PhD students and a postdoctoral scholar at Florida State University (FSU). Field and laboratory activities are developed and incorporated into K–12 education programs and outreach opportunities at FSU.

The spatial proximity of relatives has fundamentally important consequences at multiple levels of biological organization. These consequences are likely to be particularly important in a large range of benthic marine systems, where competition, facilitation, and mating depend strongly on the proximity and number of neighbors. However, explaining and predicting the occurrence, magnitude, and direction of such effects remains challenging. Emerging evidence suggest that the ecological consequences of kin structure are unlikely to have a straight-forward relationship with dispersal potential. Therefore, it is crucial to discover new reasons for when kinship structure occurs and why it could have positive, negative, or neutral ecological consequences. This research aims to provide a new understanding of how dispersal and post-settlement processes generate spatial kin structure, how population density and relatedness influence post-settlement fitness, and how the relatedness of mating partners influences the number and fitness of their offspring (inbreeding and outbreeding). The research combines genomic approaches, experimental progeny arrays, and manipulative experiments in field and lab settings to test several hypotheses that are broadly applicable across species. By focusing on an experimentally tractable species to test broadly applicable hypotheses, the project achieves generality and a level of integration that has been difficult to achieve in previous work.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1948788

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