Biodiversity and topography

Website: https://www.bco-dmo.org/dataset/814160
Version: 0
Version Date: 2020-06-03

Project
» NSFOCE-BSF: The effects of fine-scale temperature and desiccation variability on the distribution of marine species (Intertidal ecological forecasting)

Contributors	Affiliation	Role
Helmuth, Brian	Northeastern University	Principal Investigator
Gouhier, Tarik C.	Northeastern University	Co-Principal Investigator
Choi, Francis	Northeastern University	Contact
York, Amber D.	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

---

Table of Contents

[table of contents | back to top]

Parameters

Parameters for this dataset have not yet been identified

[table of contents | back to top]

Project Information

NSFOCE-BSF: The effects of fine-scale temperature and desiccation variability on the distribution of marine species (Intertidal ecological forecasting)

Coverage: Gulf of Maine, Levatine Basin (Eastern Mediterranean)

NSF Award Abstract:
This study will explore the potential importance of small-scale temperature refugia that may allow intertidal organisms to survive extreme weather conditions and subsequently repopulate surrounding habitats. Shaded microhabitats - determined in large part by the geological topography of a shoreline - have the potential to reduce thermal and desiccation stress and buffer communities from shifting climatic conditions including increases in air temperature and varying coastal wind patterns. This project will examine how variation in these microhabitat conditions will impact the stability and persistence of ecosystems in two of the fastest-changing coastal regions on Earth: the southern Gulf of Maine in the U.S. and the coast of Israel in the southeastern Mediterranean basin. The researchers will identify features of coastal areas that are more (or less) susceptible to species mortality during extreme climatic events by (1) mapping fine-scale coastal topography using laser scanning and drones; (2) quantifying temperature variation in the physical environment at multiple spatial and temporal scales; (3) measuring the physiological vulnerability of key organisms; and (4) developing mathematical models to investigate the dynamics of the coastal ecosystem at different scales, habitat configurations, species interactions, and levels of connectivity among sites under different climate regimes. Understanding the vulnerability and resiliency of ecologically and economically important coastal ecosystems to a variety of extreme weather events is critical to making well-informed environmental management decisions.

Research findings will be incorporated into a variety of educational media created for an international audience, including short animated videos and immersive virtual tours co-produced via collaboration of high school students in both countries.

A common yet largely untested assumption is that the relevant temporal and spatial scales over which environmental variation operates are comparable to the scales of the biological process being studied. Thus, for example, latitudinal patterns of species distributions are commonly correlated against latitudinal gradients in temperature, and these correlations are used to inform forecasts of future responses to climate change. Two lines of evidence strongly suggest that such assumptions are problematic, especially in coastal zones. First, the influence of local drivers can overwhelm the importance of larger-scale gradients in environmental factors, creating complex mosaics where variability at the scale of meters can exceed that observed over thousands of km. Second, rare but extreme events can have effects on the distributions of species (and thus the stability and function of ecosystems) that last for years or decades; often spatial patterns in these extreme events differ substantially from those of "normal" conditions. Increasingly under climate change, observed spatial patterning in species distributions are thus likely a reflection of the distribution of refugia during extreme events, and the ability of refugia to serve as rescue sites to surrounding locations during periods of recovery. This proposal will use a combination of environmental mapping (terrestrial laser scanning, drone photography), thermal engineering (finite element models), physiological experimentation, and metapopulation/metacommunity modeling to explore how fine-scale (<1m) environmental variation may result in emergent properties that influence much larger-scale (10-1000 km) ecological and biogeographic patterns. The rocky intertidal zone, where spatial and temporal patterns of thermal and desiccation stresses during low tide are exceedingly high, will be used as a model system. The project will take place in two locations facing some of the fastest rates of environmental and biotic change on the planet: the southern Gulf of Maine and the Eastern Mediterranean Sea. This proposal will facilitate collaborations between educational outreach programs at two marine labs in the U.S. and Israel, and leverages strengths developed by both groups to produce an integrated approach that will create a learning environment that spans both countries. The first goal is to use virtual tour technology to enhance hands-on learning by K-12 students. These virtual "palettes" can be populated with photos, video, data, and natural history observations taken in the field. Through a series of workshops, students from the two countries will use these virtual tours to teach each other about their field experiences and local habitats. Second, the researchers will develop short, animated, educational videos highlighting the project's major questions, approaches, and findings.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1635989

[table of contents | back to top]