A Comparison of Reproductive Potential of Red Snapper, *Lutjanus campechanus*: Natural and Artificial Habitats in the Northern Gulf of Mexico

Comparación del Potencial Reproductivo de Pargo Rojo, *Lutjanus Campechanus*: Hábitats Naturales y Artificiales en el Norte del Golfo de Méxicoune

Comparaison de Potentiel Reproducteur de Snapper Rouge, *Lutjanus Campechanus*: les Habitats Naturels et Artificiels dans le Golfe du Nord du Mexique

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EXTENDED ABSTRACT

Reproductive potential is an important component of fisheries management that can help identify either stock recovery or signs of overexploitation. Without a healthy spawning population a stock may have a difficult time recovering from overfishing (Trippel 1995). The red snapper *(Lutjanus campechanus)* fishery is especially sensitive to overfishing because the species is long lived (50+ years) and reaches peak fecundity at over 10 years of age, although red snapper can mature as early as age 2 (Collins et al. 1996). Red snapper are broadcast gonochoristic spawners with the ability to spawn multiple times during a season. Juvenile mortality is high and the possibility of an egg surviving to become a reproductively active adult and contribute to the population is very low. The recreational and commercial fisheries for red snapper are economically important to Louisiana and other states along the Gulf of Mexico (GOM). Therefore, a substantial, healthy spawning population of red snapper would greatly benefit both the species and the managers of this species.

Information regarding red snapper reproduction in the northern GOM is based almost exclusively on studies at artificial habitats. Some studies suggest the addition of artificial reefs into the GOM produces an increase in the biomass of red snapper (Shipp and Bortone 2009). Other studies have also shown a younger red snapper age structure and lower reproductive potential at artificial habitats (Gallaway et al. 2009). If artificial reefs are producing red snapper with decreased reproductive potential, there is the possibility that the resulting cohorts could be stressing the population due to the reduction in offspring produced by these cohorts. It would follow that the resulting year classes will be weaker if the population relies on the reproduction from fish within artificial habitats. Red snapper in natural habitats are potentially crucial to the population, but information regarding the species in these habitats is sparse. The lack of information on red snapper from the natural habitats makes comparisons of life history variables between the habitat types difficult.

Few quantitative studies of red snapper reproduction have been conducted on specimens from offshore natural hard bottom (NHB) banks in the northern GOM. These banks are located from 80 km to120 km off the coast of Louisiana at 30 m to 300 m depth. The series of banks runs along the Louisiana/Texas continental shelf from the Mississippi River to the West and East Flower Gardens south of Galveston, Texas (Rezak et al. 1990). This study focused on three NHB habitats that both represent an east to west gradient among the banks and are easily accessible by boat from southern Louisiana. Two other artificial reef sites in the study represent eastern and western artificial habitats (AH) within the northern GOM.

This study compares reproductive potential of red snapper from AH and from NHB. The natural hard bottom habitats in the GOM are thought by some to be historical centers of abundance for this species, given that red snapper are a relief associated fish and the existence of the banks precedes artificial reef in the GOM. Red snapper were collected in the summer (June-August) of 2009 and 2010 and then again twice quarterly from 2011 to 2013. Three NHB sites (Jakkula, McGrail, and Bright Banks) and two AH sites (East Cameron and Eugene Island) were sampled. Red snapper were collected opportunistically with vertical long lines and single hook lines. All female red snapper were measured for total length, total weight, and eviscerated body weight. Ovaries were removed and frozen at sea. In the lab, ovaries were weighed and fixed in 10% formalin for a minimum of two weeks. Histological slides from sectioned ovaries were then prepared either at the LSU Vetinary School or in our laboratory. Mean gonadosomatic index (GSI) values were plotted by month to examine seasonal changes in red snapper reproductive potential among sites. The GSI is indicative of the energy a fish has invested in reproduction, thus a larger GSI corresponds with a greater potential reproductive output.

Red snapper GSI at all sites was significantly higher in June, July, and August, during peak spawning season, than for other months (Figure 1, ANOVA, $p<0.0001$). The GSI were not significantly different among sites in other non-peak spawning months (September-May). Data from summer samples were graphed individually and showed red snapper mean GSI was higher at the three natural habitats than at artificial habitats (Figure 1). When the sites were pooled by habitat type the data show that red snapper from NHB sites exhibited higher mean GSI than red snapper from AH sites (Figure 2, ANOVA, $p < 0.0001$) during all peak spawning months.

We hypothesize these differences may be attributed to more abundant older fish at NHB sites that invest more energy to reproduction and less energy to growth. These results corroborate previous studies, which found age 2-3 red snapper dominate AHs, whereas older individuals are normally found inhabiting NHBs (Gallaway et al. 2009). Habitat differences in red snapper mean GSI could be the result of disparate age structure of red snapper between the habitats. Moving forward, age and growth data from fish collected in this study will be used to help elucidate possible mechanisms driving the large disparity in red snapper mean GSI between the habitat types.

KEY WORDS: Red snapper, reproduction, gonadosomatic index (GSI)

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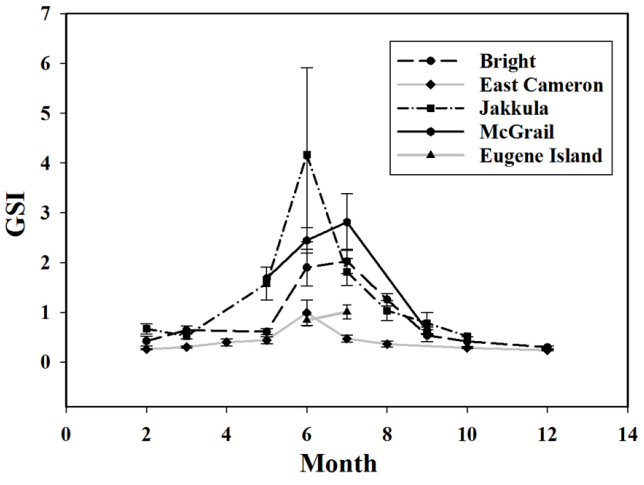

Figure 1. Monthly mean gonadosomatic indices (GSI) of female red snapper *(Lutjanus campechanus)* sampled from the Gulf of Mexico. Jakkula, McGrail, and Bright are natural habitats; Eugene Island and East Cameron are artificial habitats. Verticle bars are 95% confidence intervals for the means.

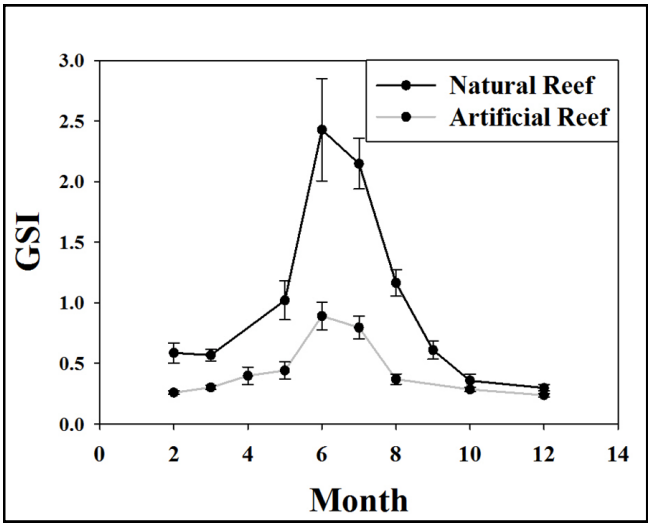

Figure 2. Monthly mean gonadosomatic indices (GSI) of female red snapper *(Lutjanus campechanus)* sampled from the Gulf of Mexico. Data was pooled by habitat, natural hard bottom banks Jakkula, Bright, McGrail and artificial reefs Eugene Island, East Cameron. Verticle bars are 95% confidence intervals for the means.