

# Fluctuating asymmetry in larval Spanish Mackerel otoliths as an indicator of condition

Katie Homa

Mentors: Frank Hernandez, Alison Deary

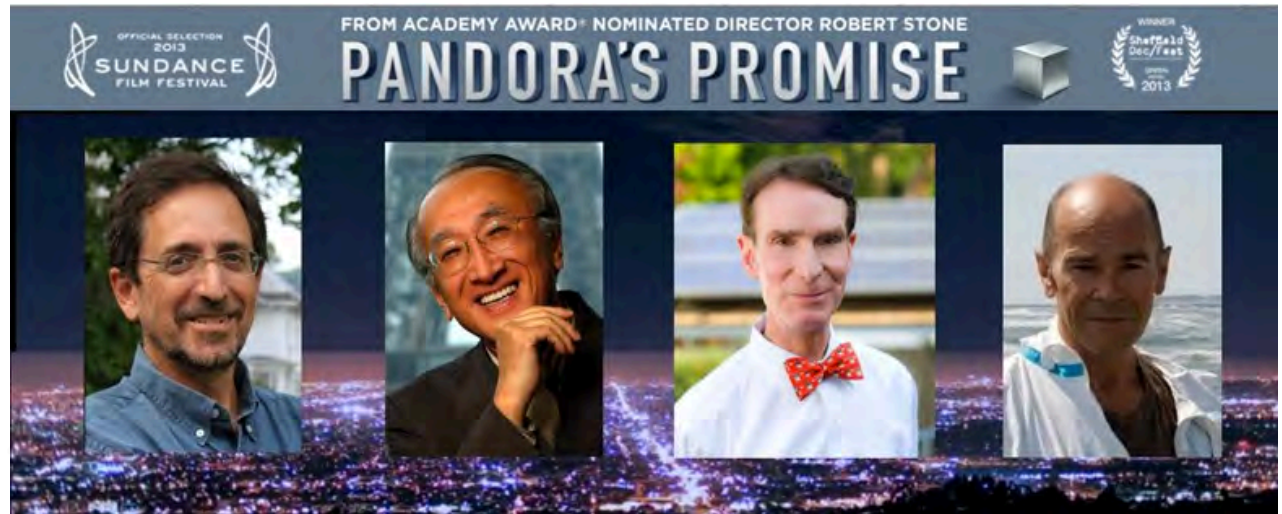
Gulf Coast Research Laboratory, Ocean Springs, MS



# COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK

Kathryn Homa  
Professor Tiffany Shaw  
The Climate System  
24 September 2014

Lab #3: The Modern Atmospheric  $CO_2$  Record



## $CO_2$ Concentrations in the Atmosphere and Greenhouse Gases

### Introduction:

The purpose of this lab was to analyze current and past-recorded data of  $CO_2$  concentrations in the atmosphere. Using measurements derived from running experiments of the National Oceanic and Atmospheric Administration the relationships between temperatures, seasons, location, and vegetation concentration were examined in order to understand phenomena such as anthropogenic carbon emissions and global warming.



COLUMBIA UNIVERSITY COALITION  
FOR SUSTAINABLE DEVELOPMENT



# Mentors



THE UNIVERSITY OF  
**SOUTHERN**  
**MISSISSIPPI**



## **Frank J. Hernandez, Ph.D.**

Assistant Professor, Department of Coastal Science  
Fisheries Oceanography & Ecology Laboratory

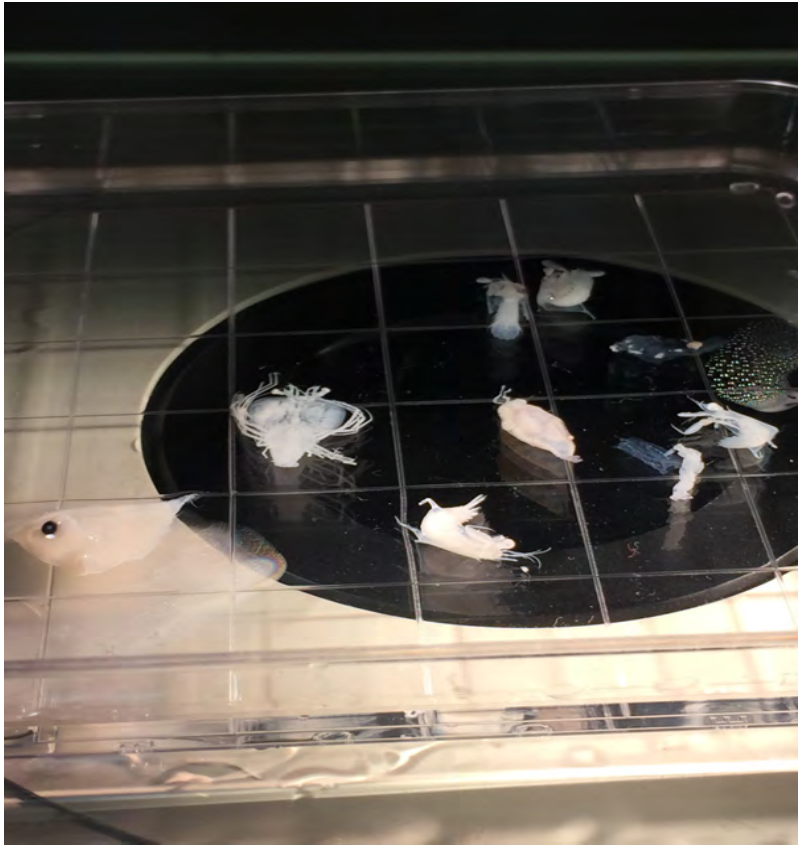
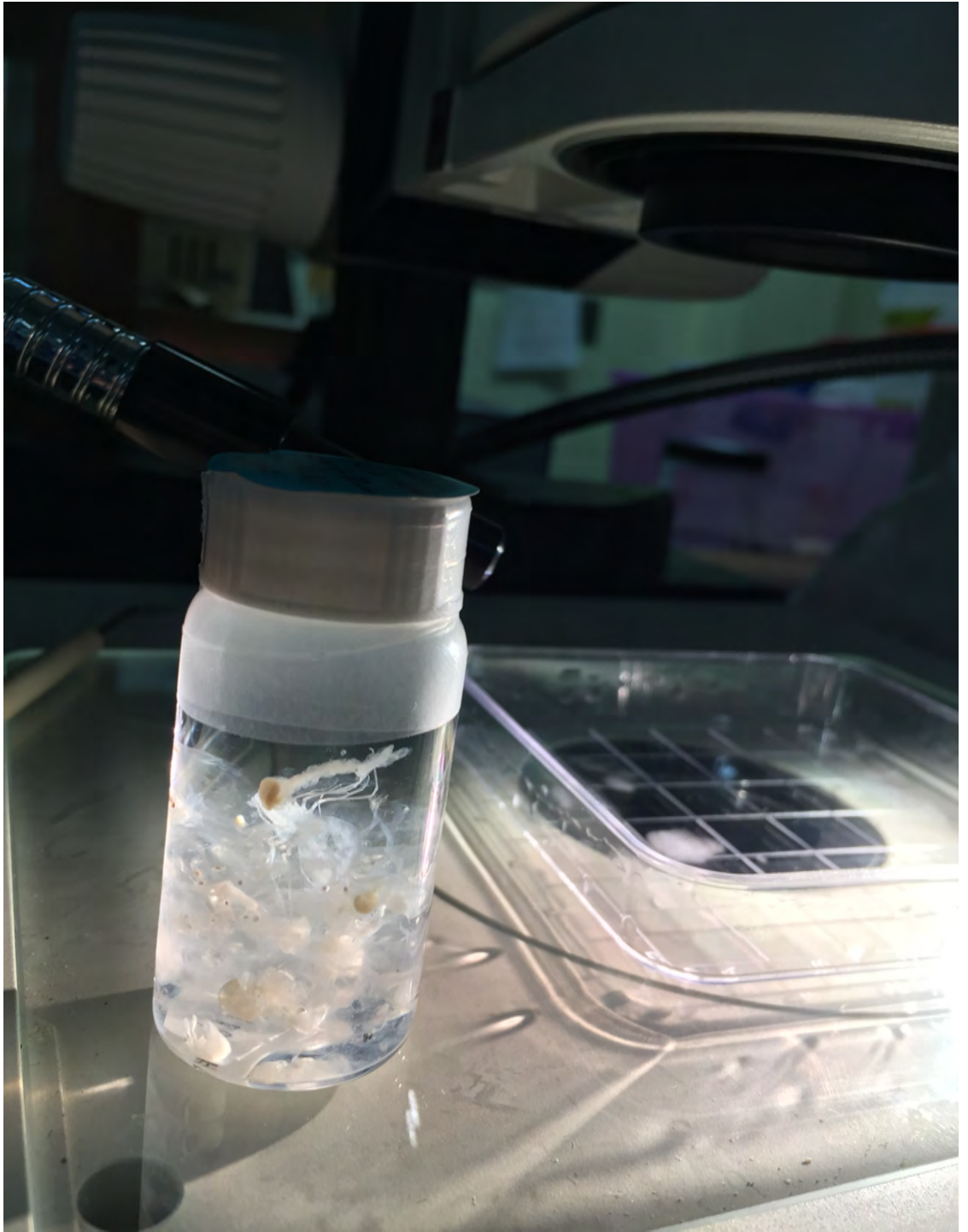
Research focuses on early life stages (fish eggs, larvae, and juveniles) and how they are affected by anthropogenic and natural disruptions.

## **Alison L. Deary, Ph.D.**

Postdoctoral researcher  
Fisheries Oceanography & Ecology Laboratory

Research focuses on the ecomorphology of early life history stage fishes.









# Equipment



focal.disl.org

sefsc.noaa.gov

# What is condition?

## Why is it important?

## How is it measured?

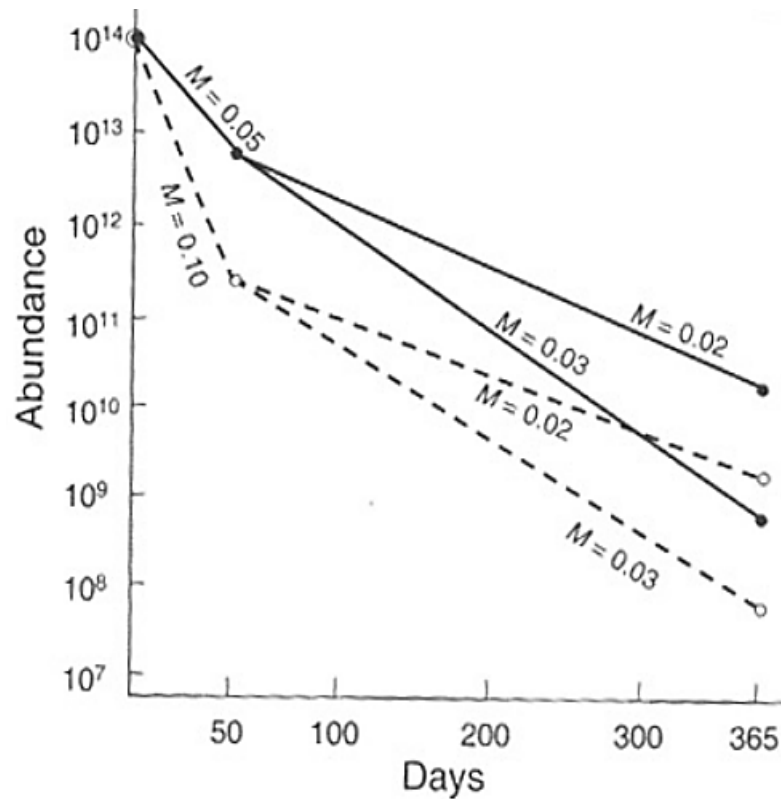
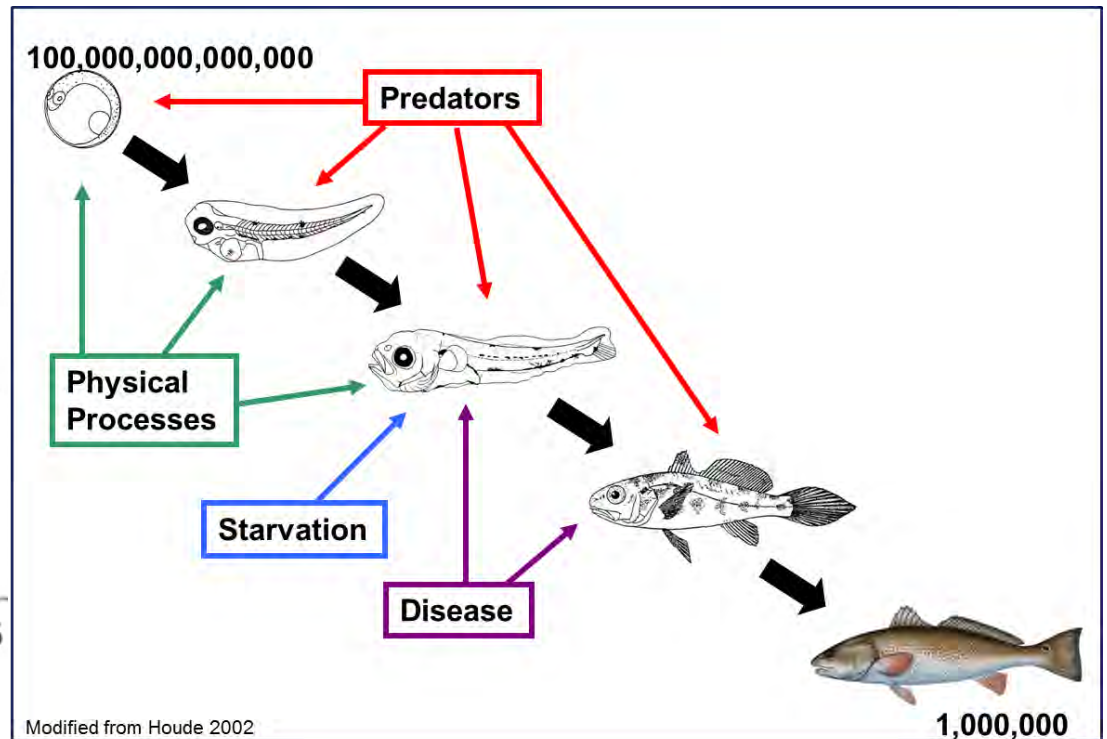
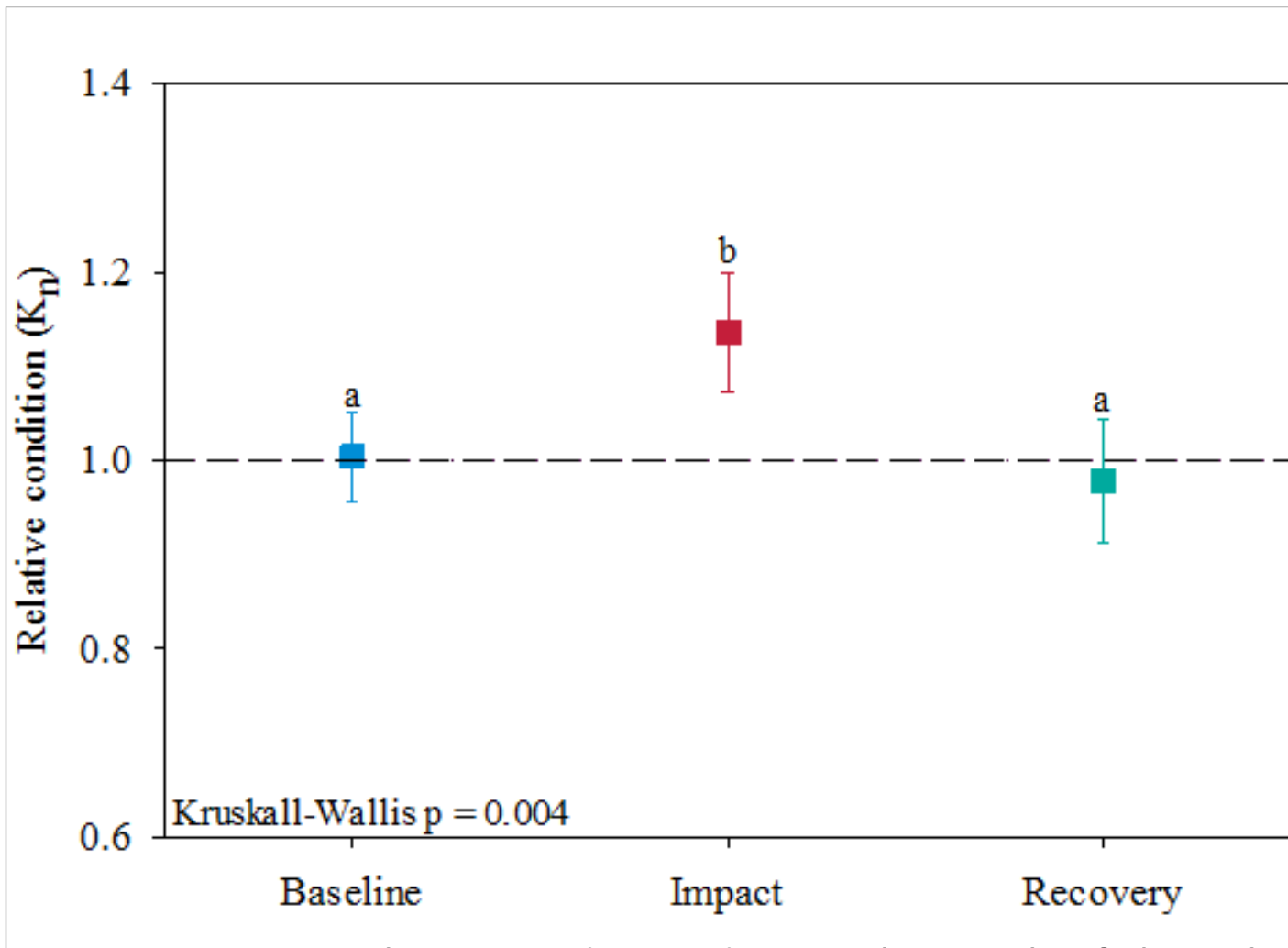


Figure from Houde 2003



# “DEEPWATER HORIZON IMPACTS ON THE DIET, GROWTH, AND CONDITION OF LARVAL SPANISH MACKEREL (*SCOMBEROMORUS MACULATUS*)”



Deeper body  
Larger head



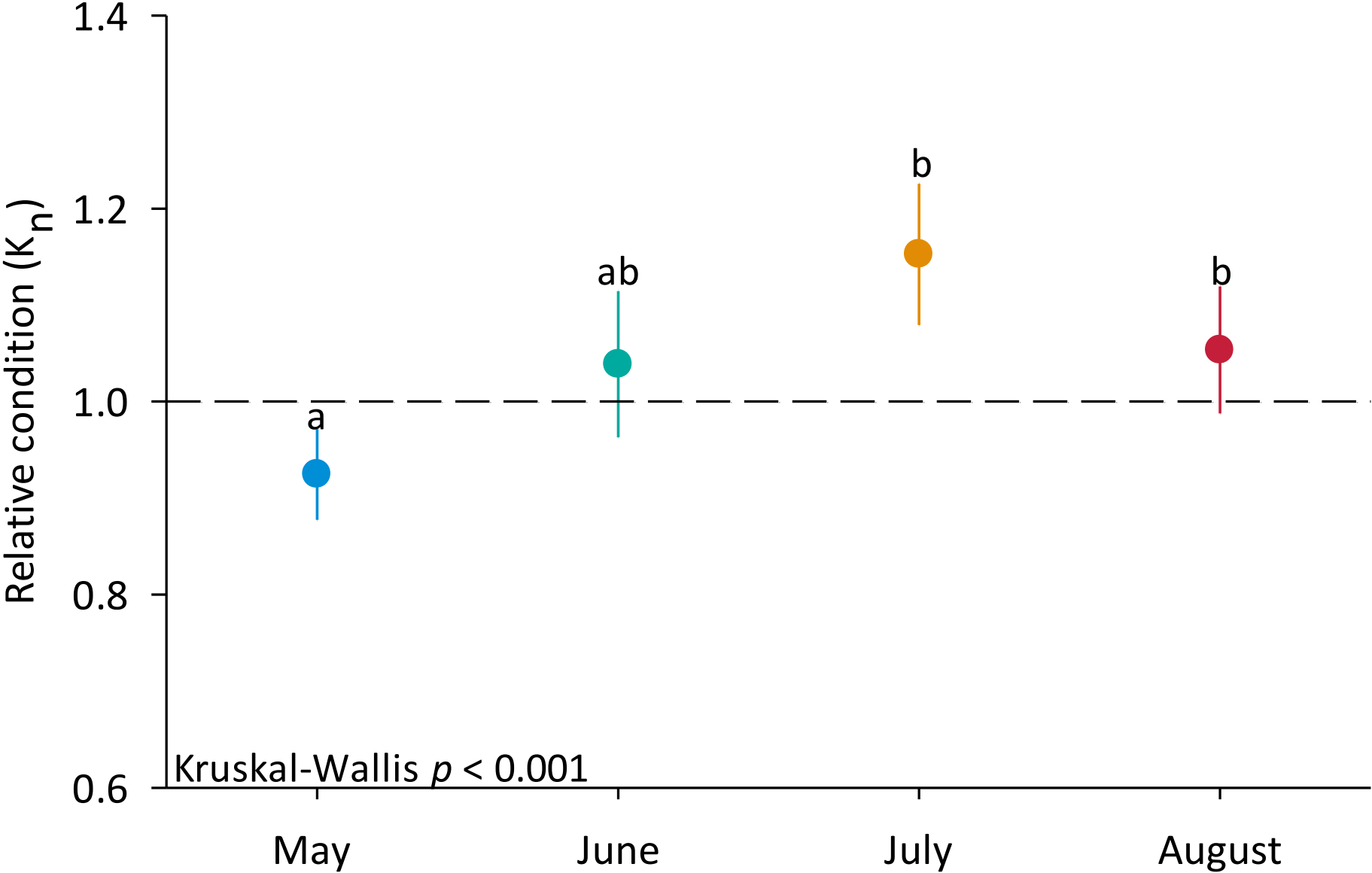
Shallower body  
Smaller head

Larvae were in best condition during the peak of the oil spill

Ransom (2015)



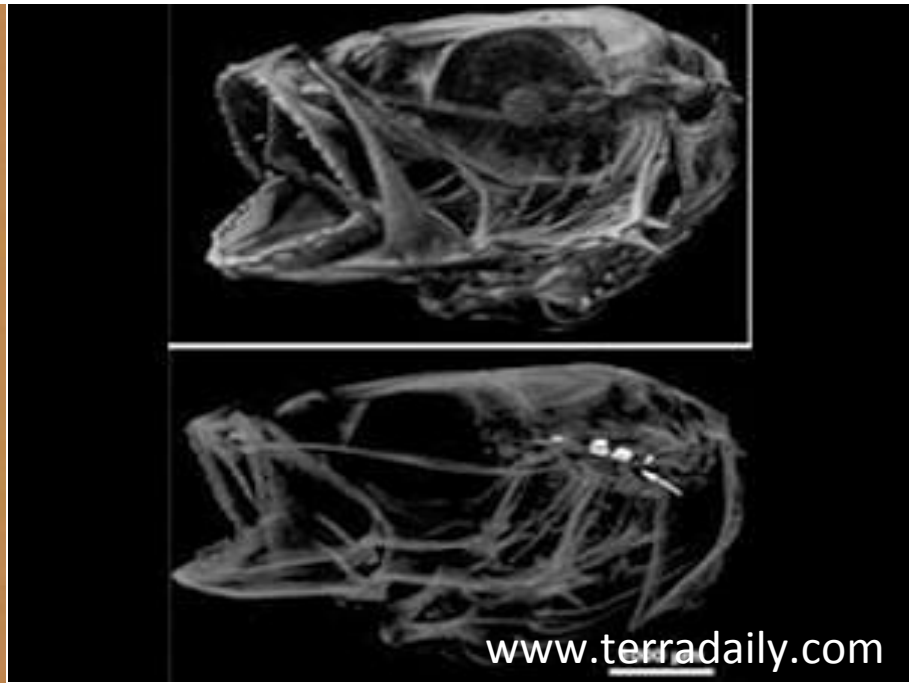
# Larvae in less condition in May than July and August



# Why Spanish Mackerel?

- Tourism
- Commercial fishing
  - 1.3 million pounds are harvested in the Gulf of Mexico
- Bait
- Applicability
  - Found in the Gulf of Mexico and the Atlantic





Spanish mackerel, *Scomberomorus maculatus*



# Metric of Condition: Using Otolith Measurements

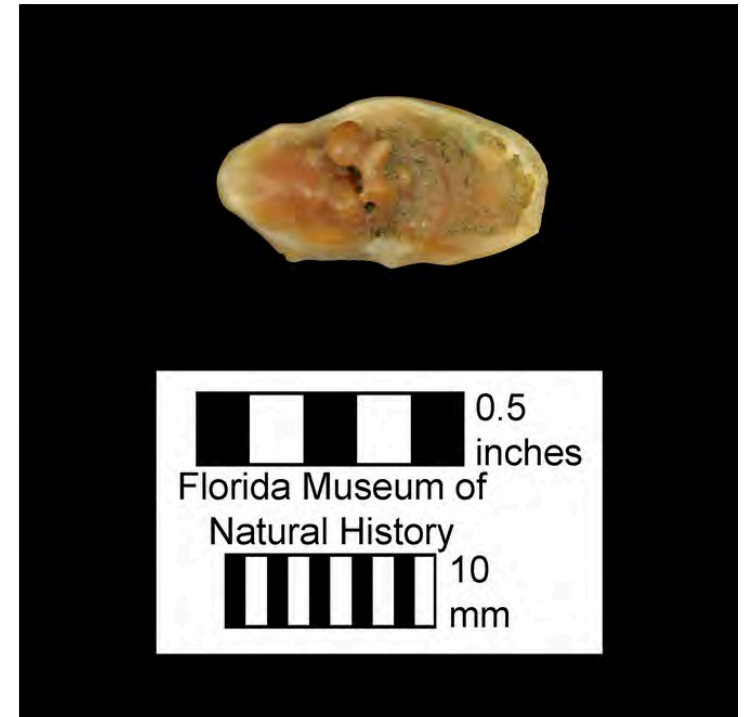
Why?

-Many surveys take otoliths

Would be applicable and relatively accessible

-Could provide baseline data

i.e. effects of natural and anthropogenically  
influenced events

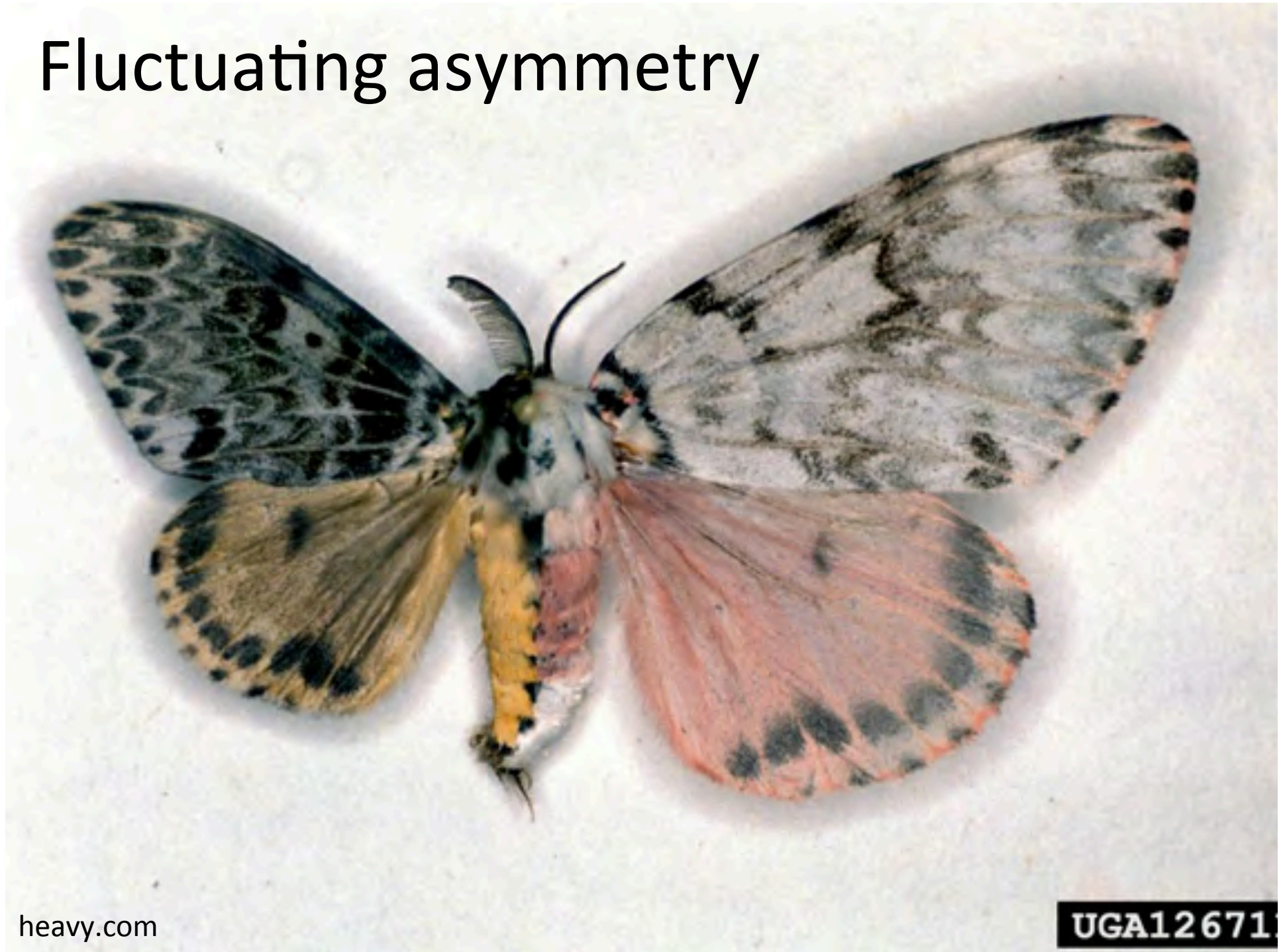


soundwaves.usgs.gov



brownlab.biology.lsu.edu/

# Fluctuating asymmetry

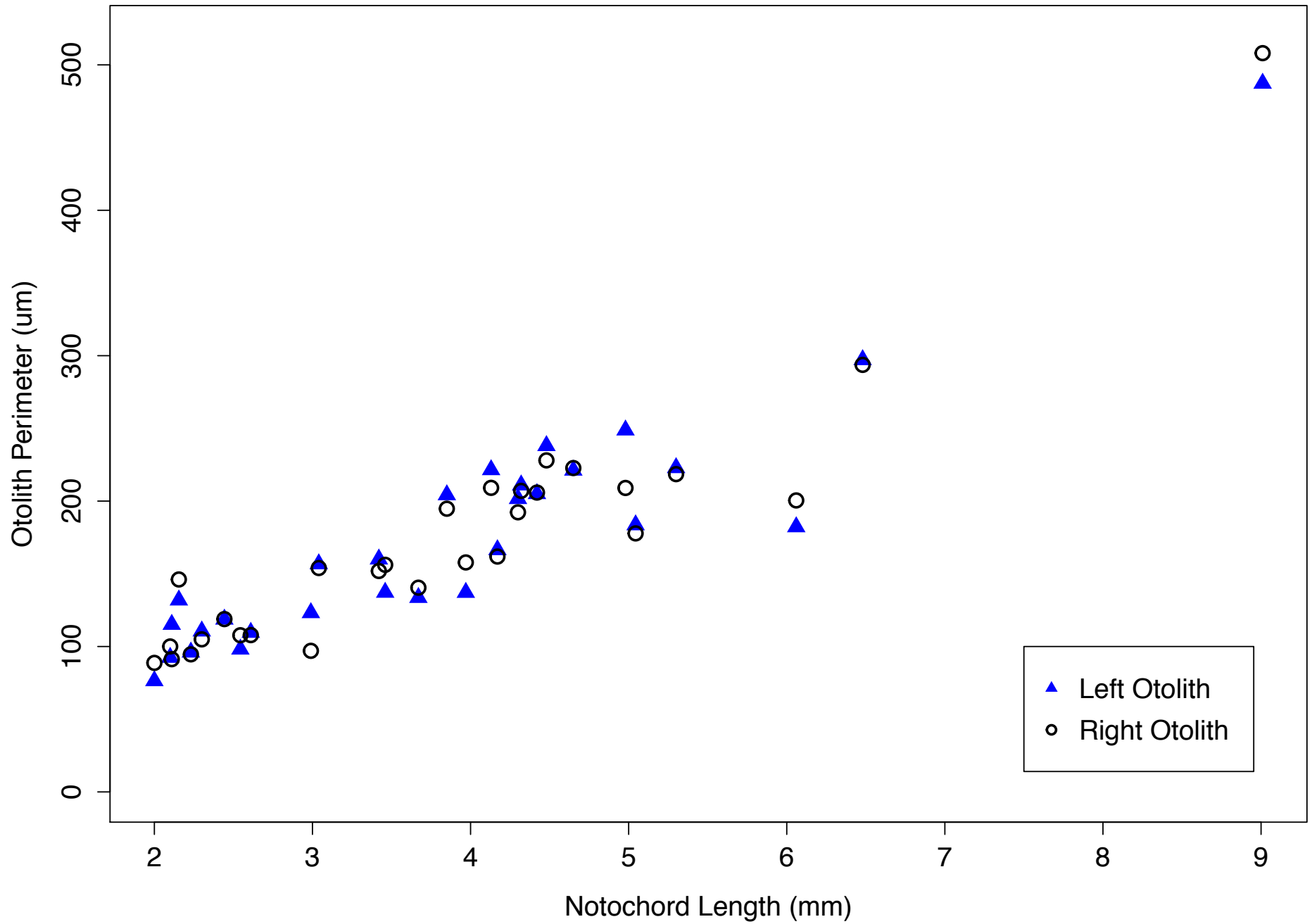




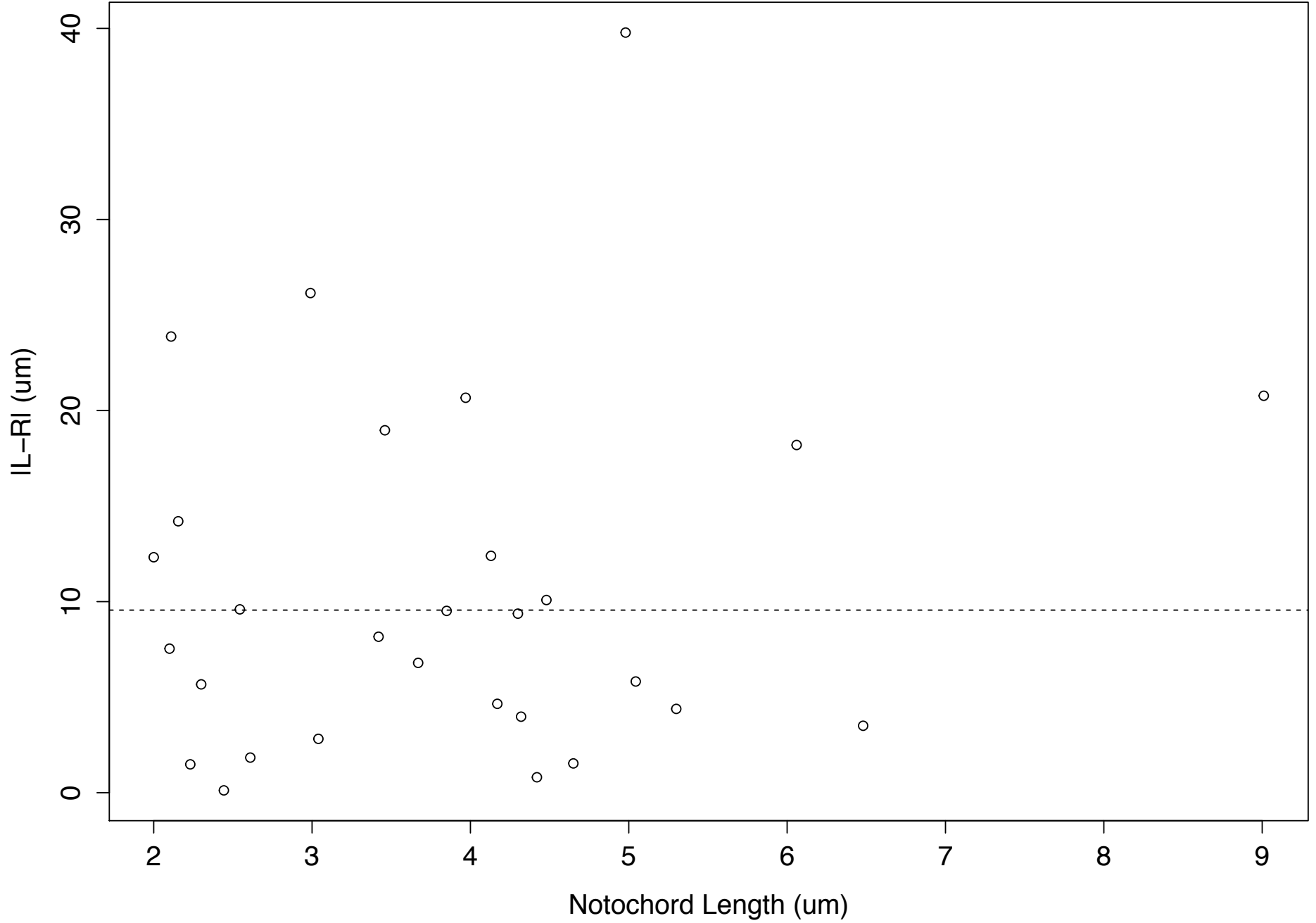
Area

2940.651  $\mu\text{m}^2$

# Otolith Perimeter



# Asymmetry Between Otolith Perimeter



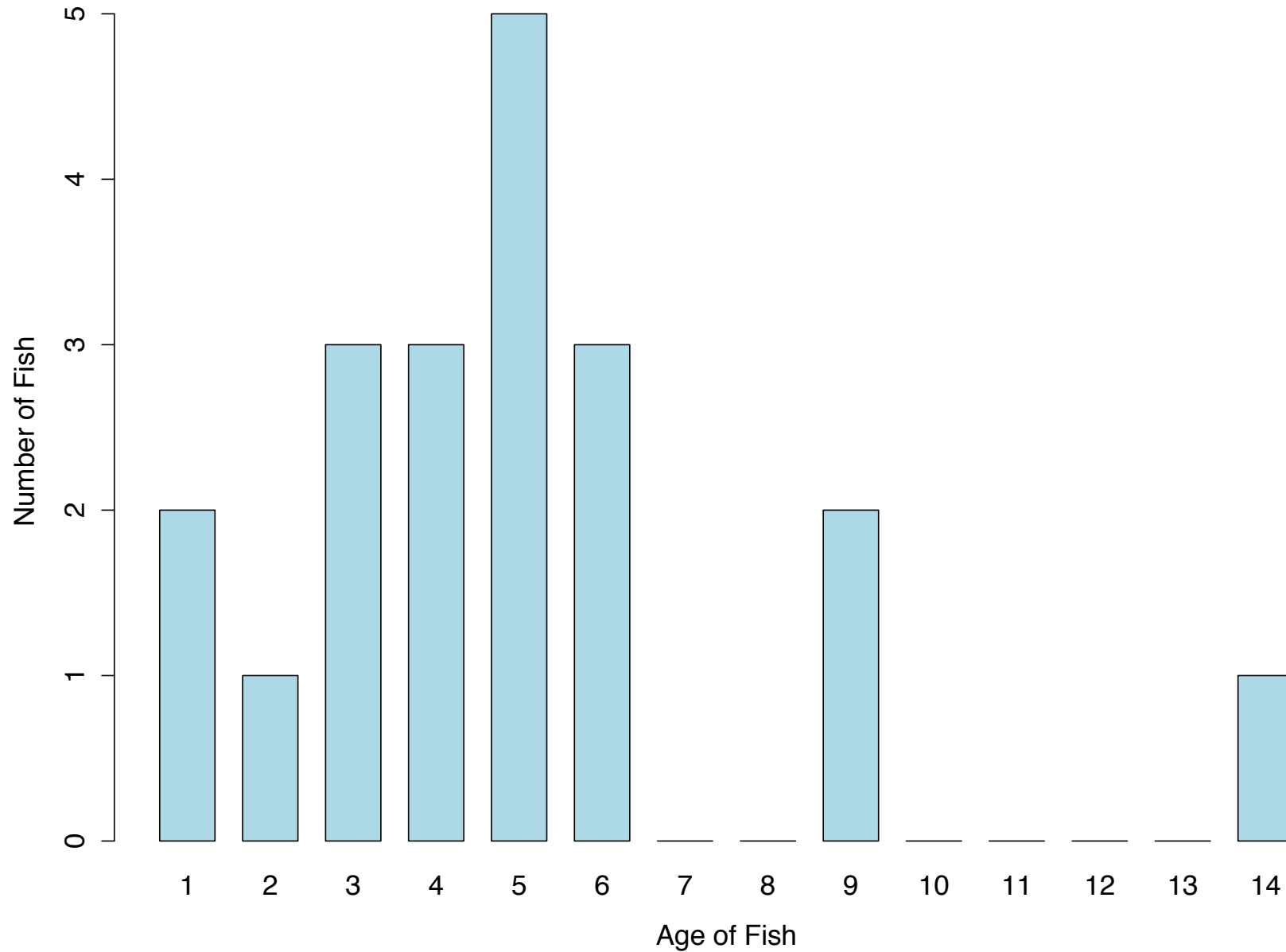


# Interpreting the Statistics

	R <sup>2</sup>	Notochord Length p-value	Month p-value	Notochord Length Significant?	Month Significant?
Perimeter	Left: 0.8247 Right: 0.8249	3.92e-10	0.6891	Yes	No
Area	Left: 0.8108 Right: 0.8339	3.866e-10	0.8405	Yes	No
Length	Left: 0.8294 Right: 0.8176	4.074e-10	0.7646	Yes	No
Width	Left: 0.7746 Right: 0.8299	5.509e-10	0.7151	Yes	No
Fractal Dimension	Left: -0.07665 Right: -0.02562	0.4803	0.4621	No	No

# Caveats

Age Distribution of Larval Spanish Mackerel



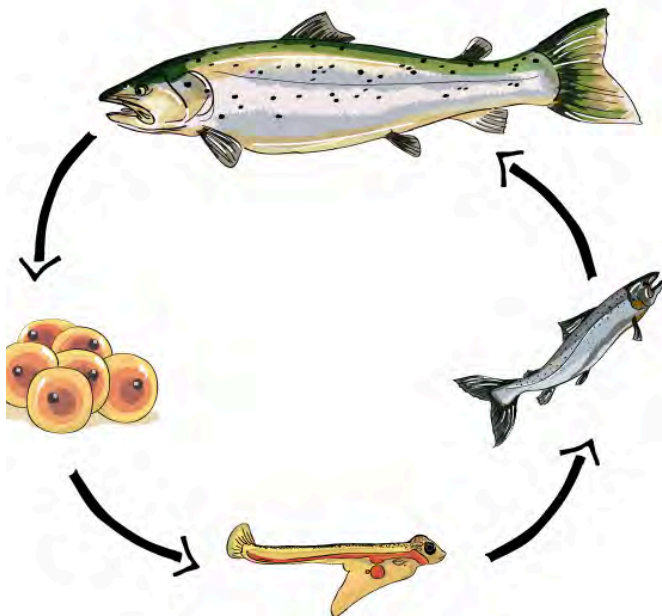
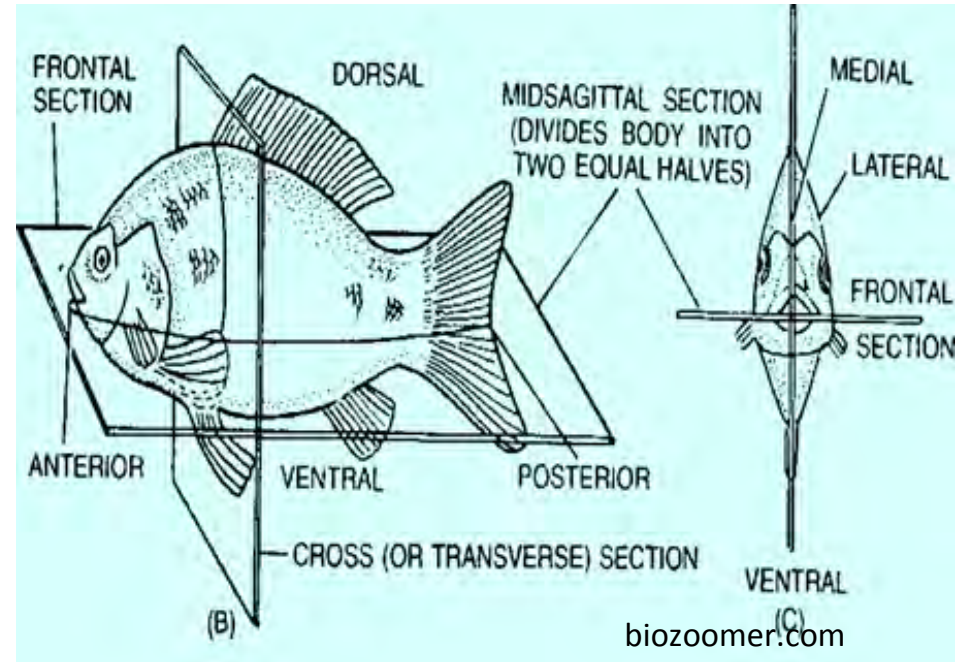
# Conclusions

For both Red Snapper and Spanish Mackerel

**Month:** not significant

**Age:** significant

Does not support Ransom's results



## Possible Explanations:

- Larval fish dependence on yolk sacs (9 days)
- Larval fish age
- Product of sample size



# Overview

- Internship has contextualized my studies
- Allowed me to make connections
- Reinforced my want to continue exploring the public sector
- Exposed me to new software (Image J, R/RStudio)



**ImageJ**  
Image Processing and Analysis in Java





# Acknowledgments

## **Fisheries Oceanography and Ecology Gulf Coast Research Lab**

My mentors Dr. Frank Hernandez and Dr. Alison Deary  
Sarah Muffleman and Carla Culpepper

## **Northern Gulf Institute Dauphin Island Sea Lab**

Tina Miller-Way  
Rachel MacDonald

## **Columbia University Department of Environmental Science**

Dr. Jerry McManus

# Supplementary Slides

# Fractal Dimension



$11.5 \times 200 = 2300 \text{ km}$



$28 \times 100 = 2800 \text{ km}$



$70 \times 50 = 3500 \text{ km}$