

Investigating The Potential Non-lethal Physiological Impacts Of The 'Spinning Fish' Condition For Coastal Sharks In the Lower Florida Keys

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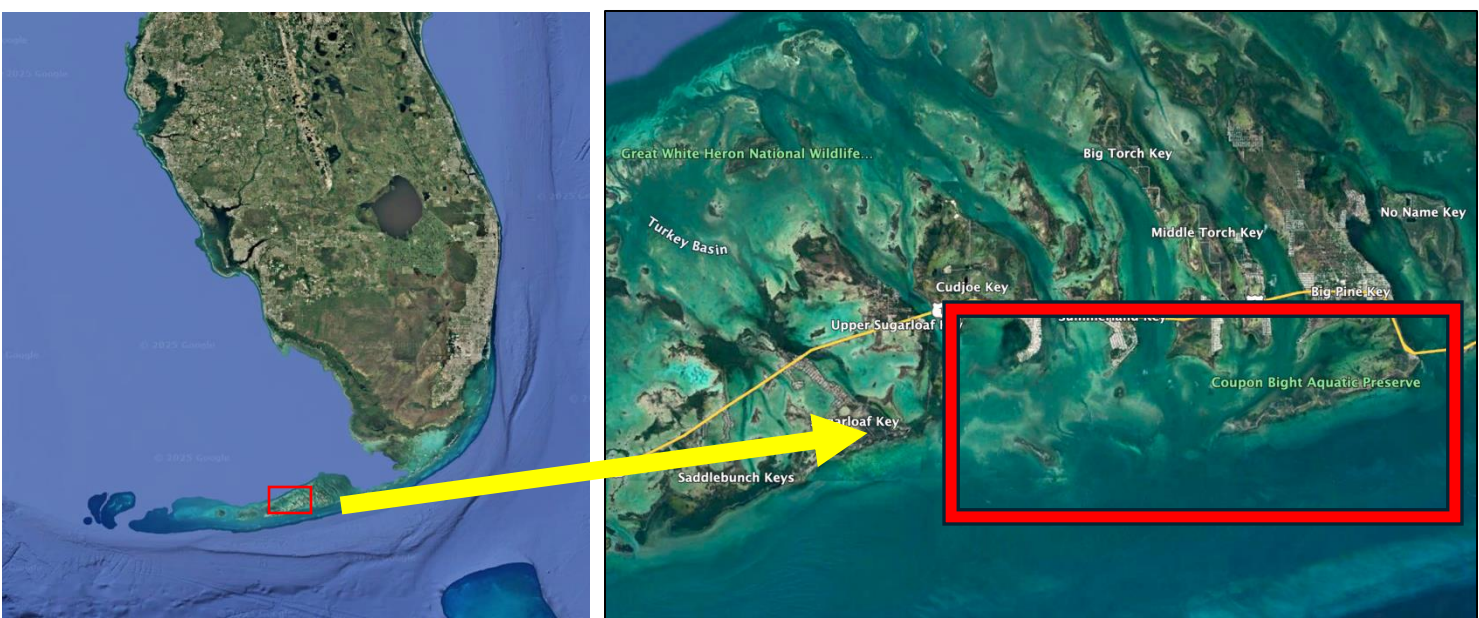


INTRO

In late 2023 and early 2024, fishers and researchers began reporting an ‘anomalous spinning fish’ condition throughout the Lower Florida Keys. This condition has been documented to affect a number of teleost and elasmobranch species, and initial findings suggest that neurotoxins produced by the algae Gambierdiscus could be linked to the spinning fish behavior. In addition to the spinning behavior, our team noted lower catch rates of coastal sharks and observed sharks with physiological impairments such as “lock-jaw”.

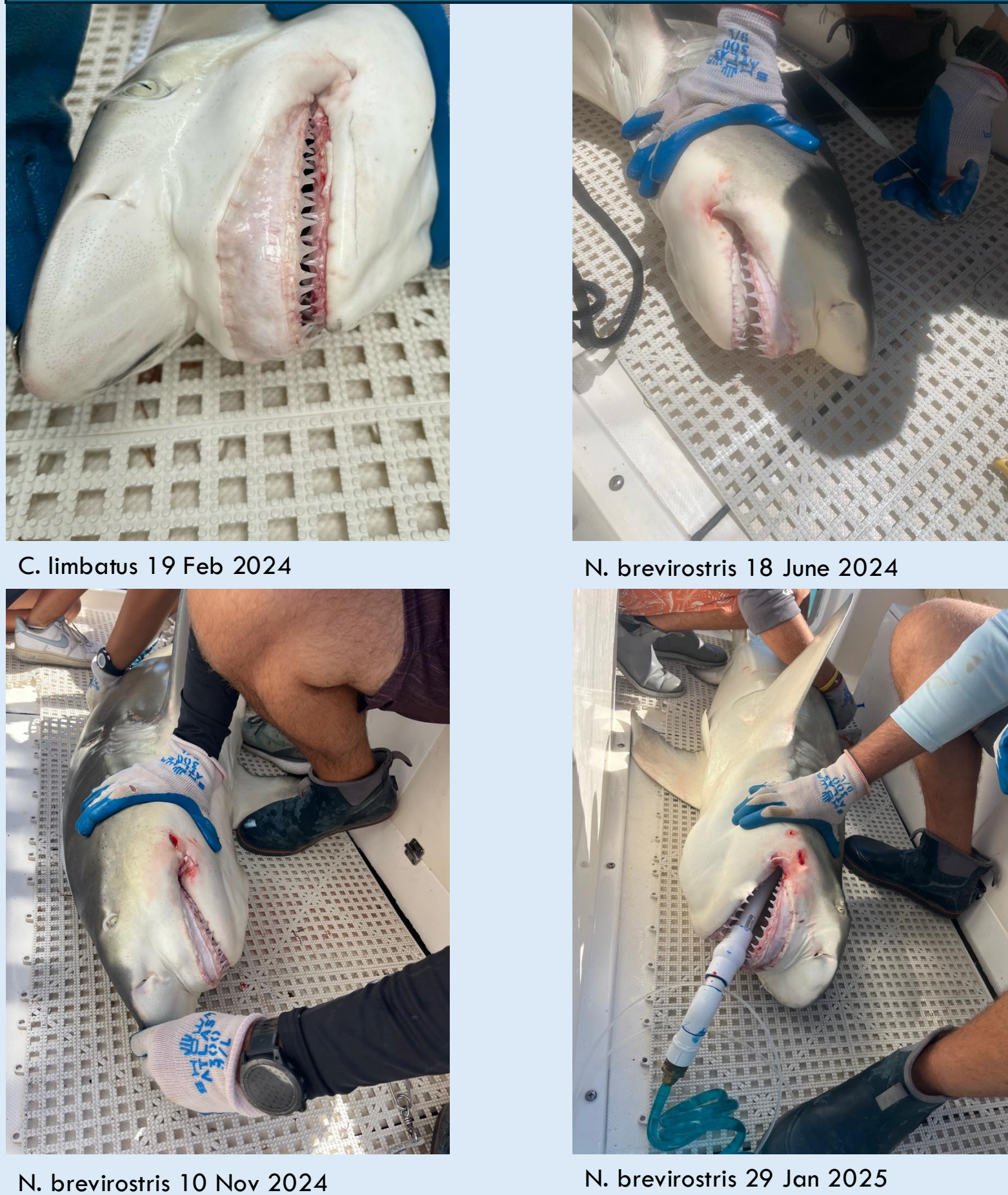
Considerable research has noted high mortalities of small tooth sawfish in the area, however the sublethal physiological impacts for coastal sharks is uncertain. Blood panels of lemon sharks (Negaprion brevirostris), blacktip sharks (Carcharhinus limbatus), and nurse sharks (Ginglymostoma cirratum) were analyzed for a variety of metabolites and biomarkers to assess physiological condition. Samples were collected prior to, during, and following the peak of the reported ‘spinning event’ allowing us to conduct a preliminary comparison of these markers across time. These findings may help to understand the implications of the spinning behavior and the species most effected from the occurrence.

STUDY SITE



The Spinning Fish Event occurred between Key West and lower Key Largo on both sides of the Keys, ocean and bay side. However, the deemed “hotspot” occurred between Cudjoe Key, Big Pine Key and Sugarloaf. This was where most of our efforts for biological sampling took place.

SHARKS WITH LOCK-JAW



METHODS

Capture and Sampling:

Sharks were captures on fisheries independent longline surveys with a soak time of one hour. Captured sharks were quickly worked up in a time of 2-6 minutes. Precaudal length, fork length, and total length were measured, identification tags deployed, and biological samples collected; including fin clip, muscle samples and blood.

Blood collection and processing:

Whole blood (approximately 5-10ml) was collected from the ventral tail artery of each shark using a 12-18G needle syringe. Half of the whole blood collected was immediately put into a heparinized vial and the remaining blood was put into a non-hep 2ml vial. All vials were immediately stored on ice in a cooler while in the field. Whole blood was separated into red blood cells and plasma using a centrifuge within 12 hours of collection and stored at -10c until analysis.

Sample analysis:

0.5ml of plasma of each shark was used for biochemical analysis at the University of Miami. Samples were analyzed for glucose, total protein, aspartate transferase, alanine transaminase, creatine kinase, gamma-glutamyl transferase, uric acid, blood urea nitrogen, carbon dioxide, phosphate, calcium, phosphate/calcium, magnesium chloride, potassium, sodium, osmolality, cholesterol, triglycerides, glutamate dehydrogenase, albumin and globulins.

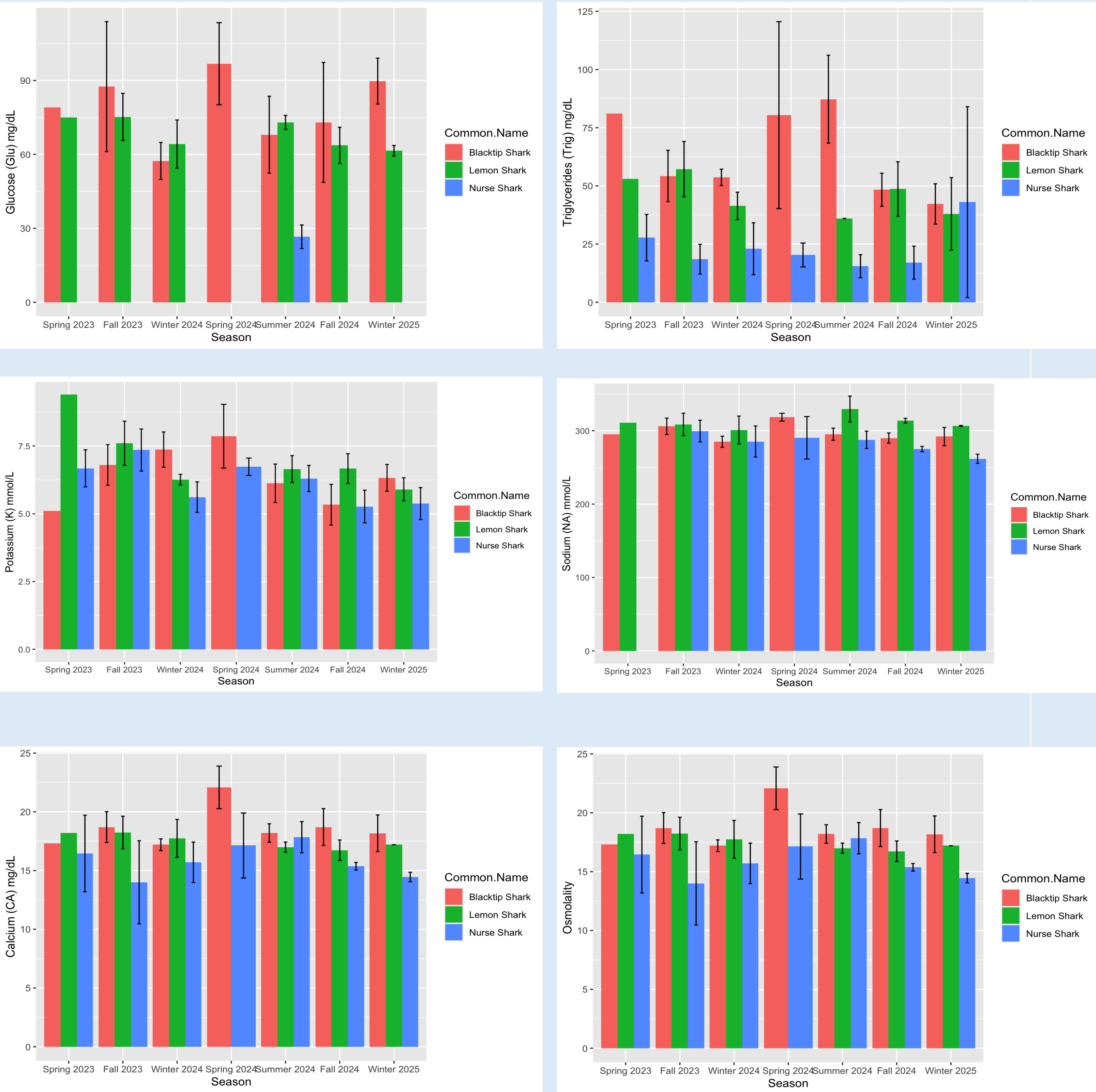
ANALYSIS

Based on previous studies (Skomal & Mandelman 2011, Hoffmayer et al 2011, Brooks et al 2011) we focused the preliminary biochemical analysis on levels of potassium, calcium, glucose, osmolality, sodium, and triglycerides to test for signs of physiological stress across time. The mean values of each species was compared across seasons to investigate if there were trends before, during and after the spinning event. Seasons were classified as the following: *Winter* (December, January, February), *Spring* (March, April, May), *Summer* (June, July, August), and *Fall* (September, October, November).

SPECIES SAMPLED

Season	Shark Species	# Individuals Sampled
Spring 2023	G. cirratum	5
	N. brevirostris	1
	C. limbatus	1
Fall 2023	G. cirratum	3
	N. brevirostris	5
	C. limbatus	4
Winter 2024	G. cirratum	11
	N. brevirostris	5
	C. limbatus	3
Spring 2024	G. cirratum	3
	N. brevirostris	0
	C. limbatus	5
Summer 2024	G. cirratum	5
	N. brevirostris	2
	C. limbatus	4
Fall 2024	G. cirratum	3
	N. brevirostris	3
	C. limbatus	3
Winter 2025	G. cirratum	4
	N. brevirostris	2
	C. limbatus	4

FIGURES



RESULTS & DISCUSSION

RESULTS

Results found that for blacktip sharks, both potassium and osmolality levels were elevated during the spring of 2024. During this time, our team also observed blacktip sharks with visible signs of physiological stress at the time of capture. This included some sharks with musculature cramping of the jaw and comparatively decreased fight energy while on the line.

DISCUSSION

Elevated levels of potassium can be an indication of physiological stress. Changes in osmolality can also be indicative of severe stress characteristic of altered liver condition, including starvation. These indications of stress correlate with the peak of the spinning fish conditions in the area during the spring of 2024. As collection of our samples were derived from sharks caught on baited lines, sharks in the most imperiled physiological state may not have been feeding or likely to take the baited hooks and therefore, may not be represented in the data. In addition, it is possible that the larger sharks in the sample set are not resident to the area or could have transited from other areas. It is still unclear where fish and elasmobranchs are being exposed to the neurotoxins, and highly mobile species may not be as susceptible to this. Additional analysis across broader size class, temporal, and spatial scales will be important.

FUTURE AND NEXT STEPS

In the future we are hoping to conduct a more in-depth analysis to better understand if there are any nonlethal phycological impacts on sharks due to the spinning fish event.

- Testing for other biomarkers such as pH, lactate and hematocrit, that are known to be indicators of stress in sharks.
- Investigate seasonal fluctuations in environmental parameters and if this influences physiological and behavioral changes in sharks
- Potentially test smaller size lemon sharks from the deemed “hotspot” as they are more residential and could potentially be better indicators of changes in environment.
- Test more individuals with lock jaw and see if they fall within normal or abnormal ranges.

References
“The physiological response to anthropogenic stressors in marine elasmobranch fishes: A review with a focus on the secondary response” Gregory B. Skomal, John W. Mandelman
“Seasonal modulation in the secondary stress response of a carcharhinid shark, Rhizoprionodon terraenovae” Eric R. Hoffmayer, Jill M. Hendon, Glenn R. Parsons
“The physiological response of the Caribbean reef shark (Carcharhinus perezi) to longline capture” Edward J. Brooks et al

