Thermal condition of A. pisonii in three habitats: under dock, mangroves, saltmarsh

Website: https://www.bco-dmo.org/dataset/741032
Data Type: experimental
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Project
» Linking Variation in Metabolic Processes as a Key to Prediction (Variation in Metabolic Processes)

Contributors	Affiliation	Role
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Coverage

Spatial Extent: **N**:30.1325 **E**:-80.28611 **S**:27.43 **W**:-81.38556
Temporal Extent: 2015-05-23 - 2016-07-23

Dataset Description

This dataset includes the crab body and air temperature readings from a mangrove, under a dock, and in a nearby salt marsh for a study of mangrove tree crabs, Aratus pisonii. Also reported are the proportion of time the crabs spent in the sun, relative solar exposure of each crab, and associated parameters.

Methods & Sampling

We observed the behavior of individual crabs *in situ*. In each habitat, we collected groups of five adult *A. pisonii* by hand and determined the sex and carapace width (to the nearest 0.1mm) of each individual. The groups of crabs were made up of the first five individuals that we encountered and could capture and were drawn from all accessible habitat. We then painted the carapace of each crab an identifying color with nail polish to aid in identification and visibility. Following a short period of observation to ensure normal behavior, we released the crabs onto a single tree within 10 m of the collection tree of all individuals (mangrove), onto separate *S. alterniflora* stalks within 10 m of the area of collection (saltmarsh), or onto the same piling (dock) of the dock where all individuals were captured. Release in the saltmarsh occurred during the rising tide when the crabs had no access to the sediment.

We observed crabs in the mangrove and saltmarsh habitats from the time they lost access to the sediment

until the receding tide once again allowed access to the sediment (~6h depending on site and day). In contrast, we observed crabs on docks from three hours before slack high tide until three hours after slack high tide. The total time of observation, in minutes, was recorded. Throughout the observational period we recorded the position of the crab as in sun or shade. We calculated the proportion of time during the observational period that each crab spent in the sun and shade.

To further examine the thermal habitat experienced by the observed crabs, we used a FLIR instruments C2 compact thermal imaging camera to take a thermal image of each visible marked crab every 15 minutes throughout the observational period. The days when crabs were observed took place over a wider range of air temperatures, which was measured on site, in the mangrove and saltmarsh habitats than on docks. Thus, to avoid the confounding factor of relatively cooler air temperatures in these habitats, only thermal pictures taken on days which had an average air temperature greater than 29^{o}C were examined. We then employed the program FLIR tools to obtain the temperature at the center of the carapace of each crab.

We averaged the recorded body temperature of individual crabs over the course of an observational period. We expected that the solar radiation experienced by crabs over the course of an observational period (~6h depending on site and day) would impact their body temperature. Thus, to examine the impact of solar exposure on crab temperature, we obtained short and long-wave solar radiation from the NCEP North American Regional Reanalysis (NARR). NARR has a resolution of 32km and calculates solar radiation in 3hr intervals. We obtained the solar radiation at the grid point closest to each site and averaged the sum of the short and long-wave solar radiation over the observational period. This number, in W/m^2 was then multiplied by the number of seconds the crab was observed to spend in the sun to obtain a relative measure of the solar energy experienced over the observational period. This calculated variable will hereafter be referred to as “solar exposure”.

Average crab body temperature was calculated as the average body temperature, obtained from thermal photos, over the course of the observational period.

Proportion of time in sun and water were both calculated as the proportion of minutes that crab was observed in the sun or water during the observational period.

Relative solar exposure was calculated by using NARR to obtain the solar radiation at the grid point closest to each site and averaging the sum of the short and long-wave solar radiation over the observational period. This number, in W/m^2 was then multiplied by the number of seconds the crab was observed to spend in the sun over the course of the observational period to obtain a relative measure of the solar energy experienced over the observational period.

Locations:
Florida East Coast:
Round Island Park: 27o33'33"N 80o19'53"W
Pepper Park: 27o29'42'N 80o18'12"W
Bear Point: 27o25'48"N 80o17'10"W
North Causeway Park: 27o28'28"N 80o19'12"W
Oslo Road: 27o35'14"N 80o21'55"W
Anastasia State Park: 29o52'40"N 81o16'32"W
Guana-Tolomato-Matanzas NERR: 30o0'49"N 81o20'42"W
Palm Valley/Nocatee Canoe Launch: 30o07'57"N 81o23'08"W
St. Augustine Yacht Club: 29o53'09"N 81o17'08"W

Data Processing Description

BCO-DMO Processing
- added column for Year and ISO_Date columns
- reduced decimal precision: Avg_Crab_Temp (8 to 2), Sun_Prop (9 to 4), Temp_Diff (8 to 2), Solar (7 to 0), Solar_Time (5 to 0)

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Data Files

File
Apisonii_thermal_picture.csv (Comma Separated Values (.csv), 9.24 KB) MD5:f92e2f1db6f1799c7c2da9dd64207691 Primary data file for dataset ID 741032

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Related Publications

Cannizzo, Z. J., Dixon, S. R., & Griffen, B. D. (2018). An anthropogenic habitat within a suboptimal colonized ecosystem provides improved conditions for a range-shifting species. Ecology and Evolution, 8(3), 1521–1533. doi:10.1002/ece3.3739
Results

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Parameters

Parameter	Description	Units
Year	Year of observation/collection	unitless
ISO_Date	Day of observation/collection formatted as yyyy-mm-dd	unitless
ID	individual ID number given to each crab	unitless
Habitat	The habitat where the crab was collected and observed.	unitless
Site	Site of observation/collection. RI= Round Island Park; PP=Pepper Park; BP=Bear Point; NC=North Causeway Park; Oslo=Oslo Road; ANA=Anastasia State Park; GTM= Guana-Tolomato-Matanzas NERR; PV= Palm Valley/Nocatee Canoe Launch; YC=St. Augustine Yacht Club	unitless
CW	Size of crab; measured as carapace-width	millimeters (mm)
Sex	Sex of crab	unitless
Prop_Water	The proportion of time the crab spent in water during the observational period	unitless
Avg_Crab_Temp	The body temperature of the crab averaged over the course of the observational period	degrees Celsius
Temp_Day	Ambient air temperature at the site during the observational period.	degrees Celsius

Sun_Prop	Proportion of time the crab was observed to be in the sun during the observational period.	unitless
Temp_Diff	Difference between the average crab body temperature and the ambient air temperature.	degrees Celsius
Solar	Solar radiation averaged over the observational period obtained from NARR at the grid point nearest to the observational site.	W/m2
Time	Time of observational period.	minutes
Time_S	Time of observational period	seconds
Solar_Time	Relative solar exposure experienced by crab over the course of the observational period.	watts*seconds/square meter [(W*s)/m2]

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Instruments

Dataset-specific Instrument Name	HOBO thermal data loggers
Generic Instrument Name	Temperature Logger
Generic Instrument Description	Records temperature data over a period of time.

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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

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