Spatial Distribution and Habitat Associations of Spawning Spotted Seatrout *(Cynoscion nebulosus)* in South Texas

Distribución Espacial y Asociaciones de Hábitat del Desove de Seatrout Manchado *Cynoscion nebulosus)* en el Sur de Texas

Répartition spatiale et associations d'habitats de la multiplication du truite de mer à pois *(Cynoscion nebulosus)* dans le sud du Texas

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EXTENDED ABSTRACT

Spotted Seatrout *Cynoscion nebulosus* are among the most sought-after fish by recreational fishers throughout the Gulf of Mexico. In Texas, seatrout were the most harvested fish over the last 10 years, comprising 40% of the annual recreational catch on average (NMFS 2017). Seatrout have a protracted spawning season (April – September) in the Gulf of Mexico and spawn along the coast and in estuaries (Brown-Peterson et al. 2002). While general information exists on the spawning habitat for spotted seatrout, there is insufficient knowledge about how spawning activity or fish abundances coincide with specific habitats (e.g. seagrass beds, oyster reefs, oil/gas platforms, navigation channels) in Texas and how such factors vary with changes in environmental conditions (e.g. salinity, temperature, depth).

Drumming sounds produced by seatrout during spawning have been extensively described and classified according to their cadence and frequency composition (Mok and Gilmore 1983, Montie et al. 2017), which makes the use of hydrophones an effective strategy to identify spawning sites (Walters et al. 2009). Hydrophones can measure the sound pressure level (SPL) at different frequencies, which can be used to identify the species calling and the relative number of individuals (Connaughton & Taylor 1995, Luczkovich et al. 1999). The goal of this project was to characterize the locations and dynamics of spotted seatrout spawning within and adjacent to the Mission-Aransas Estuary near Port Aransas, Texas.

The study areas included Redfish Bay, Aransas Bay and the East Flats area of Corpus Christi Bay, Texas. Each region was divided into 1 nm^2 grids with each full grid containing four listening stations distributed proportionally over the available habitat. Seatrout spawning aggregations were identified and mapped using a mobile hydrophone (sensitivity: -170 dBV re 1 µPa; High-Tech, Inc. HTI: 96 min) that was deployed for short intervals (~ 1 min.). Spawning sounds were classified as small aggregations (1 – 5 individuals), medium aggregations (more than 5, but individuals distinguishable) or large aggregations (individuals indistinguishable). Habitat was classified as mud and sand, channel, seagrass, or reef/ structure.

Sampling occurred on 23 days from May through August 2016. Large spawning aggregations were observed at 176 of the 375 stations sampled. The distribution of spawning sites among each habitat type (seagrass, mud/sand, channel, reef/ structure) was proportional to those sampled (Figure 1). Average distance between large aggregations was 2.54 $\pm$ 0.61 (SEM) km. Although there were not differences in temperature at spawning and non-spawning sites, salinity was significantly greater at large aggregation sites (27.5 $\pm$ 0.6 psu) than non-spawning sites (22.3 $\pm$ 1.3 psu) (Wilcoxon test w=3071, $p < 0.01$) (Figure 1B).

We observed seatrout spawning throughout the estuary at sites associated with multiple habitat types, including seagrass, channels, reef or structure, and mud/sand. Most of these habitat associations are consistent with other seatrout spawning sites ranging from Louisiana to North Carolina. In those studies spawning was most frequently observed in association with submerged aquatic vegetation (Moody 1950, Mok and Gilmore 1983, Holt et al. 1985, Brown-Peterson et al. 1988, Walters et al. 2009) reef, structure or navigation channels (Hein and Shepard 1979, Saucier & Baltz 1992, Lowerre-Barbieri et al. 2013). The use of mud habitat in our study was not expected and may reflect that previous studies conducted in Texas did not randomly sample all available habitats (Holt et al. 1985, Brown-Peterson et al. 1988). This information is of significant value to the resource management efforts in the region regarding fisheries, oil and gas activities, land use and the effects of freshwater inflow on spawning habitat.

KEYWORDS: Reproduction, passive acoustics, sciaenidae

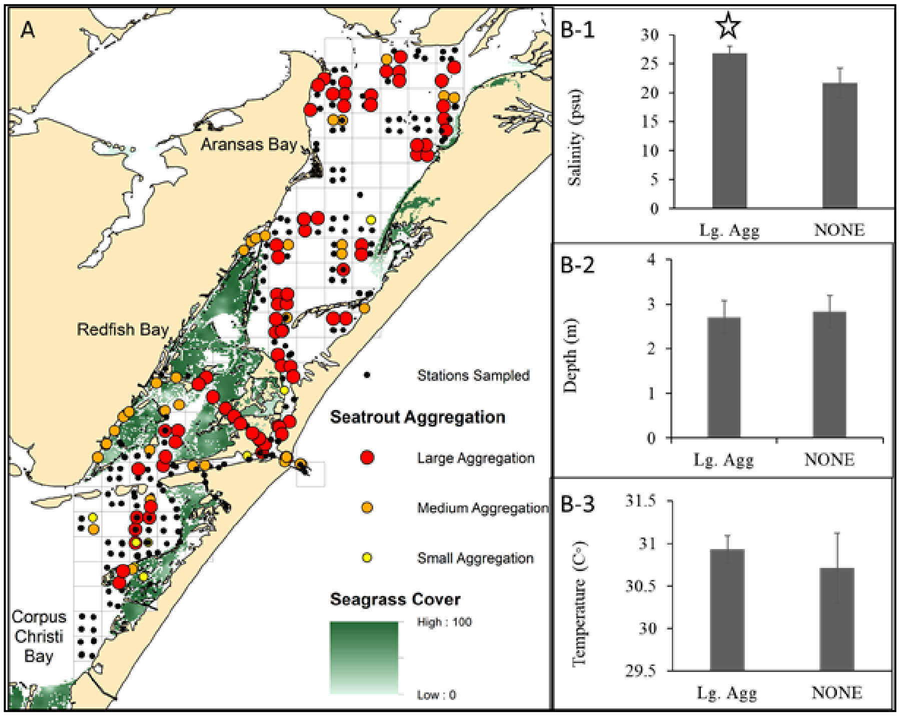

Figure 1: A) Sampling map of Spotted Seatrout spawning in Corpus Christi Bay, Redfish Bay and Aransas Bay, Texas. Sites with large, medium, small and no spawning aggregations are represented along with seagrass cover. **B 1-3):** Average temperature, depth and salinity at large aggregation sites and sites with no spawning. The star indicates significant difference and error bars represent 95 % confidence intervals.

LITERATURE CITED

National Marine Fisheries Service. 2017. *Fisheries Economics of the United States, 2015.* NOAA. U.S. Department of Commerce.

Brown-Peterson, N.J., M.S. Peterson, D.L. Nieland, M.D. Murphy, R.G. Taylor, and J.R. Warren. 2002. Reproductive biology of female spotted seatrout, *Cynoscion nebulosus*, in the Gulf of Mexico: differences among estuaries? *Environmental Biology of Fishes* **63**(4):405–415.

Mok, H. and R.G. Gilmore. 1983. Analysis of sound production in estuarine aggregations of *Pogonia cromis, Bairdiella chrysoura,* and *Cynoscion nebulosus* (Sciaenidae). *Bulletin of the Institute Zoologica - Academia Sinica* **22**:157-186.

Montie, E.W., M. Hoover, C. Kehrer, J. Yost, K. Brenkert, T. O'Donnell, and M.R. Denson. 2017. Acoustic monitoring indicates a correlation between calling and spawning in captive spotted seatrout *(Cynoscion nebulosus)*. *PeerJ* **5**:e2944

Connaughton, M.A. and M.H. Taylor. 1995. Seasonal and daily cycles in sound production associated with spawning in the weakfish, *Cynoscion regalis*. *Environmental Biology of Fishes* **42**:233-240.

Luczkovich, J.J., H.J. Daniel, and M.W. Sprague. 1999. Characterization of critical spawning habitats of weakfish, spotted seatrout and red drum in Pamlico Sound using hydrophone surveys. *Final Report Annual Performance Report* 1–128.

Moody, W. 1950. A study of the natural history of the spotted trout, *Cynoscion nebulosus* in the Cedar Key, Florida, area. *Quarterly Journal of the Florida Academy of Science* **12**:147-171.

Holt, G.J., S.A. Holt, and C.R. Arnold. 1985. Diel periodicity of spawning in sciaenids. *Marine Ecology Progress Series* **27**:1-7.

Brown-Peterson N., P. Thomas, and C.R. Arnold. 1988. Reproductive biology of the Spotted Seatrout, *Cynoscion nebulosus*, in South Texas. *Fishery Bulletin* **86**:373-388.

Hein, S., and J. Shepard. 1979. Spawning of spotted seatrout in a Louisiana estuarine ecosystem. *Proceedings of the Annual Conference - Southeast Association of Fish and Wildlife Agencies* **33**:451-465.

Saucier, M.H. and D.M. Baltz. 1993. Spawning site selection by spotted seatrout, *Cynoscion nebulosus*, and black drum, *Pogonias cromis*, in Louisiana. *Environmental Biology of Fishes* **36**:257-272.

Lowerre-Barbieri, S.K., S. Walters, J. Bickford, W. Cooper, and R. Muller. 2013. Site fidelity and reproductive timing at a spotted seatrout spawning aggregation site: individual versus population scale behavior. *Marine Ecology Progress Series* **481**:181-197.

Walters, S., S. Lowerre-Barbieri, J. Bickford, and D. Mann. 2009. Using a passive acoustic survey to identify spotted seatrout spawning sites and associated habitat in Tampa Bay, Florida. *Transactions of the American Fisheries Society* **138**:88-98.