Five-year Colonization Dynamics of Fish Populations at the Texas Clipper Artificial Reef, Northwestern Gulf of Mexico

Cinco Años de Dinámica Poblacional en la Colonización por Peces en el Arrecife Artificial "Texas Clipper" en el Noroeste del Golfo de México

Cinq Ans de Colonisation par des Populations de Poissons dans Récif Artificiel "Texas Clipper" au Nord-ouest du Gulf du Mexique

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EXTENDED ABSTRACT

Artificial reefs are a coastal management tool used to enhance local fisheries to the benefit of recreational fishers and recreational divers (Bohnsack 1991, Baine 2001, Svane and Petersen 2001, Broughton 2012). Upon approval of the Artificial Reef Act of 1989 by the Texas legislature, the Texas Parks and Wildlife Department (TPWD) began promoting, developing, maintaining, monitoring, and enhancing artificial reef potential in state and federal waters adjacent to Texas (Stephan et al. 1990). Since that time, three major programs: Rigs-to-Reefs, Ships-to-Reefs, and the Nearshore Reefing have been initiated to deploy materials at over 86 sites covering approximately 2,800 hectares along the Texas coast consisting of 16 ships, 150 petroleum platforms, and thousands of individual pieces of concrete material. The purpose of this study was to document fish recruitment and population dynamics during the first five years at the site of the USTS Texas Clipper (Texas Clipper hereafter) reefed on November 17, 2007, 17 nm (31.5 km) offshore of South Padre Island, Texas, USA in the Gulf of Mexico (26.18°N, 96.98°W) at a regional depth of 40.8 m and a clearance depth of 18.9 m. At 145 m long and 22 m wide, the Texas Clipper is the United States' fourth-largest ship sunk for the purpose of creating an artificial reef (Figure 1).

The TPWD-Artificial Reef Program (ARP) program has utilized the roving diver technique (RDT) of surveying reef fish communities since 1995. The RDT is a rapid visual census method wherein divers freely roam reef environments and record all fish species that can be positively identified in logarithmic abundance categories: Single (1 fish), Few (2-10), Many (11 - 100), or Abundant (> 100); hereafter referred to as SFMA data (www.REEF.org). In this study, two consecutive paired-diver, RDT fish surveys, separated by a 2 hour surface interval, were conducted during each site visit. Dives were 30 -40 min allowing survey of the length of the ship within sport diving depths (18 - 35 m). The Texas Clipper reef site was visited approximately quarterly from February 2008 to November 2012 with approximately 8 - 12 surveys per year.

The order-of-magnitude SFMA count-categories recorded in this study were converted to a simple log-scale abundance by taking the natural log of the category midpoint values according to the log-normal distribution. The ln(X+1) transformed values of SFMA midpoints were rounded to the nearest whole number resulting in log-normal abundances of 0, 1, 2, 4, or 6 for the Zero (0 fish), Single (1 fish), Few (2 - 10), Many (11 - 100), and Abundant (101 - 1,000) groupings, respectively (Hicks et al. 2016). Changes in fish community structure were analyzed using a metric multidimensional scaling (mMDS) of 100 bootstrap averages (and associated 95% bootstrap regions) for each year. A similarity percentages routine (SIMPER) was used to identify the taxa most commonly occurring in each year as well as those primarily responsible for driving dissimilarities among years. In addition, univariate diversity indices (DIVERSE) including Shannon's Diversity (H'), species richness (S'), and Simpson's evenness (1-λ') were computed from species relative abundances and compared across years (Clarke and Gorley 2015).

As of November 2012, a total of 70 fish species had been documented from RDT fish surveys at the Texas Clipper reef. Species richness increased approximately two fold in five years starting with 39 taxa in 2008 (Table 1). Large increases in both species number and abundance over the five year period indicated rapid community succession that was easily visualized by metric multidimensional scaling (Figure 2). This increasing trend was also observed in species similarity, where initially, five and later, 13 species accounted for 70% of the within year similarity. SIMPER analyses based on Bray-Curtis similarity matrices of the SFMA count data indicated that the species documented were fairly consistent within years (average within year similarities ranged 46-57%). Snappers (red - *Lutjanus campechanus* and grey - *Lutjanus griseus*) have been recorded consistently and are now considered typical species. Dissimilarities among years were highest between 2008 and 2010, 2011, and 2012 at 69, 67, and 67% dissimilarity, respectively. Two species (*Lutjanus campechanus* and *Chaetodipterus faber*) consistently reoccurred in surveys among all years (i.e., highest contributors to within site similarity) and four species (*Balistes capriscus*, *Haemulon aurolineatum*, *Lutjanus griseus*, and *Parablennius marmoreus*) consistently reoccurred in four of five years. Grey snapper became a typical species in 2009 and was the first or second most common reoccurring fish species in RDT surveys thereafter. *Mycteroperca microlepis* were absent the first year and increased in

number through 2011, while *Sphyraena barracuda* only made the top 70% (cumulative) similarity in abundance in 2010 and thus increases in predator abundance may be responsible for the odd shift in community composition that year (Figure 2).

The USTS Texas Clipper added a single large high profile habitat to an area that was previously sand and mud. Two hurricanes passed near the ship in 2008 (Dolly: July 23, 2008, Ike: September 13, 2008) causing a large crack in the hull that appeared to increase available habitat. Surveys of the Texas Clipper will continue approximately quarterly through the tenth year (2017), making it the longest continuous artificial reef monitoring program on the Texas coast.

Table 1. Species richness (S'), Shannon's Diversity (H'), and Simpson's evenness (1-λ') calculated on fish species abundance data averaged annually (2008-2012) at the Texas Clipper Reef in the northwestern Gulf of Mexico.

Year	S	H'	1-λ'
2008	39	3.04	0.960
2009	49	3.43	0.976
2010	41	3.35	0.970
2011	29	3.21	0.965
2012	46	3.43	0.976

KEYWORDS: Artificial reef, visual fish census, Gulf of Mexico, roving diver survey, red snapper

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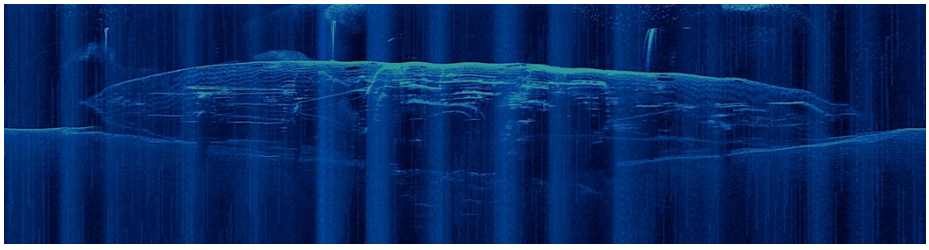

Figure 1. Sonar image of the 145 m USTS Texas Clipper lying on its port side in the northwestern Gulf of Mexico.

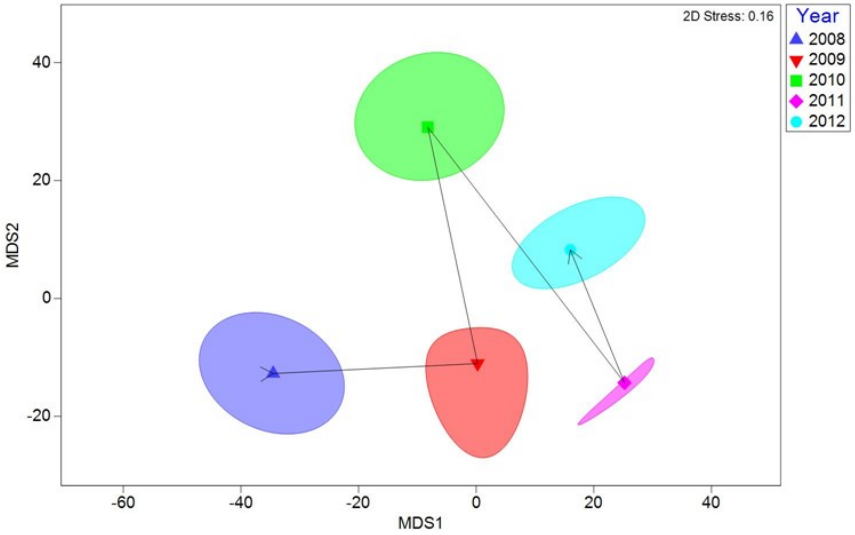

Figure 2. Two-dimensional metric MDS plot comparing fish populations at the Texas Clipper Reef in the northwestern Gulf of Mexico. Points represent the group averages in each year. The contours represent nominal 95% bootstrap regions generated from 100 bootstrap averages for each year.