CORIS Submittal for Project 1068 – Assess/monitor affects of MPA status on reef fish populations and spawning aggregations in the Tortugas Ecological Reserves.

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CORIS Product Name – Final Annual Sampling Report FY2009

Project Summary:

Goals: Project goals were several. Primarily, we wanted to continue to collect visual census transect data enumerating all major predators (snappers and groupers) in order to determine if protection of fishes via ecological reserve designation was having any effect on population numbers. Secondly, we wanted to identify additional areas that were potential spawning sites for mutton snapper aggregations. We wanted to continue our work comparing numbers of major predators at stations inside and outside the Tortugas North Ecological Reserve in order to compare adjacent fished and un-fished areas. We wanted to conduct photographic transect surveys for habitat characterization on the stations in the TSER. While a long term goal of this project has been to conduct visual census work at TSER during the winter months to explore for grouper aggregations, this has not been possible in the last few years due to funding cycle issues. We hope to be able to resume this work in the future, especially in light of recently published research on multi-species spawning sites. Nonetheless, our observations of grouper numbers during the summer months, outside the spawning season, give us good background data for future comparisons. (Note: as of the writing of this report, this investigator has been funded to do acoustics/visual census work in the TSER in the winter months to explore grouper aggregations.)

Significance: This project is very significant from a Sanctuary management standpoint because we are trying to assess the fisheries resources of the Riley's Hump area of the Tortugas South Ecological Reserve. Since the southern reserve was established specifically with the protection of mutton snapper spawning aggregations in mind, it seems important to try and determine if the establishment of the reserve is contributing to a population increase in the species and the reestablishment of the historically large spawning aggregations. Similarly, fishermen know Riley's Hump as a place where grouper are abundant. The area has never been explored to scientifically document the existence of grouper spawning aggregations. The presence of grouper aggregations forming in the reserve would provide added justification for the designation, creation and continued existence of the Tortugas South Ecological Reserve. The comparison of snapper-grouper populations within and outside the Tortugas North Ecological Reserve directly addresses the question of whether protected areas offer enough protection to target or exploited species to enhance population abundance between fished and unfished areas.

Hypotheses: H_0: Numbers of snappers and groupers are not increasing at Riley's Hump since the creation of the South Tortugas Ecological Reserve in 2001.

$H_{O.2}$: There is no difference in snapper and grouper abundance in stations located within the TNER and stations outside the TNER.

Results: We conducted a research cruise to stations in the Tortugas South Ecological Reserve (TSER) (Fig. 1) and the Tortugas North Ecological Reserve (TNER) during the period July 7-12, 2009. A total of 16 scientists and volunteers went. Participants included biologists from the NMFS Beaufort Laboratory, NOS's CCFHR Beaufort facility, the SEFSC's Miami laboratory, the SEFSC's Panama City Laboratory, the Florida Fish and Wildlife Commission's Marathon Laboratory, The University of South Florida's Dept. of Marine Science, and volunteers from the Reef Environmental Education Foundation.

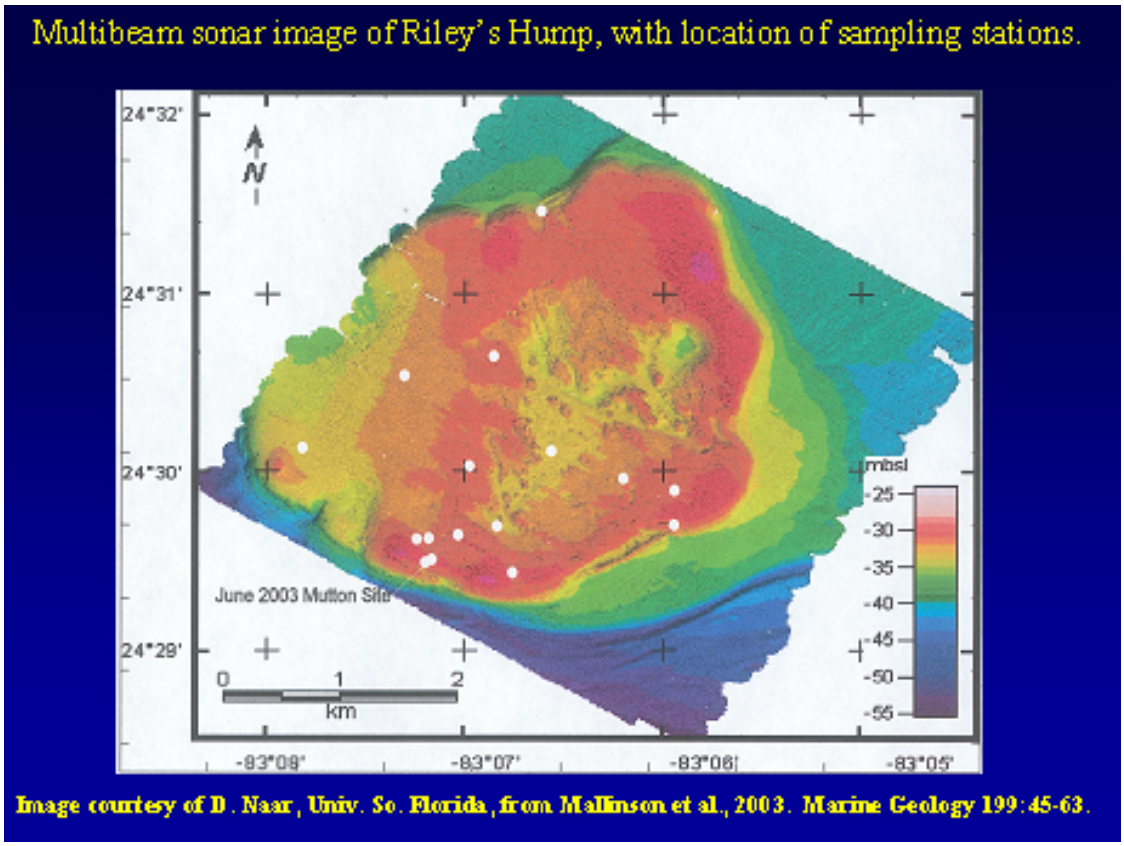

Fig. 1. Multibeam image of Riley's Hump, northeast corner of Tortugas South Ecological Reserve.

In 2009 we completed 125 visual fish census transects in the TSER and 32 in the TNER. WE continued our search in probable locations for spawning aggregations of mutton snapper. We recorded three different spawning events of smaller groups of mutton snapper photographically, probably the first documentation of this occurrence. We expanded our overall exploration for probable spawning aggregation sites and spawning aggregations (mutton snapper) by deploying a split beam transducer and echosounder using a custom tow-fish, towing the acoustic fish for approximately 3 to 4 hours on three of the nights (7-9 July 2009). Only fish >1m from the bottom and greater than -45dB (approximately 20cm) are included in this report due variable transducer orientation and sea conditions. We surveyed 16.2 linear km around the historical location of mutton snapper aggregations (Station 12, Figure) on 7 July 2009. The survey design was intended to

provide a broad survey of the S-SW region of Rileys where mutton snapper have been observed in previous years (Figure 2). The second stage on 8 July was a survey that was focused with tighter lines around locations of observed snappers (or large fish detected using sonar). Fishes within the range of sizes expected to be mutton snapper (>30 cm) were observed in the echogram. In some cases, large fishes were in the same vicinity, but no large and tightly packed aggregations were detected (Figure 3).

Table 1. No. Visual Census Transects, Tortugas Ecological Reserves Study, 2002-2009

Year	2002	2003	2004	2005	2006	2007	2008	2009
TSER	168	69	48	65	73	106	122	125
TNER	---	---	18	36	34	32	35	32

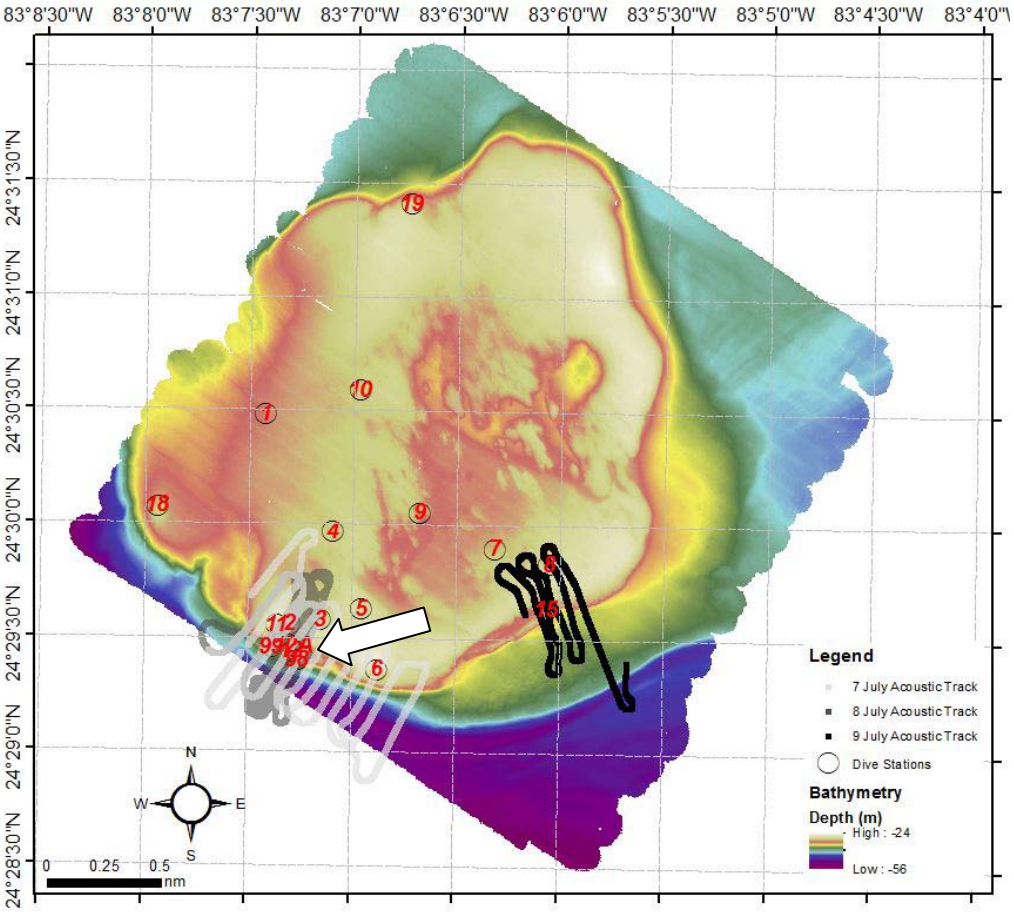

Figure 2. Locations of acoustic survey tracks for 7-9 July 2009. Dive stations and bathymetry are also added for spatial reference. White arrow represents area of interest and general location where mutton snapper have been observed. (Figure provided courtesy C. Taylor and B. Degan, CCFHR, NOS, NOAA, Beaufort NC.)

With additional scrutiny of the acoustic data in Echoview, it may be possible to extract more fish tracks for fish in closer proximity to the. We acquired large quantities of acoustic data that will be

analyzed to define new sites to explore in the future with potential as essential fish habitat for spawning aggregations, both snappers and groupers (Fig. 3).

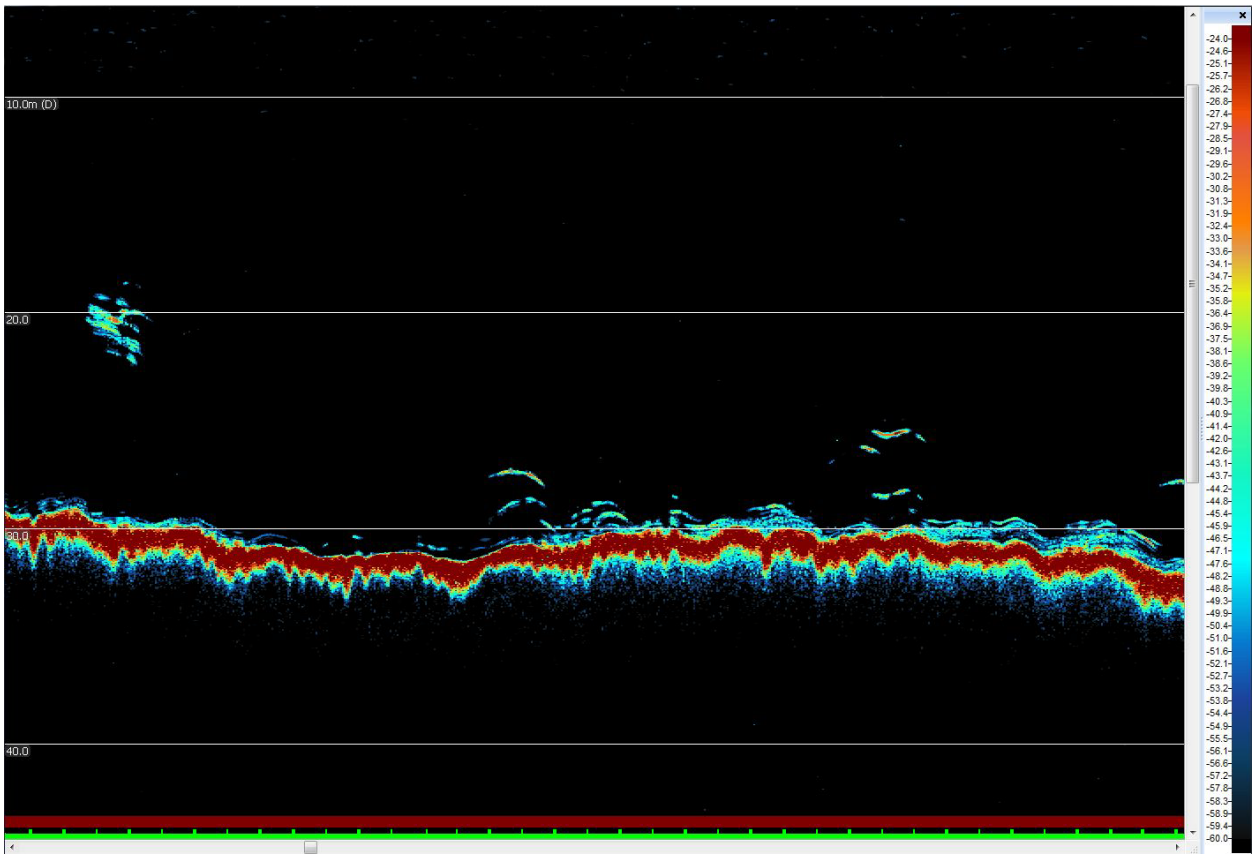

Figure 3A. Excerpt of echogram from 8 July 2009 hydroacoustic survey in the vicinity of Station 12/12A shown with the white arrow in Figure 2. Time is represented along horizontal axis, and depth is vertical axis. Red color represents high acoustic energy of the bottom. Color scales from blue to pink indicating strength of echoes. Fish traces are observed well off the bottom and roughly -30 dB, which is within the range of expected fish sizes. (Figure provided courtesy C. Taylor and B. Degan, CCFHR, NOS, NOAA, Beaufort NC.)

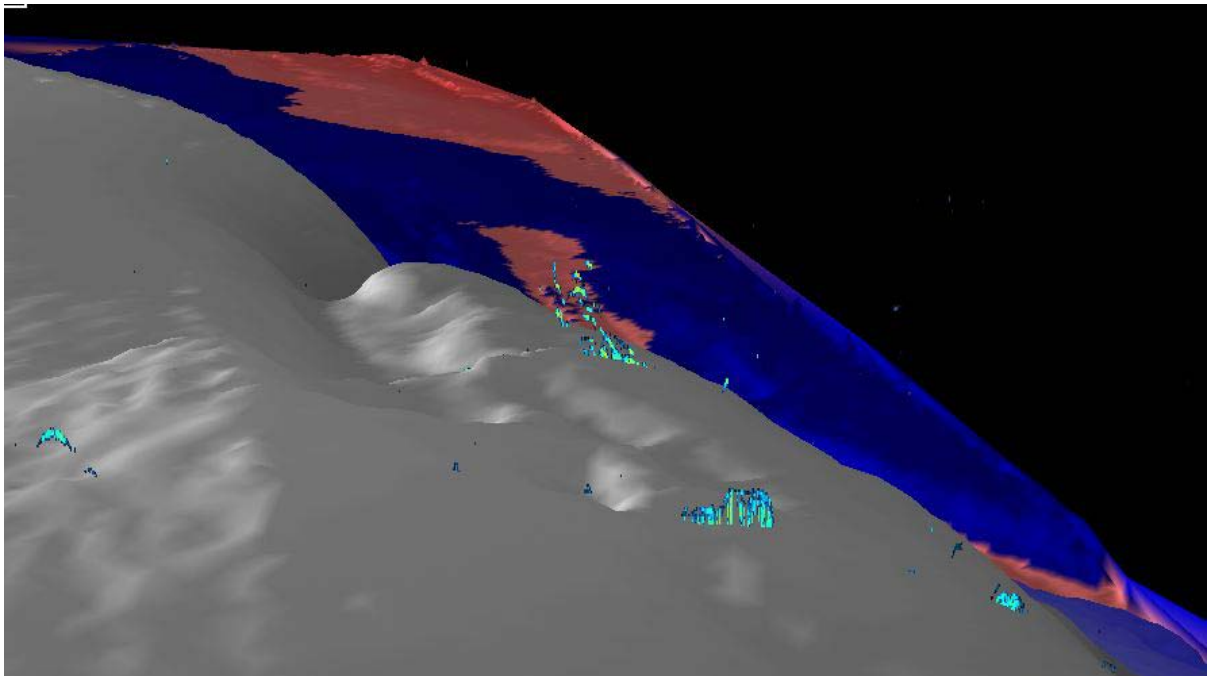

Figure 3B. 3D perspective of large fishes detected over outer ridge on the S-SW edge of Rileys Hump. Grey, blue and salmon color are depth catagories. The red-blue color on the echo traces are representations of acoustic strength as described in Figure 3A.

We assisted with a FWC study investigating spatial and temporal rates of movement of acoustically tagged snappers and groupers in the Tortugas region, including annual spawning migratory movements between Riley's Hump (RH), the Tortugas Ecological Reserves (TERs) and the Dry Tortugas National Park (DRTO), including the Research Natural Area (RNA). A VemcoVR28 tracking system, a 4-channel receiver that provides transmitter position and bearing, was towed on two of the nights for up to 3 hours at a time to confirm the presence of tagged fish (8 mutton snapper, 2 red grouper, and 1 Nassau grouper were successfully tagged with VEMCO V16-4H coded transmitter tags at Riley's Hump). Our cruise corresponded to a post-tagging time of two weeks, and several acoustic recaptures were recorded. We plan to use the VR28 tracking system on future cruise collaborations with FWC to expand the geographic coverage of the VR2s in the region and more thoroughly document the usage of the ecological reserves by these important species.

In 2009 we retrieved all of three temperature loggers deployed in 2008, on stations on the north, south and east ends of Riley's Hump, the prominent sea bottom feature of the TSER. We redeployed new temperature loggers on all three stations. All three loggers were deployed by attaching them with cable ties to a 4 to 5 ft length of reinforced steel bar, painted with high visibility yellow spray paint, hammered into the seafloor at the precise coordinates of the sampling station. We now have a five year time series of seafloor temperature data, unfortunately split in the middle by the loss of all loggers during the 2005 hurricane season. We anticipate this data to be a valuable input into NOAA's climate science program.

We continued to document recovery of the spawning aggregation of mutton snapper by censusing station 12 during the summer spawning months. In 2009 we not only continued to see large numbers (thousands) of mutton snapper on particular dives (not every dive, however), but we observed and documented actual spawning of small groups of mutton snapper in the water column. Spawning was observed by divers in June and July, and recorded by an underwater video camera left deployed on the bottom overnight. All instances of spawning occurred at approximately 1630 hours during the week of the full moon.

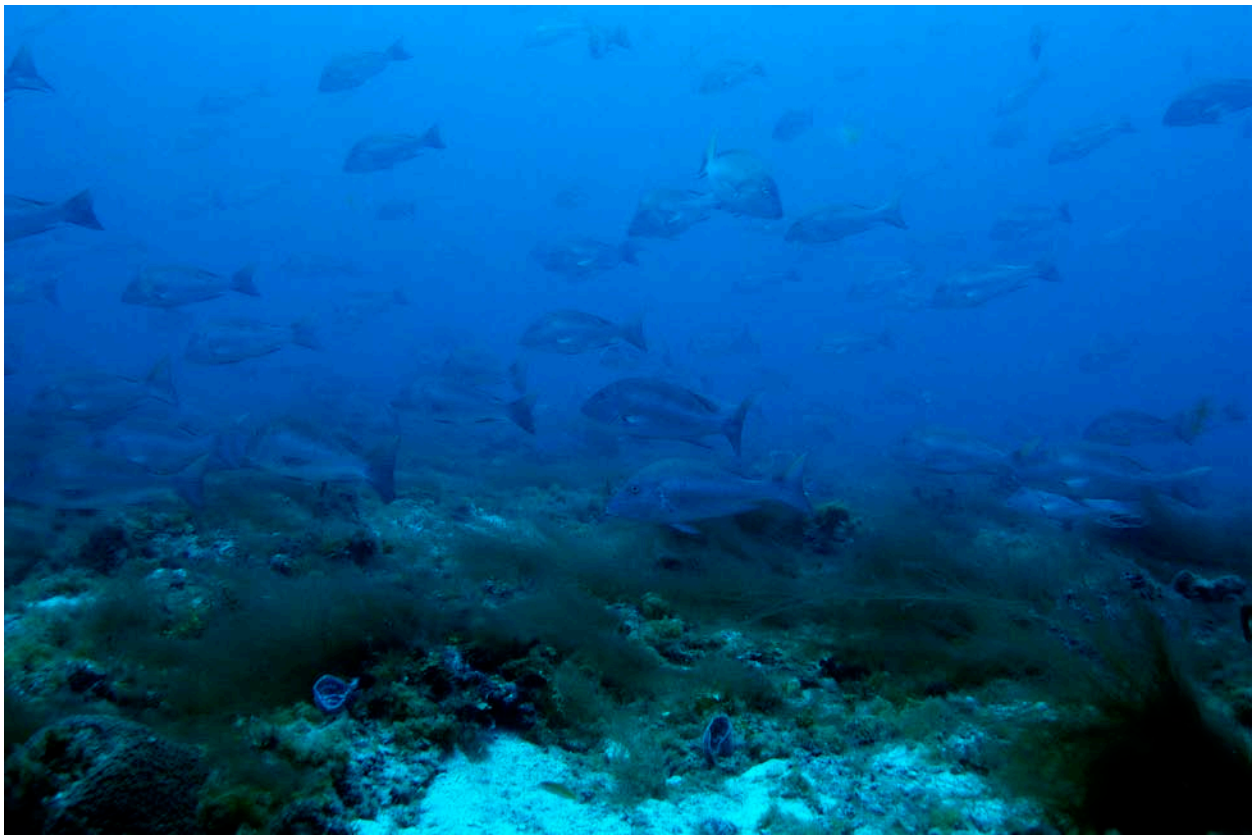

Fig. 4. Mutton snapper 'aggregation' at Riley's Hump, June 2009.

We remain extremely interested in conducting winter time work for exploration of grouper aggregations on Riley's Hump. This has been problematic because of the federal budget process and the inability to get monies from the NOAA Coral Reef Conservation Program until the spring, and attempts to carry over money into the next fiscal year have been disapproved by the funding agency. We are seeing increasing numbers of black and yellowfin grouper during the summer months, which encourage us to think the reserve is having the intended effect at rebuilding exploited stocks. We eventually were awarded CRCP funds to look at winter grouper aggregations acoustically, we will complete that data collection in the summer of 2012, and we will provide an analysis and summary shortly thereafter.

We assessed predator abundance in the Tortugas Ecological Reserves over 157 randomly oriented 30 m visual census transects in each year, and trends indicate that abundance of key species (e.g., mutton snapper, black grouper) is increasing when compared with the pre-reserve time period (prior to 2001). Additionally, we documented that the previously overexploited

mutton snapper spawning aggregation is successfully reforming each summer and spawning, and both of these results indicate that marine protected areas protect and replenish exploited populations.

Publications/Presentations resulting from research

Rileys Hump, South Tortugas Ecological Reserve: A preliminary comparison of snapper grouper populations before and after marine reserve designation. Talk and power point presentation to Florida Keys National Marine Sanctuary Advisory Committee, Marathon, Florida, April 2004.

Rileys Hump, South Tortugas Ecological Reserve: A preliminary comparison of snapper grouper populations before and after marine reserve designation. Poster presentation, Gulf and Caribbean Fisheries Institute Meeting, November 2004, Tortola, British Virgin Islands.

Burton, M.L., K. J. Brennan, R. C. Munoz, and R. O. Parker, Jr. 2005. Preliminary evidence of increased spawning aggregations of mutton snapper (*Lutjanus analis*) at Riley's Hump two years after establishment of the Tortugas South Ecological Reserve. Fish. Bull. 103:404-410.

Shulzitski, K, M. McCartney, and M. L. Burton. 2009. Population connectivity among between Dry Tortugas, Florida and Caribbean populations of mutton snapper (*Lutjanus analis*), inferred from multiple microsatellite loci. Fishery Bulletin 107: 501-509.