Long-term consuption for 2-clawed and 1-clawed Stone Crabs (Menippe spp.) in North Inlet Estuary, Georgetown, SC during 2012 (Variation in Metabolic Processes project)

Website: https://www.bco-dmo.org/dataset/638622
Data Type: experimental
Version:
Version Date: 2016-03-30

Project
» Linking Variation in Metabolic Processes as a Key to Prediction (Variation in Metabolic Processes)

Contributors	Affiliation	Role
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Dataset Description

Data was gathered experimentally at the Baruch Institute for Marine & Coastal Sciences. Consumption of mussels was recorded daily. Crabs were collected from North Inlet Estuary, Georgetown, SC.

Related Reference:
Hogan and Griffen (2014). The Dietary And Reproductive Consequences Of Fishery-Related Claw Removal For The Stone Crab *Menippe* Spp. Journal of Shellfish Research, Vol. 33, No. 3, 795–804.

Related Datasets:
Stone crab: 052012-DietChoiceExp1
Stone crab: 062013-DietChoiceExp2
Stone crab: 062013-PreySizeSelection

Methods & Sampling

Data was gathered experimentally at the Baruch Institute for Marine & Coastal Sciences. Consumption of mussels was recorded daily.

The 3-mo experiment (June 2012 to August 2012) assessed how claw loss influenced the prey consumption rate by stone crabs and whether 1-clawed stone crabs became more efficient at foraging over time. There was difficulty obtaining the large number of legal-size crabs needed to examine the effects of claw loss while concomitantly accounting for other factors that influence mussel consumption, such as crab size, mussel size, and so forth. This experiment was therefore conducted with a modest number of crabs (13 total: 8 females, 5 males; mean CW ± SD, 89.1 ± 6.1 mm). It was expected that the variation in consumption would be greatest for 1-clawed crabs. Therefore crabs were allocated to experimental treatments unevenly, which reflects the desire to maximize the replication of 1-clawed individuals while also attempting to account for differences in

size among the available study animals. The considerably lower mussel consumption of 1-clawed crabs relative to 2-clawed crabs (see Results) made the qualitative results unambiguous; however, the low replication means specific quantitative differences in consumption between 1- and 2-clawed crabs in this experiment should be interpreted with caution.

The crabs were housed in individual lobster wire cages (approximate dimensions 152 3 152 3 300 mm), to prevent escape, each within a separate 5-gal bucket that had its own flow-through seawater source, which allowed temperature and salinity to fluctuate with ambient conditions. Stone crabs were divided into 4 different 4.5-mm size classes and were each fed ribbed mussels (Geukensia demissa) ad libitum until declawing. At the start of the experiment (June 4, 2012), the larger, crusher claw was removed from 9 of the 13 stone crabs. Four stone crabs, one from each size class, were not declawed and served as control stone crabs in the experiment.

All stone crabs were provided with a diet of 5 live ribbed mussels daily, and fragments of consumed ribbed mussels were removed after 24 h. Any ribbed mussels not consumed within 1 wk were replaced. The ribbed mussels used in the experiment ranged from 55-75mmin length and were scaled with respect to the 4 crab size classes. The ribbed mussels provided to each crab were consistent within 1 mm for the duration of the experiment. The length of all ribbed mussels provided was measured prior to placement in the aquaria and each was marked with a small dot of nail polish to allow distinction between individual ribbed mussels.

For each day of the experiment, the total number of mussels cracked was recorded to determine whether crabs would improve in their ability to crack mussels over time. This ability to improve was examined using a generalized mixed-effects model (Poisson distribution), with number of mussels cracked daily as the response variable, days in the experiment as a continuous predictor variable, number of claws and sex as categorical predictor variables, and crab identification number as the random variable to control for repeated measures. The interaction between days in the experiment and the number of claws in the initial analysis was included to determine whether 1- and 2-clawed crabs responded differently to the amount of time in the experiment.The interaction was not significant (Z¼0.137,P¼ 0.89) and was therefore removed from the analysis. To examine the overall difference in consumption between 1- and 2-clawed crabs, the total number of mussels consumed throughout the length of the experiment was calculated for each crab. A paired t-test (paired by size class) was used to compare the average number of ribbed mussels consumed during the experiment for 1- and 2-clawed crabs (data from multiple 1-clawed crabs within a single size class were averaged prior to this analysis).

Data Processing Description

Data has not been processed.

BCO-DMO Processing:
- added conventional header with dataset name, PI name, version date, reference information
- renamed parameters to BCO-DMO standard
- reformatted date from d-Mon-yy to yyyy-mm-dd

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Data Files

File	
longterm_consumption.csv	(Comma Separated Values (.csv), 49.31 KB) MD5:7eca0cf0799e349335a05b599ba54b01
Primary data file for dataset ID 638622	

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Parameters

Parameter	Description	Units
days	days since the start of the experiment	days
date	date in experiment	yyyy-mm-dd
temp_avg	average daily temperature	degrees Celsius
sal_avg	average daily salinity	ppt
crab	subject number	unitless
duration	days that the crab was subjected to experiment	days
sex	male = M; female = F	unitless
claw	1-clawed = Y; 2-clawed = N	unitless
carap_width	width of crab carapace at widest point	millimeters
size_class	grouped size classes; 1 = smallest...5 = largest	unitless
days_ACR	days after claw removal (0 = claw was not removed)	days
mussels_con	number of mussels consumed daily	mussels
pcent_cracked	percentage of provided mussels consumed (out of 5)	percent

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Deployments

Griffen_lab

Website	https://www.bco-dmo.org/deployment/638572
Platform	Univ_S_Carolina
Start Date	2012-01-01
End Date	2016-12-31

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Project Information

Linking Variation in Metabolic Processes as a Key to Prediction (Variation in Metabolic Processes)

Description from NSF award abstract:
A major goal of biological and ecological sciences is to understand natural systems well enough to predict how species and populations will respond to a rapidly changing world (i.e., climate change, habitat loss, etc.). A population under any conditions will grow, shrink, or disappear altogether depending on how efficiently individuals consume resources (food), utilize that food metabolically, and eventually reproduce. However, making accurate predictions based on these metabolic processes is complicated by the realities that each species has different resource requirements and that no two individuals within a species are exactly alike. Rather, individuals vary and this variation, both within and across species, is central to many ecological and evolutionary processes. Developing the ability to predict responses of biological systems to a changing world therefore requires a mechanistic understanding of variation. The goal of this project is to improve this mechanistic understanding by examining variation within a metabolic context across a range of species that have a spectrum of commonly-seen resource requirements. Further, the work capitalizes on a unique biological characteristic of this group of species that allows control and manipulation of individual reproduction, facilitating experimental study of the mechanistic links between variation in individual consumption, metabolism, and reproduction. The foundation this research is a combination of field measurements and laboratory experiments using both well-established and newly-developed techniques to quantify these links. The result will be a quantitative framework to predict how individuals will respond reproductively to changes in resource use. Because of the close link between individual reproduction and population dynamics, this research will contribute substantially to predictions in population dynamics under realistic conditions where individuals use more than a single resource, and improve the prediction of responses to current and future ecological changes.

The following publications and data resulted from this project:

Belgrad, B. and B. Griffen. 2016. Predator-prey interactions mediated by prey personality and predator identity.*Proc. Roy. Soc. B*: In Review. [2016-01-20]
P. herbstii mortality data: Mortality of crabs when exposed to either a single blue crab, toadfish, or no predator for a week
P. herbstii personality data: Refuge use of crabs when exposed to predator odor cues from either blue crabs, toadfish, or control of no cue
P. herbstii predator behavior data: Refuge use and mobility of blue crabs and toadfish while in mesocosms for a week - behavior measured during two days.

Belgrad, B. and B. Griffen. 2016. The influence of dietary shifts on fitness of the blue crab, *Callinectes sapidus*. *PloS One. DOI: 10.1371/journal.pone.0145481*.
Blue crab activity: Activity of crabs fed different diets over a summer
Blue crab egg size: Volume of eggs for crabs fed different diets
Blue crab hepatopancreas index (HSI): Weight of hepatopancreas for crabs fed different diets
Blue crab hepatopancreas lipid content: Hepatopancreas lipid content of crabs fed different diets
Blue crab reproductive tissue analysis (GSI): Gonadosomatic index of blue crabs on various diets
Blue crab survival: Blue crab survival data during the dietary study

Knotts ER, Griffen BD. 2016. Individual movement rates are sufficient to determine and maintain dynamic spatial positioning within *Uca pugilator* herds. *Behavioral Ecology and Sociobiology* 70:639-646
Uca pugilator: behavior change with carapace marking: Search space behavior due to carapace treatment (control, nail polish, and food dye)
Uca pugilator: field spatial position: Assessment of individual's position within a herd at 3 min. intervals; for proportion of time found at edge of herd
Uca pugilator: herd position proportion: Individual's proportion of time spent in an edge/alone position among a herd
Uca pugilator: search space distribution: Search space that crabs traveled; to evaluate the sample's distribution of exploratory behavior

Belgrad, B. and B. Griffen. 2015. Rhizocephalan infection modifies host food consumption by reducing host activity levels. *Journal of Experimental Marine Biology and Ecology*. 466: 70-75.
E. depressus digestion time : Time taken for food to pass through gut of flat-backed mud crabs infected by a parasite
E. depressus metabolism: Respiration rate of infected/uninfected flat-backed mud crabs
E. depressus reaction time to prey: Time taken for infected/uninfected flat-backed mud crabs to react to the

presence of prey

Blakeslee, A.M., C.L. Keogh, A.E. Fowler, B. Griffen. 2015. Assessing the effects of trematode infection on invasive green crabs in eastern North America. *PLOS One* 10(6): e0128674.(pdf)
Carcinus: hemocyte density: Counts of circulating hemocyte density in Carcinus maenas
Carcinus: parasites physiology behavior: Behavior and physiology of Carcinus maenas infected with trematode parasite

Griffen BD, Norelli AP (2015) Spatially variable habitat quality contributes to within-population variation in reproductive success. *Ecology and Evolution* 5:1474-1483.
P. herbstii diet: sampling site characteristics (Eco-Evo 2015)
P. herbstii diet: body measurements (Eco-Evo 2015)
P. herbstii diet & reproduction (Eco-Evo 2015)
P. herbstii: collection sites (Ecol-Evol 2015)

Griffen BD, Riley ME (2015) Potential impacts of invasive crabs on one life history strategy of native rock crabs in the Gulf of Maine. Biological Invasions 17:2533-2544.
Cancer consumption and reproduction (Bio.Inv. 2015): Lab experiment linking dietary consumption and reproduction

Griffen BD, Vogel M, Goulding L, Hartman R (2015) Energetic effects of diet choice by invasive Asian shore crabs: implications for persistence when prey are scarce. *Marine Ecology Progress Series* 522:181-192.
Hemigrapsus diet 1 (MEPS 2015)
Hemigrapsus diet 2 (MEPS 2015)

Hogan and Griffen (2014). The Dietary And Reproductive Consequences Of Fishery-Related Claw Removal For The Stone Crab *Menippe* Spp. Journal of Shellfish Research, Vol. 33, No. 3, 795–804.
Stone crab: 052012-DietChoiceExp1: Prey choice for 2-clawed and 1-clawed Stone Crabs (Menippe spp.)
Stone crab: 052012-LongTermConsumption: Long-term consuption for 2-clawed and 1-clawed Stone Crabs (Menippe spp.), summer of 2012
Stone crab: 062013-DietChoiceExp2: Prey choice for 2-clawed and 1-clawed Stone Crabs (Menippe spp.)
Stone crab: 062013-PreySizeSelection: Prey Size selection ranking for 2-clawed and 1-clawed Stone Crabs (Menippe spp.)

Riley M, Johnston CA, Feller IC, and Griffen B. 2014. Range expansion of *Aratus pisonii* (mangrove tree crab) into novel vegetative habitats. *Southeastern Naturalist* 13(4): 43-38
A. pisonii: range expansion: Aratus pisonii survey in native mangrove and novel salt marsh habitats

Riley M, Vogel M, Griffen B. 2014. Fitness-associated consequences of an omnivorous diet for the mangrove tree crab *Aratus pisonii*. *Aquatic Biology* 20:35-43, DOI: 10.3354/ab00543
A. pisonii: fitness and diet: Impact of diet variation on physiological and reproductive condition of A. pisonii

Toscano BJ, Newsome B, Griffen BD (2014) Parasite modification of predator functional response. Oecologia 175:345-352b
E. depressus - parasite and feeding (Oecologia, 2014): Feeding with and without parasitic barnacle infection
E. depressus - parasite and prey handling (Oecologia, 2014): Food handling with and without parasitic barnacle infection
E. depressus - parasite study - field survey (Oecologia, 2014): Parasitised field survey

Toscano BJ, Griffen BD (2014) Trait-mediated functional responses: predator behavioural type mediates prey consumption.*Journal of Animal Ecology* 83:1469-1477
P. herbstii - activity and feeding (JAE, 2014): Activity level and feeding with and without predator cue

Toscano BJ, Gatto J, Griffen BD (2014) Effects of predation threat on repeatability of individual crab behavior revealed by mark recapture. *Behavioral Ecology and Sociobiology* 68:519-527
P. herbstii - recapture behavior (BESB, 2014): Mud crabs refuge use and activity level - initial measurements
P. herbstii - refuge use (BESB, 2014): Effect of predation threat on repeatability of individual crab behavior revealed by mark-recapture

Griffen BD, Altman I, Bess BM, Hurley J, Penfield A (2012) The role of foraging in the success of invasive species. Biological Invasions. 14:2545-2558
Hemigrapsus seasonal diet (Bio.Inv. 2012): Percent herbivory and gut fullness for Hemigrapsus sanguineus at different times of year

Griffen BD, Toscano B, Gatto J (2012) The role of intraspecific trait variation in mediating indirect interactions.

Ecology 93:1935-1943
P. herbstii refuge use (Ecology, 2012): Proportion of time that Panopeus herbstii spent using refuge habitats in a lab experiment
P. herbstii: Field personality distribution (Ecology, 2012): Field distribution of personality types in the mud crab Panopeus herbstii relative to tidal height
P. herbstii: Trait mediated indirect effect (Ecology, 2012): Influence of refuge use by the mud crab Panopeus herbstii on consumption of bivalves

Riley ME, Griffen BD (2017) Habitat-specific differences alter traditional biogeographic patterns of life history in a climate-change induced range expansion. PLOS One 12(5):e0176263
A. pisonii: egg size: Comparing egg size in Aratus pisonii populations from mangrove and salt marsh habitats
A. pisonii: fecundity: Determining fecundity of Aratus pisonii populations in mangrove and salt marsh habitats
A. pisonii: larval starvation resistance: Comparing larval quality in Aratus pisonii populations from mangrove and salt marsh habitats
A. pisonii: latitudinal body size: Survey examining latitudinal body size patterns in Aratus pisonii
A. pisonii: predation: Comparing predation pressure on Aratus pisonii in mangrove and salt marsh habitats
A. pisonii: reproductive effort: Survey comparing Aratus pisonii reproductive effort in native and novel habitats
A. pisonii: herbivory: Relationship between leaf herbivory, tree characteristics, and refuge availability
A. pisonii: mangrove tree survey: Mangrove tree distribution and characteristics in a dwarf mangrove system

Cannizzo ZJ, Dixon SR & Griffen BD (2018). An anthropogenic habitat within a suboptimal colonized ecosystem provides improved conditions for a range-shifting species. Ecology and Evolution, 8(3):1524-1533.
A. pisonii: behavior: Proportion of time the mangrove tree crab Aratus pisonii spent in different behaviors related to diet and energy storage
A. pisonii: dock-marsh thermal: Thermal readings from under a dock and in a nearby salt marsh
A. pisonii: sun-shade: Proportion of time that mangrove tree crab Aratus pisonii spent in sun and shade in three habitats, 2015-2016.
A. pisonii: thermal picture: Thermal condition of A. pisonii in three habitats: under dock, mangroves, saltmarsh

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1129166
Slocum-Lunz Foundation	Lerner Grey Memorial Fund of the American Museum of Natural History

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