Determining the age-size relationship of *Panulirus argus* in the southwest area of Puerto Rico.

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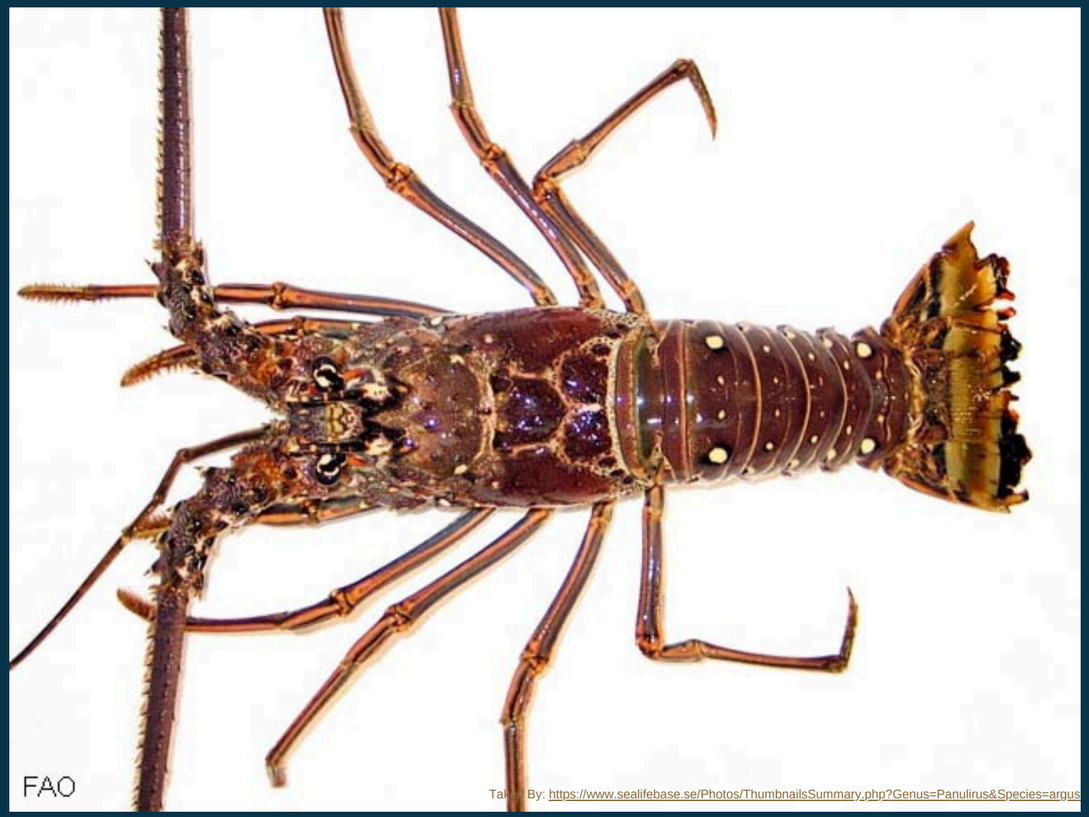
Introduction

- The Caribbean Spiny Lobster is a nocturnal crustacean.
- They grow by molting.

- At night, they move away from the cravices and holes in coral reefs to feed on a wide variety of marine invertebrates.
- They vacate their old shells while simultaneously absorbing water , expanding their body size.

Panulirus guttatus



Panulirus argus

Taken By:https://fineartamerica.com/featured/1-caribbean-spiny-lobster-sally-weigand.html

Caribbean Spiny Lobster

Panulirus argus

- This is the most economically valuable species in Puerto Rico.
- Representing up to 30% of the total commercial catch in Puerto Rico.
- Unlike fish, estimation of age has been a challenge in lobsters, since it wasn't until recent years that ossicles were considered.

Taken By :https://www.uncommoncaribbean.com/caribbean/spiny-lobster/

Justification

- There are signs that this animal is being overfished.
- Many factors play crucial roles in influencing the productivity of lobsters.
- Fishing pressure can also influence length and growth of *P. argus*

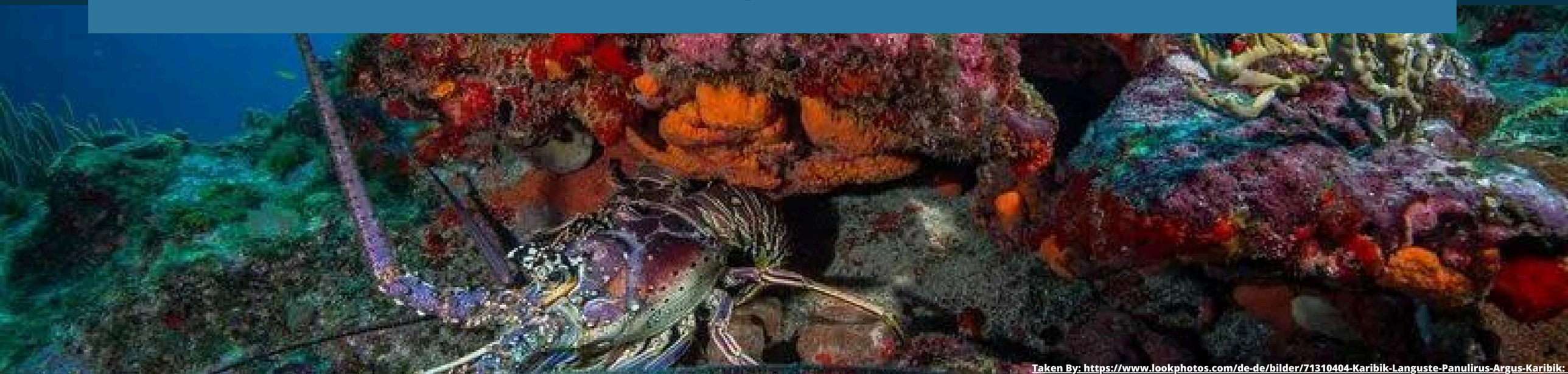
Taken By: https://www.researchgate.net/figure/The-Caribbean-spiny-lobster-Panulirus-argus_fig1_357870922

- In the U.S., fishery management actions, plans, and rules of commercially important species are mostly based on stock assessments of individual species or closely related groups of species.

Objetives of the Study:

- Estimate and construct the age structure of *P. argus* population of the south-west coast of Puerto Rico using ossicles.

- In addition, this allowed us to construct length-age and weight-age relationships which are fundamental for stock assessment.
  - Stock assesments: scientific evaluations conducted to estimate abundance, status, annual catch limit (ACL) and health of important fisheries.



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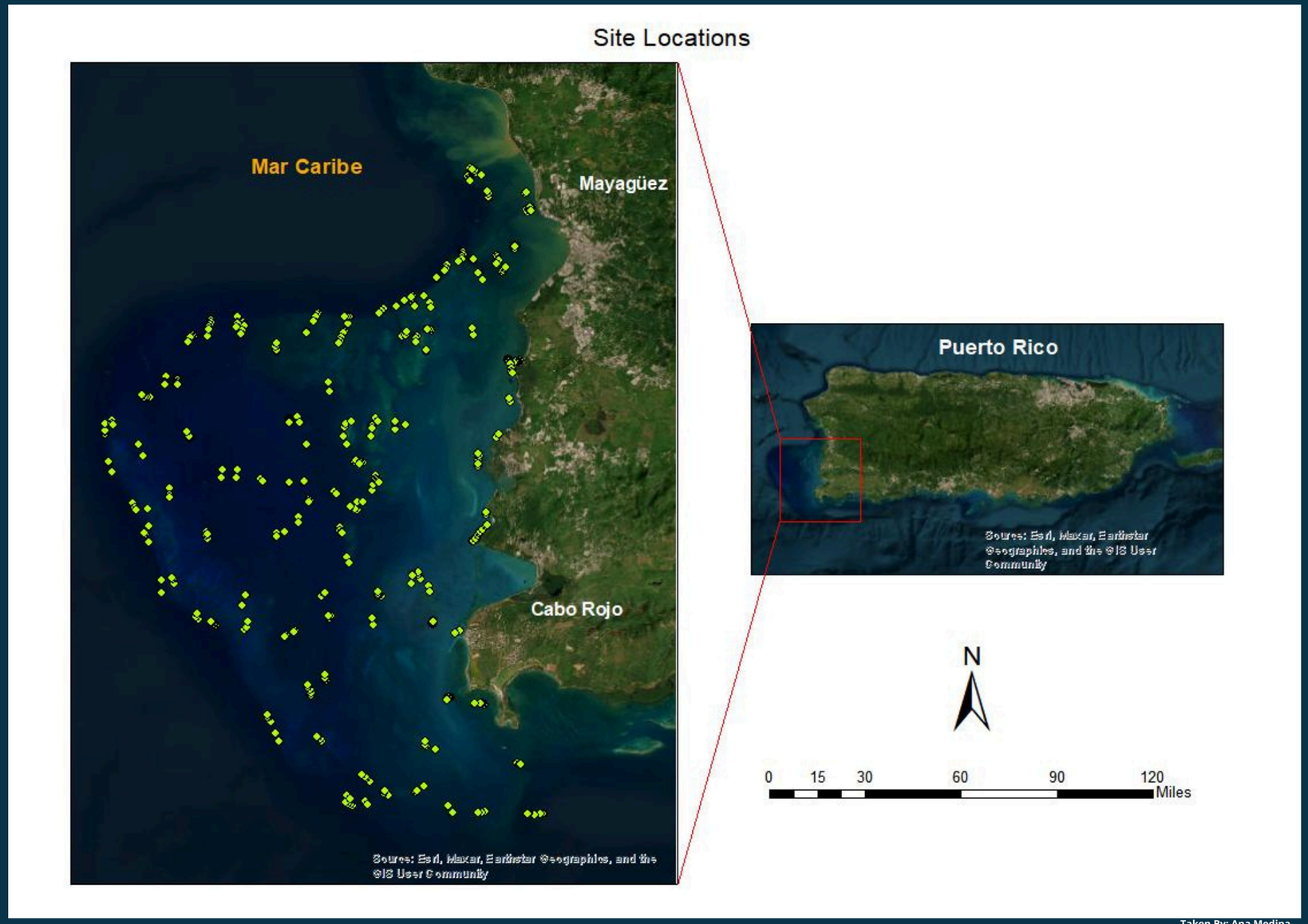
Materials and Methods



Taken By: Ana Medina

Materials and Methods

- More than a 100 lobsters where capture from the southwest area of Puerto Rico. Every lobster captured was tagged with a number.
- From every localization a lobster was captured, we have the coordinates, the the area and the time and duration of the dive.

Taken Byhttps://seafoodsustainability.org/a-first-for-caribbean-fisheries-bahamas-spiny-lobster-earns-msc-certification-2/:

Laboratory Work

Determine the sex, if female does it have eggs or spermataphore?

Detect if its molting.

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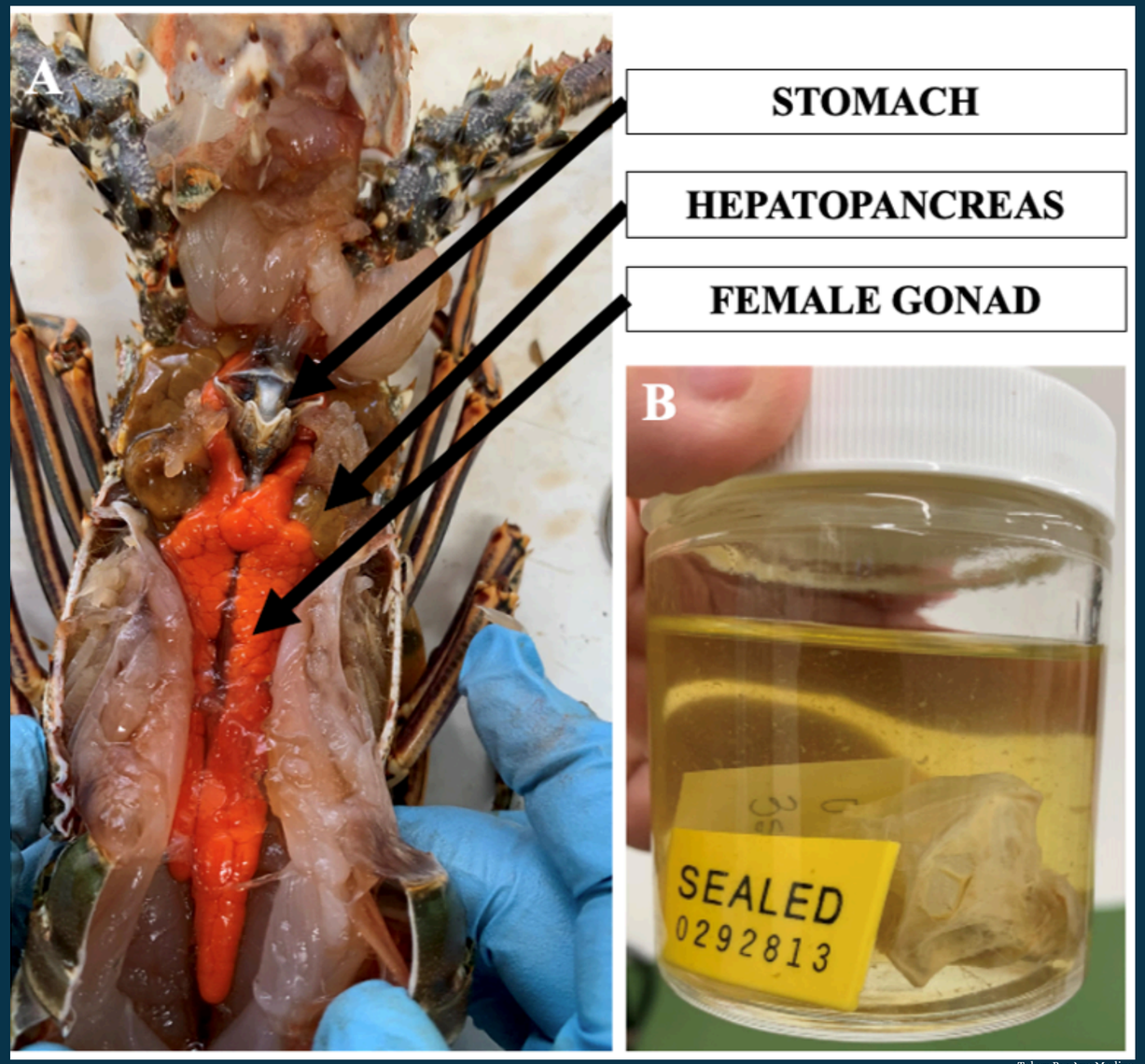
Does it have any wounds?

Weight the animal and measure carapace lenght.

This figure shows:(A) *P. argus* Opened, Exposing Hepatopancreas, Stomach, and Gonads. (B) Stomach in Preservation Solution.



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Laboratory Work

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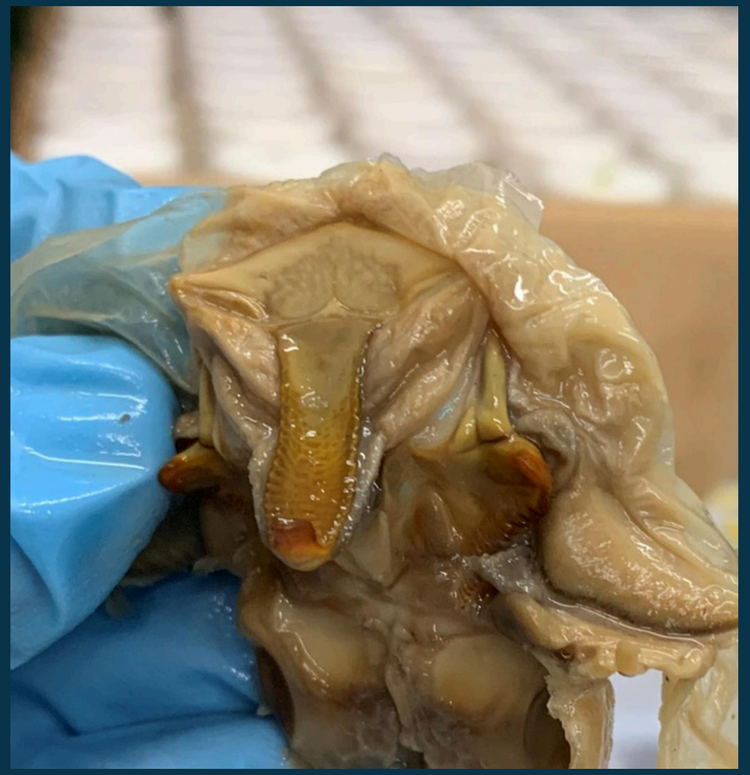
Stomach opened

Laboratory Work



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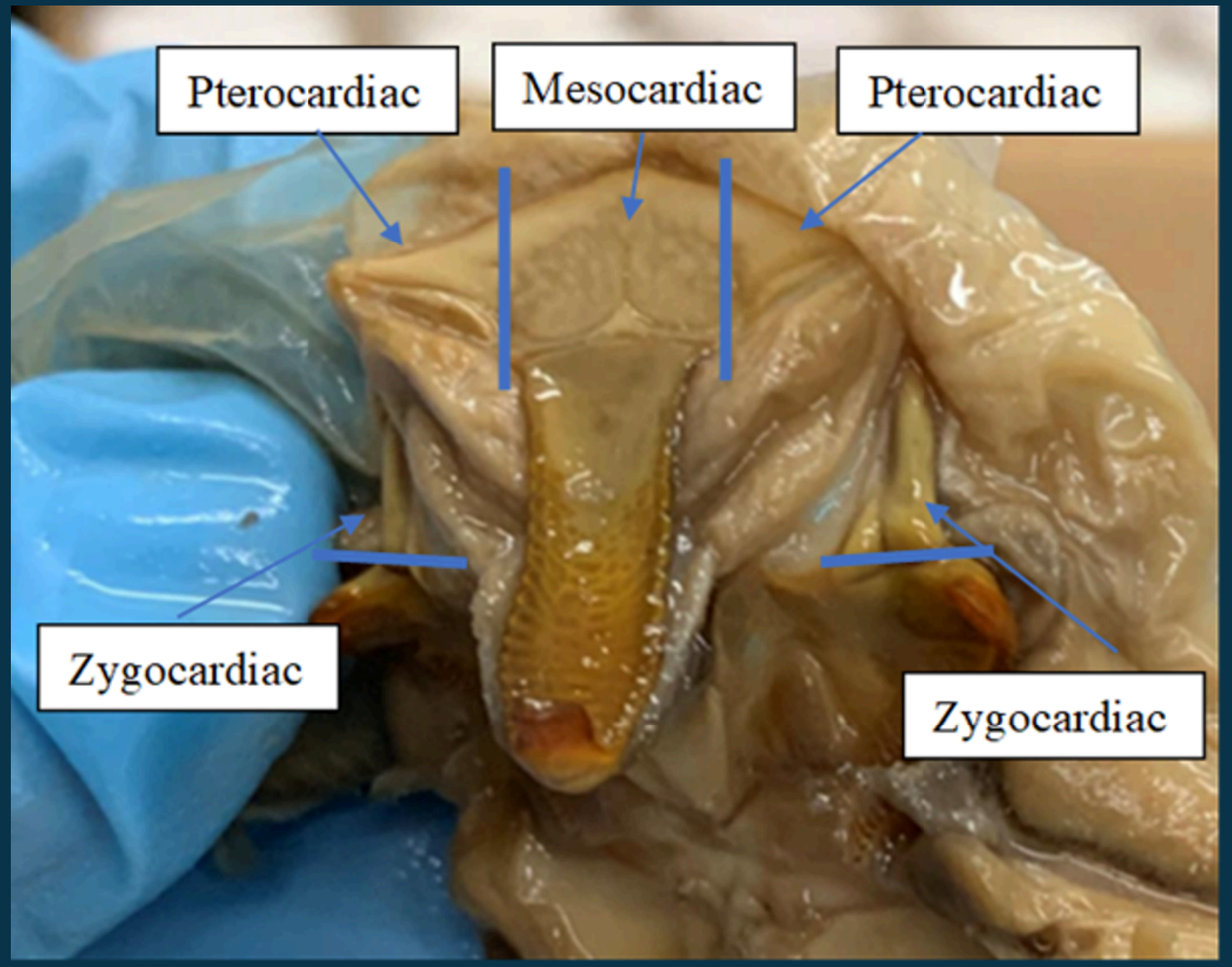
Ossicle exposed

Laboratory Work



Ossicle divided into parts

Laboratory Work

- First layer of epoxi ready to bake for 3 hours.

- Ossicles placed in the firts layer of epoxi to be covered with a another layer of epoxi.

- Baked for another 3 hours

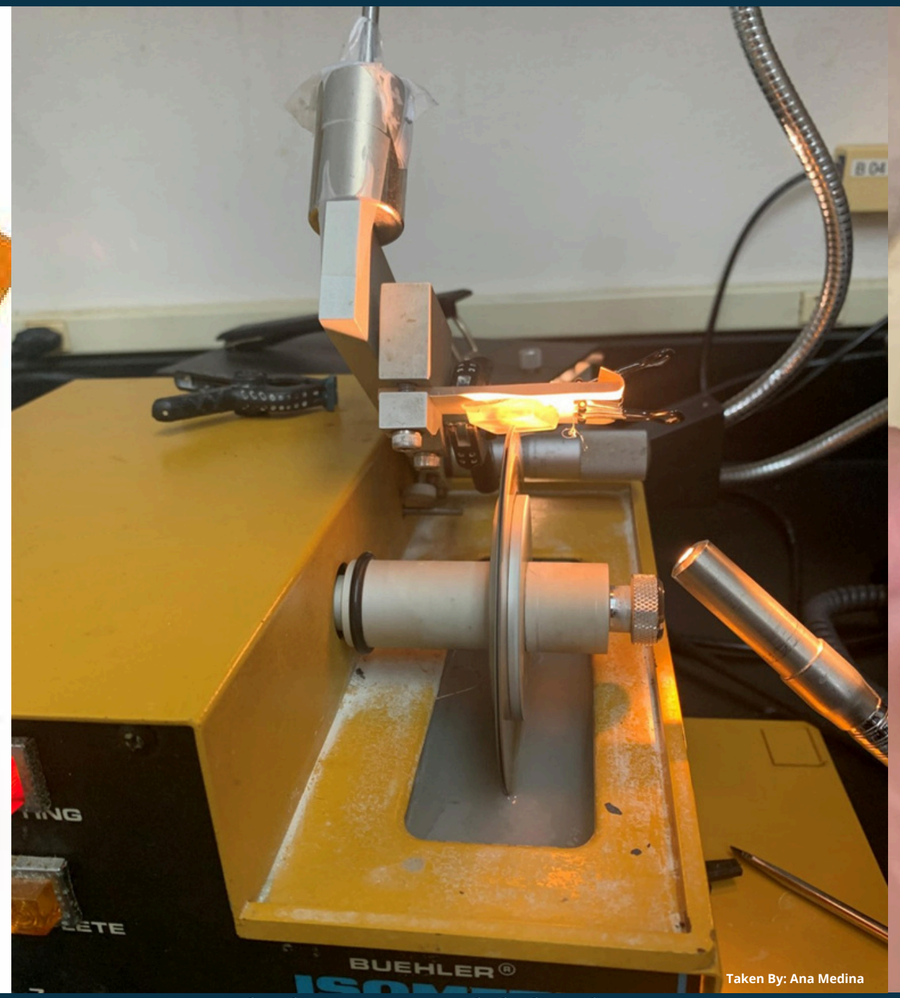
- Final result: a clear cube with the sample inside.

All Taken By: Ana Medina

Laboratory Work

Taken By: https://www.uline.com/BL_1580/Coin-Envelopes?pricode=WK837&utm_source=Bing&utm_medium=cpc&utm_term=coin%20envelope&utm_campaign=Envelopes%20%2F%20Mailers&AdKeyword=coin%20envelope&AdMatchtype=e&msclkid=30b565cc6b4661e42bc9f03ebab3548

- Coin envelope to store the samples



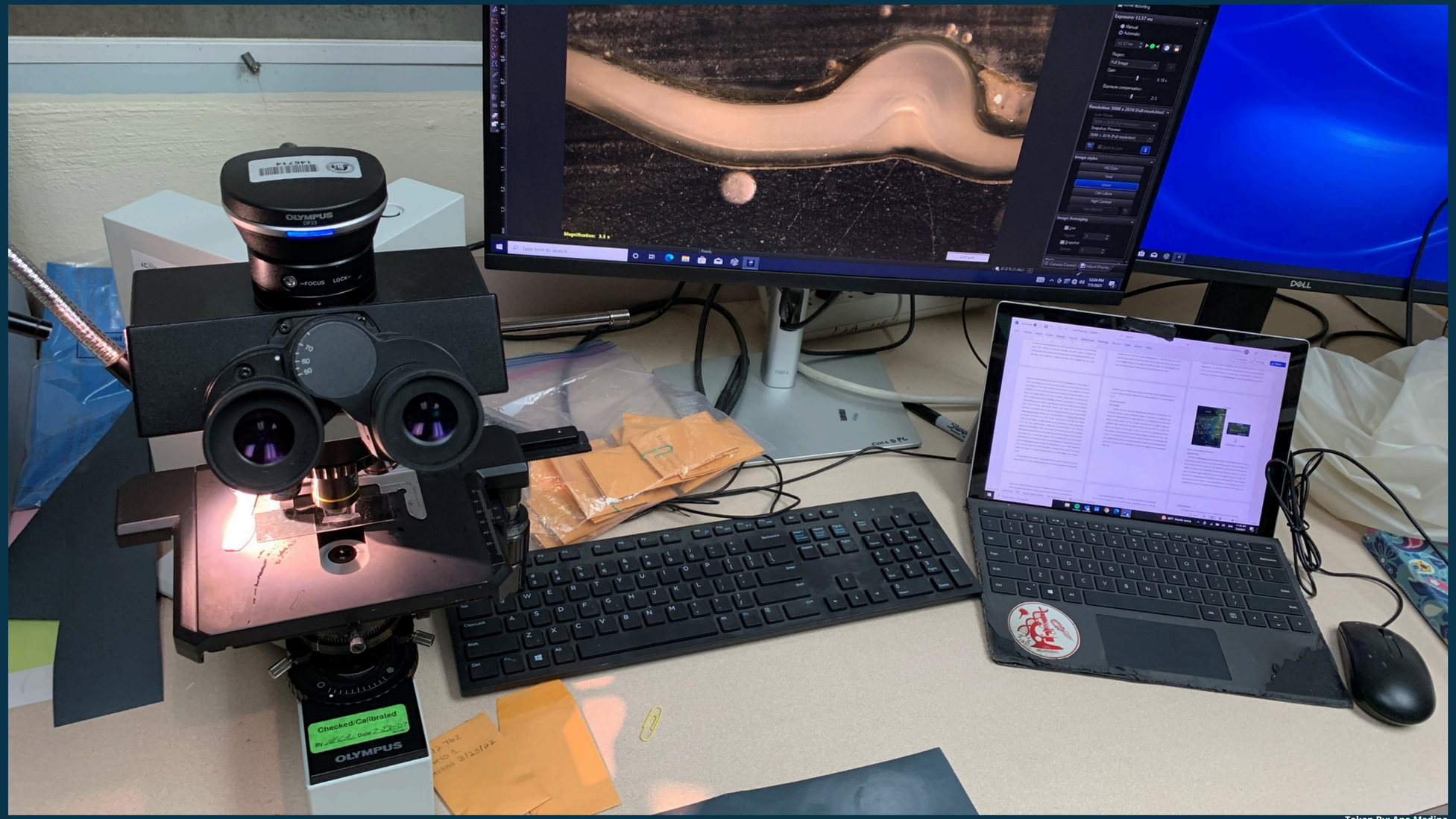
Taken By: Ana Medina

- Paired diamond blades to cut the sample.

Taken By: Ana Medina

- A fine cut was obtained

Taking Pictures of each sample.



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Band Reading

- All ossicles were read by a total of 4 readers to confirm the quantity of the bands and verify band counting precision between readers.

- Each reader made two estimates of the maximum and the minimum bands that the animal showed in the image. Then the average of those two estimates were calculated to determine the age.

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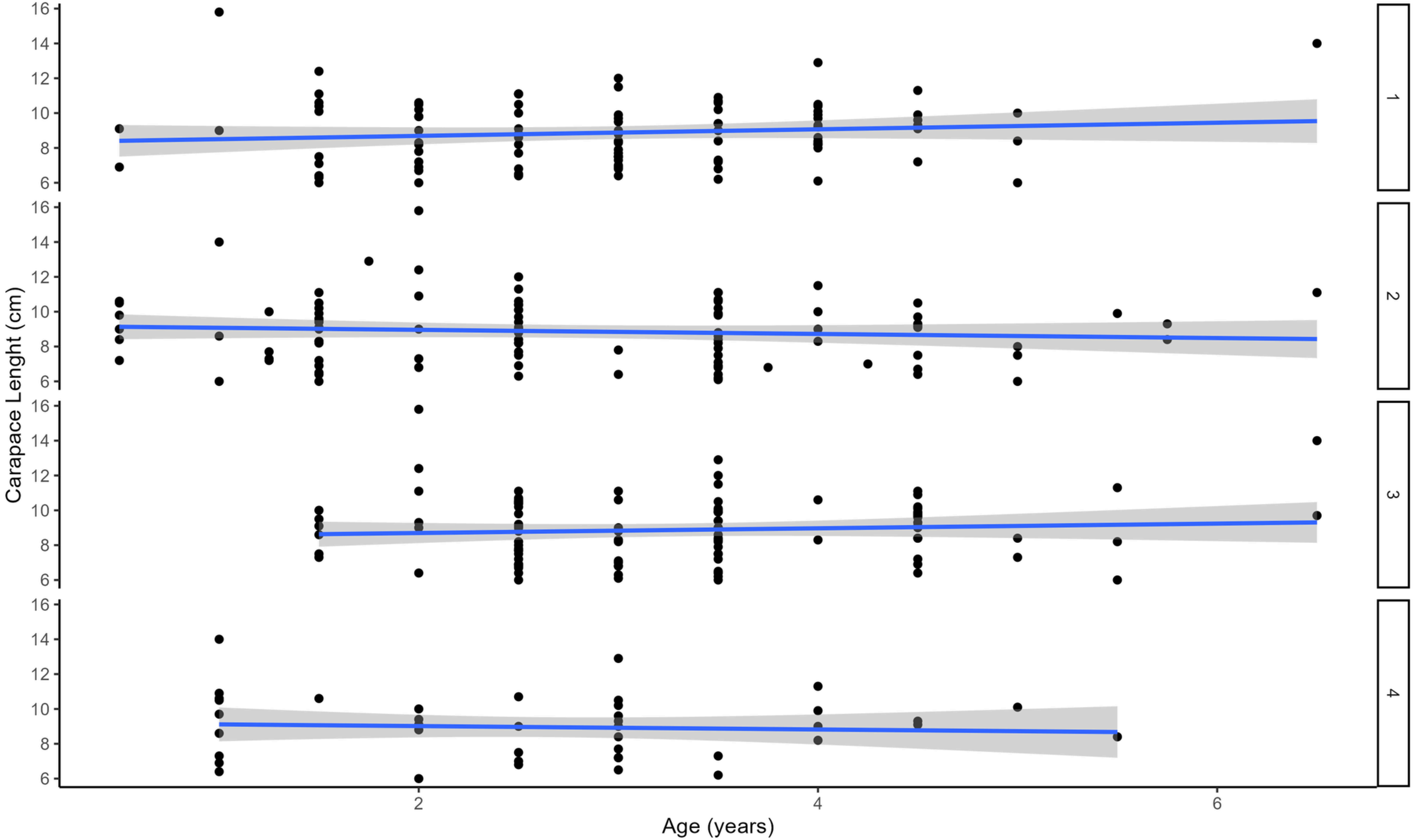
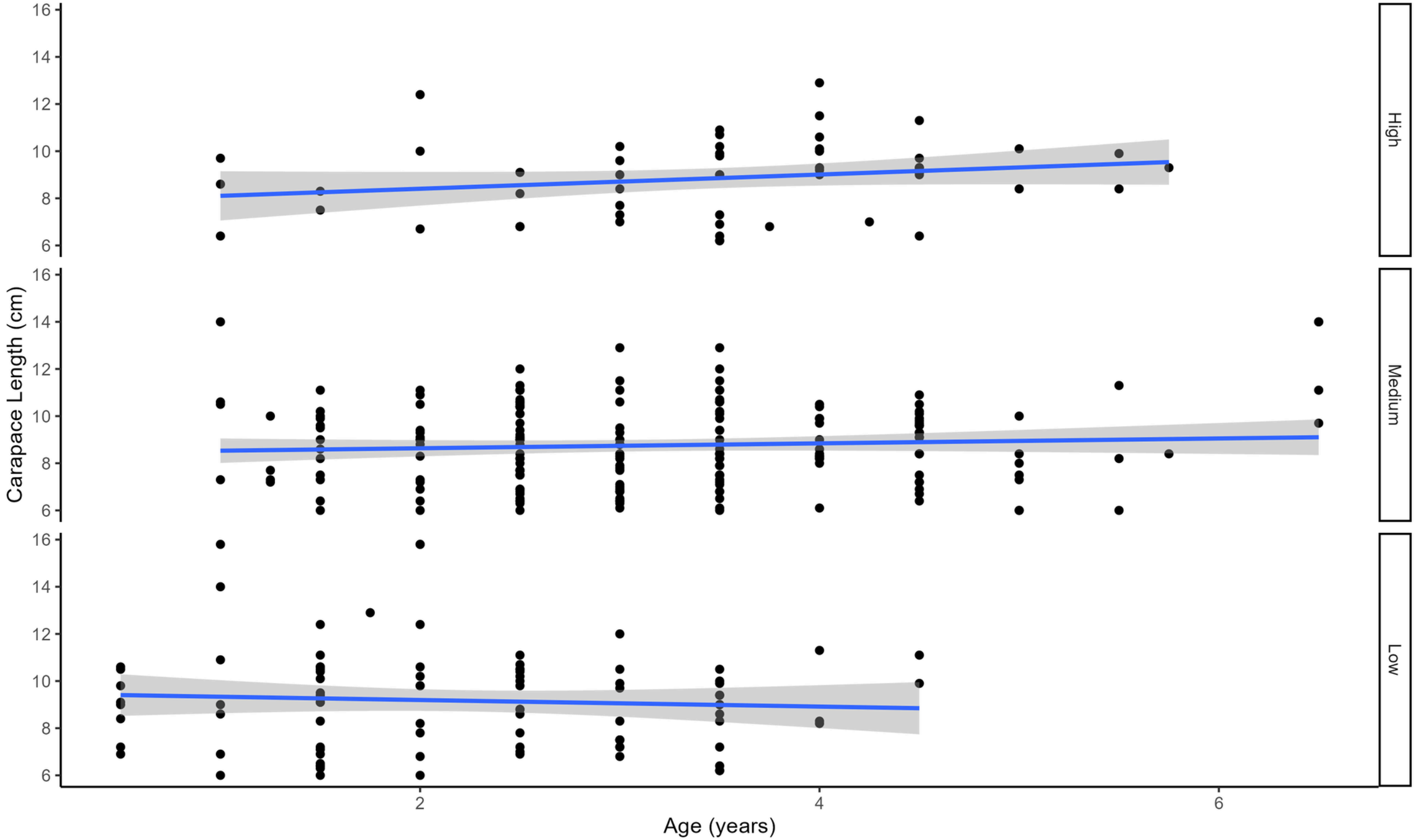
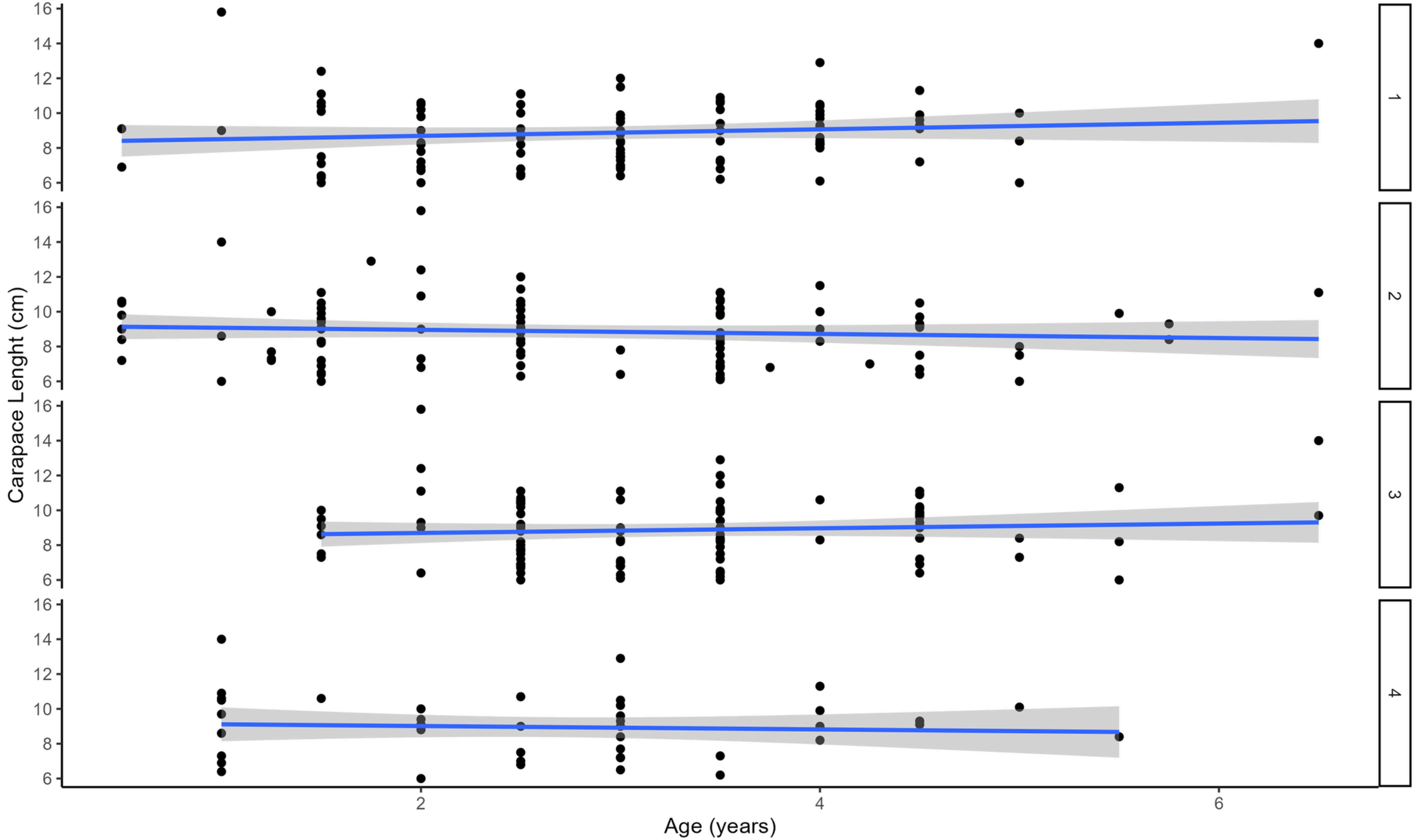

Carapace Lenght (cm)
16
14
12
10
8
6
2
4
6
Age (years)
1
2
3
4


Carapace Length (cm)
16
14
12
10
8
6
2
4
6
Age (years)
High
Medium
Low

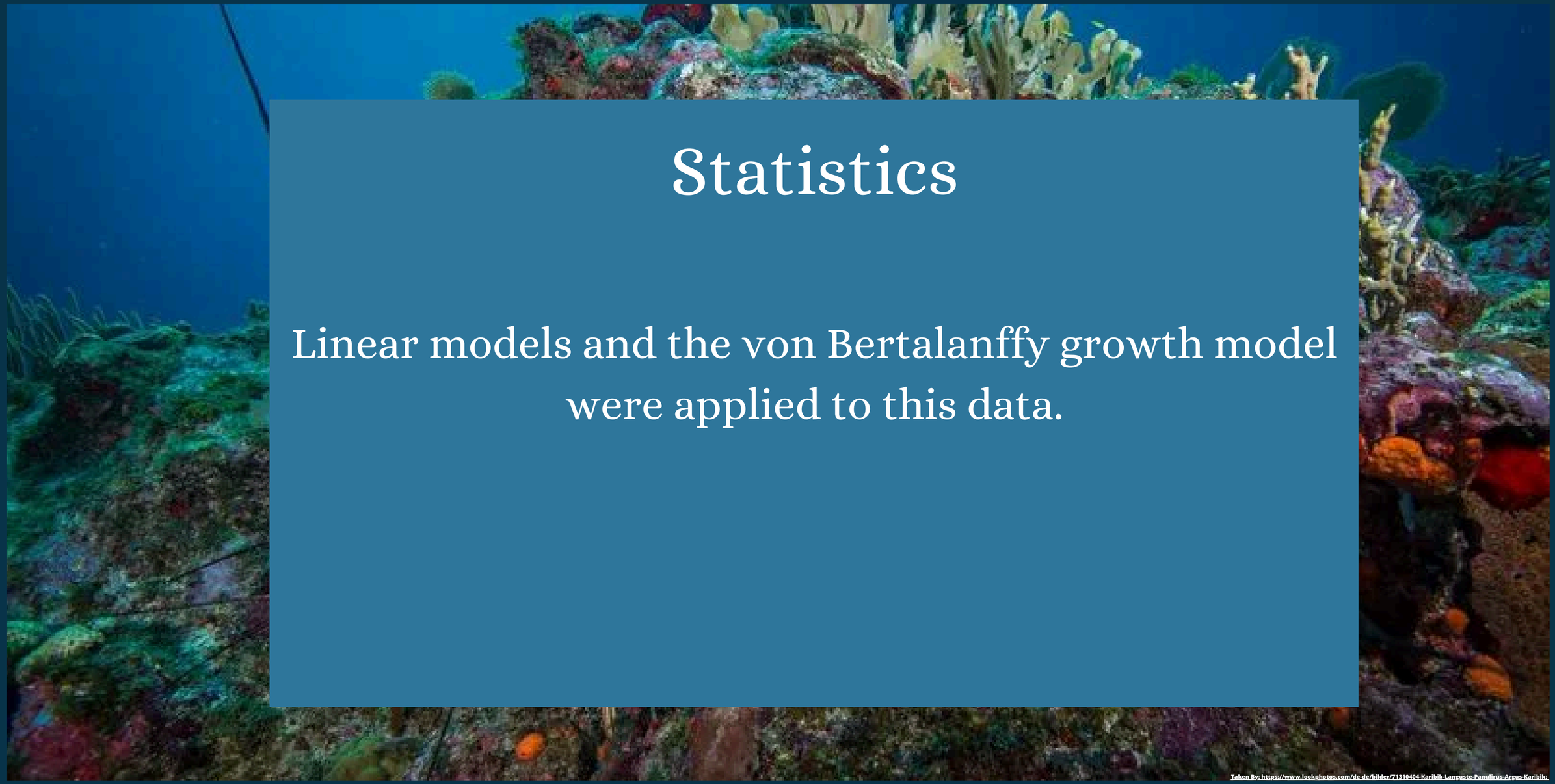

Carapace Lenght (cm)
16
14
12
10
8
6
2
4
6
Age (years)
1
2
3
4

- Based on all these preliminary analyses, the data used for final analysis was filtered by: i) reader: only reader 1 and 3 were considered; ii) quality of the images: only images classified as “Excellent” and “Good” were considered, and iii) confidence of the reading: only “High”, and “Medium” were used.

- Out of the 100, 35 ossicles were used for the final analyses.

Statistics

Linear models and the von Bertalanffy growth model were applied to this data.



Taken By: https://www.lookphotos.com/de-de/bilder/71310404-Karibik-Languste-Panulirus-Argus-Karibik:

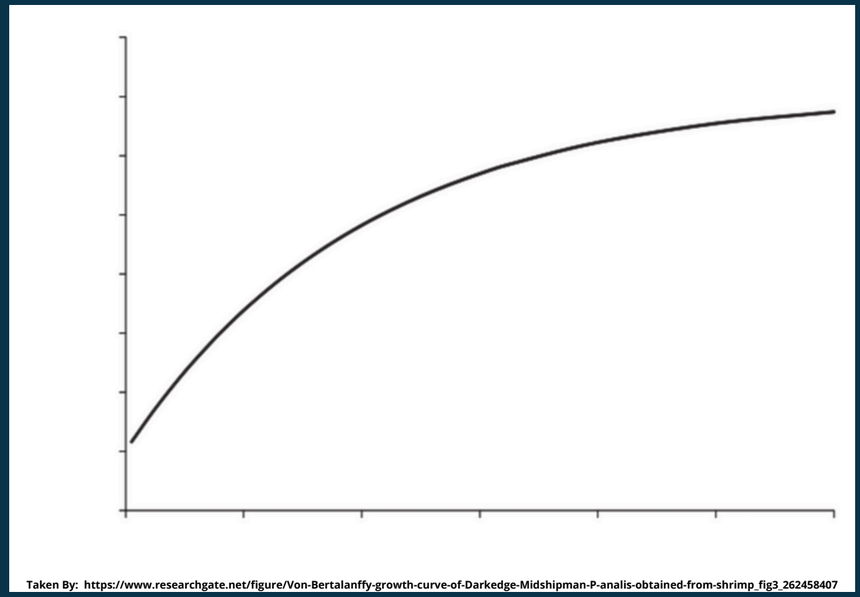
Ludwig von Bertalanffy


Taken By: https://encyclopedia.herdereditorial.com/wiki/Autor:Bertalanffy,_Ludwig_von

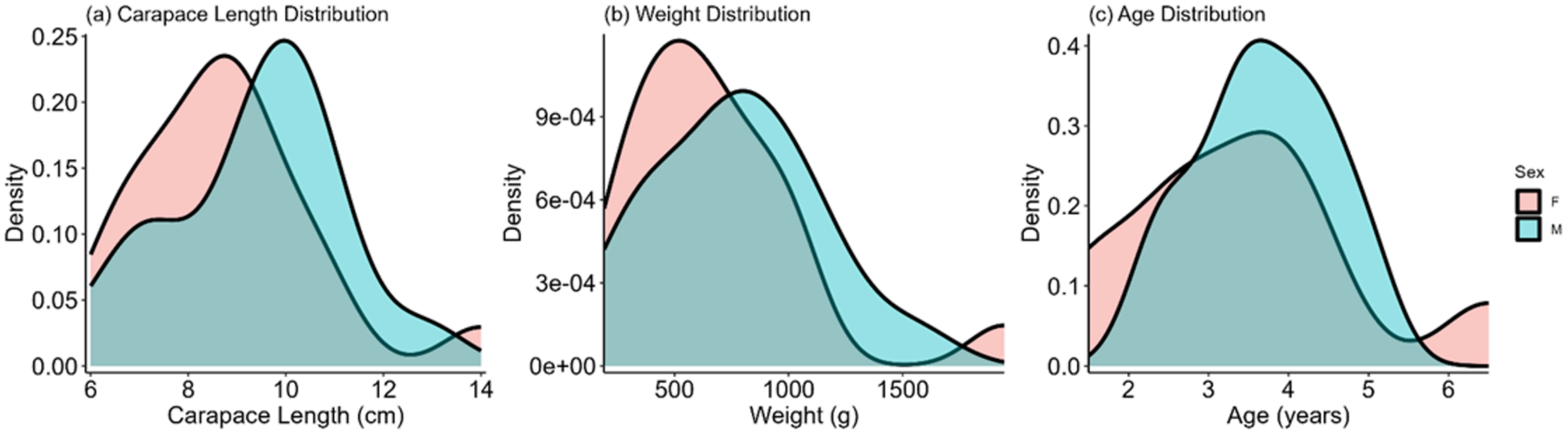
- The von Bertalanffy Growth Model (1938):

$$L_t = L_\infty \{1 - exp[-k(t - t_0)]\}$$

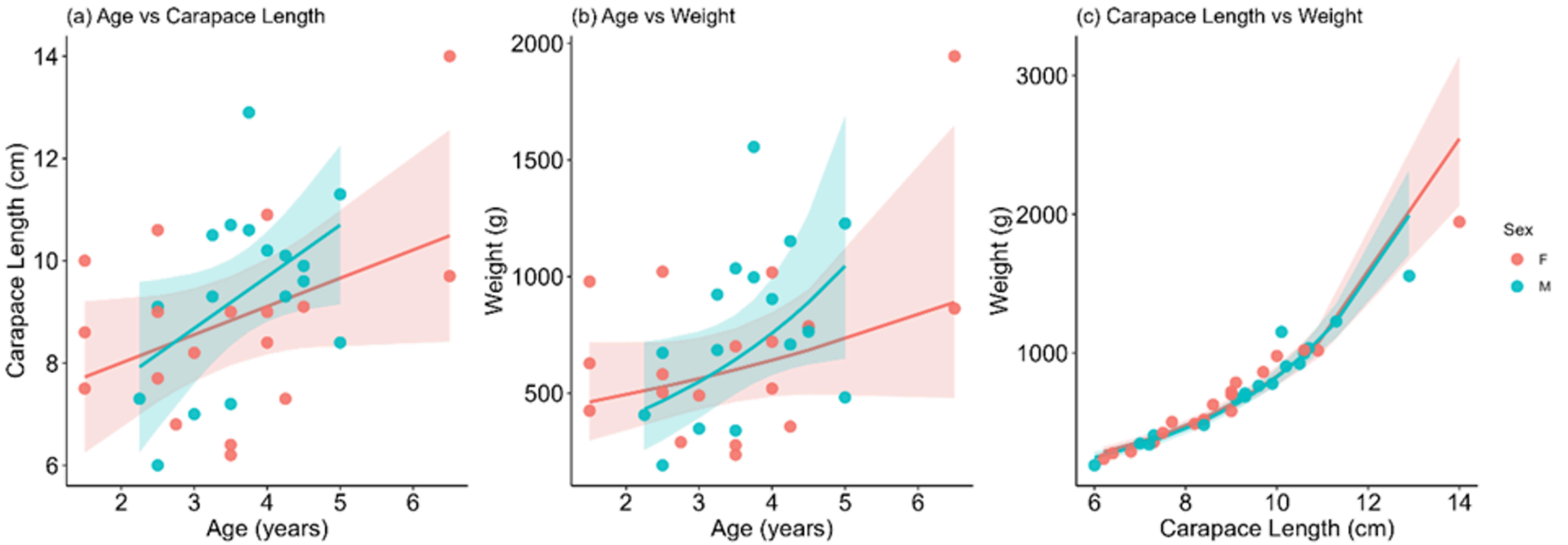
  - This model assumes that growth of living organism overtime is not linear but rather follows a sigmoidal curve.


Taken By: https://www.researchgate.net/figure/Von-Bertalanffy-growth-curve-of-Darkedge-Midshipman-P-analis-obtained-from-shrimp_fig3_262458407

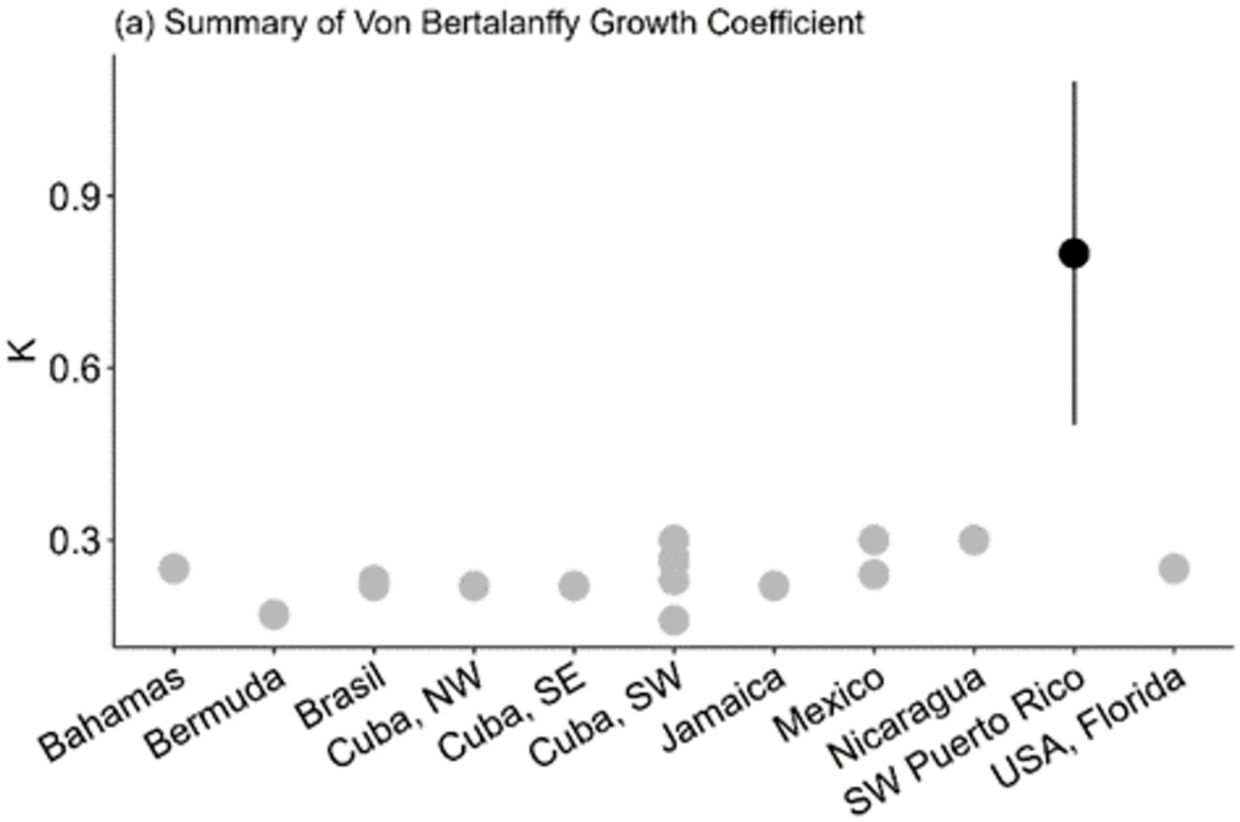
Results

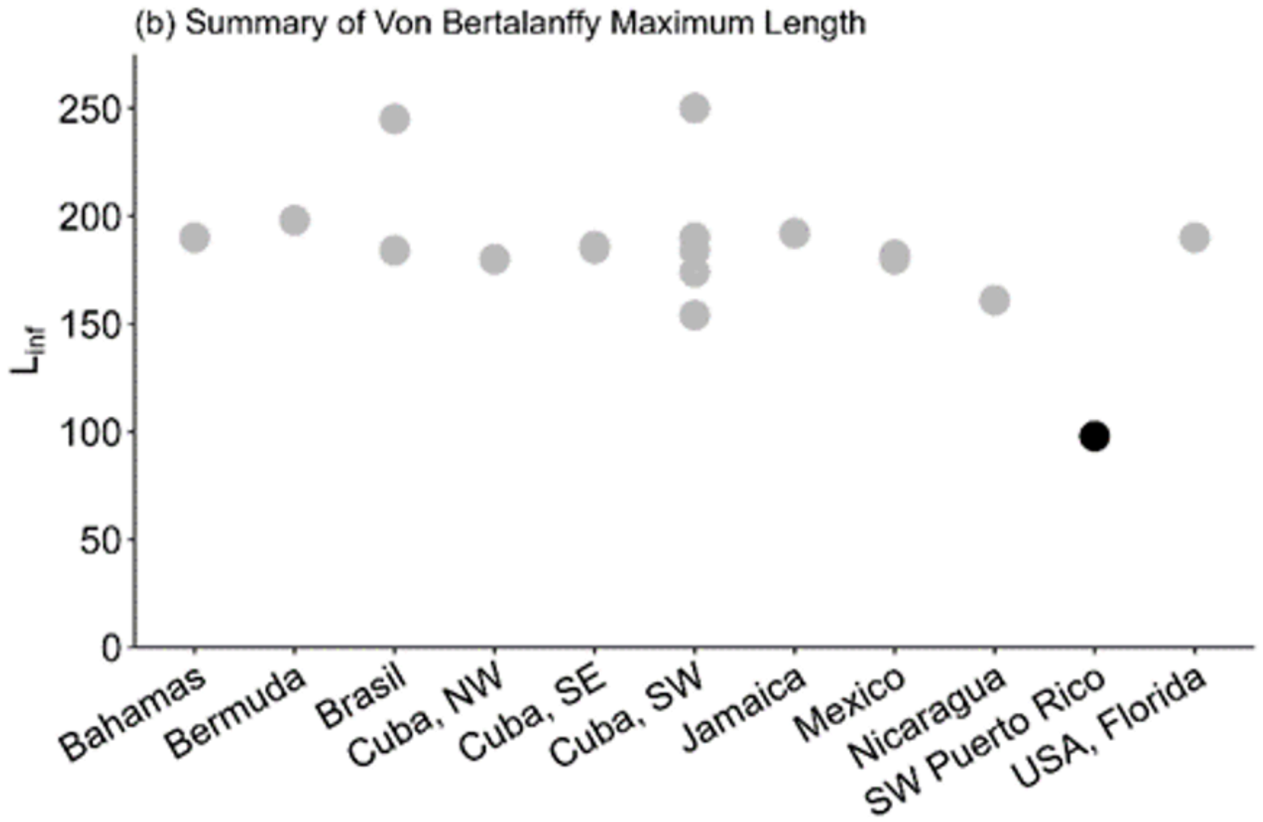


Plots showing the distribution of (a) carapace length, (b) weight, and (c) age with pink shading for female lobsters (F) and blue shading for male lobsters (M).



Relationships between (a) carapace length and age, (b) weight and age, and (c) carapace length and weight are reported for female lobsters (F, pink) and male lobsters (M, blue).





Comparison of von Bertalanffy (a) growth rate k values and (b) maximum length (Linf) for Caribbean Spiny Lobster P. argus populations across the Caribbean. The gray points are from Leon (2005) and labeled by their respective region and the black points are the mean estimates (±standard error) for all lobsters from this study.

Conclusion

- The age, carapace length, and weight of Caribbean Spiny Lobster has been determined for a total of 35 individuals from southwest Puerto Rico.

- The quality of the images significantly impacted the outcomes, which indicates that the technique can be further enhanced through continuous training of new readers and continuous practice of the more experienced.

Conclusion

- Even though some filtering of the images and readers used in this study was necessary due to readers experience and image quality, the age-length and age-weight relationship can be considered in further analysis of the status of the lobster population in the study area.

- Consequently, there was considerable variability in the age-length, age-weight, and von Bertalanffy relationships from this study.

Taken By: https://www.floridakeysrealty.com/exploring-the-delights-of-lobster-season-in-the-florida-keys/

Recomendations

- Ongoing ossicle age training.
- Collaborating with fishermen and restaurants who can donate the carapace (stomach) part to this type of studies instead of sacrificing wild lobsters .
- Create a research cooperative agreement if more samples are needed.

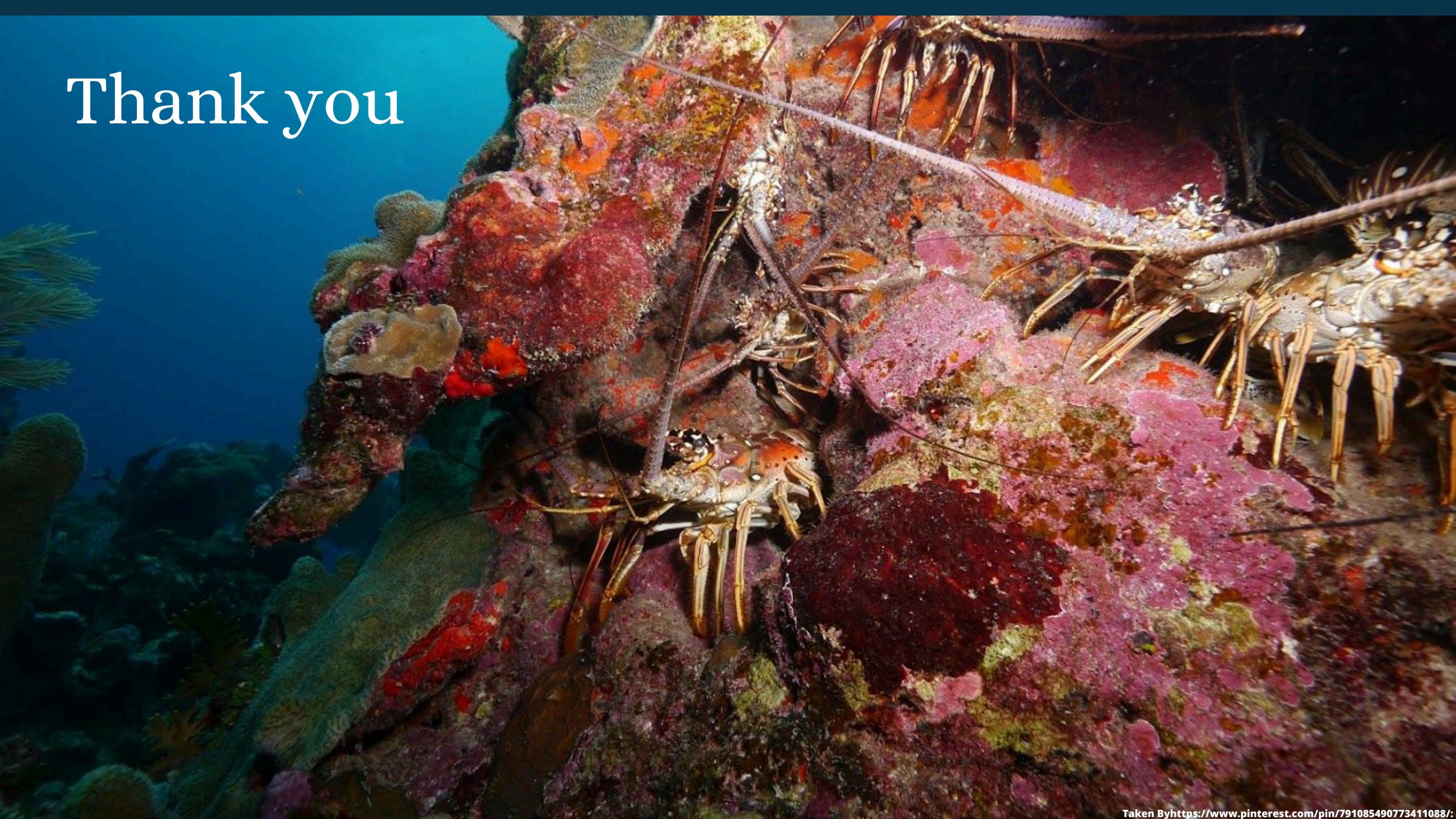
Taken By:https://keywestcustomcharter.com/key-west-lobstering-charters/

Recomendations

- Continue to promote to the community that it is illegal to fish female lobsters with eggs and that the minimum carapace length to catch lobster is 3.5 inches.

- Reinforce regulations for a sustainable Caribbean Spiny Lobster fishery in Puerto Rico.

Thank you



Taken Byhttps://www.pinterest.com/pin/791085490773411088/: