Effects of Rod and Reel Fishing on the Physiological Stress Response of Southeastern Elasmobranchs and the Post Release Mortality of Atlantic Sharpnose Sharks, *Rhizoprionodon terraenovae*

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Introduction

- Bonnetheads (Fig. 1) and Atlantic sharpnose sharks (Fig. 2) are abundant species in the Charleston Harbor, SC, and are heavily recreationally fished[2]

Figure 1: Bonnethead shark, *Sphyrna tiburo*

Figure 2: Atlantic sharpnose shark, *Rhizoprionodon terraenovae*

- Studies have shown that recreational fishing can result in physiological stress[3] and mortality[4] for elasmobranchs
- Physiological stress can be analyzed using Nuclear Magnetic Resonance (NMR) spectroscopy to create metabolic profiles, and is a novel method in elasmobranch studies[1]
- Biologging methodology using tagging techniques allows organismal monitoring following a catch-and-release event, and the possibility of determining post-release mortality (PRM)

Significance

- Understanding the physiological stress response of sharks following recreational fishing can inform proper management of their populations
- Application of NMR spectroscopy to elasmobranch research provides a novel new method of stress physiology analysis

Objectives

1. Analyze the effects of recreational fishing on the physiological stress response of Atlantic sharpnose sharks and bonnetheads
2. Determine post-release mortality of Atlantic sharpnose sharks

Methods

Tagging of Atlantic sharpnose sharks

- Sharks caught via rod-and-reel from May to September
- Pop-up Satellite Archival Tags (PSATs) applied to 32 individuals
- Morphometric measurements taken (Fig. 3) and release condition assessed

Figure 3: Measurement of an Atlantic sharpnose shark.

Blood Sample Collection

- Blood drawn via caudal venipuncture immediately following shark landing and prior to release (Fig. 4)
- Blood lactate, pH, and pCO_2, analyzed with i-STAT portable blood analyzer
- Blood separated into plasma and red blood cells for downstream metabolite analyses

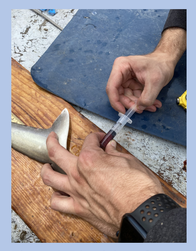

Figure 4: Blood draw from an Atlantic sharpnose shark.

Metabolomics

- Blood plasma is analyzed through several NMR spectroscopy experiments to identify metabolite profiles and quantify concentrations (Fig. 6)

Data Analysis

- A principal component analysis (PCA) will be used to determine the interaction between encounter-based variables, stress response, and survival status (Figs. 7 and 8)
- Following determination of explanatory variables, a General Linearized Model (GLM) will be used to predict PRM occurrence

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Preliminary Results & Discussion

Lactate Increases with Fight Time

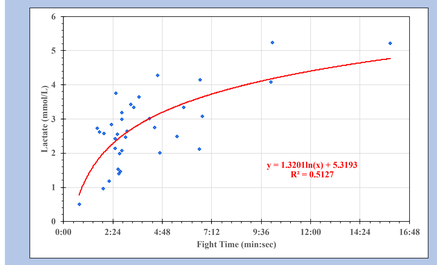

Figure 5: Plasma lactate concentrations relative to fight times for Atlantic sharpnose sharks. Analyzed using logarithmic regression (p = 1.326E-06; N = 35).

- Lactate increases rapidly during initial fight period, but plateaus over time
- Data indicate an increased physiological stress response likely due to elevated metabolic activity and oxygen demand

Metabolite Spectrum Analyses

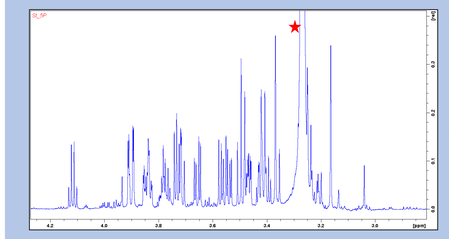

Figure 6: An enhanced view of a plasma metabolite spectrum of a bonnethead obtained from ^{1}H NOESY-presat through NMR spectroscopy.

- A peak occurs at 3.25 ppm, which indicates a high concentration of TMAO
- TMAO is an important osmolyte used to counteract high basal concentrations of urea in elasmobranchs

Survival Determination

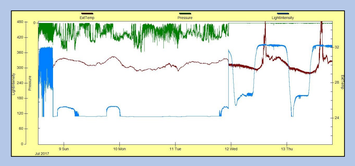

Figure 7: **Mortality due to predation.** Representative visualization of PSAT data collected from a blacktip shark deemed to have been preyed upon.

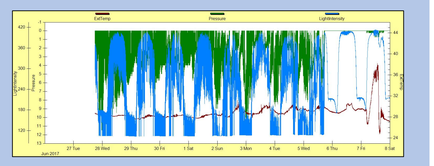

Figure 8: **Survival following catch-and-release**. Representative visualization of PSAT data collected from a blacktip shark deemed to have survived the capture event.

References

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