Assessing environmental covariates and ontogenetic and sex-specific patterns in blue sharks (*Prionace glauca*) off the coast of Nova Scotia

Lena Chown

Supervised by: Dr. Heather Bowlby, DFO, Bedford Institute of Oceanography

Introduction

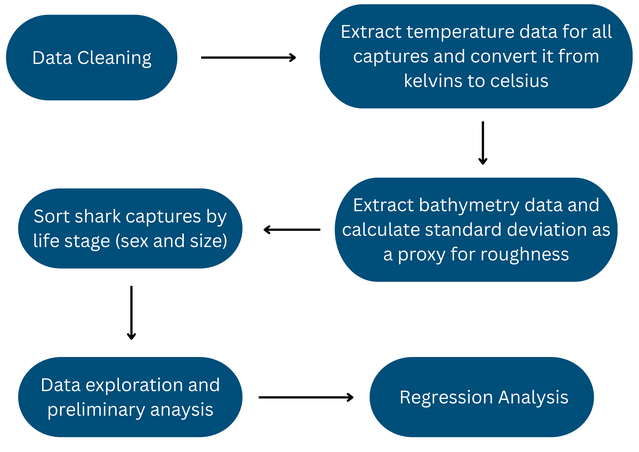
- Blue sharks are found throughout Atlantic Canada and the North Atlantic Ocean.[3]
- They're classified as near threatened by the IUCN.[24]
- Bycatch and targeted fishing (in waters outside Canada) are their biggest threats.
- Bathymetry and sea surface temperature (SST) have been found to be the two most informative predictors of blue shark presence in California.[13]
- Specific SST range preferences based on size and sex have been observed in the North Pacific Ocean.[17]
- Juvenile blue sharks are known to associate with topographic features like steep bathymetric gradients in the Azores.[27]
- Juvenile blue sharks are the life stage most frequently bycaught by pelagic fishing fleets, so if differences in habitat use are found in Atlantic Canada, then this knowledge can be used to limit bycatch mortality by excluding fishing activities in the habitats most commonly used by juveniles.[16]

Objectives

This study aims to determine what habitat characteristics are associated with blue shark captures off the coast of Nova Scotia and to explore ontogenetic and sex-specific patterns in habitat use.

- **H1:** Blue sharks will be more commonly captured in water temperatures between 10 - 20 degrees Celsius.
- **H2:** Juvenile female blue sharks will be more commonly captured in colder waters than mature males.
- **H3:** Blue sharks will show an association with edges and slopes in bathymetry.

Methods



Results

Table 1. P-values from Levene's and Kruskal-Wallis Tests performed on various environmental covariates to compare their variance and means respectively across blue shark life stages. Analysis performed in RStudio. "*" represents a significant p-value.

	SST	Bathymetry	Bathymetry Standard Deviation
Levene's Test	p = 6.44E-10*	p = 0.07	p = 0.24
Kruskal-Wallis Test	p = 1.92E-15*	p = 0.14	p = 0.43

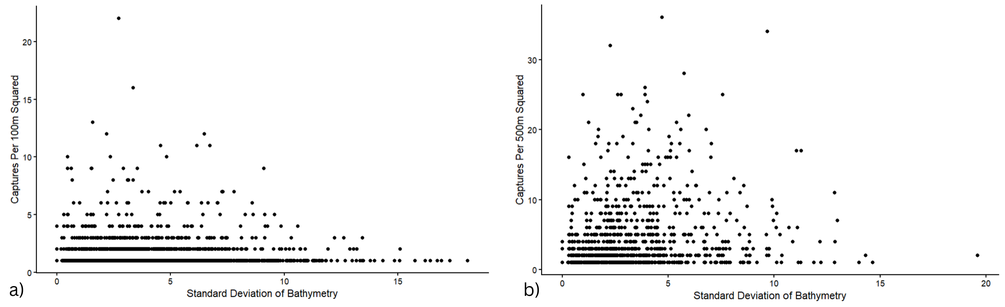


Figure 1. a) Standard deviation of bathymetry vs blue shark captures per 100m^2. b) Standard deviation of bathymetry vs blue shark captures per 500m^2. Analysis performed in RStudio. Either dataset a or b will be used to perform a negative binomial generalized linear model regression analysis to determine if blue sharks tend to be in habitats with rough bottom types. Bathymetry and/or a quadratic term may also be included in the regression to improve fit.

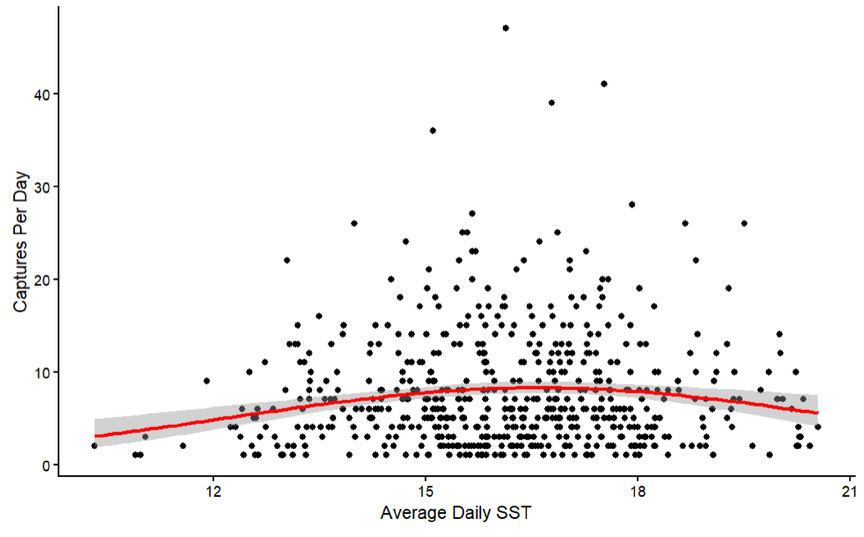


Figure 2. Negative binomial generalized linear regression model of average daily SST vs blue shark captures per day with a quadratic term included. Captures per day = -4.770612 + 0.829538(average daily SST) - 0.025005(average daily SST)^2. Analysis performed in RStudio.

Null Deviance = 624.32 on 593 df

Residual Deviance = 611.05 on 591 df

Discussion

- SST is the only environmental covariate assessed that varies across life stage.
- Juvenile males show a larger range of SST tolerance.
- Mature males are more commonly found in slightly warmer SSTs than other life stages.
- Blue sharks were captured in SSTs between 10 - 20°C as hypothesized.
- Juvenile female blue sharks had a lower median SST than mature males, suggesting they are more commonly captured in colder waters than mature males likely due to sexual segregation by juvenile females for avoiding aggressive courtship behaviors until they are approaching sexual maturity.
- The null and residual deviances for the SST regression model suggest that SST is an explanatory variable for daily blue shark captures, but there are also other unknown explanatory variable(s) at play which should be assessed in future research.
- The third hypothesis cannot be answered until the standard deviation of bathymetry regression has been finalized.

Limitations

- The small study area assessed in this study limits the applicability of its results to other areas. Further analysis should be performed on larger study areas to confirm results.
- The lack of zero or no capture values in the dataset limited the analyses possible for this study. Future studies could benefit from collecting data on the times when no sharks were captured so capture conditions could be compared to non-capture conditions.
- Both this study and other literature show that there are likely other explanatory variables, either environmental or otherwise, influencing blue shark captures. Future studies would benefit from further exploring these possible variables and their interactions with current suspected variables.

Conclusions

While this study provides a first glimpse at potential environmental covariates that impact blue shark captures and presence in Atlantic Canada, further research needs to be done to attain a concrete view of what variables need to be considered to best protect blue sharks in Atlantic Canada from bycatch mortality.

Acknowledgements & References

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For more information please contact:
Lena.Chown@dal.ca

QR Code: Contact information and references