

**STUDY TITLE:** Seasonal and Spatial Variation in the Biomass and Size Frequency Distribution of Fish Associated with Oil and Gas Platforms in the Northern Gulf Of Mexico

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CUMULATIVE PROJECT COST: \$390,585

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**KEYWORDS:** artificial reef, oil and gas platform, hydroacoustics, fish abundance, fish density, target strength, visual survey, Gulf of Mexico, species composition, hypoxia, continental shelf, continental slope

**BACKGROUND:** The largest artificial reef complex in the world, although unplanned, is composed of the 4,000 petroleum platforms scattered across the outer continental shelf (OCS) of the northern Gulf of Mexico (GOM). Scientists have hypothesized that artificial reefs and platforms improve and/or diversify habitat, increase resources, modify the assemblages of organisms in the region or concentrate existing resources. The placement of these defacto reefs has undoubtedly impacted the regional marine community although little information is available. Only recently have assessment methods been developed to test these and other hypotheses concerning artificial reefs.

Scientific investigations of fish assemblages at petroleum platforms did not start until the late 1970's. The reports consisted of visual surveys conducted by SCUBA divers,

remotely operated underwater vehicles (ROV) and stationary cameras; the majority were short term, often only “snapshots” of the fishes at each site. The results of this early research provided insights into structure associated assemblages; abundance and species composition varied with platform, water depth and time of the year. However, results were difficult to compare due to problems with limited visibility, gear bias, diver avoidance and a lack of standardized survey methodology.

**OBJECTIVES:**

- 1) Measure and compare the species composition, abundance and size frequency distribution of fish associated with three petroleum structures of varying depths.
- 2) Determine the effect of temporal, physical and chemical variables on species composition, biomass and size distribution of fish associated with platforms.
- 3) Define the spatial near field influence of each platform on the abundance of fish and estimate the associated fish population.

**DESCRIPTION:** We used complimentary sampling methods of visual surveys and quantitative dual beam hydroacoustic surveys to document the assemblage of fishes associated with three petroleum platforms in the northern Gulf of Mexico. With the sampling protocol established, the objectives of this research were to use dual beam hydroacoustics in conjunction with visual point count surveys to measure the density and size distribution of fishes associated with three petroleum platforms off the Louisiana coast. The goals of this research were to determine the effect of water depth on fish density, size distribution and species composition and ultimately to measure the fisheries value of platforms of different depths in the same geographical region.

**SIGNIFICANT CONCLUSIONS:** The results of this project demonstrate the variability in abundance, size and species composition of fishes associated with petroleum platforms. Similar results from earlier studies have been found with natural and artificial reefs. The variability in density and the size distribution of fishes at petroleum platforms in this project was linked to temporal, spatial and environmental variables.

This research confirms the variability of fish assemblages associated with petroleum platforms and reinforces the need to sample on each side and throughout the water column to obtain an accurate estimate of fish abundance. The high abundance of fishes found at the sites demonstrates the importance of petroleum platforms to the marine environment of the northern GOM. Although some variance was observed, 10,000 to 30,000 fishes were found per site at any one time and since over 1,000 platforms are located in similar water depths it is clear that these structures impact the fisheries of the region.

In response to the use of platforms by fishers in the region Louisiana and Texas both created artificial reef programs where the materials of choice are retired platform jackets. The standard deployment of these structures as reefs involves placing the jacket on its side, however, this minimizes vertical relief. If a platform such as GC18 were deployed in this manner it would extend approximately 80 m off the bottom. Based on our results at the site very few fishes would utilize the structure in this

orientation and its value, as an artificial reef would be questionable. This project is the first demonstrating the importance of vertical relief in maximizing the effectiveness of platforms as artificial reefs, especially with respect to deepwater environments.

This study continues to demonstrate the utility of merging hydroacoustics and visual survey techniques to study the assemblage of fishes associated with petroleum platforms. The combination of these techniques allows for the measurement of the area of influence of these defacto artificial reefs, as well as estimates of abundance, size distribution and species composition throughout the water column and over long time periods.

**STUDY RESULTS:** At the shallowest site, South Timbalier 54 (ST54, water depth 22 m), the decline in fish density with distance from the platform was precipitous; beyond 18 m fish densities were similar to that of the open waters of the northern Gulf of Mexico. At the deeper sites a drop in fish density with distance from the site existed, although fish density was much higher to greater distances. At both Grand Isle 94 (GI94, water depth 60 m) and Green Canyon 18 (GC18, water depth 219 m) fish density approached that found in the open waters of the Gulf of Mexico after a distance of approximately 50 m. Despite some complications hydroacoustics again illustrated its effectiveness in defining "area of influence" of the platform or the effective size of the artificial reef to the fish assemblage. As we defined it, the area of influence extended 10 m at GC18 and 18 m at GI94; fish densities within these distances were significantly higher than densities at greater distances and while this may result in conservative estimates of total abundance we feel it more accurately reflects the true abundance of fishes at the sites.

Six species made up over 90% of the fishes observed at each site on any survey and platform assemblages could be characterized as not specious and dominated by a few individual species. By site the dominant six species (highest to lowest abundance) were; GC18; creolefish, blue runner, Bermuda chub, almaco jack, amberjack, and barracuda; GI94; blue runner, horseeye jack, red snapper, mangrove snapper, gray triggerfish and barracuda; ST54; Atlantic spadefish, bluefish, blue runner, mangrove snapper, red snapper and sheepshead. While the species found at each site were somewhat unique and the dominant species at each site was different, a large amount of overlap of observed species existed between sites, especially adjacent sites. Seasonal migrations were common at each of the study sites. Since this research took place throughout the year we were able to document the seasonality alluded to by past research. Common seasonal migrations observed in the winter were the appearance of significant numbers of Florida pompano and bluefish at ST54; and the appearance of blue runner and barracuda at GI94 and GC18. Summer seasonal observations included the appearance of tarpon and cobia at ST54, an increase in abundance of cobia, red snapper, greater amberjack and almaco jack at GI94, while no summer migrants were observed at GC18.

Comparison of results from this research with other petroleum platform studies from the northern Gulf of Mexico revealed similarities as well as significant differences in density

and abundance. Comparison of acoustically derived estimates of density from our past research showed similar values with those from this project especially at ST54 and GI94. Mean densities from our earlier work at a site in 24 m of water were 0.244 (+/- 0.062, 95% confidence interval) fish  $\text{m}^{-3}$ , while mean densities found during this project were 0.333 (+/- 0.034) fish  $\text{m}^{-3}$  at ST54, 0.496 (+/- 0.017) fish  $\text{m}^{-3}$  at GI94 and 0.029 (+/- 0.003) fish  $\text{m}^{-3}$  at GC18.

Total fish abundance estimates from the platforms in this project summer within the range of estimates of fishes at platforms from our earlier research in the Gulf of Mexico but are higher than those derived by visual only surveys. Our earlier research found an average of 12,473 (+/- 6,522, 95% confidence interval) fishes at a site in 24m of water, while during this project estimates of the total number of fish per site were 13,472 (+/- 1,346) at ST54, 28,952 (+/- 1,806) at GI94 and 13,856 (+/- 1,324) at GC18. One of the most interesting results of the project was the comparison of abundance between the sites. GC18 was 3 to 10 times larger than the others but the total abundance estimates were not significantly different than the smallest site (ST54), while the abundance estimates from GI94 were twice that of the other sites. The low abundances observed at GC18 are likely due to its location and water depth at the site. Fish abundance was essentially zero below 100m and densities above 100 m were lower than those observed at the other sites. Because of the location of GC18 it is not influenced by the eutrophic waters on the continental shelf and the outflow from the Mississippi River, it most influenced by oligotrophic oceanic waters from the Caribbean. The combination of water depth and cooler oligotrophic water conditions likely reduced the abundance of fishes around GC18.

## **STUDY PRODUCTS:**

Stanley, D.R. and C.A. Wilson. 2000. Seasonal and spatial variation in the biomass and size frequency distribution of fish associated with oil and gas platforms in the northern Gulf of Mexico. A final report for the U.S. Department of the Interior, Minerals Management Service Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-005.

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