Conservation and Management of Grouper Spawning Aggregation Sites: Adaptive Strategies Based on Fish Movement Patterns

Conservación y Gestión de los Sitios de Agregación para el Desove de Meros: Estrategias de Adaptación Basadas en los Patrones de Movimiento de Peces

Conservation et Gestion des Sites de Frai de Loches: Stratégies d'Adaptation Basées sur les Habitudes de Déplacement des Poissons

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EXTENDED ABSTRACT

Most large groupers (Serranidae) form annual fish spawning aggregations (FSA) at predictable times and locations (Domeier and Colin 1997); a life-history trait that makes them extremely vulnerable to over-fishing (Sadovy de Mitcheson et al. 2008). Seasonal or permanent fishery area closures can provide effective protection (Nemeth 2005), but defining biologically relevant boundaries is difficult due to limited knowledge of the movement and migration patterns associated with spawning. The aim of this study was to compare the spatial and temporal patterns of movement and migration of groupers at spawning aggregations in the Caribbean and Pacific.

METHODS

This study was carried out between January 2010 and April 2012 at two FSA sites located in the Caribbean and Pacific. The Grammanik Bank is a 1.5 km^2 seasonally protected area located 12 km south of St. Thomas, United States Virgin Islands. Several species of groupers and snappers form annual spawning aggregations from January through May each year (Nemeth et al. 2006). The second study site was located on the outer barrier reef of Pohnpei, Micronesia in the Kehpara Marine Reserve and also contains FSAs for several species of Pacific groupers (Rhodes and Sadovy 2002) which aggregate from January through April. In St. Thomas *Epinephelus striatus*, *E. guttatus*, *Mycteroperca venenosa*, and *M. tigris* were captured using Antillian fish traps baited with squid, drop nets or hand lines. In Pohnpei *Epinephelus polyphekadion, E. fuscoguttatus* and *Plectropomus areolatus* were captured with baited hand lines. Captured groupers were surgically implanted with acoustic transmitters (Vemco V9 and V13) and movements were tracked using a large array of 40 acoustic receivers (Vemco VR2W) that were strategically placed around each FSA site. Receivers were moored using either a stainless steel cable shackled to a large coral head or polypropylene line attached to a concrete base.

RESULTS AND DISCUSSION

Acoustic data of fish movement patterns indicated that distance travelled was positively related to fish length and that these species commonly swam 1 to 3 km in a few hours and could cover 15 km or more in a 24 hour period. Some differences in spatial patterns of movement were detected between reef types in the Caribbean and Pacific. For example, the Grammanik Bank is surrounded by the extensive Puerto Rican plateau which allowed grouper to swim over very large areas surrounding the FSA site. In contrast, the movements of groupers in Pohnpei were constrained by the barrier reef which restricted grouper to swim along linear migration pathways following the contour of the barrier reef and only allowing access to the inner lagoon via reef passages. In most cases, however, movements of tagged groupers in both locations carried them outside the existing protected area boundaries and exposed them to fishing mortality on a daily basis. We found a positive relationship ($r^2 = 0.78$, $p < .02$) between fish size and area utilized during spawning season. General area requirements were as follows: *E. polyphekadion* and *P. areolatus* (2 km^2), *M. tigris* (3 km^2), *E. striatus* and *E. fuscoguttatus* (5.5 km^2) and *M. venenosa* (10 km^2). Using information from this study we can recommend general guidelines for establishing spatial requirements for each species around spawning aggregation sites which can greatly increase the efficiency of MPA design while minimizing the impact on fisher livelihoods.

LITERATURE CITED

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