Comparing the Diving Behaviour of Four Shark Species in the Atlantic Ocean

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1. BACKGROUND

As apex predators, sharks play a crucial role in maintaining the health and balance of marine ecosystems. Understanding the behaviour and movement patterns of sharks is pivotal for advancing our comprehension of marine ecosystems and for developing effective conservation strategies[1]. However, given the complexity of the marine environment, researchers have identified simplified explanations of spatial dynamics as a significant problem in tagging studies, which often underestimate the influence of different factors and their interactions[2, 3, 4]. A framework centered on habitat selection theory may be more helpful in this case since it examines a comprehensive web of factors (e.g., life history traits and community dynamics) to justify behaviour and niche use rather than singular drivers. This research utilizes existing tagging data to examine the diving behaviours of four sharks in the Atlantic Ocean.

White Shark	Blue Shark	Porbeagle Shark	Shortfin Mako Shark
Carcharadon carcharias	***Prionace glauca***	***Lamna nasus***	***Isurus oxyrinchus***

2. AIMS

Research Questions

1. How do the depth and temperature profiles of these four sharks compare?
2. What are the implications of these findings under the lens of habitat selection theory?

Hypotheses

- White sharks will have shallower depth profiles than other sharks (competitive exclusion) due to prey abundance in the top of the water column.
- Blue sharks will exhibit warmer and narrower temperature profiles than other sharks since they are ectothermic.

3. METHODS

Data Pre-Processing

A) Remove data for mortalities or tag releases
B) Remove data influenced by tagging events
C) Sort and clean data

Visual Analysis

A) TAD and TAT distributions of each species
B) Interpolate water column temperatures
C) Plot depth time-series for each species

Statistical Analysis

A) Calculate measures of central tendency
B) Compare between species + test for significance

4. PRELIMINARY RESULTS

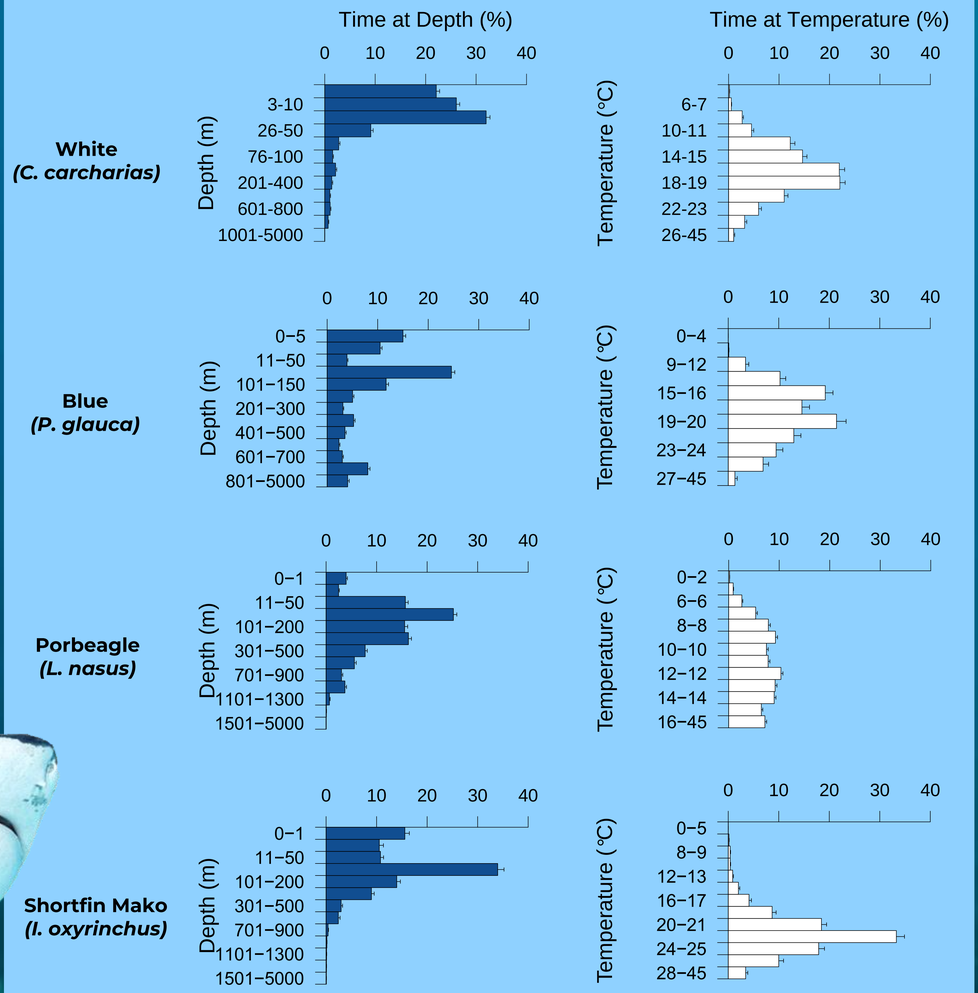

Figure 1. Time-at-depth (blue) and time-at-temperature (white) distributions, + 1 standard error, for white (*C. carcharias*, n_{depth}= 11, n_{temp}= 9), blue (*P. glauca* , n_{depth}= 15, n_{temp}= 8), porbeagle (*L. nasus* , n_{depth}= 19, n_{temp}= 26), and shortfin mako sharks (*I. oxyrinchus* , n_{depth}= 13, n_{temp}= 10). Depth (in meters) and temperature (in degrees Celsius) were recorded into pre-programmed bin breaks specific to each tagging event. Time is measured in average daily percentages spent in common bin breaks. Graphs were developed in R 4.3.1. using the Rchival Tag package 0.1.9[5].

5. DISCUSSION

Hypotheses

- Though white sharks exhibited the expected depth distribution, blue sharks do not occupy the warmest and narrowest temperature distribution suggesting external factors influence the behaviour of these sharks.

Depth

- Blue sharks exhibit higher variability in depths exploited, potentially using temperature gradients to their advantage as ectothermic.
- White sharks spend the majority of their time in the top 25 m, potentially due to prey abundance in shallower areas.

Temperature

- Different individuals and different species have been programmed with different bin breaks. In order to amalgamate data by species, common bin breaks are required, though they may not always match up or retain substantial information.

6. LIMITATIONS

Tag Pre-Programming

- Individual tags are pre-programmed to record into certain depth and temperature bins, potentially leading to lower resolutions which can hinder subsequent analyses and comparisons on similar scales. .

Lack of Data

- Identifying causal links between factors and behaviours require diverse datasets, of which are difficult to obtain and require heavy computation.

Controlling Factors

- Due to limited data, controlling for factors like time-of-year, life stage, and sex in the analysis is not feasible.

REFERENCES

[1]Kneebone et al. 2020. Fish Bull. 118 (4): 399-412.
[2]Bowlby et al. 2021. Can J Fish Aquat Sci. 79 (11): 1843-1859.
[3]Bowler & Benton. 2005. Biol Rev. 80: 205-225.
[4]Kubisch et al. 2013. Oikos. 123 (1): 5-22.
5 Bauer. 2023. CRAN Repository.

Images:
- https://pngimg.com/image/18831
- https://www.cleanpng.com/png-great-white-shark-downtown-aquarium-tiger-shark-pu-6656366/