

Description of Mutton Snapper (*Lutjanus analis*) Spawning and Movement in the US Virgin Islands

Descripción del Pargo Criollo (*Lutjanus analis*) el Desove y el Movimiento en las Islas Vírgenes de E.U.

Description de la Viande de Mouton Vivaneau (*Lutjanus analis*) Frai et le mouvement dans les Îles Vierges Américaines

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ABSTRACT

Mutton snapper (*Lutjanus analis*) is a very important commercial and recreational species throughout the Caribbean including Puerto Rico and the U.S. Virgin Islands. They form fish spawning aggregations (FSA) that are vulnerable to recreational and commercial fishing during the spawning season. *L. analis* spawning aggregations in the USVI are known to occur along the shelf edge within in large area along the southwest corner of St. Croix and at a site located south of St. John. The St. Croix location is included in a seasonally closed area, which was established in 1993. Due to continued poaching in the seasonally closed area the spawning population remains at risk. Evidence for this is that the average total length of snappers in the seasonally closed area on St. Croix ($57.7 \text{ cm} \pm 1.13 \text{ s.e.}$) are not significantly different from another unprotected FSA site on St. John ($57.7 \text{ cm} \pm 1.21 \text{ s.e.}$). Despite their important commercial status, little information exists of the population status and almost nothing is known about their movement and migration patterns around the spawning aggregation site. An acoustic telemetry study was conducted around the St. Croix and St. John FSA sites and preliminary data and observations of spawning are presented. Preliminary analysis suggests that spawning occurs between 12:30 and 17:00 outside the closed area. Alternative management scenarios are presented.

KEY WORDS: Acoustic telemetry, reproduction, spawning aggregation

INTRODUCTION

Mutton snapper (*Lutjanus analis*) is a very important commercial and recreational species throughout the Caribbean including Puerto Rico and the U.S. Virgin Islands (USVI) (Heyman et al. 2008). As with other aggregating species, they are vulnerable to overfishing during the spawning season because their aggregations are predictable in time and space (Heyman and Kobara 2005, Kadison et al. 2006, Nemeth 2012). *L. analis* is known to spawn in an area along the southwest corner of the St. Croix insular shelf within or near a seasonally closed area, which was established in 1993 by the Caribbean Fisheries Management Council (CFMC) (Kojis and Quinn 2010). Due to continued fishing in and adjacent the Mutton Snapper Seasonally Closed Area (MSSCA), the CFMC and the USVI implemented a seasonal prohibition on the harvest of mutton snapper from April 1 – June 30th in federal and territorial waters in 2005 and 2006, respectively. *L. analis* is also known to spawn at a site located south of St. John known as Tampo, which benefited from the seasonal fishing prohibition. Despite their important commercial status, little information exists of their population status and almost nothing is known about their movement and migration patterns around the spawning aggregation site. In fact, in a recent study of *L. analis* spawning aggregation in the MSSCA, Kojis and Quinn (2010) were unable to identify the location of the aggregation which is suspected to possibly occur outside the MSSCA. This may, in part, explain why the estimated average long-term effective size of mutton snapper populations on St. Croix ($N_e = 341$) is almost three times smaller than on St. Thomas ($N_e = 922$) (Carson et al. 2011), where N_e refers to the number of breeding individuals in an ideal population based on genetic drift and inbreeding. This is extremely troubling since the low effective population size on St. Croix is less than 500, which is considered the effective size needed to ensure a healthy population. The purpose of this study was to:

- i) Accurately identify the spawning locations, migration pathways and area requirements of mutton snapper,
- ii) Collect baseline length data from each spawning aggregation, and
- iii) Evaluate the effectiveness of different management regulations on spawning stock characteristics of mutton snapper.

METHODS

At least two mutton snapper spawning aggregation sites are known to occur within the US Virgin Islands. MSSCA is located along the southwest coast of St. Croix and Tampo is on the shelf edge south of St. John (Figure 1). MSSCA habitat ranges from highly complex coral reef habitat in a spur and groove formation 20 to 45 m depth in the south to colonized pavement and sand approximately 10 m depth in the north (Quinn and Kojis 2010)). Tampo is composed primarily of sparsely colonized hard bottom 30 to 45 m depth with some areas containing ledges and deep undercuts. Two additional sites south of St. Thomas (Red Hind Bank Marine Conservation District, Grammanik Bank) are also suspected of hosting mutton snapper spawning aggregations (i.e. over 200 *L. analis* were observed in an aggregation in the MCD in May 2012, Nemeth personal observation). Both of these sites are composed of complex mesophotic reef (40 to 50 m). In order to understand mutton snapper movements and identify migration pathways and spawning areas, acoustic receivers (Vemco

VR2W) were placed in an array within MSSCA and along the shelf edge to the west (Figure 2). The acoustic receiver array was deployed from May to December 2014 and April to July 2015. Each receiver was attached to a polypropylene line which was threaded through garden hose to prevent chaffing and tied to two concrete blocks and suspended with two subsurface polystyrene floats. Receivers were facing downward in mid-water (ca. 15 to 20 m) with bases in 30 to 40 m depth.

Mutton snapper were caught on St. Croix by fishing at night with circle hooks baited with squid and round robin (*Decapterus sp.*), or during day on St. John with fish traps baited with squid. Fishing was conducted the week after the full moon between April to July 2014 and 2015 depending upon weather and success catching snapper. Fish that were brought on board were held in seawater tubs or live wells and their airbladder deflated using a sterilized hypodermic needle. Each fish was measured (mm), tagged with a numerically coded dart tag below the dorsal fin, and gender was examined using visual methods (abdominal pressure or cannula). Vemco acoustic transmitters (V13) were surgically implanted in the body cavity of each fish and the incision sutured (Holland et al. 1993, Meyer et al. 2000). The fish were either hand released by divers on the sea floor or lowered with a weighted barbless hook attached to the lower lip.

Scuba surveys were conducted using nitrox or closed circuit rebreathers (CCR) to estimate total spawning population size and make observations on habitat utilization and fish behavior (i.e. courtship, spawning and inter- and intra-specific interactions).

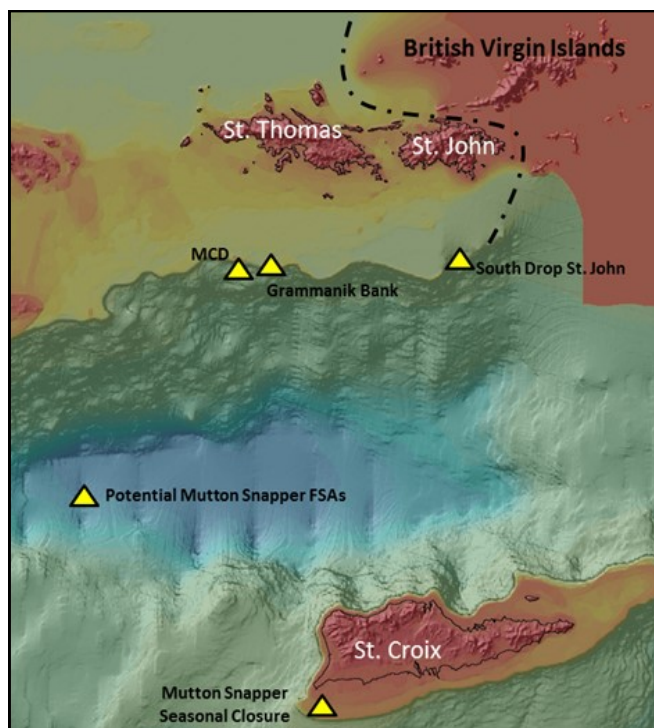


Figure 1. Location of known and suspected mutton snapper (*L. analis*) fish spawning aggregation sites.

Drift dives were conducted during the week following the full moon in the afternoon hours. Divers entered the water and swam with the current while towing a surface float with GPS to track dive routes. The diver's watch and GPS clock were synchronized so that areas of particular interest recorded by divers could be relocated by matching up time and location of coordinates on GPS.

RESULTS AND DISCUSSION

Population characteristics - Fishing trips were carried out on St. Croix in May, June and July 2014 and April and May 2015, on St. John in May and June 2015 and on St. Thomas in May, June, July, August and September 2014. During the two field seasons a total of 108 mutton snapper were collected (Table 1). Only two mutton snapper were caught in St. Thomas and were omitted from analysis. There was no difference in fish length ($F_{(1,71)} = 1.94, p = 0.16$) between mutton snapper caught on St. Croix in 2014 (mean TL = 53.6 cm \pm 0.04 s.e., n = 15) and 2015 (mean TL = 57.5 cm \pm 0.003 s.e., n = 58) so these data were combined for analysis. Although maximum length of mutton snapper on St. Croix was 14 cm larger than on St. John (Table 1, Figure 3), there was no significant difference in length between islands ($F_{(1,104)} = 0.004, p = 0.94$) despite the fact that St. Croix has had a 4 month seasonal closure for 23 years. This is surprising considering that Nemeth (2005) showed that a release in fishing pressure at a red hind FSA site resulted in a rapid increase in length of the adult spawning population. The lack of difference in the protected and unprotected mutton snapper spawning populations may be partly due to high incidence of poaching which was observed on most occasions that night fishing was conducted within the Mutton snapper seasonal closed area on St. Croix. At least 2 - 3 boats were seen fishing on the site each night (RN personal observation) during the closed season. However, fishing pressure on mutton snapper on the shelf south of St. Thomas and St.



Figure 2. Location of acoustic receivers within the Mutton Snapper Seasonally Closed Area (MSSCA, black polygon) on the south west corner of St. Croix. Star indicates suspected spawning location for mutton snapper on western tip of promontory.

John is also reduced because of the high incidence of ciguatera in mutton snapper caught in that area (Kojis pers obs.). Mutton snapper are not purchased by restaurants on St. Thomas (Kojis, pers. obs.), and most of the major commercial fishers on St. Thomas will not sell it unless they catch small individuals on the north side of the islands (G. Greaux, pers. com.). In contrast, mutton snapper is not known to be ciguatoxic on St. Croix and is prized by consumers (Kojis, pers. obs.). We also compared the data from the 2014/2015 spawning season to 2009 when Kojis and Quinn (2010) established a baseline for the mutton snapper spawning population. During this five to six year time span no difference in fish total length was found (2009: 55.4 cm \pm 0.77 s.e. TL, n = 109; 2014/15: 56.7 cm \pm 1.13 s.e., n=73; $F_{(1,71)} = 0.91, p = 0.34$).

Dive Surveys

On St. Croix within the MSSCA only 1-4 mutton snapper were counted on any dive despite diving on the historical fishing location just prior to sunset. In St. John however divers surveying the shelf edge encountered a large aggregation of mutton snapper in May (ca. 800) and June (ca. 1000) 2015. These observations were 3-4 days after the full moon each month. On June 4 divers observed a large school of mutton snapper along the bottom in 120 ft (37m) depth. Shortly afterward the school moved off the shelf and ascended and descended at regular intervals. At 12:30 the first of several mutton snapper spawning rushes was observed and resulted in a large gamete cloud. These were characterized by 10 – 20 males following a presumed female up into the water column to about 150 (46 m) to 120 ft (37 m) depth. In September 2015 dives were conducted at Tampo to retrieve acoustic receivers and over 200 mutton snapper were observed again swimming in loose groups along the bottom suggesting that the spawning season extends into late summer months.

Telemetry

Acoustic receivers were retrieved in St. Croix in late July 2015 and downloaded. Tagged fish were present on the acoustic array from March to July with peaks in May and June. Tagged fish arrived on acoustic array as early as two days before full moon and stayed as late as 14 days

after full moon. Nearly 80% of detections, however, occurred from 1 to 8 days after full moon. Initial results from movement analysis indicate that mutton snapper in St. Croix travelled slowly from east to west along the shelf edge and were last detected on the western most receiver (Figure 2) between 12:30 to 13:30. Around sunset fish were again detected on the western most receiver but travelling eastward. Tagged mutton snapper returned to the MSSCA after dark and remained mostly within the eastern end of the closed area but with some fish travelling eastward beyond last receiver. The receiver array, however, did not allow us to determine what proportion of tagged fish remained within the MSSCA or continued to swim eastward and leave its boundaries.

CONCLUSIONS

Based on our diving observations of timing of spawning in St. John, this pattern of movement suggests that fish were swimming west to spawn between 12:30 to 18:30 and returning to the MSSCA after spawning. This explains why very few fish were seen during late afternoon dives within the MSSCA. Although further observations and confirmation of spawning are required to support this hypothesis, it also suggests that mutton snapper do not spawn within the boundaries of the MSSCA. This sets up

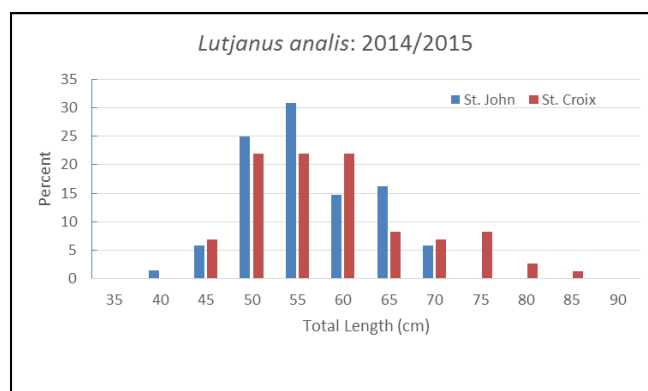


Figure 3. Length frequency of mutton snapper caught at St. Croix (mean TL = 56.7 cm \pm 1.13 s.e.) and St. John (mean TL = 56.6 cm \pm 1.21 s.e.) spawning aggregations.

Table 1. Mutton snapper data in 2014/2015 for St. Croix, St. John and St. Thomas including number of fish caught and tagged and average, minimum and maximum total length (TL) for males, females and undetermined gender. The gender of the 2 fish caught near St. Thomas was unknown.

Island	Fishing days	No. caught	No. tagged	Mean TL (cm)	Min TL (cm)	Max TL (cm)
St. Croix		73	42	56.7	44.0	82.6
	male	21	15	53.7	42.2	70.1
	female	25	4	61.2	44.7	82.6
	unknown	27	23	53.7	42.4	73.2
St. John		33	18	56.6	46.5	68.8
	male	9	5	56.9	49.1	68.8
	female	11	-	51.3	46.5	61.8
	unknown	13	12	53.4	35.9	67.6
St. Thomas	12	2	2	58.0	50.9	65.2
TOTAL	41	108	61			

an interesting management dilemma where fishing pressure is targeting the migration pathway and staging area (Nemeth 2012) of mutton snapper but not the actual spawning site. This fishing pressure however can be mitigated if current regulations are enforced. These regulations include the MSSCA where fishing is prohibited within its boundaries from March 1 to June 30 each year. There is also a seasonal prohibition on fishing for or possession of mutton snapper from April 1 to June 30 in U.S. Caribbean exclusive economic zone waters. These regulations protect fish spawning in April, May and June making spawning fish vulnerable in March and July. Since individual mutton snapper return monthly to the spawning aggregation site (R. Nemeth, unpublished data) the current regulations mean that fish caught in March or at the beginning of the spawning season have no or only one chance to spawn, while a fish caught in July has already spawned several times. Since the MSSCA straddles Federal and Territorial waters, both management agencies need to work cooperatively to not only increase education about current regulations, including the rationale behind the regulations, with commercial and recreational fishers, but also implement greater enforcement oversight each month during the spawning season during the week of aggregation formation (days 1 – 8 after each full moon in April – June).

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