

Observations of *Mycteroperca venenosa* from a Spawning Aggregation at Mona Island, Puerto Rico

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ABSTRACT

Surveys have been conducted since 2005 on a multi-species grouper spawning aggregation at Mona Island, Puerto Rico. Over two years, red hind (*Epinephelus guttatus*) and yellowfin grouper (*Mycteroperca venenosa*) were found aggregated and exhibiting signs of spawning activity (distended abdomens, unusual coloration, and peculiar behavior). Diver surveys with GPS tracking were used to pinpoint the location of highest densities within the site as well as determine how these vary around the full moon and among the winter spawning months. The focal areas used by the two species were separate (~100m) and remained constant over two years. *Epinephelus guttatus* aggregated at 20 m on low relief colonized hard-bottom while *M. venenosa* were found at 25-30 m on the high relief shelf edge. The density of *E. guttatus* peaked in January and *M. venenosa* 2 days after full moon in March. A third species, tiger grouper (*M. tigris*), has also been observed aggregating at this site but has not been surveyed quantitatively. Maintaining these aggregations may be critical. The Mona Channel is a semi-permeable geographic boundary, and the Mona fish fauna is most probably dependent upon self recruitment, but may also serve as an important stepping stone for ecological connectivity between Puerto Rico and Hispaniola. This baseline information is a first step in monitoring these spawning populations, advancing our knowledge of their reproductive behavior, and assessing the success of management actions.

KEY WORDS: Spawning aggregation, grouper, *Mycteroperca venenosa*

Observaciones de Una Agregación de Desove de *Mycteroperca venenosa* en Isla de Mona, Puerto Rico

Desde el 2004 se han llevado a cabo inspecciones de una pequeña agregación de desove de meros multi-especie en Isla de Mona, Puerto Rico. Por dos años la cabrilla (*Epinephelus guttatus*) y el guajil (*Mycteroperca venenosa*) fueron avistados agregados y exhibiendo señales de actividad de desove (abdomenes dilatados, coloración inusual, y comportamiento peculiar). Buceadas de inspección con rastreo de GPS se utilizaron para precisar la localización de las densidades mas altas y determinar como estas cambian en relación a la luna llena y durante los meses de desove en invierno. Las áreas focales utilizadas por las dos especies se encontraron separadas (100 m) y se mantuvieron constante por dos años. *Epinephelus guttatus* se agrego a los 20 m en fondo duro colonizado y de poco relieve, mientras que *M. venenosa* se encontró a 25-30 m al borde de la plataforma insular en fondo de alto relieve. Las densidades de *E. guttatus* fueron máximas en enero y para *M. venenosa* 2 días después de la luna llena en marzo. Una tercera especie, el mero diente de sable (*M. tigris*), también se ha avistado agregándose en este lugar pero no ha sido muestreado cuantitativamente. Mantener en vigor estas agregaciones puede ser de carácter crítico. El canal de la Mona es un límite geográfico semipermeable, y la fauna de peces es probablemente dependiente de reclutamiento local. La isla también puede servir como un enlace importante para conectividad ecológica entre Puerto Rico y Hispaniola. Esta información de base es un comienzo para el monitoreo de estas poblaciones, para aumentar nuestro conocimiento sobre comportamiento reproductivo, y para determinar la efectividad de medidas de manejo.

PALABRAS CLAVES: Agregación de desove, meros, *Mycteroperca venenosa*

INTRODUCTION

Reef fish spawning aggregations are increasingly in the focus of managers and scientist because of their importance in maintaining sustainable fisheries for species that exhibit this reproductive strategy. Certain species of commercially important groupers are known to form 'transient' spawning aggregations in that fish travel long distances to specific sites during a short spawning season (Colin *et al.* 2003). This site fidelity and temporal predictability coupled with the traits of late maturation and protogyny in aggregating groupers renders them particularly susceptible to overfishing (Sadovy 1999). The heavy exploitation of grouper spawning aggregations in the Caribbean is likely responsible for observed stock declines (Aguilar-Perera

2004, Sadovy 1999, Sala *et al.* 2001), a situation that has lead to the economic extinction of some species and the loss of ecological function (Sadovy and Domeier 2005).

Many spawning aggregations have been documented and some are the focus of long-term research efforts to examine trends in abundance and characterize environmental conditions during spawning (Heyman *et al.* 2005, Nemeth *et al.* 2006, Whaylen *et al.* 2004). Factors that influence the formation of spawning aggregations are of great interest for extracting patterns that may be widely applicable. Observations from separate spawning aggregations and having different site characteristics will aid in determining the factors that trigger spawning including temperature, tide, current, moon cycle and day length

(Colin *et al.* 2003). Monitoring aggregations existing under varying site conditions and exploitation levels will provide information valuable for following population trends as well as understanding what factors and site characteristics are important to aggregation formation. It is probable that numerous unknown aggregations exist at varying levels of fish abundance due to historic exploitation patterns and status of the spawning population. Regional efforts to protect spawning aggregations advocate the need to monitor aggregations at all levels of exploitation to determine trends in abundance through time (Colin *et al.* 2003). More information is needed on the location, status and temporal patterns of grouper spawning aggregations to assist efforts to stem their decline from overexploitation.

In Puerto Rico spawning aggregations of grouper have been documented from Vieques (Matos-Caraballo *et al.* 2006, Sadovy *et al.* 1994), La Parguera (Shapiro *et al.* 1993) and the west coast (Sadovy *et al.* 1994). Intensive fishing has caused stock declines of some of these aggregations, the most notable being the disappearance of several Nassau grouper aggregations (Sadovy 1999). On Mona Island, Puerto Rico, reports from fishermen indicate that a spawning aggregation of Nassau grouper existed but was extirpated by the 1970's (Colin 1982). Recent efforts to relocate it have been unsuccessful but have provided new information on an aggregation of other commercially and ecologically important species of groupers (M.T.S. unpublished data). In January 2005 a multi-species grouper spawning aggregation was first observed during large scale aggregation surveys at Mona Island. Here we provide a description of species observed, site characteristics and temporal abundance patterns with an emphasis on the yellowfin grouper (*Mycteroperca venenosa*) classified as Near Threatened on the IUCN Red List (Burle and Garcia-Moliner 2006).

METHODS

Study Site

Mona Island is located 72 km west of Puerto Rico (18° 05.0' N, 67°54.0' W) (Fig.1) and is managed as a Natural Reserve. Mona Island exhibits a relatively narrow submerged insular platform dominated by hard bottom and coral reef habitats, with a limited amount of shallow sea grass habitat on the southern coasts. Because of the depths (>1000 m) in the Mona Channel, the island may represent biogeographical filter for the distribution of shallow water marine species in the Caribbean as well as a stepping stone for regional connectivity.

Survey Methodology

The spawning aggregation site was first observed in January 2005 while conducting large scale survey dives throughout Mona Island. Surveys were conducted at the aggregation site January to March and December 2005, and January to March 2006. The site was visited for 1-4 days each month with an emphasis on full moon days. Obtaining

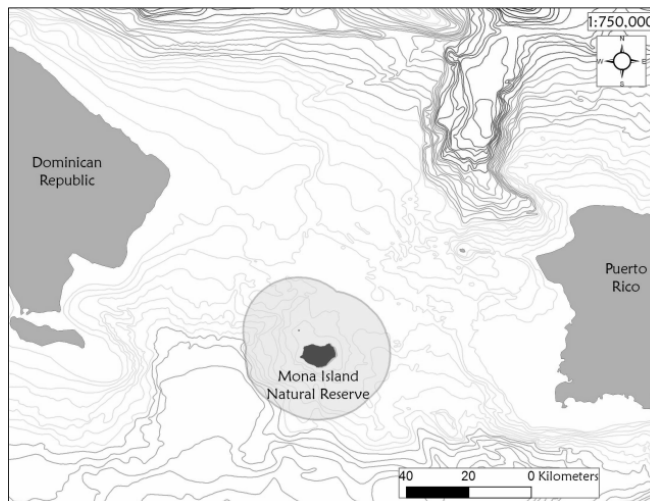


Figure 1. Location of Mona Island, Puerto Rico.

accurate estimates of abundance from spawning aggregations is difficult because the density of fish can vary greatly through time and space. The survey protocol utilized methods to collect information on the spatial limits of the aggregation as well on changes in fish abundance among months and around the full moon (Pat Colin, Coral Reef Research Foundation, personal communication). Each survey dive consisted of one continuous transect over the site and was tracked with a GPS attached to a buoy towed by the divers. Divers recorded species counts, time of sighting and fork length of fish within a 10m belt. The time of sighting and GPS track provided locations of individuals or groups of fish. These point data were grouped into 2 minute bins (varying length by 10m width) to calculate density (# fish/100m²). The mean number of fish counted per dive was used to make comparisons among months. Digital camera and video were used to record color patterns and behavior of fish at the aggregation site.

RESULTS

The aggregation site encompasses approximately 3 hectares on the insular platform adjacent to the shelf edge at 20-30 m depth. The habitat in the shallower areas of the site is a gently sloping hardbottom with sand channels colonized by scleractinian corals (*Montastrea*, *Diploria*), gorgonians and barrel sponges (*Xestospongia muta*). Topographic relief increases at the shelf edge with larger coral colonies (1 m), promontories and ledges. Seaward of the shelf edge the bottom slope increases to 30-40 degrees to depths > 50m.

Three species were found at higher than background densities at the site: yellowfin grouper (*Mycteroperca venenosa*), red hind (*Epinephelus guttatus*) and tiger grouper (*M. tigris*). Fish locations derived from the GPS track of the survey dives revealed that the 3 grouper species generally utilize separate areas. There is overlapping use of the site but the areas of highest abundances for the different

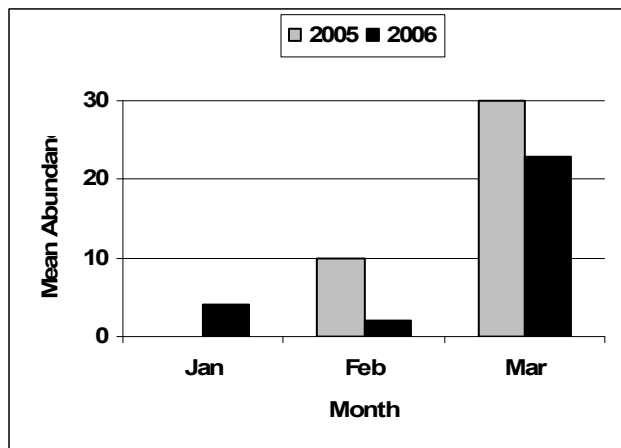


Figure 2. Mean abundance (individuals per dive) of *Mycteroperca venenosa* at aggregation.

species were separated by approximately 100 m. *Epinephelus guttatus* occur at depths of 20-22 m in low relief colonized hardbottom. *Mycteroperca venenosa* and *M. tigris* occurred together and were most abundant along the shelf edge at 25-30 m.

Epinephelus guttatus aggregated in December and January with greater abundances in the latter. *Mycteroperca venenosa* were observed at the aggregation site from January to March with highest abundances in March (Figure 2). In March 2006 more frequent surveys were conducted from the 13th -16th (full moon 14th) between 15:00 and 18:00 h. Peak densities of *M. venenosa* were observed 2 days after the full moon with 34 individuals counted on a single dive (Figure 3). During these 4 days in March 2006 *M. venenosa* were distributed throughout a broad area (~ 1 hectare) although an area of higher densities occurred on the west end of the site. *Mycteroperca tigris* sightings coincided with *M. venenosa* but at lower densities.

The overall mean length (FL) for both years of *M. ve-*

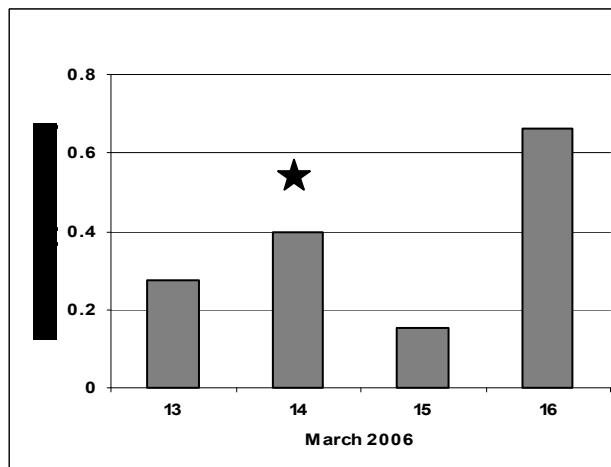


Figure 3. Mean density (individuals per 100 m²) of *Mycteroperca venenosa* on 4 days around the full moon (star).

nenosa was 62.6 cm, ranging from 35-85 (Figure 4). *Mycteroperca venenosa* exhibited two coloration patterns: (1) dark spots on a white background and (2) bi-colored with dark margins on caudal, anal and rear dorsal fins and pronounced yellow margins of pectoral fin and mouth. Unusual behavior observed included groups of ~5 fish moving slowly 3m off of the bottom for short periods. Several individuals were observed with a distended abdomen, an indication that the fish are approaching spawning.

DISCUSSION

Some grouper aggregation sites in the Caribbean are known to be utilized by multiple species including Nassau, tiger, yellowfin, yellowmouth and black groupers (Nemeth *et al.* 2006, Sala *et al.* 2001, Whaylen *et al.* 2004). At the Mona Island site at least 3 species of grouper (*E. guttatus*, *M. venenosa* and *M. tigris*) are present exhibiting indirect signs of forming a spawning aggregation. Yellowmouth grouper (*M. interstitialis*) has been observed at this site but

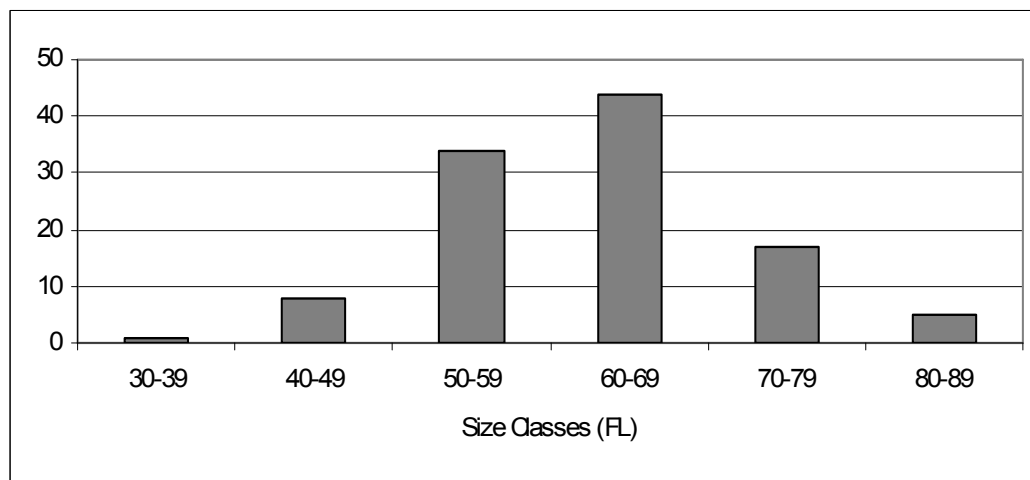


Figure 4. Size frequency distribution of *Mycteroperca venenosa* observed at the aggregation.

in low numbers.

Spawning aggregations of *M. venenosa* are known from the Bahamas, Cuba, Belize, Cayman Islands, Turks and Caicos and US Virgin Island (SCRFA Database). Spawning appears to occur from January to May in the Caribbean (Claro and Lindeman 2003, Nemeth *et al.* 2006, Thompson and Munro 1978). In Puerto Rico the commercial fisheries landings data reflects a peak in catches in February and March (Daniel Matos-Caraballo, Fisheries Research Lab, personal communication). In the Virgin Islands *M. venenosa* are observed at the Grammanik Bank aggregation site from February to April (Nemeth *et al.* 2006). At this site *M. venenosa* densities peaked 4 days after the full moon in April 2004. At a multi species grouper aggregation in Belize, the abundance of *M. venenosa* peaked 3 days after the full moon in January (Sala *et al.* 2001). At Mona Island the highest densities observed were 2 days after the full moon in March 2006, but no observations have been made in April to determine if the fish also aggregate during this month.

The size frequency distribution of *M. venenosa* in this study is similar to that from the aggregation at the Grammanik Bank (Nemeth *et al.* 2006). Based on the sex at size estimates from other aggregations, it appears that both sexes may be represented at the Mona Island aggregation (Tuz-Sulub *et al.* 2003).

The survey protocol utilizing GPS track provided valuable information on the spatial extent of the aggregation and on temporal changes in fish abundance. Surveying during consecutive days (as in March 2006) is essential for determining accurate trends in abundance through time. This aggregation site should be protected to insure the spawning and recovery of these grouper species at Mona Island. Spawning by groupers was not observed at the site but high densities, presence of fish with distended abdomens and behavior provides indirect evidence for the formation of a spawning aggregation. Additionally, the months sampled coincide with the spawning seasons for the species observed.

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