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Spatial and temporal patterns in demographics and catch rates of red grouper from a fishery-independent trap survey in the northeast Gulf of Mexico, 2004-2005

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Introduction

In 2002 the Panama City NMFS lab began work on developing a fishery-independent survey on the inner shelf of the eastern Gulf of Mexico utilizing chevron fish traps with the objective of establishing an age-based annual index of abundance for young (approx. age 0-3), pre-recruit gag, scamp, and red grouper. The chevron trap had been tested and found to be efficient at capturing a broad size range of several species of reef fish (Nelson et. al.1982, Collins 1990), and has been used by the South Atlantic MARMAP program for over 20 yr (McGovern et. al. 1998). Other objectives of the survey included examining regional catch, recruitment, and demographic patterns of several other economically important reef fish species in the NE Gulf

The first two years, sampling was restricted to the Panama City area and focused on determining how effective the traps were in capturing pre-recruit shallow water groupers, comparing effects of bait type and trap throat size, and observing behavior of the three grouper species within and outside the trap. Although the initial plan was to use exactly the same trap configuration and soak time used in the South Atlantic MARMAP program (McGovern et. al. 1998) so that findings would be directly comparable, results in 2003 indicated that traps with a throat size area 50% of that used in the MARMAP program much more effectively met our goal of capturing enough individuals of all three species of grouper. Video data and consultations with fishermen suggested that larger aggressive red grouper occurring offshore had a dominant effect on trap catches. At 100% throat size, red grouper far exceeded gag and scamp in trap catches (0.7, 0.07 and 0.2 per hour, respectively). At the 50% throat size, red grouper numbers declined notably to 0.21 per hour while all other species increased (gag to 0.24 and scamp to 0.27 per hour). At 33% throat size, overall fish numbers dropped off and red grouper were very rare in the catch. Results for abundant species such as red snapper suggested that the reduction in throat size did not affect size composition. Beginning in 2004, the 50% trap throat size became the standard.

In 2004 the survey was expanded spatially to include hard/live bottom sites in the Big Bend region of Florida off Carabelle and Steinhatchee. Potential site locations were obtained from various sources and found fortuitously during the course of conducting the survey. In most cases potential sites were sampled only if cursory hook and line sampling indicated the presence of species associated with hard/live bottom, e.g. white grunt, black seabass, lutjanids. Beginning late in 2004, all potential sites were evaluated using an underwater video camera lowered to the bottom which provided live video to the research vessel.

Beginning in 2005, at many of the sites, visual (stationary video) data on relative abundance and species composition was collected immediately preceding the trap set. This was done to provide insight on trap selectivity, better information on community structure, relative abundance estimates on species rarely or never caught in the trap, and an additional, independent estimate of abundance on species typically caught in the traps.

This report presents data on catch rates, frequency of occurrence, and size and age structure of red grouper caught by chevron traps on inner shelf waters of the northeast Gulf of Mexico in 2004 and 2005. Results of the small pilot study in 2005 comparing trap and video estimates of relative abundance of red grouper are also presented.

Methods

The chevron fish trap used in this survey was constructed of 1.5-inch vinyl-clad wire mesh, and was 1.76 m in length in its greatest dimension, 1.52 m in width, and 0.61 m in depth. Traps were freshly baited with frozen Atlantic mackerel on each set. Two mackerel were cut in half, threaded on stiff wire, and tied inside. One was cut in thirds, with two pieces wired in the throat (entrance) of the trap and one just inside the throat opening. Soak time was 90 min during daylight hours (1hr after sunrise-1hr before sunset). Because catch rates of all three species of groupers showed extreme variability (many zero catches) during preliminary work in 2002 and 2003 and our sample site universe was small, all sites were sampled at least once a year (some twice) in hopes of increasing the accuracy and precision of our abundance estimates. Logistic constraints precluded us from even randomly selecting the order of sampling. Our goal is to eventually have a sample universe large enough to allow stratified random selection of a subset of sites each year.

All red grouper caught in the traps were counted and measured to maximum total and fork lengths (mm). Otoliths were obtained from all specimens and processed at the Panama City Laboratory. Otoliths were examined either whole or sectioned, depending on the size of the fish, and ages assigned by persons with considerable experience ageing red grouper.

Beginning in 2005, visual data on relative abundance was collected using an array comprised of four video cameras mounted at 90E angles to each other in the horizontal plane at a height of 30 cm above the bottom of the array. Soak time was 30 min to allow sufficient time for sediment stirred up during camera deployment to dissipate and ensure tapes with an unoccluded view of at least 20 min duration (Gledhill and David 2003). At those sites where both the trap and video camera array were used, the latter was deployed first. The array was then retrieved and the trap deployed in the same location. This provided data from both gears at the same site on the same day, eliminating all but extremely short term temporal effects which could confound the comparison.

To analyze the video data from a given site, tapes of all four cameras were scanned, then the tape with the best view of the habitat (if there was a difference) was examined in detail. If none of the four tapes was obviously better, one was randomly chosen. The estimator of abundance was the maximum number of red grouper in the field of view at any time during the 20 min viewed.

Results

Results to date have been promising and support the utility and feasibility of using chevron traps to monitor long-term abundance trends in pre-recruit red grouper. In 2004, Jun 24 - Nov 22, red grouper were caught in 18 of 59 (30.5%) trap sets made at 49 unique sites in the northeast Gulf of Mexico in depths from 8.6 to 37.2 m (Fig. 1). In 2005, Jun 9 - Oct 15, red grouper were caught in 33 of 101 (32.7%) trap sets made at 77 unique sites in depths from 6.4 to 31.4 m (Fig. 1). West of Cape San Blas, a known hydrographic and zoogeographic boundary, 27.3% of trap sets contained red grouper in 2004 and 41.7% in 2005. East of Cape San Blas (the Big Bend region), the frequency of occurrence was 34.6% in 2004 and 29.9% in 2005. Not surprisingly, the distribution of catch rates of red grouper was highly skewed, with a large proportion of zero catches, usually only one or two individuals in those sets where any were caught; and no obvious differences east and west of Cape San Blas (Fig. 2). Among those sets west of San Blas which caught red grouper, the median catch per trap hour was 1.27 in 2004 and 0.93 in 2005, while east of the Cape, median cpue was 1.31 in 2004 and 1.29 in 2005 (Fig. 3). Although there was very little overlap in depths sampled east and west of Cape San Blas, a plot of CPUE (positive catches only) on depth (Fig. 4) showed no obvious differences between the two regions nor any obvious relationship between CPUE and depth.

Size and age structure of red grouper were clearly different east and west of Cape San Blas. In 2004 most (68%) red grouper caught east of the Cape were age two, while west of the Cape 71% were age five (Figure 5). In 2005 the catch east of the Cape was dominated (89%) by three year olds, while six year olds predominated (62%) to the west. These data also clearly showed that at least two strong year classes – 1999 and 2002 - were present in the population in the northeast Gulf. The 1999 year class also dominated the commercial and recreational landings in 2004 and 2005 (Lombardi-Carlson et al., 2006). In 2004 the modal length was 350 mm TL east of San Blas versus 525 mm west of the Cape (Figure 6). The following year there was a strong mode at 400 mm east of the Cape and a very weak mode at 550 mm to the west.

The rarity of any fish under age four in catches west of Cape San Blas, even as an apparently strong 2002 year class dominated catches to the east, strongly suggests that the fishery in that area is totally dependent on recruits from east of the Cape. Although there was very little overlap in the depths sampled in the two areas, there is virtually no hard/live bottom habitat west of the Cape any shallower that what was sampled in the survey, and small, young (age 0 or 1) red grouper are quite rare in the nearshore and inshore area around Panama City. The rarity of older (ages 4-7) individuals in catches east of the Cape is likely related to the shallower depths (mean = 13.2 m) sampled there compared to those sampled west of the Cape (mean = 25.3 m) (Figure 4). Given that the majority of all commercial and recreational landings of red grouper are made east of the Cape, larger, older individuals obviously occur there, but there is apparently an ontogenetic movement to deeper depths.

Visual data was collected at 41 of the 101 trap sites in 2005 and all were east of Cape San Blas. Red grouper were seen at 7 (17.1%) of those 41 sites, compared to 9 of 41 (22%) in corresponding trap sets, but in only 2 instances were they both seen and caught in the trap.

Conclusions

Despite the short time series and limited number of samples, the trap survey has already provided considerable insight on spatial, bathymetric, and demographic patterns of red grouper, as well as many other reef fishes in the NE Gulf. The age structure data were surprisingly clear, despite annual sample sizes within areas (east vs. west) of only 19-47 fish, demonstrating the potential value of a trap survey for monitoring population trends in red grouper.

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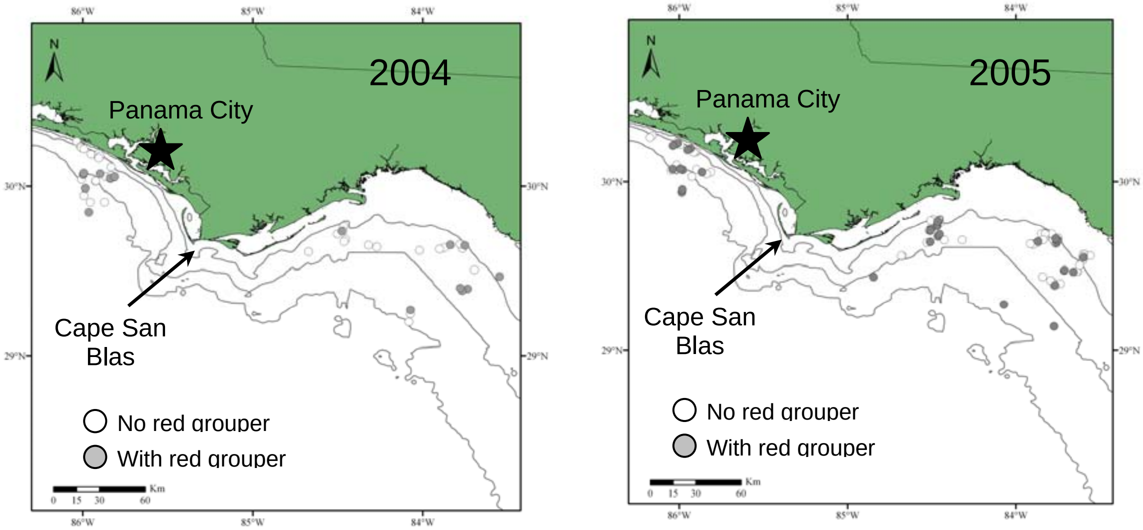

Figure 1. Red grouper chevron trap survey sites in 2004 and 2005.

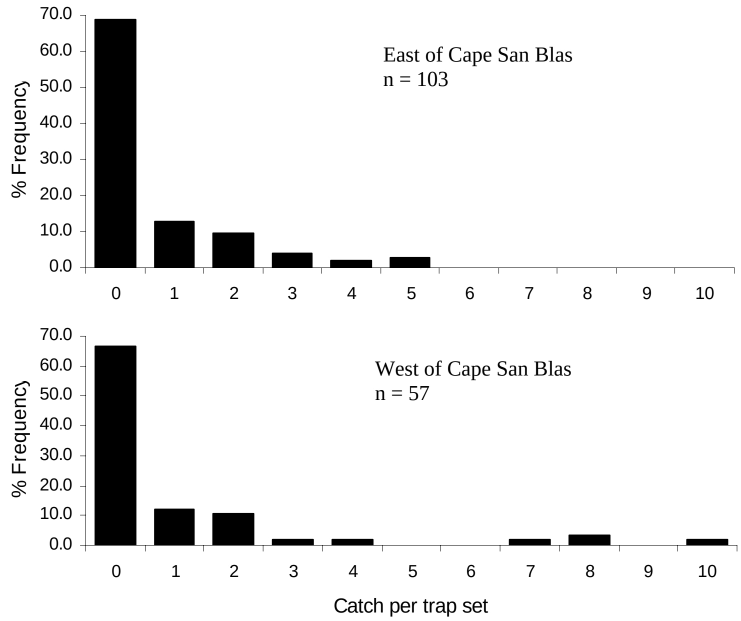

Figure 2. Frequency distributions of red grouper catch per trap set east and west of Cape San Blas for all sets in 2004 and 2005.

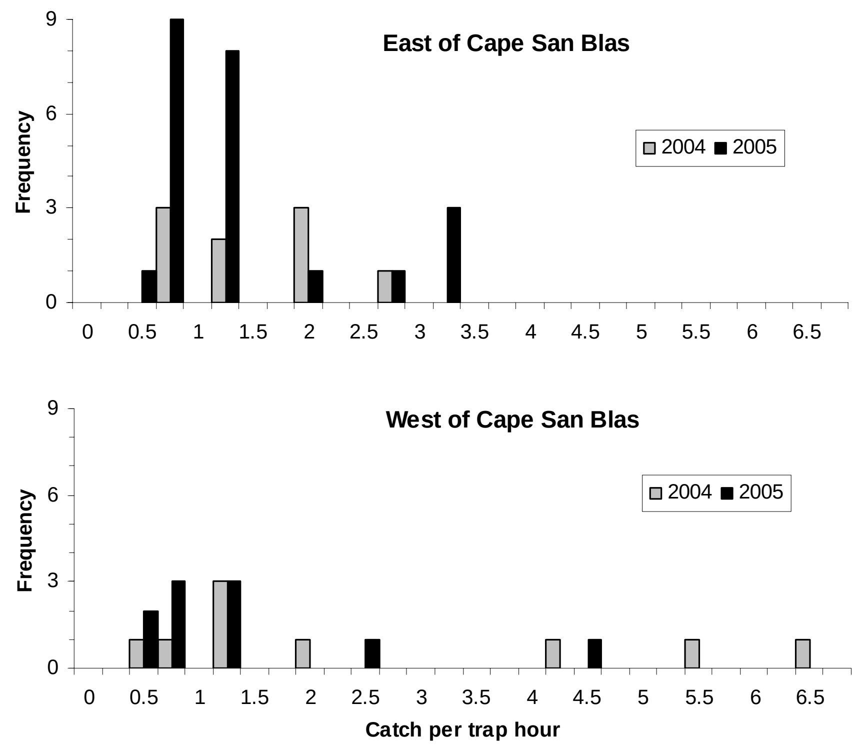

Figure 3. Frequency distributions of red grouper catch per trap hour (positive catches only) by year east and west of Cape San Blas.

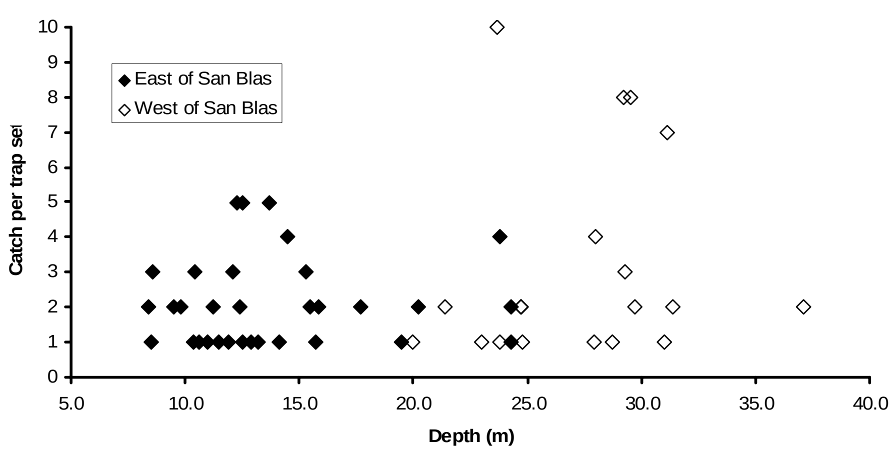

Figure 4. Distribution of red grouper catch per set versus depth for all positive catches.

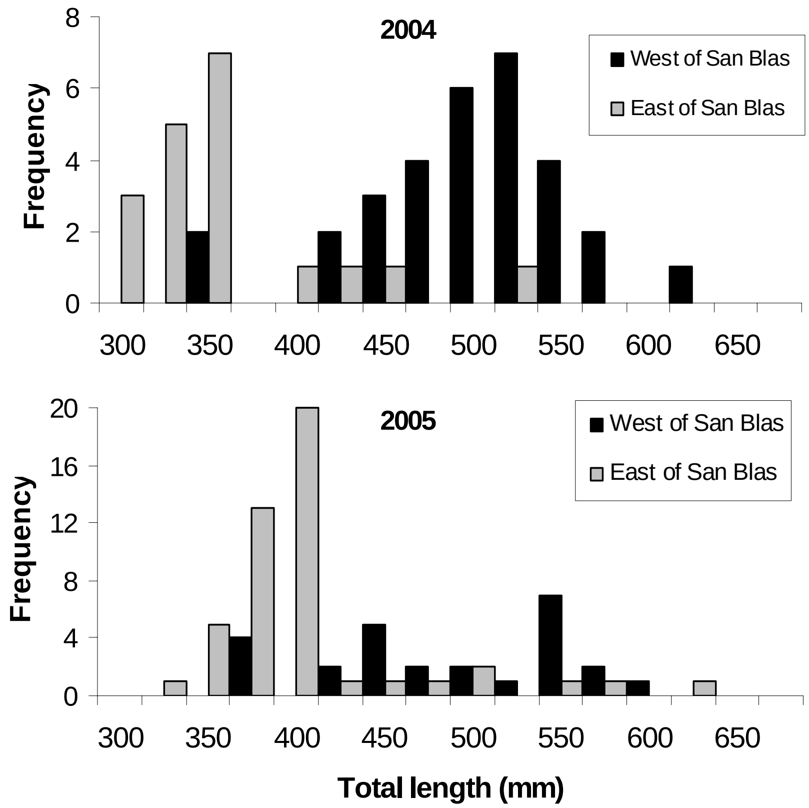

Figure 5. Size distribution of red grouper caught in chevron traps east and west of Cape San Blas during 2004 and 2005.

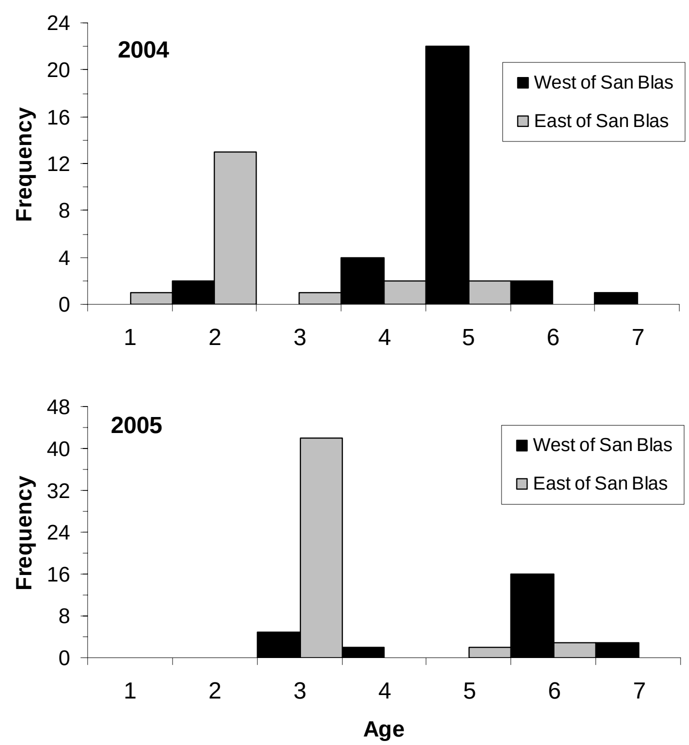

Figure 6. Age distribution of red grouper caught in chevron traps east and west of Cape San Blas during 2004 and 2005