Seasonal variation of dry energy density of Gulf Menhaden and blue crab from the Gulf of Mexico

Anna M. Swigris[1], Alaina Woods[2], Robert T. Leaf[3], Megumi Oshima[3], Taylor Daley[3]

[1]University of Florida, Gainesville, FL, [2]Paul Smith's College, Paul Smith's, NY, [3]Department of Coastal Sciences, The University of Southern Mississippi, Ocean Springs, MS

THE UNIVERSITY OF SOUTHERN MISSISSIPPI
GULF COAST RESEARCH LABORATORY

Introduction

- Gulf Menhaden and blue crab are believed to be key prey species in the Gulf of Mexico.
- Variations in ecosystem productivity are reflected in caloric value of resident animals.
- One measure of caloric value is dry energy density.
- Bomb calorimetry quantifies dry energy density.
- Understanding trophic interactions can inform an understanding of ecosystem dynamics including predator-prey relationships.

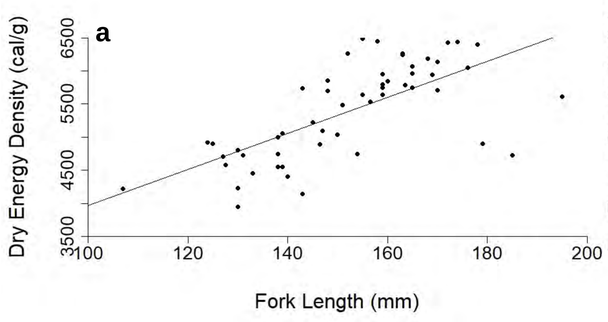
Objectives

1) Determine appropriate methods to process fish and crabs for calorimetry analysis.
2) Evaluate seasonal variation in dry energy density of Gulf Menhaden
3) Compare dry energy densities of Gulf Menhaden and blue crabs

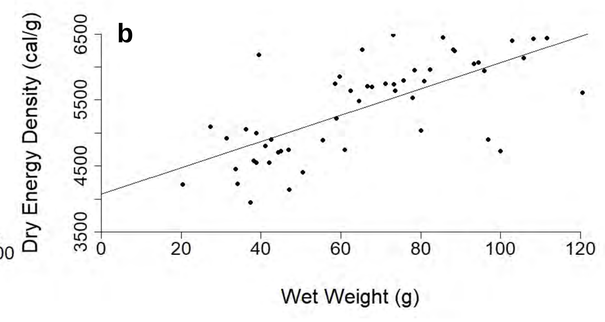
Materials and methods

- We collected crabs in June and July 2017 using crab traps, seine nets, cast nets, and one flounder trap.
- We used frozen menhaden collected from coastal LA by gillnetting during spring to fall seasons, March to October.
- We weighed and measured fork length (FL) on 53 menhaden and carapace width (CW) on eight crabs.
- FL ranged from 107mm to 195 mm, and CW ranged from 91mm to 165 mm.
- We homogenized and freeze dried each sample.
- We ground each sample into a powder and compressed the powder into a pellet weighing between 1.0 and 1.9 g.
- We combusted each pellet in a Parr 6100 Bomb Calorimeter to determine dry energy density in calories per gram, correcting for fuse wire and nitric acid.

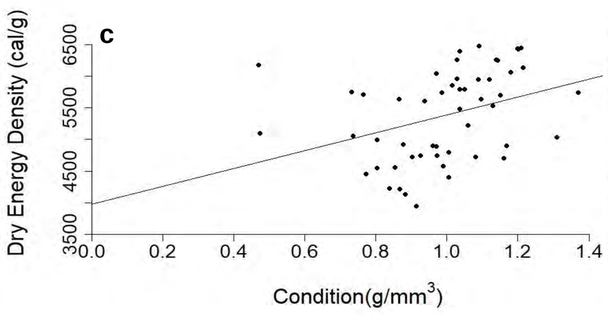
Results



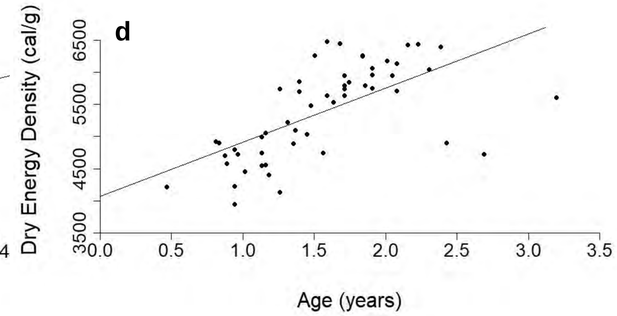
Fork length (FL) and dry energy density had a significantly positive, linear relationship in Gulf Menhaden (Cal g^{-1} = 27.2FL + 1,243.9; $p < 0.05$) (***Figure 1a***).



Wet weight (W) and dry energy density had a significantly positive, linear relationship in Gulf Menhaden (Cal g^{-1} = 20.0W + 4,070.3; $p < 0.05$) (***Figure 1b***).



Condition (K) and dry energy density had a significant positive, linear relationship in Gulf Menhaden (Cal g^{-1} = 1,416.2K + 3,973.9; $p < 0.05$) (***Figure 1c***).



Age (T) and dry energy density had a significant positive, linear relationship in Gulf Menhaden (Cal g^{-1} = 840.4T + 4,074.6; $p < 0.05$) (***Figure 1d***).

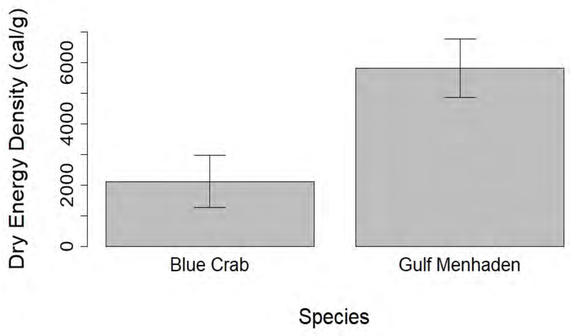


Figure 2.
There was a significant difference between dry energy density of June and July Gulf Menhaden and June and July blue crab ($p < 0.05$).

Results

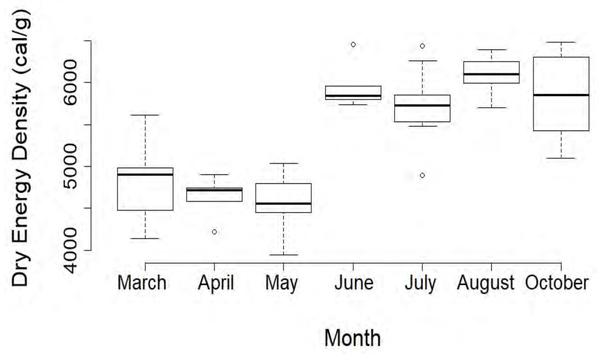


Figure 3.
There was a significant difference between dry energy density and month for Gulf Menhaden, with dry energy density increasing through spring and reaching a peak during summer.

Conclusions

- Wet weight, fork length, and condition are significant predictors of dry energy density for Gulf Menhaden, so rough estimates of dry energy density could be made in-field by weighing and/or measuring the length or carapace width of individuals.
- Gulf Menhaden exhibit a seasonal dry energy density trend that increases through spring and peaks in summer. This could be because Gulf Menhaden spawn and overwinter from late fall to early spring.
- Blue crab dry energy density is lower than that of Gulf Menhaden.
- Gulf Menhaden caloric density is approximately three times that of blue crab.
- This contrast in caloric density indicates that Gulf Menhaden may be a preferred prey item for generalist predators that can feed on both.

Acknowledgments

Funding for this research provided by the National Science Foundation's REU program.