Shipwrecks as Artificial Reefs: A Comparison of Fish Assemblage Structure on Ships and Their Surrounding Natural Reef Areas Offshore Southeast Florida - Preliminary Results

Paul T. Arena, Lance K.B. Jordan, David S. Gilliam, Robin L. Sherman, Kenneth Banks[1] and Richard E. Spieler

National Coral Reef Institute, Nova Southeastern University Oceanographic Center (NSUOC), 8000 North Ocean Drive, Dania Beach, FL 33004

[1]Broward County Department of Planning and Environmental Protection, 218 S.W. 1st Avenue, Ft. Lauderdale, FL 33301

INTRODUCTION:

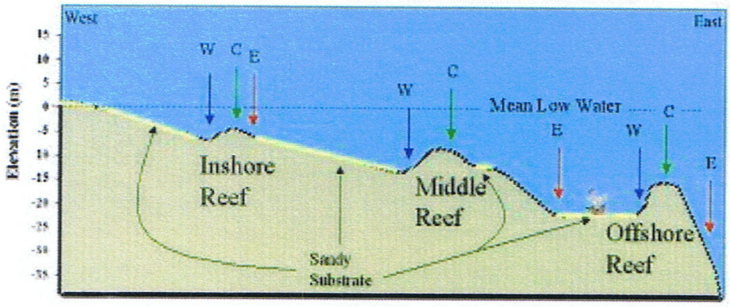


Figure 1. Depth Profile of a generalized transect from west to east. Census sites indicated by ↓. Blue = Western Edge, Green = Crest, Red = Eastern Edge. Diagram not drawn to scale.

Derelict ships are commonly used as artificial reefs in many areas worldwide, including Florida. Deployed mainly for recreational fishers and divers, well over 100 such reefs exist in the state, with 40+ in Broward County alone. Despite the popularity of these reefs, this study is one of few to compare the fish assemblages on artificial reefs, in particular shipwrecks, to adjacent natural reefs.

MATERIALS AND METHODS

We are currently comparing fish assemblages on six ships (Table 1) with neighboring natural reefs. The inshore environment of Broward County consists of three reef tracts (inshore, middle, and offshore), each separated by sand substrate, running parallel to the coast in sequentially deeper water (Figure 1). The six ships were deployed as artificial reefs at various times between the early 1970s and 1999. All vessels lie on the sandy substrate separating the middle and offshore reef tracts in approximately 21m of water (Figure 2). This is a preliminary report of a study scheduled to run two years, with each ship being censused four times a year, two ships per month.

Table 1. A list of the six ships used in this study and their descriptions.

Ship Name	Vessel Type	Length(ft)	Deployment Year	Depth(m)	GPS Coordinates
Unnamed	Barge	80	1970's	21	N 26 08.520' W 80 04.886'
Edmister	USCG Cutter	95 (broken up)	1989	21	N 26 09.193' W 80 04.837'
Scutti	Tug	97	1986	21	N 26 09.520' W 80 04.760'
Tracy/Vitale	Supply Boat	133	1999	21	N 26 09.578' W 80 04.754'
Merci Jesus	Freighter	90	1998	21	N 26 09.635' W 80 04.747'
McAllister	Tug	85	1998	21	N 26 10.149' W 80 04.718'

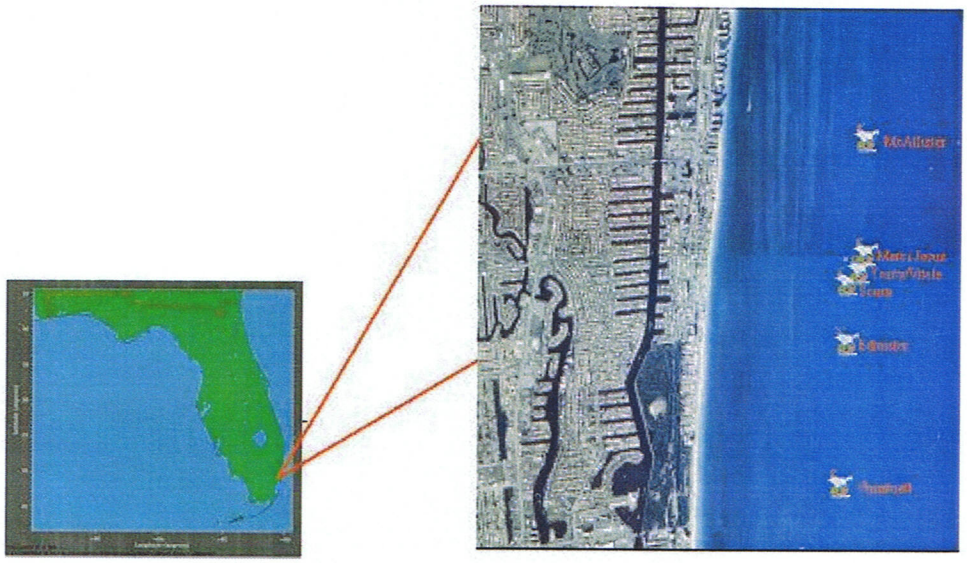


Figure 2. Geographical location of the six ships located in the sandy substrate between the middle and offshore reefs.

During a 7-month period (March 2000 through September 2000) scuba divers used a non-destructive, visual census method (Bohnsack and Bannerot point count) to determine fish species richness and abundance at the ships and the adjacent natural reef sites. In brief, the technique is a point count of fishes in a 15 m diameter cylinder, which extends from the substrate to the surface. The diver records all the fishes seen during a 5 min period. After the 5 min species count is completed, the number of fish per species and the minimum, maximum and mean total length is recorded. The bow, stern, port and starboard sides were censused on 5 of the 6 ships to obtain an estimate of the ships fish assemblages. Due to its high complexity and extensive footprint, the sixth ship (Edmister) required two additional midship sites to get an accurate estimate of its fish assemblage. The neighboring natural reefs were censused on east-west transects spaced every 0.25 nm along Broward's coastline. Nine sites were censused on each transect, three per reef tract, one site at the easternmost edge, one at the westernmost edge, and one at the crest or centrally located(Figure 1). Data analysis of abundance and species richness values was performed using a PROC GLM procedure (ANOVA) and Student-Newman-Keuls comparison of means (SAS Institute Inc., Cary, N.C., USA).

RESULTS

From the seven months of data collected thus far, 19,922 fishes belonging to 149 species (41 families) have been recorded for the natural reef areas and 27,216 fishes belonging to 116 species (33 families) have been recorded for the artificial reefs. Preliminary results indicate a statistically significant ($p<0.05$) difference in fish assemblages between the ships and the natural reefs. The ships tend to have a statistically higher total fish abundance, per count, than the surrounding inshore, middle, and offshore reef tracts (401.9+ 68.0, 198.0+74.4, 125.9+16.6, 177.9+35.5. respectively) (Figure 3). The ships were also found to have a higher mean species richness, per count, than the inshore, middle and offshore reef tracts (24.9+2.8, 16.5+1.0, 18.4+.73, 19.5+.49.respectively) (Figure 4). In addition, several fish species were found only in association with either the ships or the natural reefs (See Species List attached below).

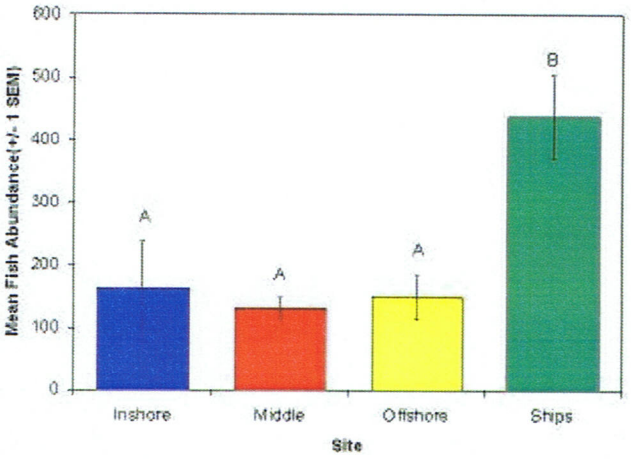


Figure 3. Mean(+/- 1 SEM) fish abundance on the ships and each of the three reef tracts. Mean levels with different letters, differ significantly ($p<0.05$, SNK).

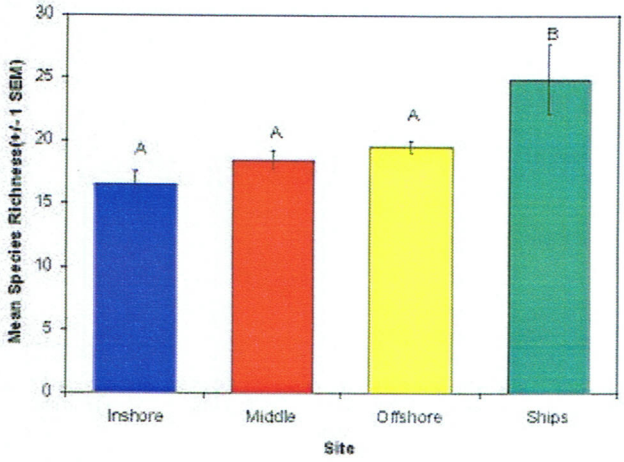
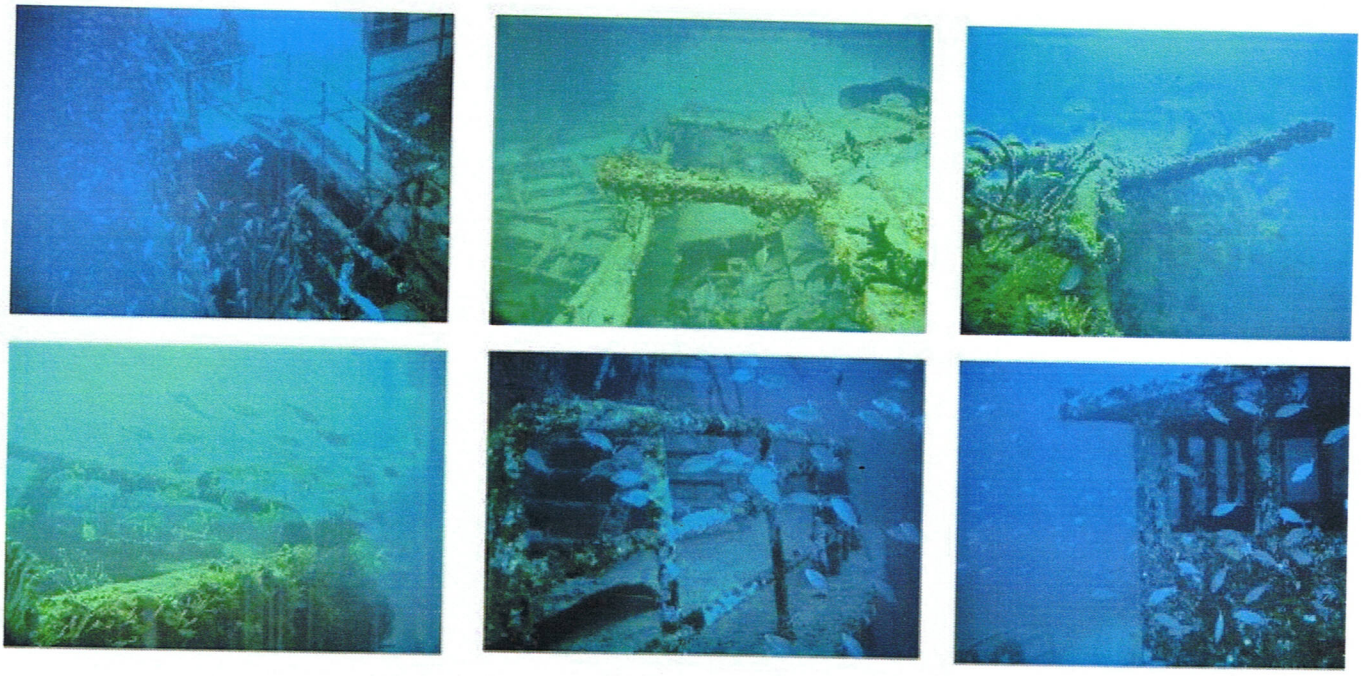


Figure 4. Mean (+/- 1 SEM) species richness on the ships and each of the three reef tracts. Mean levels with different letters, differ significantly ($p<0.05$, SNK).

CONCLUSION Broward County is located near the northern limits for coral growth, which results in the area consisting of poorly developed reefs with relatively low topographic complexity. This may be a factor to consider when trying to understand the local species distribution on ships and the adjacent natural reef areas. The preliminary results of this study indicate that ships have higher fish abundance and mean species richness, as well as assemblages containing species exclusive to the artificial reefs. Although it is too early in the study to draw firm conclusions, the appearance of many fish species on the artificial reefs apparently absent from nearby natural reefs may indicate the ships provide some structural or chemical attribute which is lacking on the natural reef. Furthermore, the presence of species on ships not seen on nearby natural reefs may be an indication of local production on the artificial reefs. This study should aid in evaluating the value of derelict ships as artificial reefs and provide an accurate representation of the fish assemblage structure on shipwrecks in Broward County.

Acknowledgements

We thank personnel from the Broward County Department of Environmental Protection as well as the many volunteer NSUOC graduate students for their diving assistance. This study was funded, in part, by Grant FWCC-99054 from the Florida Fish and Wildlife Conservation Commission, as well as, the Pompano Beach Fishing Rodeo.



Examples of several of the artificial reefs and their associated fish assemblages.

Back to NCRI Projects Page