Green crab (Carcinus maenas) density from intertidal surveys in the Gulf of Maine during 1973, 2003, 2017-2018 and 2021

Website: https://www.bco-dmo.org/dataset/990378
Data Type: Other Field Results, Synthesis
Version: 1
Version Date: 2026-03-17

Project
» Local adaptation and the evolution of plasticity under predator invasion and warming seas: consequences for individuals, populations and communities (evolution of plasticity)

Contributors	Affiliation	Role
Trussell, Geoffrey C.	Northeastern University	Principal Investigator
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Abstract
The impact of invasive predators during the early stages of invasion is often variable in space and time. Such variation is expected to initially favor plasticity in prey defenses but fixed defenses as invaders become established. This dataset contains green crab density (Carcinus maenas) data for multiple sites throughout the Gulf of Maine that were collected in 1973, 2003, 2017-2018 and 2021. These data were used to examine historical changes in the latitudinal distribution of green crabs and their potential role in shaping spatiotemporal changes in snail (Littorina obtusata) shell thickness and thickness plasticity.

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Coverage

Location: Rocky intertidal shores in the Gulf of Maine
Spatial Extent: **N**:44.98 **E**:-66 **S**:42.42 **W**:-70.93
Temporal Extent: 1973 - 2021

Dataset Description

This dataset contains measurements of green crab (*Carcinus maenas*) density from rocky intertidal sites throughout the Gulf of Maine. Data were compiled from multiple sampling efforts conducted in 1973, 2003, 2017–2018, and 2021. Crab density is reported as the number of individuals observed per person-hour of standardized survey effort.

This dataset is part of a broader study conducted in the Gulf of Maine to investigate phenotypic plasticity of prey species in response to predator invasion and warming oceans:

1. Green crab surveys plus historical crab density data **(this dataset)**
2. Green crab density from field studies at rocky intertidal sites from April 2019 to December 2021 (dataset

911365)
3. Latitudinal (clinal) variation in *Littorina obtusata* shell thickness and tissue mass (dataset 990839)
4. Field experiment outplanting *Littorina obtusata* with predators (green crabs) to examine local and regional geographic variation in inducible defenses conducted from April to August 2021 (dataset 911221)
5. Morphological data from reciprocal transplant experiment in the field (dataset 990830)

Methods & Sampling

We documented latitudinal variation in green crab abundance with manual surveys on sheltered intertidal shores throughout the Gulf of Maine.

Green crab (*Carcinus maenas*) abundance was quantified using standardized manual surveys conducted on rocky intertidal shores throughout the Gulf of Maine. Surveys were performed during low tide conditions, beginning and ending within two hours of low tide, and were conducted monthly from July through October.

During each survey, a single observer searched the mid-intertidal zone (approximately ±1.5 m relative to mean low water) for a duration of one hour. Crabs were located by turning over loose cobble and inspecting beneath fucoid algal canopy, including *Ascophyllum nodosum* and *Fucus vesiculosus*. The total number of crabs observed during each survey was recorded and standardized to individuals per person-hour.

Sampling effort varied by year: six sites were surveyed in 2017, eight sites in 2018, and twelve sites in 2021. Historical data from 1973 and 2003 were collected using comparable survey methods by the Maine Department of Marine Resources (Welch et al., 1973; Edgell et al., 2008), enabling integration with recent surveys for long-term analysis.

BCO-DMO Curation Notes

- Imported file named "2026.02.13.Trussell.Corbett.Updated.CrabDensity.xlsx" into the BCO-DMO system.
- Renamed fields/columns to comply with BCO-DMO naming conventions.
- Altered data structure so each row of the data table represents a single, complete entity/data record
- Saved the final file as "990378_v1_green_crab_density_1973_2021.csv"

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Data Files

File	
990378_v1_green_crab_density_1973_2021.csv	(Comma Separated Values (.csv), 5.41 KB) MD5:1e8674e88a1afe0c56971d1615061fca
Green crab (Carcinus maenas) density across multiple years and sites. Field observations from rocky intertidal shores throughout the Gulf of Maine; Primary data file for dataset ID 990378, version 1	

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Supplemental Files

File	
average_green_crab_density_2017_to_2021.csv	(Comma Separated Values (.csv), 1.12 KB) MD5:107e33d3b4e7c403eec61a15793cf364

Mean green crab density for 2017-2018 and 2021
Site,Site name of rocky intertidal shore along the Gulf of Maine,unitless,,site,String
Year,Year of sampling,unitless,,year,Integer
Latitude,Latitude of sampling site,decimal degrees,,lat,Float
Longitude,Longitude of sampling site,decimal degrees,,lon,Float
MEAN_Green_Crab_Density,Mean number of green crabs (Carcinus maenas) found at the sampling site per person hour,number per person hour,,abundance,Float

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Related Publications

Corbett, J. J., & Trussell, G. C. (2025). Evolution in changing seas: The loss of plasticity under predator invasion and warming oceans. Science Advances, 11(6). https://doi.org/10.1126/sciadv.adr6947
Results

Edgell, T. C., & Rochette, R. (2008). Differential snail predation by an exotic crab and the geography of shell-claw covariance in the Northwest Atlantic. Evolution, 62(5), 1216–1228. https://doi.org/10.1111/j.1558-5646.2008.00350.x
Methods

Welch, W. R., Richards, M., & Bass, B. (1973). Relative abundance of green crabs along the Maine coast. Maine Department of Marine Resources, Fisheries Research Laboratory.
Methods

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Related Datasets

IsRelatedTo

Trussell, G. C., Corbett, J. J. (2023) **Green crab (Carcinus maenas) density at rocky intertidal sites determined at 8 sites in the Gulf of Maine from April 2019 to December 2021.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-10-12 doi:10.26008/1912/bco-dmo.911365.1 [view at BCO-DMO]

Trussell, G. C., Corbett, J. J. (2023) **Littorina obtusata shell length, shell thickness, and tissue mass measured during a field experiment conducted at 12 sites in the Gulf of Maine from April to August 2021.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-10-11 doi:10.26008/1912/bco-dmo.911221.1 [view at BCO-DMO]

Trussell, G. C., Corbett, J. J. (2026) **Morphological data of Littorina obtusata populations from reciprocal transplant experiments in the Gulf of Maine conducted 20 years apart.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2025-12-29 doi:10.26008/1912/bco-dmo.990830.1 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
Site	Site name of rocky intertidal shore along the Gulf of Maine	unitless
Year	Year of sampling	unitless
Latitude	Latitude of sampling site	decimal degrees
Longitude	Longitude of sampling site	decimal degrees
Month	Month(s) of sampling	unitless
Green_Crab_Density	Number of green crabs (Carcinus maenas) found at the sampling site per person hour	number per person hour

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Project Information

Local adaptation and the evolution of plasticity under predator invasion and warming seas: consequences for individuals, populations and communities (evolution of plasticity)

NSF Award Abstract:
Over the past two decades, the Gulf of Maine has experienced unprecedented warming that, among other things, has further enabled the invasive green crab to expand its range in rocky shore habitats. The adverse ecological impacts of this invasive predator have been documented worldwide. This study examines how geographic variation in the capacity of two common prey species to respond to the combination of this predator and warming ocean temperatures can shape prey feeding and performance and impact community structure and dynamics. Hence, this research enhances understanding of the evolution of phenotypes, their plasticity, and the nature of adaptation and its role in eco-evolutionary dynamics. More broadly, it informs understanding of how organisms and marine communities may respond to future environmental change. In addition, this project makes contributions to the STEM pipeline by providing middle and high school, undergraduate, and graduate students with cross-disciplinary training in evolutionary and community ecology. In collaboration with an institutional outreach program, the investigator is also developing web-based multimedia projects and teacher resource materials based on this research.

A central principle in ecology is that species residing in the middle of food chains must balance the benefits of eating with the risk of being eaten by their predators. Solving this foraging-predation risk trade-off often involves plasticity in prey traits with consequences for the evolution of adaptation and species interactions that drive community-level processes. Hence, the foraging-predation risk trade-off provides a powerful conceptual framework that links evolutionary and community ecology. Yet at the same time, other environmental stressors like temperature can shape this trade-off, adding complexity that makes it difficult to predict the capacity of organisms to adapt to environmental change and the consequences for communities. The investigator is conducting this study in rocky shore habitats of the Gulf of Maine (GOM) which have long been influenced by strong latitudinal temperature gradients and non-native species invasions. The overarching hypothesis is that predation risk and temperature are factors shaping geographic variation in plasticity and adaptation, with consequences for individuals, populations, and communities. First, the investigator is conducting field experiments to document geographic variation in the trait plasticity of two common prey species in the green crab's diet. Second, he is using reciprocal transplant experiments to examine trait plasticity in response to risk and water temperature, generating data to compare with similar experiments conducted in the late 90s prior to recent ocean warming and expansion in range of green crabs. Third, he is conducting a laboratory common garden experiment to evaluate the effects of risk and water temperature on

trait plasticity. Finally, he is using reciprocal transplant experiments in the field to understand the interactive effects of risk and water temperature on prey foraging rates and the abundance of a species that plays an important role in intertidal community structure and dynamics.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-2017626

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