

# Spatio-temporal Dynamics of a Nassau Grouper Spawning Aggregation in Puerto Rico

## Dinámica en Tiempo y Espacio de una Agregación de Reproducción del Mero Cherna en Puerto Rico

### Dynamics Spatio-temporelle de a Nassau Merou Frai Regroupement en Puerto Rico

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#### EXTENDED ABSTRACT

The Nassau Grouper, *Epinephelus striatus*, once the most commercially important species throughout its range, has undergone drastic population declines and a recent listing under the US Endangered Species Act following decades of overexploitation focused primarily at spawning aggregations. Quantifying its spatio-temporal dynamics in relation to spawning aggregations is critical for effective management and conservation, and provides managers with pertinent information regarding site fidelity, residency, home range and movements in relation to MPA boundaries.

In Puerto Rico, Nassau Grouper have been considered commercially extinct since the early 1980s. The only known Nassau Grouper spawning aggregation exists on Bajo de Sico, an isolated seamount 27 km off the island's west coast (Schärer et al. 2014). Compared to other aggregations occurring on insular or continental slopes or large atolls, the limited spatial scale of the seamount and its isolation make this site unique and identifies connectivity to the island shelf a critical issue for management (Starr et al. 2007, Nemeth, 2012). Additionally, there is a seasonal fisheries closure (October 1 - March 31) on Bajo de Sico in order to protect its diverse benthic and reef fish assemblages, including other species using the site to aggregate for spawning.

During the 2013 and 2014 spawning aggregation seasons 29 Nassau Grouper were tagged with acoustic transmitters (Vemco: V16-4H and V16p-4H). Given the deeper depths at which this aggregation occurs (> 50 m), individuals were tagged *in situ* using closed-circuit rebreathers to prevent the potentially lethal effects (barotrauma, thermal shock, and physical trauma) of removing the fish from these depths (Tuohy et al. 2015). Tagged individuals were monitored within an array of 17 omni-directional acoustic receivers (Vemco: VR2 and VR2W) in order to quantify their reproductive migration and residence time in relation to the seasonal closure at the aggregation site, and along suspected migration corridors between the seamount and the island shelf. Additionally, acoustic telemetry data were compared to passive acoustic monitoring (PAM) data (Loggerhead acoustics: Digital spectrogram recorders; sampling rate of 20 seconds every 5 minutes) collected at the aggregation site to record the courtship associated sounds (CAS) associated with reproductive behaviors known to occur during spawning aggregations (Schärer et al. 2014).

Acoustic detection records of tagged individuals (1,240 days post-tagging) indicate high site fidelity, with 80% of tags returning to the aggregation site each year. Acoustic detection and CAS rates indicate the timing of the aggregation exhibits lunar dependency with three to four spawning peaks occurring between January through April (Figure 1). The timing of the aggregation varied between months, but not between years, with individuals present at the aggregation site during 5-15 days after the full moon (DAFM), with peak reproductive behaviors occurring within a period of 9-12 DAFM (Figure 1).

The horizontal distribution of tagged individuals during the aggregation (5-15 DAFM) indicates Nassau Grouper occupied an area of 0.15 km<sup>2</sup>, which condensed to an area of 0.07 km<sup>2</sup> during peak reproductive activity (9-12 DAFM). The scale of these movements differs from a larger aggregations (in terms of space and abundance) located on the Grammanik Bank, USVI, where Nassau Grouper occupy 15 km<sup>2</sup> during the aggregation and 2 km<sup>2</sup> during peak reproductive activity (Nemeth 2012). Vertical depth distributions indicated that Nassau Grouper on BDS occupy a mean depth of 38.7 m (min = 17.8 m; max = 155 m) for the entire tracking period, with maximum depth values recorded during the aggregation.

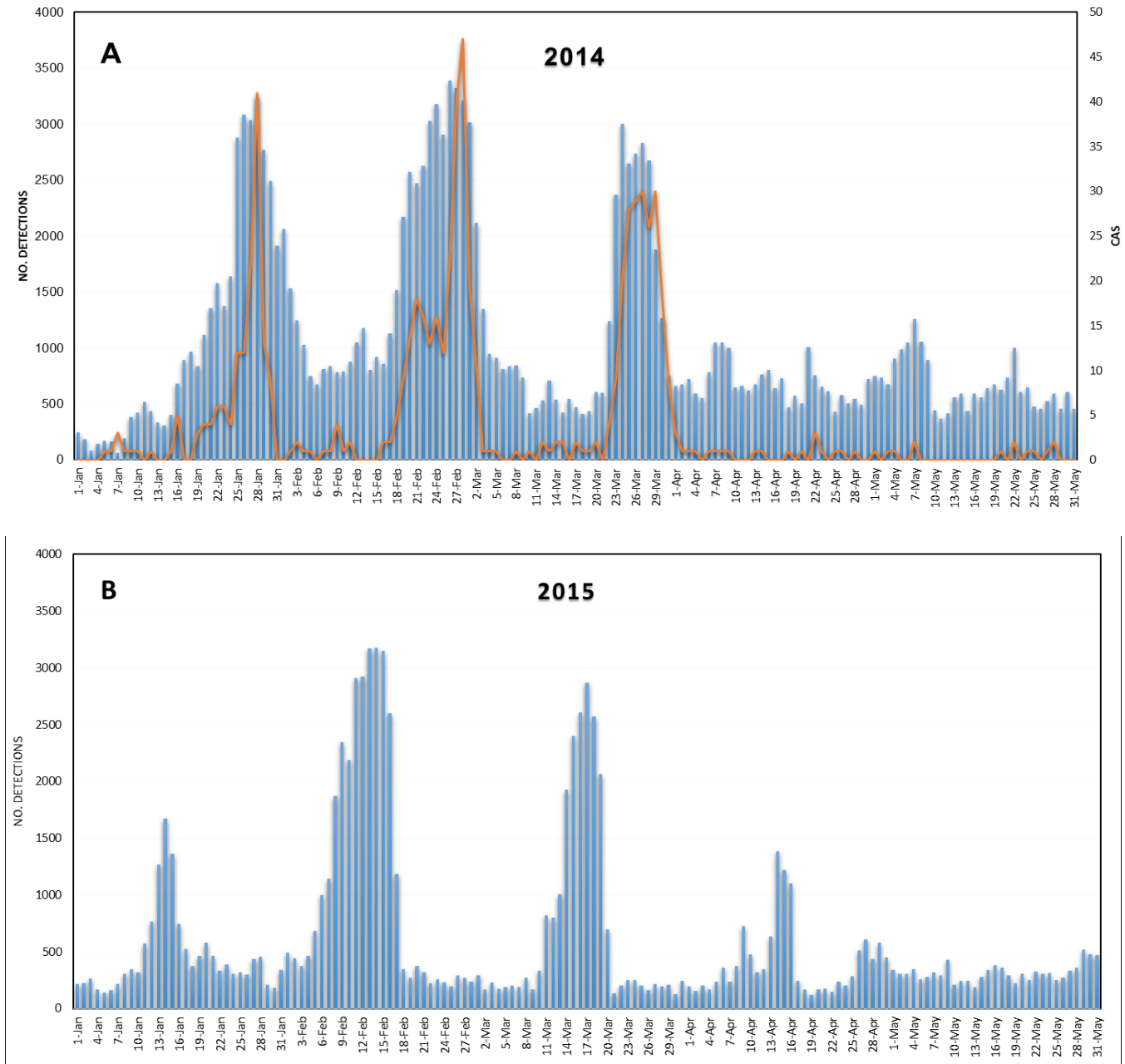
Approximately 62% of tags had consistent detection records throughout the year, while 38% were detected only during the aggregation. Detection records indicate southwesterly movement of these fish towards a narrow corridor linking BDS to the PR shelf, before disappearing from the detection array. To date, there have been no detections at receivers located off the seamount, but data from the corridor is still pending retrieval of the receivers.

In conclusion, Nassau Grouper at BDS form a spawning aggregation from January to April, indicating that the seasonal closure (October to March) for this critical habitat does not match the span of the reproductive period. Tagged individuals at this seamount exhibit less extensive movements during the aggregation compared to other sites, and depth records from tagged individuals reveal that Nassau Grouper at BDS reside at mesophotic depths year-round. High site fidelity and residency highlight the importance of BDS and mesophotic coral ecosystems as essential fish habitat.

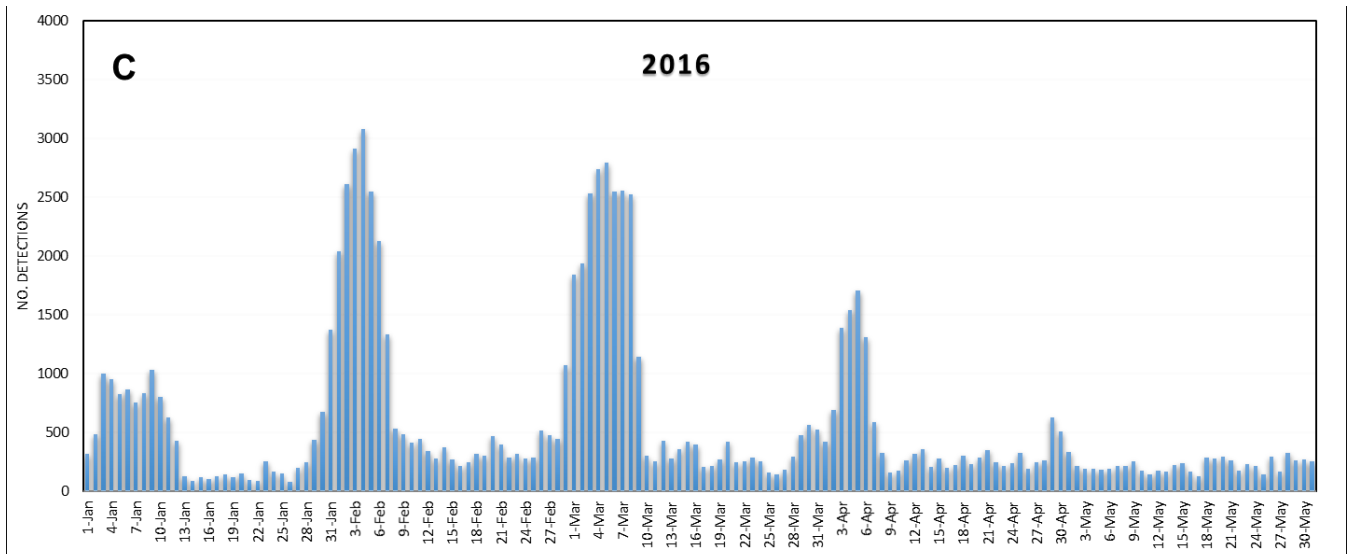
KEY WORDS: Nassau Grouper, acoustic telemetry, passive acoustic monitoring, spawning aggregations

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**Figure 1.** (A) Number of detections (blue bars) and courtship associated sounds (CAS) (orange line) of Nassau Grouper at Bajo de Sico for the 2014 spawning season. (B and C) Number of detections (blue bars) for the 2015 and 2016 spawning seasons.



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