

Using passive acoustic data to better understand the reproductive behavior and abundance patterns of Nassau grouper (*Epinephelus striatus*) over the course of their ongoing population recovery at the Grammanik Bank, USVI.

Uso de datos acústicos pasivos para comprender mejor el comportamiento reproductivo y los patrones de abundancia del mero de Nassau (*Epinephelus striatus*) durante el transcurso de su recuperación poblacional en curso en Gramanik Bank, Islas Vírgenes Estadounidenses.

Utilisation de données acoustiques passives pour mieux comprendre le comportement reproducteur et les schémas d'abondance du mérrou de Nassau (*Epinephelus striatus*) au cours du rétablissement actuel de sa population au Grammanik Bank, USVI.

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EXTENDED ABSTRACT

Passive acoustic monitoring (PAM) involves the recording, observing, and analyzing of sound production of soniferous species for the purposes of ecological monitoring. PAM is especially useful for monitoring soniferous species that form fish spawning aggregations (FSAs) which often form far offshore, in deep water and at sunset, and thus can be difficult to observe visually due to environmental factors such as weather and sea conditions, water depth and ambient lighting. Nassau grouper, *Epinephelus striatus*, are one such soniferous species and are known to make three distinctive call types including a territorial call made outside spawning season, a courtship-specific call, and an agonistic call type made between two males during spawning aggregations (Schärer et al., 2012; Rowell et al., 2018; Wilson et al., 2020). Additionally, they are considered one of the most well-documented case studies of a drastic decline in population due to overfishing at FSAs. Following their protection in US federal waters, Nassau grouper have been documented undergoing local population recovery at the Grammanik Bank FSA, which is a 1.5 km² seasonal fishery closed area located 10 km south of St Thomas, US Virgin Islands (Kadison et al. 2010).

Using passive acoustic and acoustic telemetry Rowell et al. (2015) showed that the boundaries and timing of the Grammanik Bank seasonal closed area are insufficient to fully protect Nassau grouper during the spawning season, especially with the recent increase in spawning population size. The purpose of our study was to determine the relationship between courtship-specific calls and the rapid increase in the Nassau grouper spawning population. For the past 11 years (2012-2023), passive acoustic data has been collected at fixed points along the Grammanik Bank using DSG and Cyclops audio recorders (Loggerhead Instruments). During these years, Nassau grouper annual abundance during the spawning season was recorded either visually by technical scuba divers using hand-held video cameras, with remote GoPro cameras placed on the sea floor or with Cyclops audio/video recorders on tripods. In this study, we analyzed the call patterns of Nassau grouper to see if they change alongside the changes in the annual maximum number of aggregating Nassau grouper visually recorded at the FSA over time. Linear modeling identified a positive relationship between the number of Nassau grouper at the FSA and the number of Nassau grouper courtship-associated sounds (CAS) calls at the FSA ($p = 0.02$). This work demonstrates that PAM is a useful tool in the ongoing monitoring and management of the Grammanik Bank population of Nassau grouper, and has the potential to be used to estimate population sizes of other recovering FSA sites where no monitoring is happening or no baseline data has been collected.

KEYWORDS: fish spawning aggregations, small-scale fisheries, regional management, grouper, snapper

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