Habitat Description of the St. Croix, U.S. Virgin Islands South Coast Mutton Snapper (*Lutjanus analis*) Seasonal Closed Area

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ABSTRACT

Photo quadrants were undertaken on various benthic habitats within the St. Croix, US Virgin Islands Mutton Snapper Seasonal Closed Area (MSSCA). The distribution and abundance of fish are known to been associated with benthic habitats and water quality. The deep reef slope was reported to have high coral cover experienced a sharp die off in the past several years and now is dominated with relic coral structures and low percent live coral cover. An underwater temperature logger was used to monitor subsurface sea water temperatures on dives from April to July 2009. It is uncertain how long mutton snapper aggregations will continue to exist in the face of an altered habitat. In 1993, the US Department of Commerce and US Virgin Islands Government declared a seasonally closed area from March 1 – June 30th to protect spawning aggregation of mutton snapper (*Lutjanus analis*) south of St. Croix. The management of the area was directed almost exclusively towards the extractors of the fish resource and ignored sources which have most likely contributed to the change in the habitat. Considering the association of fish communities with habitat and the decline of healthy coral reef invertebrate populations, management practices that work to preserve coral habitat should be included in the MSSCA management plans. We suggest that the US government cooperate with the international community and become a leader in the International Framework on Global Climate Change.

KEY WORDS: Coral reef, management, *Lutjanus analis*

La Descripción del Hábitat del St. Croix, EEUU Pargo Virgen de Cordero de Costa de Sur de Islas (*Lutjanus analis*) Zona Protegida

Los cuadrantes de la foto fueron emprendidos en varios hábitates de benthic dentro del St. Croix, EEUU Zona protegida Virgen de Pargo de Islas Cordero (MSSCA). La distribución y la abundancia de pez son sabidas a fue asociado con hábitates de benthic y calidad de agua. La cuesta profunda del arrecife fue informada para tener cobertura alta de coral experimentó un agudo se muere lejos durante los últimos varios años y ahora es dominado con estructuras de coral de reliquia y cobertura baja de coral de vida de por ciento. Un leñador submarino de la temperatura fue utilizado para vigilar temperaturas subterráneas de agua de mar en zambullidas de abril julio 2009. Es incierto cuánto tiempo agregados de pargo de cordero persistirán ante un hábitat alterado. En 1993, el Concilio caribe de Pesquería Gestión e Islas Virgenes Gobierno declararon un área según la temporada cerrada del 1 de marzo – 30 de junio para proteger desovando la agregado de pargo de cordero (*analis de Lutjanus*) al sur de St. Croix. La gestión del área fue dirigida casi exclusivamente hacia los extactores del recurso de pez y fuentes ignoradas que tienen más probable contribuido al cambio en el hábitat. Teniendo en cuenta la asociación de comunidades de pez con hábitat y el descenso de las prácticas sanas de gestión de poblaciones de invertebrado de arrecife de coral que trabajan para preservar hábitat de coral debe ser incluido en los planes de gestión de MSSCA. Sugerimos que el gobierno de los E.E.U.U. coopere con la comunidad internacional y sienta bien a un líder en el marco Internacional en cambio Global del Clima.

PALABRAS CLAVES: Arrecife de coral, manejo, *Lutjanus analis*

La Description de L'habitat de la Zone de Conservation du Vivaneau Sorbe (*Lutjanus analis*) de la Cote Sud de Ste. Croix, Iles Vierges Americaines

Des photographies de quadrants ont été prises sur divers habitats benthiques dans la zone de conservation de vivaneau sorbe de St. Croix, US Virgin Islands (MSCA). La distribution et l'abondance de poissons sont connues pour être associées aux habitats benthiques et à la qualité de l'eau. La pente des récifs profonds signalée pour avoir une grande couverture corallienne a connu une forte mortalité au cours des dernières années et est désormais dominée par des structures de relique de corail et un faible taux de couverture de coraux vivants. Un enregistreur de température sous l'eau a été utilisé pour surveiller les températures sous la surface de l'eau de mer en plongées, d'avril à juillet 2009. On ne sait pas combien de temps les agrégations de vivaneaux sorbes va continuer à exister en face d'un habitat modifié. En 1993, le Caribbean Fishery Management Council et le gouvernement des Iles Vierges ont déclaré une zone saisonnièrement fermée du 1er mars au 30 juin 30e pour protéger l'agrégation de frai de vivaneau sorbe (*Lutjanus analis*) au sud de Sante-Croix. La gestion de la zone a été réalisée presque exclusivement vers les extracteurs de la ressource halieutique et les sources ignorées qui ont fort probablement contribué à la modification de l'habitat. Vu l'association des communautés de poissons à l'habitat et le déclin des récifs coralliens en bonne santé, les pratiques de gestion des populations d'invertébrés de nature à préserver l'habitat de corail devraient être inclus dans les plans de gestion MSCA. Pour commencer, nous suggérons que le gouvernement américain coopère avec la communauté internationale ce décembre à Copenhague et participe à l'accord international sur les changements climatiques.

MOTS CLÉS: Récifs coralliens, gestion, *Lutjanus analis*

INTRODUCTION

The Mutton Snapper Seasonal Closed Area (MSSCA) is located 4 km off the south-western point of the island of St. Croix, U.S. Virgin Islands (USVI). The boundaries are given in Figure 1. The MSSCA lies near the southern drop -off and is 4.5 km long and 2.2 km wide (Figure 1) with depths from 12m to off the island shelf at a depth >200m. A bathymetry image of the outer reef edge which is typical of the preferred spawning aggregation location for *Lutjanus analis* is shown in Figure 2.

Latitude	Longitude
17°37.8' N	64°53.0' W
17°39.0' N	64°53.0' W
17°39.0' N	64°50.5' W
17°38.1' N	64°50.5' W
17°37.8' N	64°52.5' W

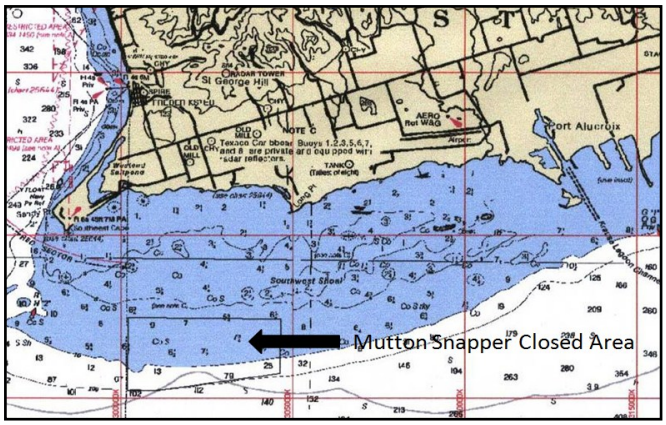

Figure 1. Mutton Snapper Seasonal Closed Area off St. Croix including latitude and longitude (WSGS-84) of boundaries.

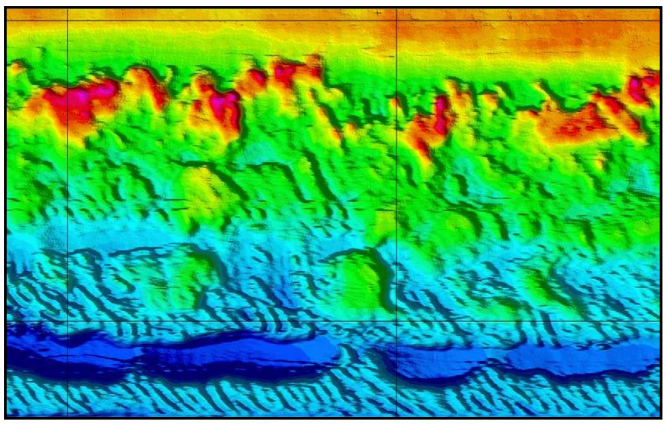

Figure 2. Example color bathymetry near the edge of the island shelf in the MSSCA (Geophysics GPR, 2003). The red / orange colors represent depth around 12-18m with the dark blue colors represents depths 25 - 30m.

Some interesting topography was present in SSS images just before the outer ridge on the south drop-off. Although a spawning aggregation was not observed during 10 dusk dives in April – June 2009, 65 ripe *Lutjanus analis* males and 30 ripe females (Kojis and Quinn In press) were caught in a habitat similar to that depicted in Figures 2, 3 and 4 showing flat sandy moats separating reef slopes.

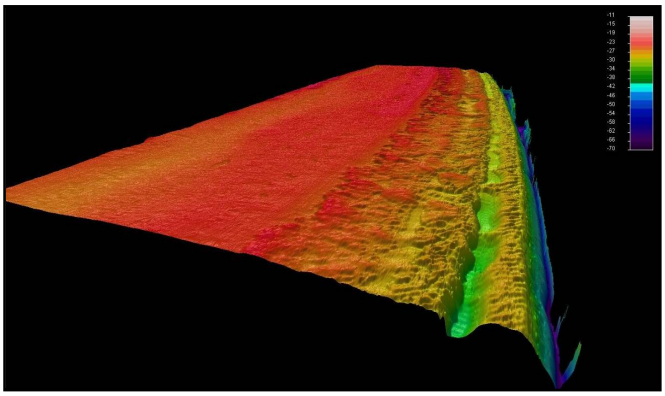

Figure 3. Multi-beam side scan sonar image of Mutton Snapper Seasonal Closed Area (Sidescan Geophysics GRP 2003). The red / orange colors represent depth around 12 - 18m with the dark blue colors representing depths of 25 - 30m.

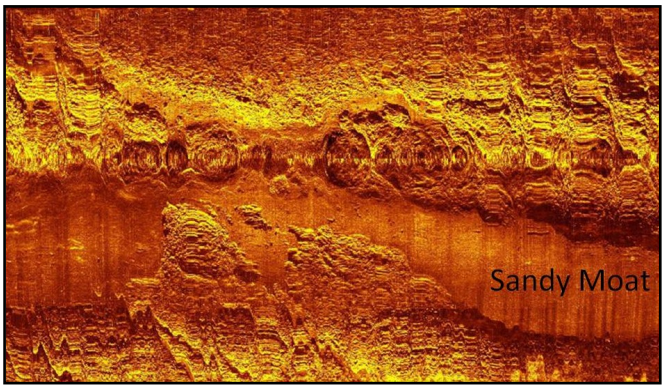

Figure 4. Side scan sonar mosaic (Prada 2003) showing sandy moat just before the outer ridge drop off similar to a location where many ripe *Lutjanus analis* were caught from April – June 2009.

Using mosaics in geotiff format from Side Scan Sonar (SSS) imagery processed at 0.2 m resolution, Prada (2003) generated detailed benthic habitat maps (Figure 5) through visual interpretation and delineation. Table 1 lists the habitats found in the MSSCA. SSS surveys of fish aggregations in the MSSCA were significantly smaller than fish aggregations at the Marine Conservation District off St Thomas and the Lang Bank closed area off S.t Croix (Rivera *et al*. 2005)

Prada (2003), however, was unable to provide an estimation of habitat classification accuracy of the maps for the MSSCA because of a lack of in water verification. She

consequently considered that the classification may need corrections and recommended that additional ground truth information should be collected for the full set of habitats, and particularly:

i) To better classify SSS mosaics not having distinct echo-returns nor sharp boundaries as observed, for instance at the Gorgonian Plain (GOPL) habitats, and

ii) To be able to estimate map accuracy for the Algae with Invertebrates (ALIN) habitat type.

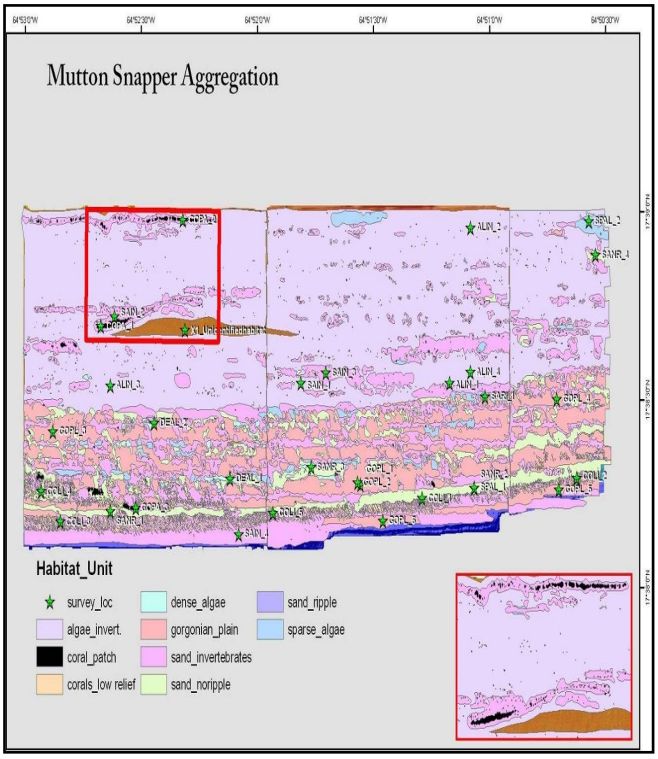

Figure 5. Example of classification of benthic habitats in MSSCA (provided by J. Blondeau from images provided by Prada (2003)).

Having more detailed habitat information, will not only benefit future users with more accurate maps, but also will allow complete habitat definitions. Knowledge of the habitat spatial distribution patterns is essential information for scientists and managers to have in order to maintain important Essential Fish Habitat within areas under legal protection and conservation (Prada 2003). The purpose of this study is to provide detailed in water verification of the classifications with metrics of dominant fauna / flora and substrate types and to characterize the temperature variation during the period of spawning.

Habitat Codes Descriptions

The following descriptions were identified from SSS as present in the MSSCA and described by Prada (2003):

COPA - Continuous corals are those areas predominantly covered by Scleractinian corals of medium to high relief extending <200 m in one linear dimension with a sharp boundary. COPA lies within COLI habitat.

COLI - Coral limestone was similar to COPA, but has a particular orientation perpendicular to the prevalent direction of current flow and less relief. This habitat was divided by sand channels and has been named "spur and groove".

GOPL - Prada describes this as flat areas covered mostly by gorgonian and sponge colonies and without a distinct boundary with adjacent habitats. In fact this habitat often had considerable vertical relief and usually consisted of large mounds with corals, gorgonians and sponges scattered over the surface.

DEAL - Dense algae are patches of presumed fleshy algae characterized by a dark and uniform side scan sonar return.

SPAL - Sparse Algae are broad areas of algae mixed with sand and having not distinct boundaries. SSS return identified alternating dark and bright areas corresponding to the algae and the sand respectively.

Table 1. Hierarchical classification scheme developed by Prada (2003) to generate detailed habitat maps around the USVI. The table lists the benthic habitats found in the MSSCA.

Meta Community	Community	Sub-community	Habitat Types	Habitat Codes
Coral and gorgonians on consolidated sediments	Corals	Coral Patch	Coral Patch	COPA
		Coral Low Relief	Coral Limestone	COLI
	Gorgonians	Plains	Gorgonian Plains	GOPL
Submerged Aquatic Vegetation on unconsolidated sediments	Macro-algae	Algae on Sand	Dense Algae	DEAL
			Sparse Algae	SPAL
			Algae and Invertebrates	ALIN
Bare or mixed invertebrates on unconsolidated sediments	Sand	Coarse Sand	Sand Invertebrates	SAIN
			Sand No Ripple	SANR
			Sand Ripple	SARI

ALIN – Algae with Invertebrates is similar to SPAL but has more invertebrates, which give additional structure to the habitat.

SAIN – Biogenic coarse sand covered with sparse corals and gorgonian colonies. The sand is a thin veneer over underlying hard bottom, Corals and gorgonians do not recruit on unconsolidated sediments.

SANR - Coarse sand similar to SAIN without abundant invertebrates which increases habitat structure. SSS pattern was characterized by its strong and continuous reflection from the sand.

SARI - Sand with ripple marks was a rare habitat similar to SANR but had distinct discontinuities in the SSS imagery.

The entire area of the Mutton Snapper Seasonal Closed Area is 692.4 ha. The specific area of each of the benthic habitats as determined by Prada (2003) is listed in Table 2. In some cases the distinction between the habitats is clear, while in other cases the change is gradual.

MATERIALS AND METHODS

Subsurface SeawaterTemperature

Using a ReefNet brand underwater temperature logger, the subsurface sea water temperatures were measured during each dive at a depth of 15 - 28 m.

Benthic Survey

Twenty photo quadrants were shot along at least five 20 m transect lines at each of the habitats described by Prada (2003) within the Mutton Snapper Seasonal Closed Area.

Using CPCe 3.6 software (Kohler and Gill 2006), the photos were classified into the substrate categories listed above and percent cover of nine substrate categories calculated.

RESULTS AND DISCUSSION

Subsurface Seawater Temperature

The mean subsurface seawater temperature in May 2009 was 27.7 °C (N = 8) and was 28.4 °C in June (N = 3) 2009. The temperature range in May was only about 0.2 °C while it ranged nearly 0.8 °C in June. Heavy rains in June resulted in cooler, lower salinity water seeping out from the reef at a depth of 22-28m in the MSSCA (Figure 6). The increase in temperature from May to June was consistent with ten years of subsurface sea water temperature patterns observations from a reef in St. Thomas, USVI (Quinn and Kojis 2003).

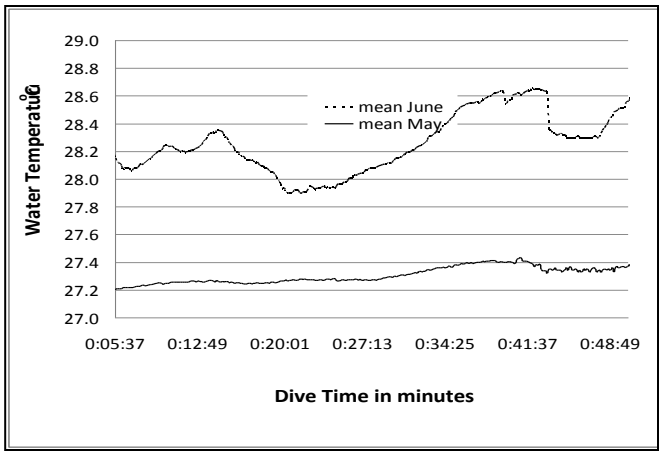

Figure 6. Subsurface sea water temperature in May (N=8) and June (n = 3) 2009 in the MSSCA.

Benthic Survey

Mean percent cover for the fauna / flora and substrate with each habitat classification is listed in Table 3. Live scleractinian coral cover was very low – even in habitats such as COPA and COLI (Table 3) that had a strong 3D structure created by corals. The dead coral skeletons in these habitats had high macroalgal cover, primarily *Lobophora*. Coral cover in similar habitats outside the MSSCA had been around 30% prior to the 2005 bleaching event (T. Smith Pers. com.).

The very thin layer of sand over hard bottom led Prada to misidentify the Meta Community for DEAL, SPAL and ALIN as "unconsolidated sediments" from the side scan signal. This Meta Community should be renamed SAV on consolidated sediments. SAIN is also a hard bottom habitat, but with more sand. Prada describes GOPL as flat areas covered mostly by gorgonian and sponge colonies and without a distinct boundary with adjacent habitats. In fact this habitat often had considerable vertical relief and usually consisted of large mounds with corals, gorgonians and sponges scattered over the surface.

Table 2. Total area (ha) of benthic habitats for the MSSCA (after Prada 2003)

	COPA	COLI	GOPL	ALIN	DEAL	SPAL	SAIN	SANR	SARI	Total
Total	4.7	15.6	102.9	341.3	2.8	13.6	162.9	48.2	0.4	692.4

Table 3. Percentage of invertebrate and substrate cover in habitat classifications in the MSSCA.

Taxa	COPA	COLI	GOPL	DEAL	SPAL	ALIN	SAIN	SANR	SARI
Coral	6.0	7.1	5.9	0.1	1.2	3.6	4.3	0.2	0.3
Gorgonian	1.0	2.1	2.7	0.0	0.0	0.1	1.2	0.0	0.0
Sponge	13.2	18.3	14.2	2.5	4.6	16.9	11.9	7.2	1.7
Macro algae	20.6	29.7	13.2	2.4	15.9	8.5	13.8	4.4	1.3
Other live	4.7	22.8	22.3	11.0	76.3	70.0	18.6	27.1	14.7
Dead coral	41.1	10.6	6.8	0.0	0.1	0.4	2.3	0.1	0.0
Coralline algae	8.3	4.8	1.4	0.0	0.0	0.1	0.5	0.0	0.0
Diseased coral	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sand, rubble, etc.	5.0	4.5	33.6	84.2	2.0	0.6	47.5	61.1	82.1
N	1	3	3	1	1	1	2	1	1

CLOSING COMMENTS

To protect coral reef habitat, especially because of its importance to fisheries, the Caribbean Fishery Management Council (CFMC) banned bottom tended fishing gear (traps, bottom long lines, etc.) in the MSSCA. However, the US Virgin Islands, which has jurisdiction over most of the MSSCA has not followed suit. It would behoove the USVI to also ban bottom tended gear within at least a portion of the MSSCA under its jurisdiction. The seaward or southern half of the MSSCA contains magnificent reef structures which, over time, might recover from the 2005 bleaching event which affected all Virgin Islands reefs (Miller *et al*. 2006).

Also, nearly thirty years ago Adey *et al*. (1981) observed that the surest approach to maintaining natural conditions is to prohibit all land and water use in the neighborhood of the reef. However, this statement is no longer true. While local impacts to reefs can certainly degrade or destroy reefs, regional and global factors are having more of an impact on reefs today. The current low coral cover in the MSSCA is largely a function of coral bleaching and disease. Coral bleaching in the USVI is related to higher than normal water temperatures, which in turn is related to global climate change. Bleaching stresses corals and makes them more susceptible to disease (Miller *et al*. 2006). We suggest that the USVI and US governments cooperate with the international community and be leaders in the International Framework on Global Climate Change.

ACKNOWLEDGEMENTS

Side scan sonar and multi-beam work done by Side Geophysics GPR International, Inc. J. Blondeau of the University of the Virgin Islands, CMES very kindly provided sidescan and multi-beam images of the overall MSSCA from Prada's data and coordinates of sample sites upon request for the various habitat types. We could not have accomplished this work without the competent boat handling, diving, and marine safety skills of G. Martinez and S. Martinez – Corcino. We also thank L. Carr for his assistance. We gratefully acknowledge funding from the Caribbean Fisheries Management Council – NOAA Coral Reef Conservation Grant Program/Projects to Improve or Amend Coral Reef Fishery Management Plans (CFDA Number: 11,463). We would also like to thank M. Rolon, G. Garcia-Moliner, and the CFMC staff for facilitating these efforts.

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