Deep Water Sharks:
Can they help us understand pre-adaptation to climate change?

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Acknowledgments

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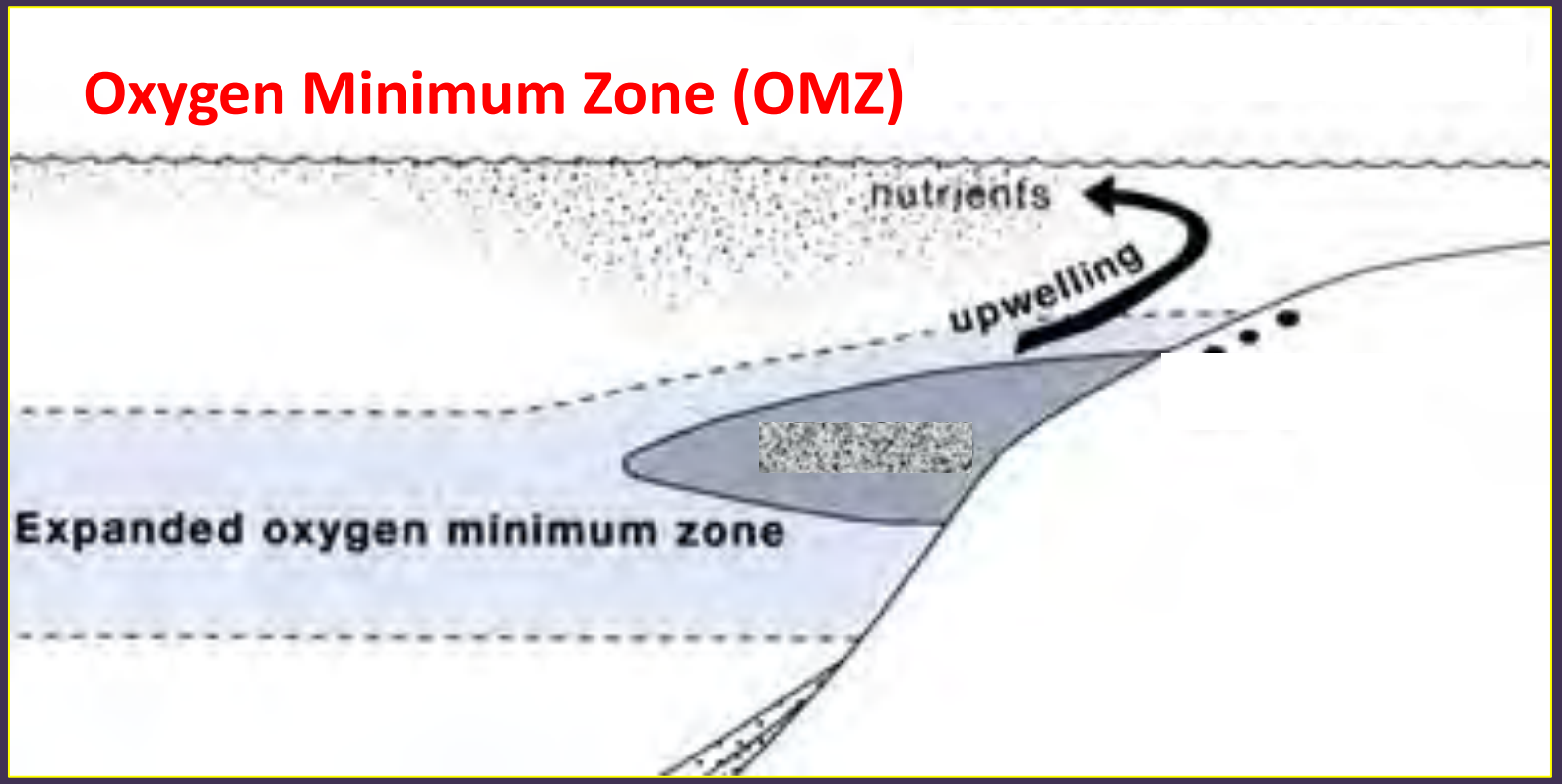
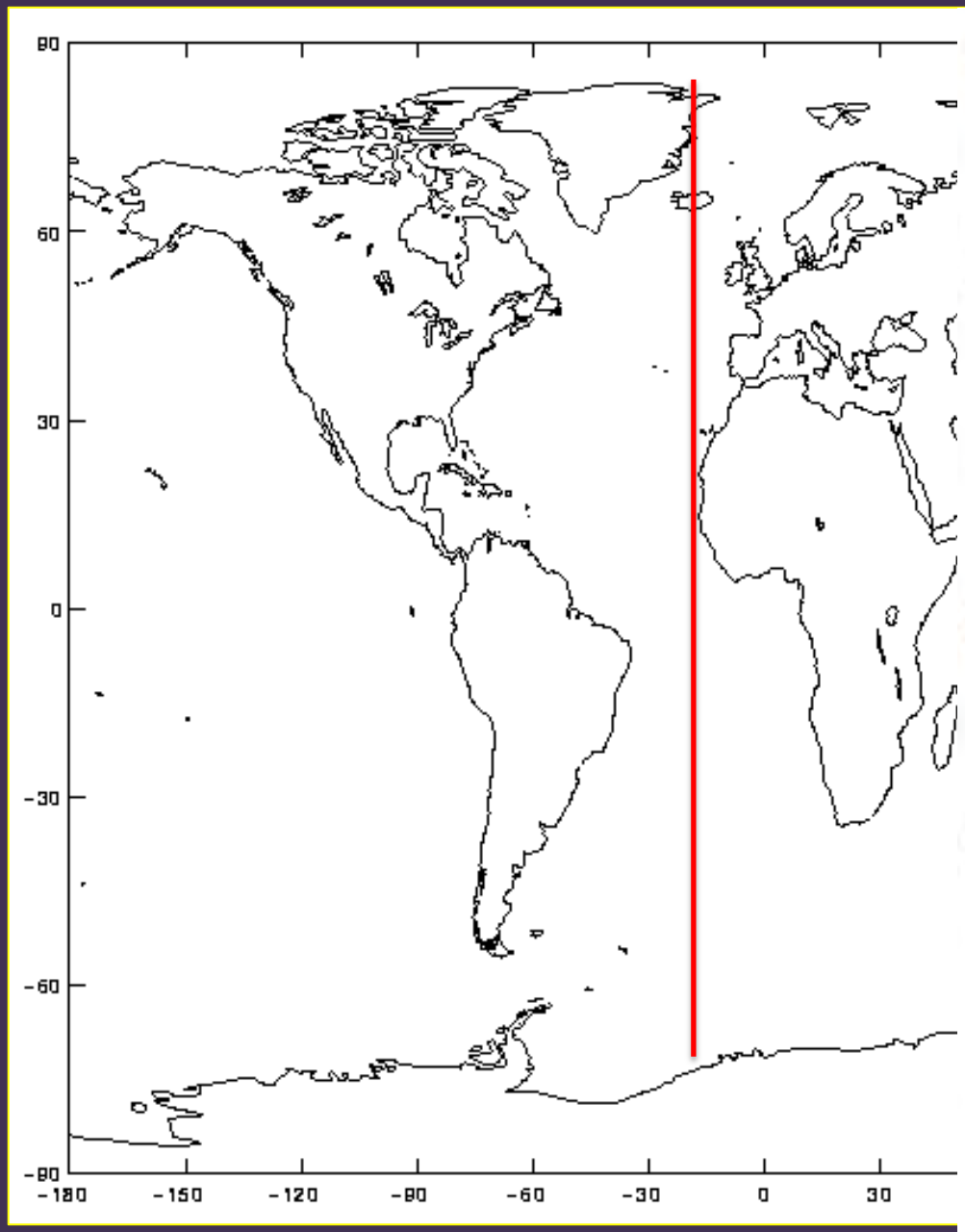
OUTLINE

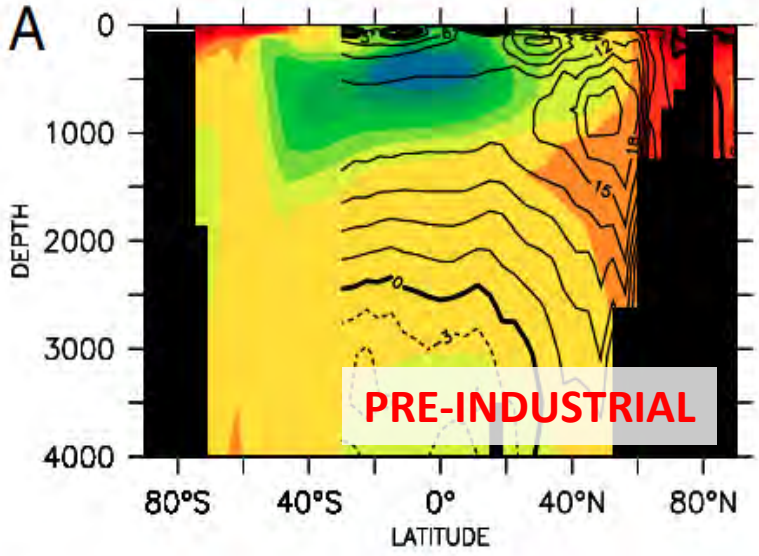
- Background
  - How is oxygen important to animals?
- Hypothesis & Questions
  - Who utilizes the OMZ?
- How?
  - Data analysis
- Future Research
  - Accelerometer

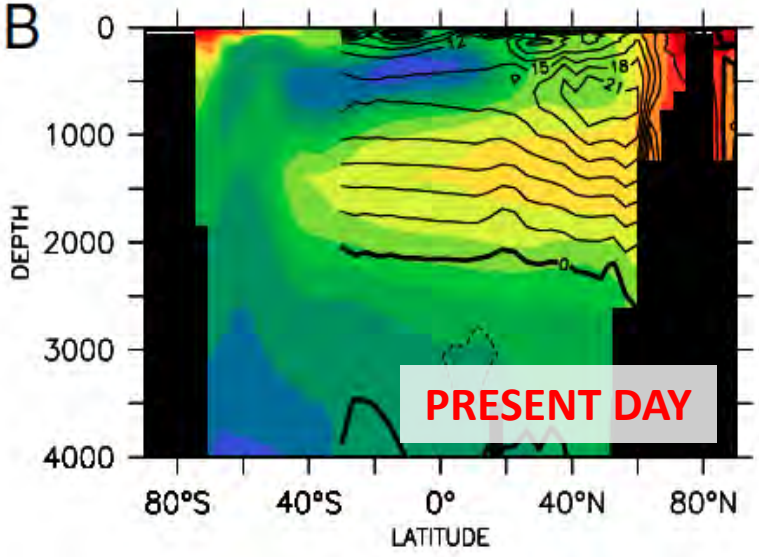
Oxygen Minimum Zone (OMZ)

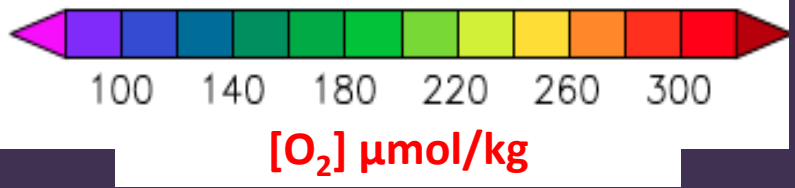


- Feature of every ocean
  - Respiration
- Expanding with climate change
- To understand implications → study animals that intersect OMZs

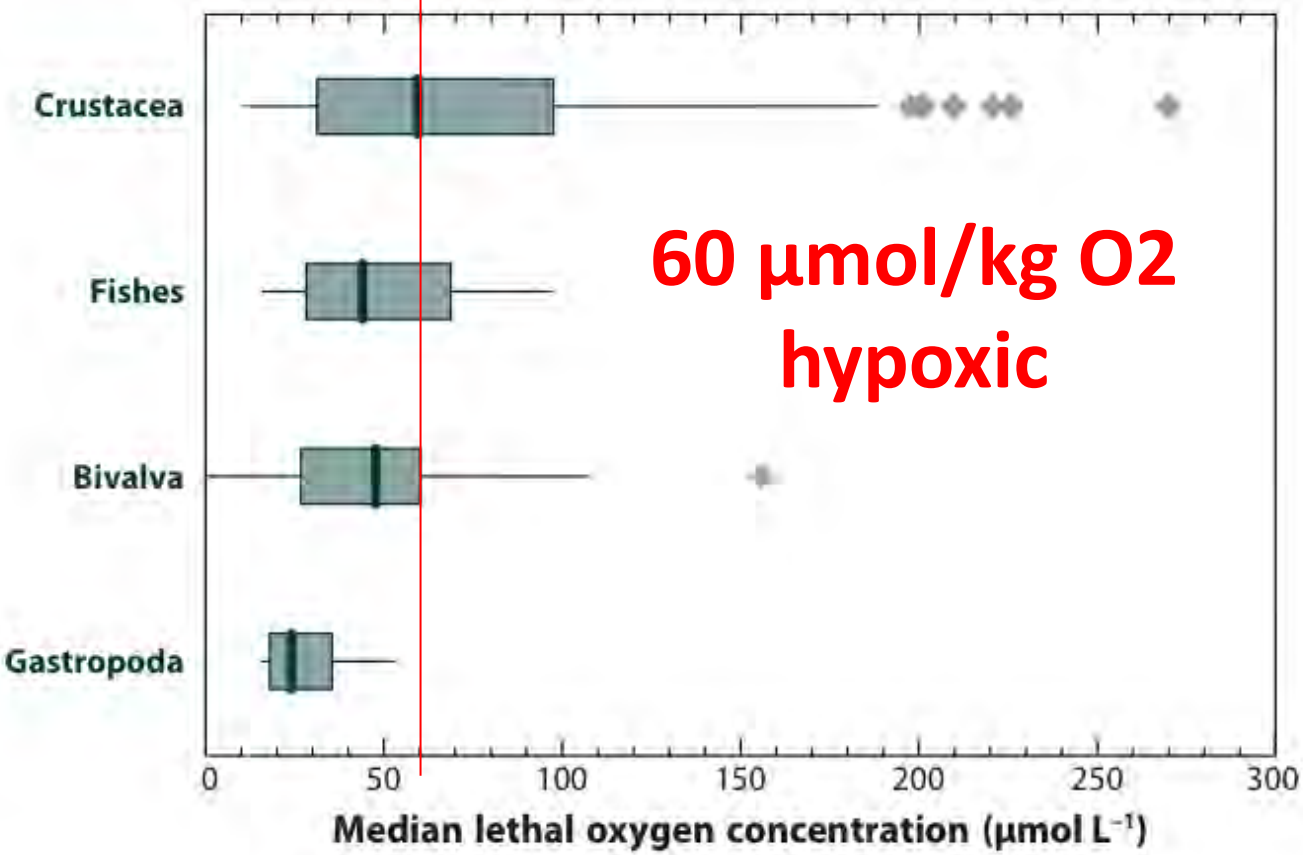








(Hofmann and Schellnhuber 2009)



60 µmol/kg O2 hypoxic

Figure 1

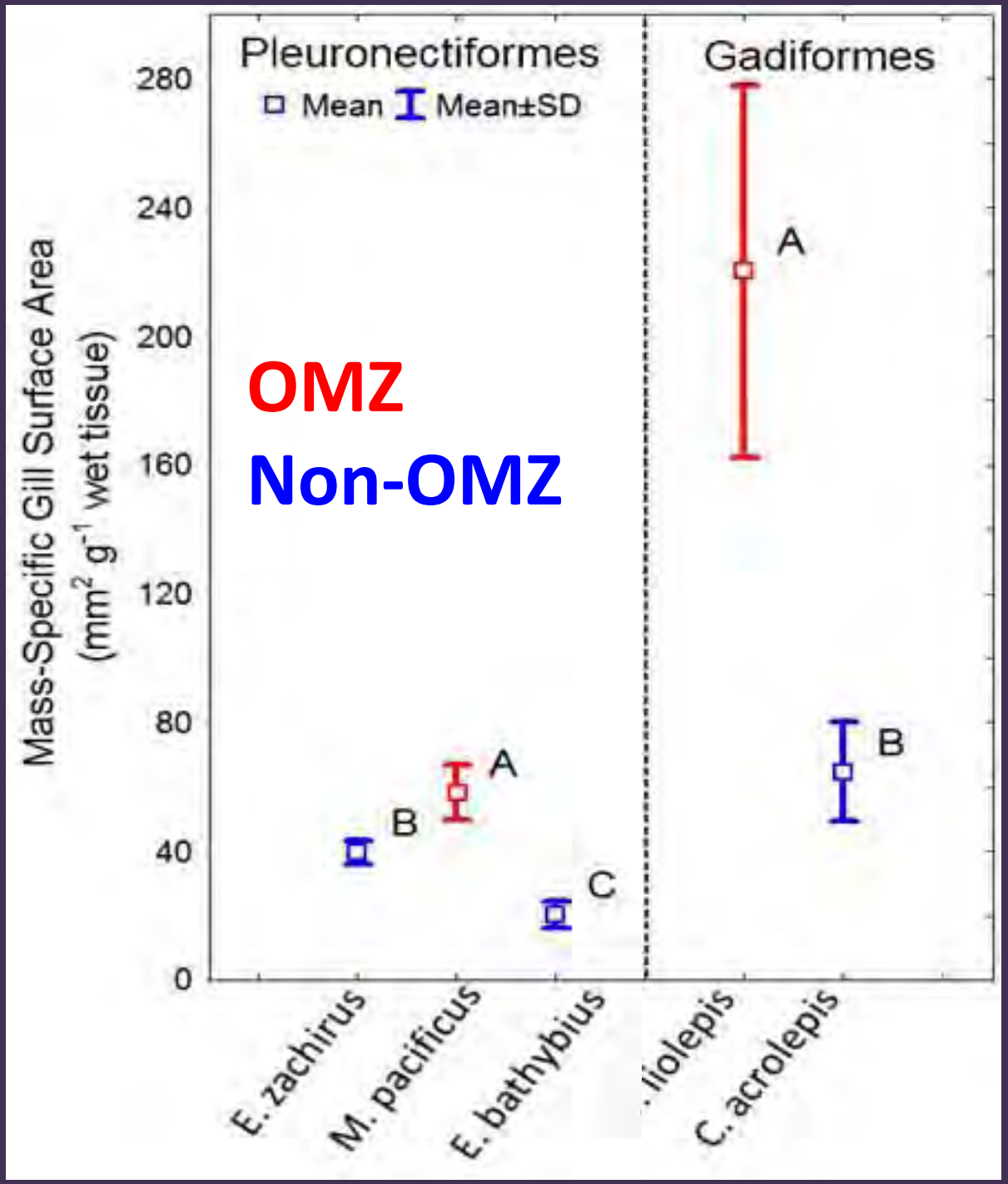
Median lethal oxygen concentration (LC_{50}, in µmol L^{-1}) among four different taxa. The box runs from the lower (Q_1, 25%) to the upper (Q_3, 75%) quartile and also includes the median (*thick vertical line*). The range of data points not considered outliers is defined as 1.5 times the difference between the quartiles (Q_3–Q_1), also known as interquartile range (IQR). The whiskers show the location of the lowest and highest datum within this range, i.e., 1.5 * IQR. Shaded diamonds are outliers as per this definition. Redrawn after Vaquer-Sunyer & Duarte (2008). Copyright (2008) National Academy of Sciences, U.S.A.

Keeling et al (2010)

Adaptations

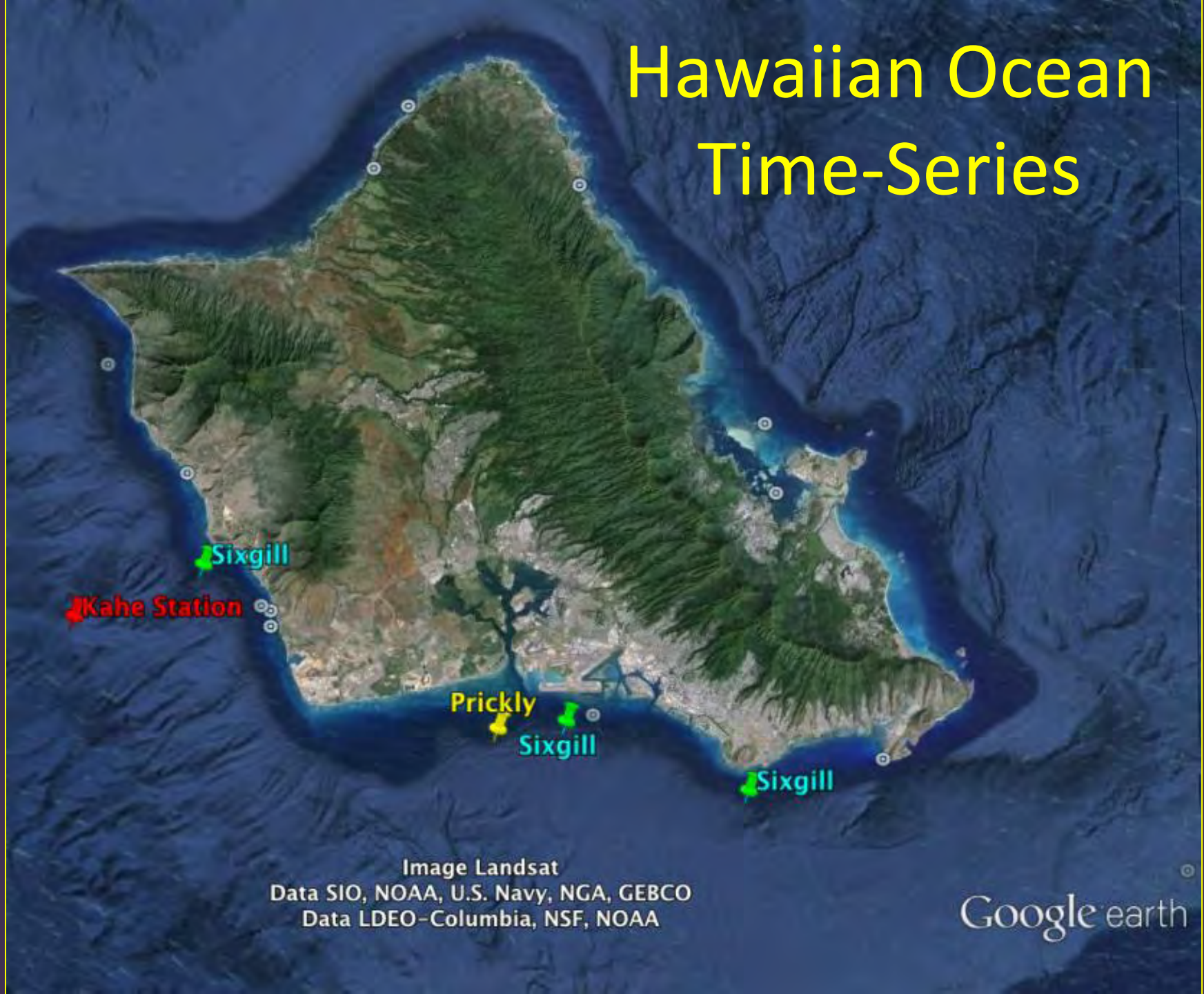
- Oxygen extraction
- Lower metabolism
- Anaerobic metabolism

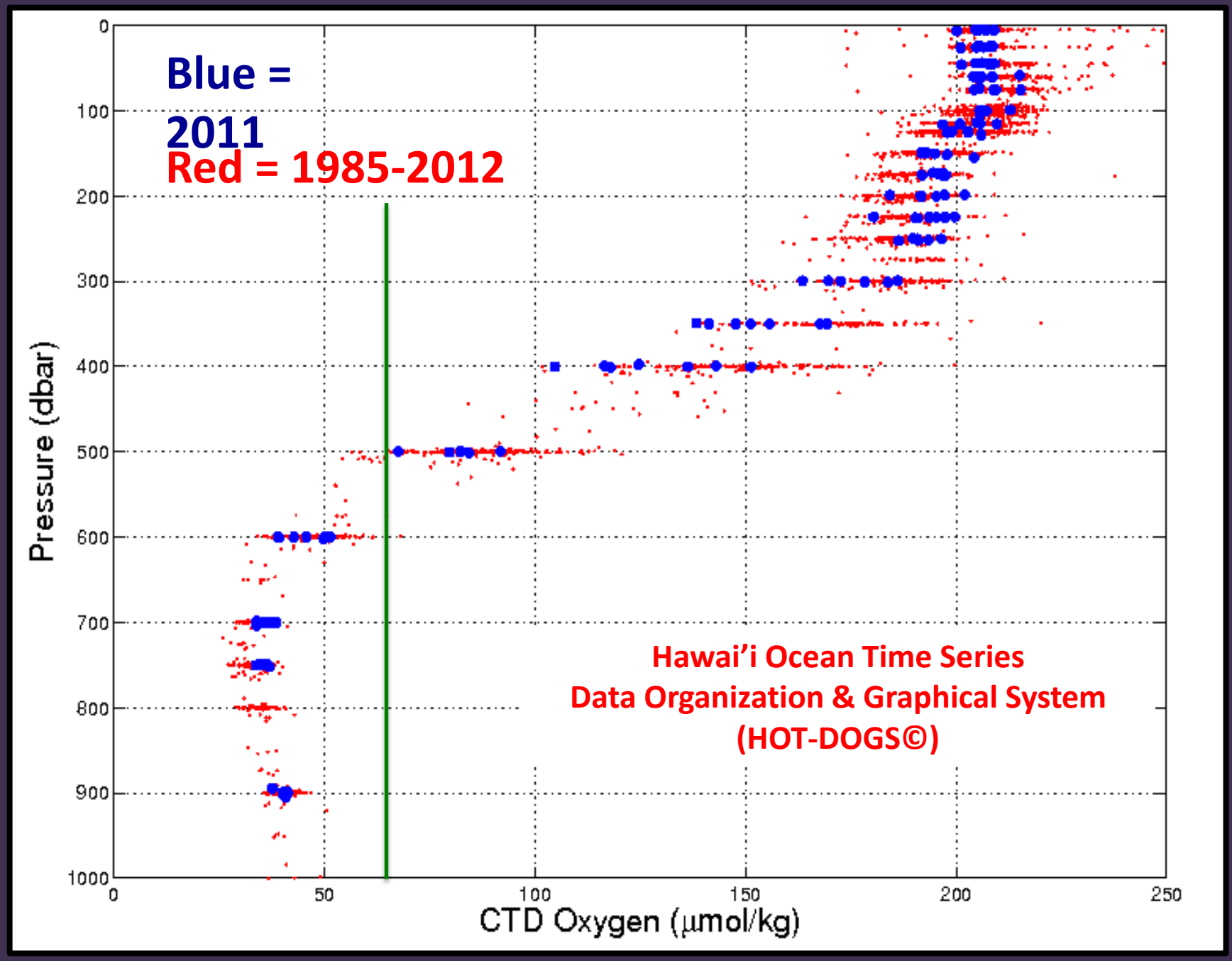
Childress and Seibel (1998)



Friedman (unpublished)

Hawaiian Ocean Time-Series




Blue =
2011
Red = 1985-2012
Hawai'i Ocean Time Series
Data Organization & Graphical System
(HOT-DOGS©)
Pressure (dbar)
CTD Oxygen (µmol/kg)
0
100
200
300
400
500
600
700
800
900
1000
0
50
100
150
200
250

Hexanchus griseus

- Common name: Bluntnose sixgill shark
- DMV and recorded as deep as 1,875 meters!

Photo by: Arik Pulsifier

Echinorhinus cookei

- Common name: Prickly/Cooke Shark
- DVM and low activity levels during the day (Dawson)

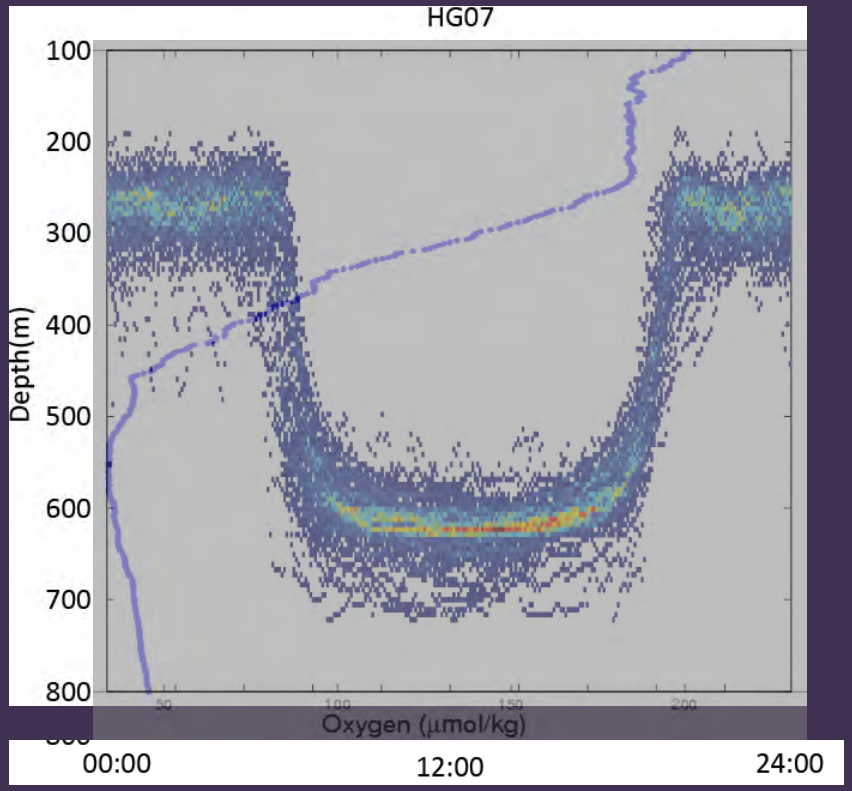
Methods

SATELLITE

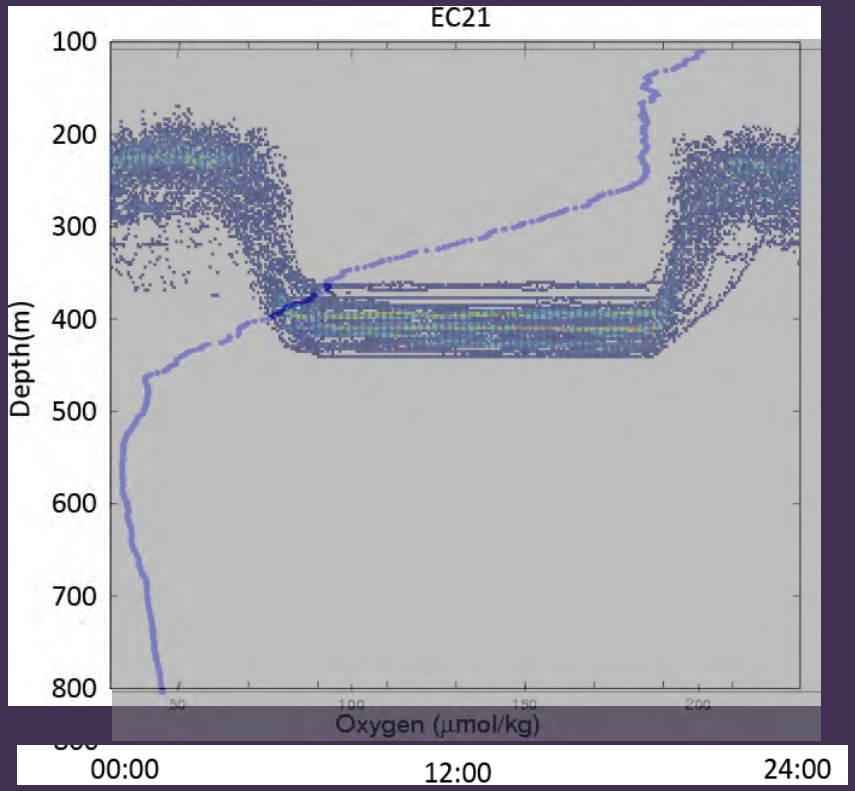
- 3 sixgill sharks
- 1 prickly shark

Preliminary Results

SIXGILL



PRICKLY



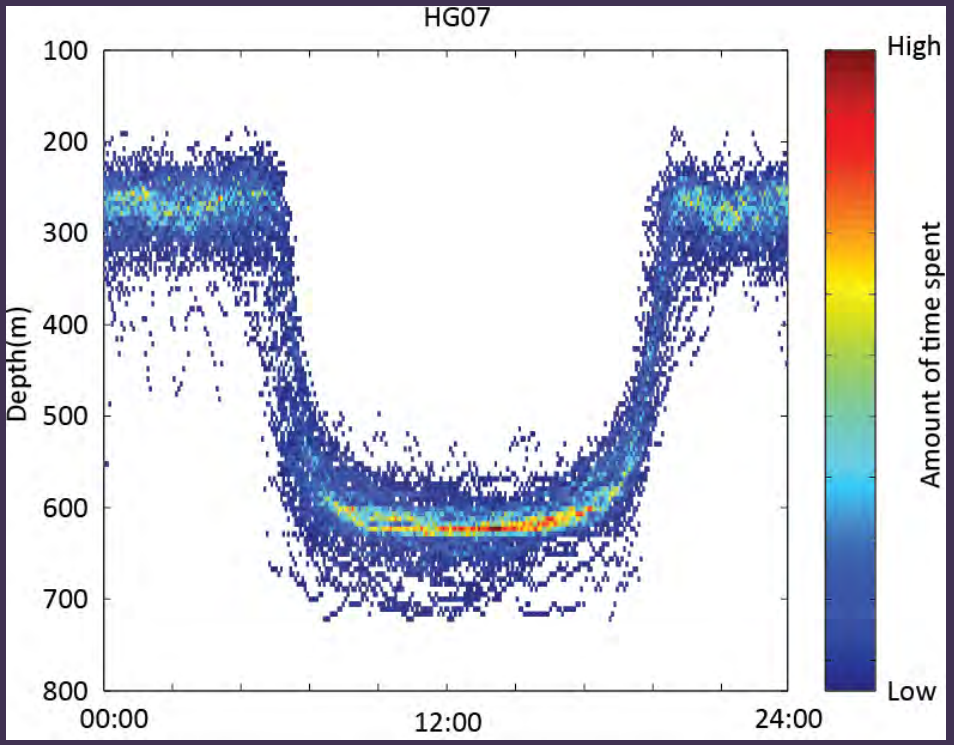
Hypothesis

The sixgill shark utilizes the OMZ and the prickly shark doesn't

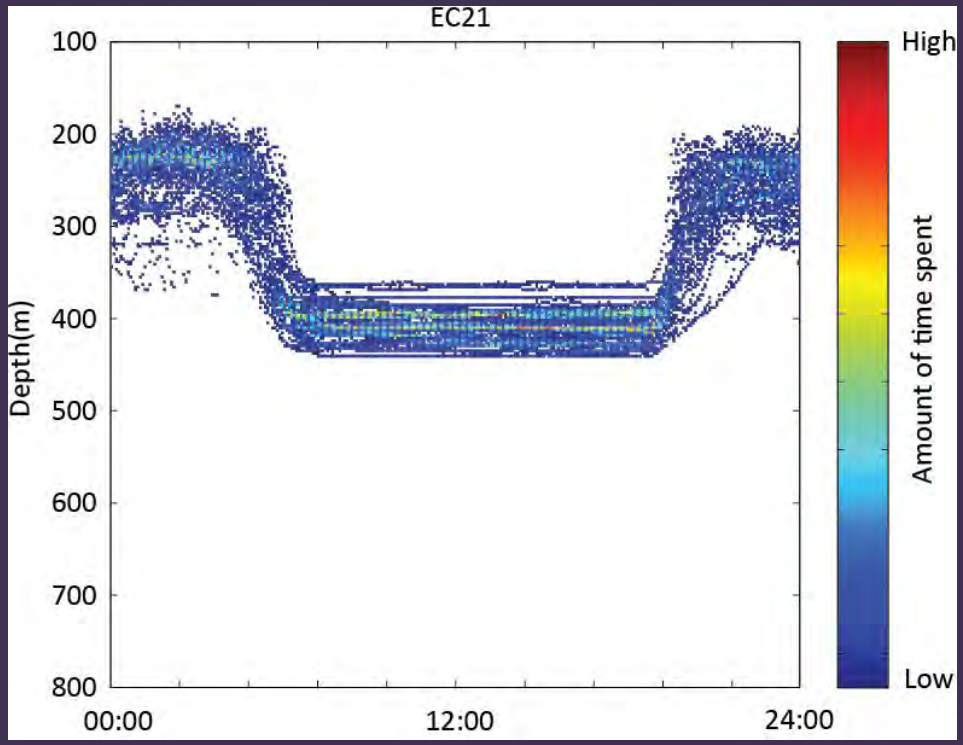
HOW?

- Are the day depths for sixgill sharks significantly deeper?

SIXGILL



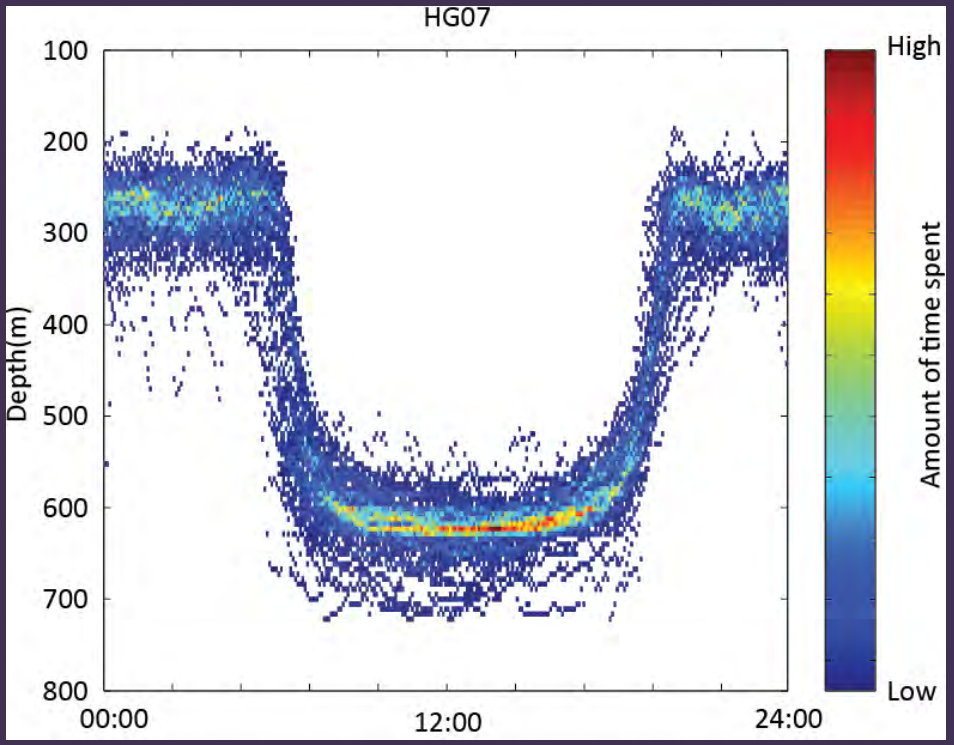
PRICKLY



HOW?

- How active are they during the day?
  - Variability in vertical movement

SIXGILL



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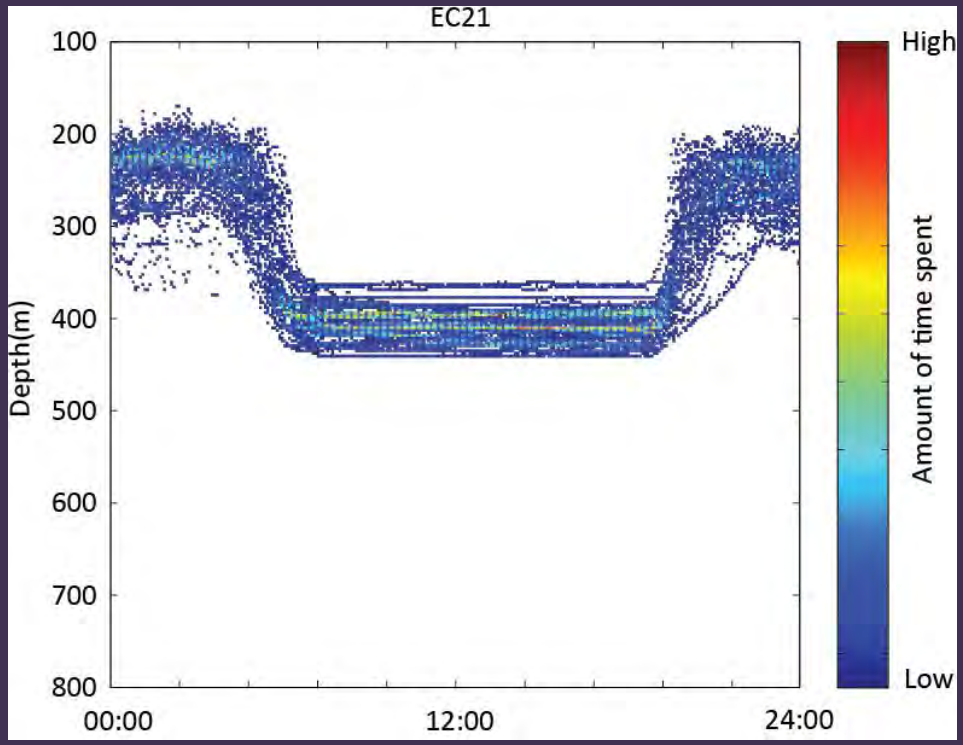
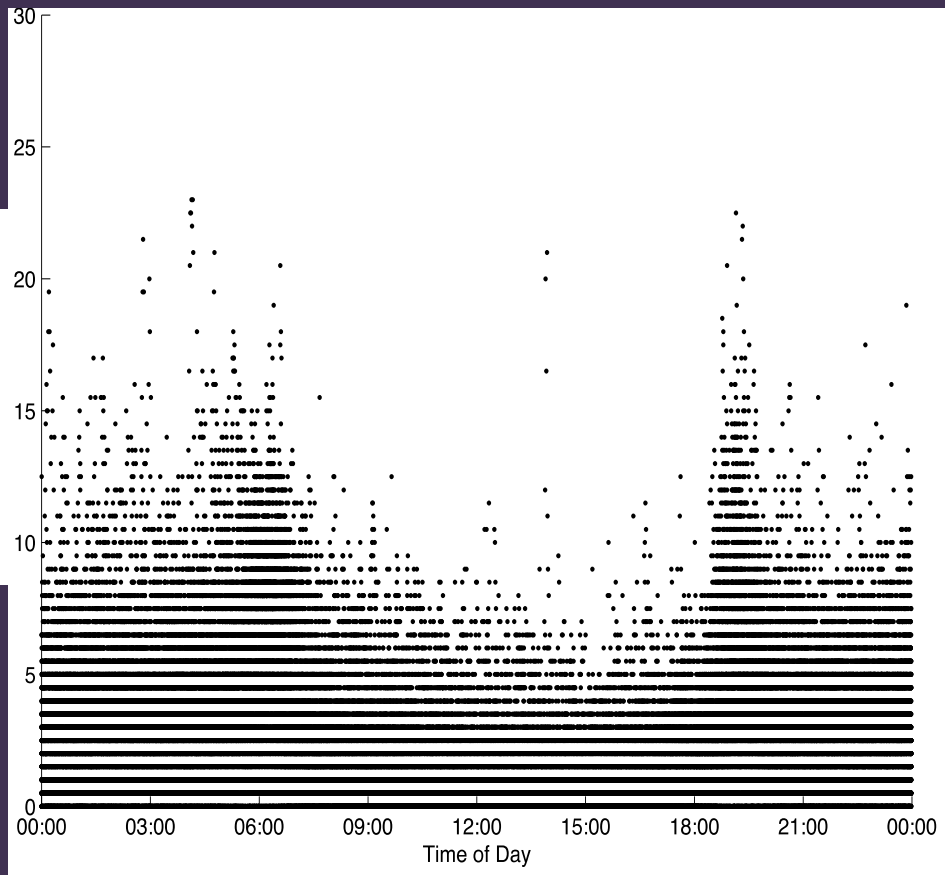
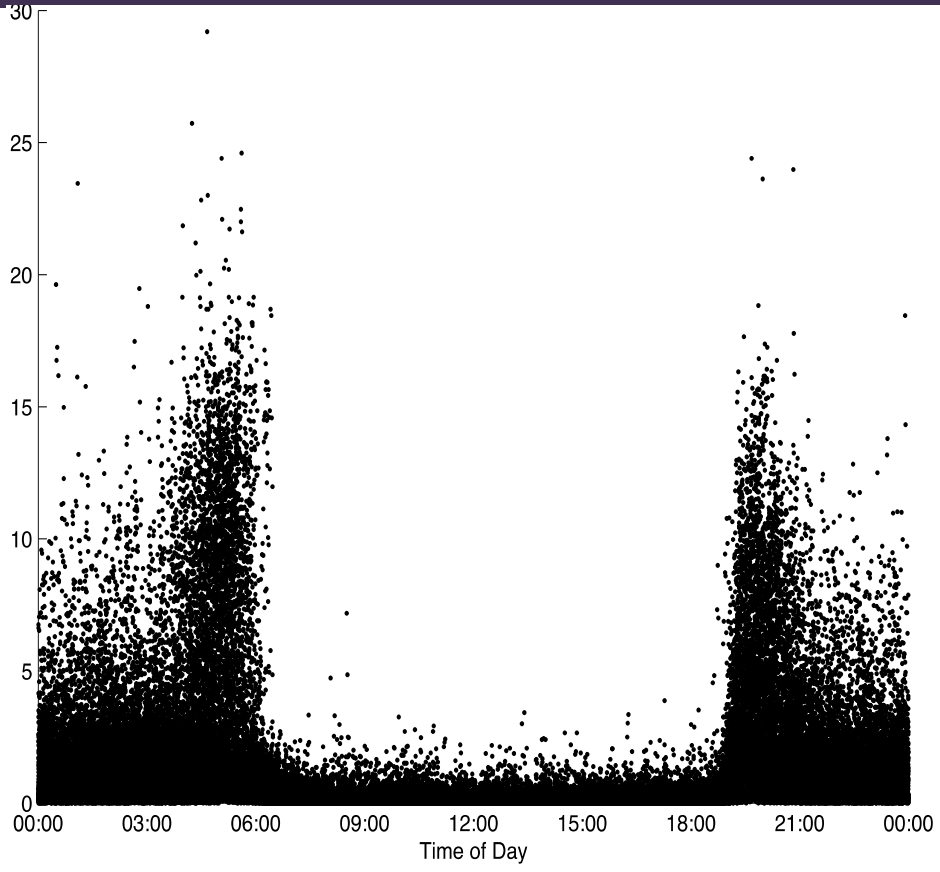


Vertical Movement

SIXGILL

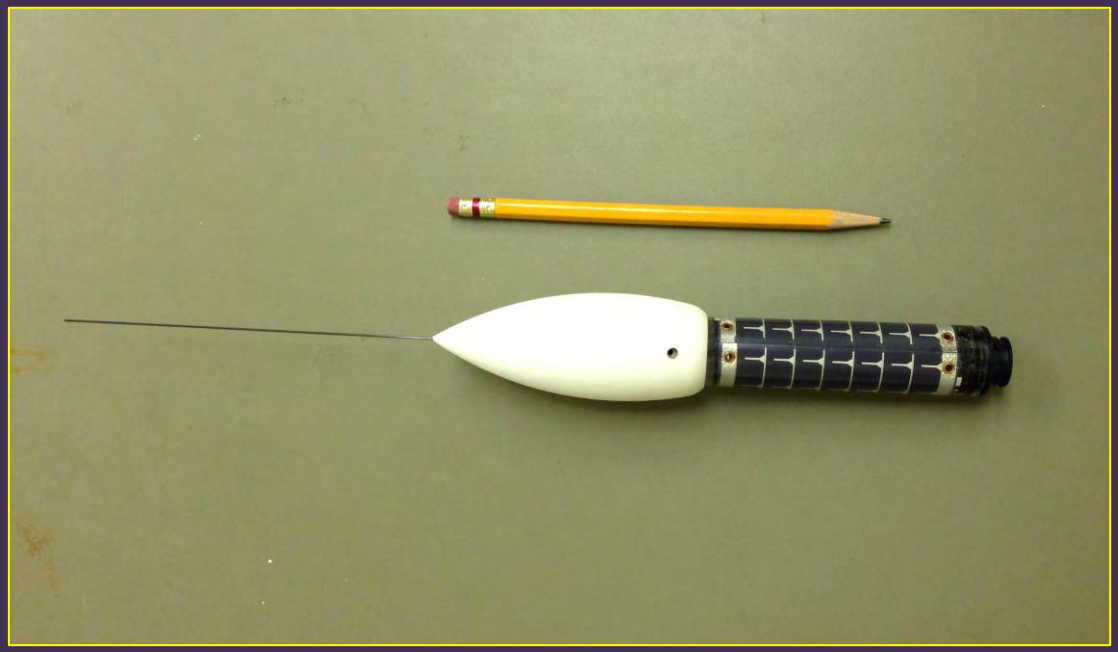


PRICKLY

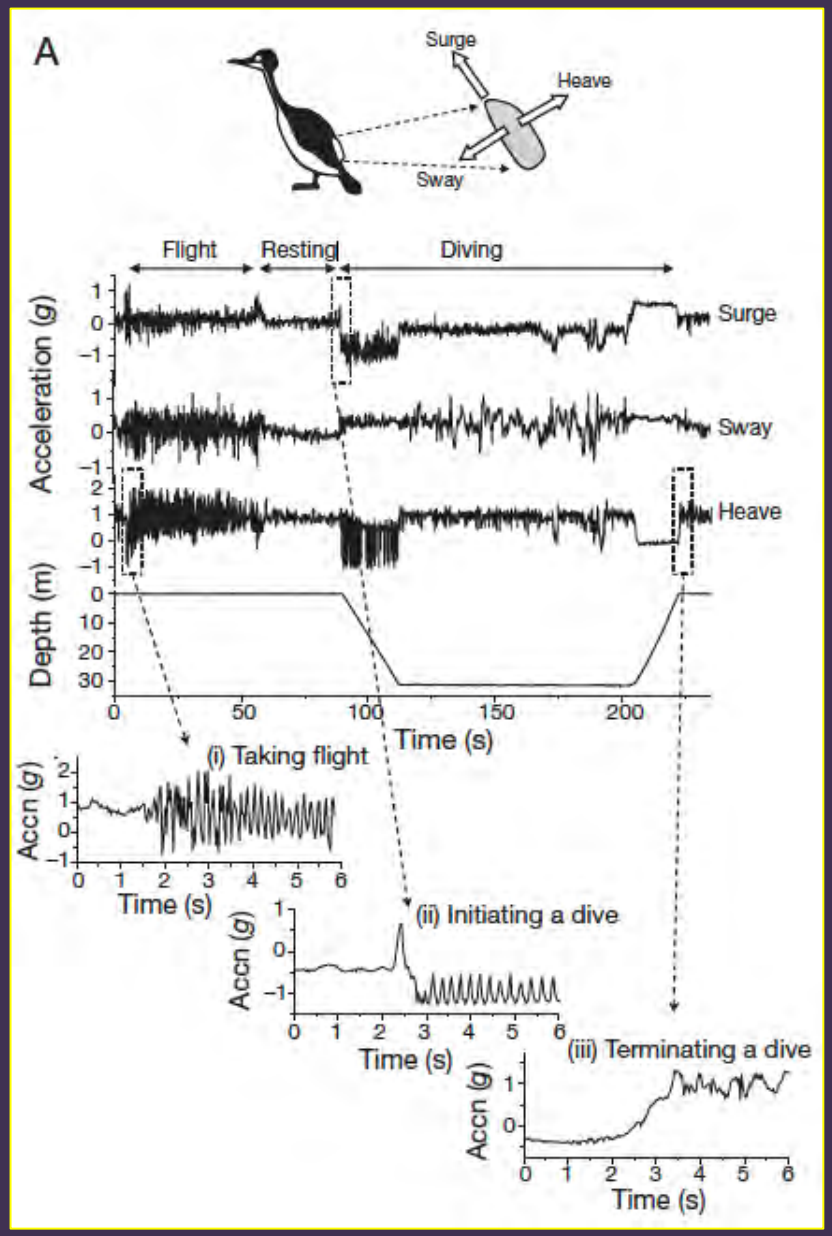


Future Research

- Modern satellite tags:
  - Tri-axial accelerometer-magnetometer
    - ODBA (Wilson et al. 2008)



Accelerometer Data



Wilson et al (2008)

THANK YOU!

Questions?

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