Interactions Among Three Species of Sharks and Grouper Spawning Aggregations in the US Virgin Islands

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ABSTRACT

Grouper spawning aggregations along deep reefs of the US Virgin Islands represent a large potential prey source for predators including sharks. To examine the relationship between grouper spawning aggregations and sharks, we tagged three species of groupers and three species of sharks with acoustic transmitters and monitored their movements over several years using an array of receivers deployed at spawning sites and at non-spawning locations along the southern shelf edge of St. Thomas, US Virgin Islands. Each species of shark demonstrated different behavioral patterns. Temporal and spatial patterns of movement of lemon sharks (*Negaprion brevirostris*) were closely associated with spawning events, but little connection between spawning aggregations and behavior of the other two species of sharks (*Carcharhinus perezi* , *Galeocerdo cuvier*). Our findings illustrate variable interactions that may occur between different species of sharks and grouper spawning aggregations and that prey availability may influence the spatial and temporal patterns of activity of co-occurring species of sharks in different ways.

KEY WORDS: Grouper spawning aggregations, migration patterns, predator-prey interactions, shark movements

Las Interacciones entre Tres Especie de Tiburones y Mero que Desovan las Agregados en US Islas Vírgenes

PALABRAS CLAVE: Mero que desovan las agregados, tiburones, interacciones, US Islas Virgenes

Les Interactions Parmi Trois Espèce de Requins et de Mérou Frayant Agrégations dans les Iles Vierges d'Etats-Unis

MOTS CLÉS: Mérou frayant agrégations, requins, interactions, Iles Vierges d'Etats-Unis

INTRODUCTION

Most large groupers (Serranidae) and snappers (Lutjanidae) form annual spawning aggregations (FSA) at predictable times and locations (Domeier and Colin 1997, Nemeth 2009). This represents a large potential prey source for predators including sharks. The most common example is the concentration of whale sharks (*Rhincodon typus*) which feed on fertilized eggs of several species at spawning aggregation sites in Belize and other locations (Heyman et al. 2001, Hoffmayer et al. 2007). Many other examples of egg predators feeding at spawning aggregation sites exist (Colin 1976, Moyer 1987, Sancho et al. 2000, Nemeth 2011). Less common is the observation of piscivores feeding on spawning adults. A review of predation at spawning aggregation sites found that 22 species within 13 families of fishes attacked and occasionally consumed spawning adults (Nemeth 2011). Although rare, these observations were more common in the Indo-Pacific (Robertson 1983, Sancho et al. 2000) than in the Caribbean (Colin and Clavijo 1988, Robertson et al. 1999). To examine the relationship between grouper spawning aggregations and sharks we tested the hypothesis that sharks will synchronize their movement patterns in space and time to coincide with grouper spawning aggregations.

METHODS

We tagged three species of sharks (*Negaprion brevirostris, Carcharhinus perezi, Galeocerdo cuvier*) with Vemco V-16 acoustic transmitters and monitored their movements over several years using an array of receivers deployed at spawning sites and locations spanning a stretch of deep reef approximately 100 km in length between the US Virgin Islands and Puerto Rico. During this same time we also tagged three species of groupers (*Mycteroperca venenosa*, *Epinephelus striatus*, *E. guttatus*) with Vemco V -13 acoustic transmitters at two spawning aggregations sites in the US Virgin Islands. Data were downloaded from acoustic receivers in the spring follow the end of each grouper spawning season, which extends from about January through April (Nemeth 2005, Nemeth et al. 2006, Nemeth et al. 2007). Frequency of occurrence of sharks detected at acoustic receivers at spawning sites was

compared to receivers at non-spawning sites during spawning and non-spawning time periods.

RESULTS AND DISCUSSION

Each species of shark demonstrated different behavioral patterns, with temporal and spatial patterns of movement of one species closely associated with spawning events, but little connection between spawning aggregations and behavior of the other two species of sharks. Lemon sharks (*Negaprion brevirostris*) were present at the spawning sites at a much higher frequency during the spawning season, but largely absent during non-spawning months. Caribbean reef sharks (*Carcharhinus perezi*) moved little throughout the year and were detected on receivers in proximity to spawning sites almost continuously. Tiger sharks (*Galeocerdo cuvier*) were detected on receivers throughout the year along the entire extent of the array of receivers and showed no obvious movement patterns associated with spawning activities and little consistency among individuals. Our findings illustrate variable interactions that may occur between different species of sharks and grouper spawning aggregations and that prey availability may influence the spatial and temporal patterns of activity of co -occurring species of sharks in different ways.

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