

STUDY TITLE: The Effect of Depth, Location, and Habitat Type, on Relative Abundance and Species Composition of Fishes Associated with Petroleum Platforms and Sonnier Bank in the Northern Gulf of Mexico

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CUMULATIVE PROJECT COST: \$787,639

PROJECT MANAGER: Charles A. Wilson

AFFILIATION: Professor, Department of Oceanography and Coastal Studies, Louisiana State University

ADDRESS: Louisiana State University School of the Coast and Environment, Coastal Fisheries Institute, Baton Rouge, LA 70803

PRINCIPAL INVESTIGATOR: Charles A. Wilson

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BACKGROUND: Scientists and managers continue to ponder both the role of artificial reefs in fisheries management and the effect that artificial reefs have on both healthy and stressed fish populations. This issue is exemplified the northern Gulf of Mexico (GOM), which has the largest artificial reef complex in the world.

We have spent over a decade studying the fish communities associated with operating oil and gas platforms and with several artificial reefs created from platforms. Although we are still uncertain of the life history consequences of this artificial habitat and its value as compared to the limited natural habitat in the region, we have gained a great deal of knowledge that has advanced this science. Platforms in the region form an

extensive resource for recreational and commercial fishery user groups; regional fisheries managers and user groups have reasonable justification to believe that platforms enhance fisheries and organisms dependent on hard substrate. Fish abundance at platforms invariably exceeds the measurable fish community associated both with open water bottoms of the GOM and with natural reef and reef-like habitats.

Petroleum platforms differ from traditional artificial reefs in that their vertical profile extends throughout the water column and provides habitat from the photic zone to the substrate. Historically, a major obstacle in deriving scientific data about the effect of deep water artificial reefs (and platforms) on fishes and other nekton was the difficulty in quantifying abundance and species composition associated with these reef communities. We have successfully used two complementary techniques, hydroacoustics and point count visual surveys, to estimate the abundance (biomass) and species composition of fishes at several of these structures and natural reefs. In these studies dual-beam hydroacoustics provided estimates of acoustic biomass, density, size distribution, and the near field area of influence, and a remotely operated underwater vehicle (ROV) was used to determine species composition.

We have found from 10,000 to 30,000 fishes associated with individual platforms; the lowest numbers were found at the largest and deepest structures, leading us to question the value of deep water structures as artificial reefs. We have also reported that density of fishes around platforms was ten times greater than open water and from two to three times greater than fish density associated with the upper portion of the West Flower Garden Bank off eastern Texas; species composition also differed between these two habitat types. (Wilson et al 2003).

OBJECTIVES: The objectives of this study were:

1. Address the effect that depth, latitude, and region have on the fish community associated with platforms
2. To determine the fish community structure at a natural hard bottom habitat (Sonmier Bank) and,
3. To evaluate the quantitative and qualitative contribution of platforms to Gulf of Mexico fish communities by comparing the fish community structure at Sonmier Bank to that at a nearby standing platform

DESCRIPTION: This research project was designed to effectively sample and compare the fish populations associated with standing oil and gas platforms located within each of three regions of the northern Gulf of Mexico: an eastern region including platforms east of the Mississippi River, a central region including platforms off Louisiana, and a western region including platforms off southeastern Texas (Figure 1). The platforms in each of these regions were located at water depths ranging from 30 m to over 200 m with the objective of selecting one platform in each of five increasing depth zones. Once the study had begun, it was decided to examine two additional sites: a natural reef with characteristics similar to a platform (Sonmier Bank) and an adjacent oil platform (VR

279) at the same water depth. All sampling was variously conducted from 1998 to 2003 beginning with the eastern region.

SIGNIFICANT CONCLUSIONS: This research continues to support the premise that standing oil and gas platforms do make useful artificial reefs because they support fish densities that can be from 10 to 1000 times greater than the densities found over adjacent sand and mud bottom habitats. Also, fish densities at standing platforms almost always exceed those found both at artificial reefs (both partially removed and toppled) and at natural habitats such as Sonnier Bank and the West Flower Garden Bank. However, the fish species associated with artificial reefs (including standing platforms) differ from those found on natural habitats.

STUDY RESULTS: Numerous technical and logistical setbacks during the study reinforce how complicated it is to work in the marine environment even when facilitated by access to an oil and gas platform and associated infrastructure.

Hydroacoustics is an extremely useful technology for comparing and estimating fish biomass, particularly that biomass associated with specific habitats. However, the users must be cognizant of the limitations of data derived from hydroacoustics. The resultant data should be construed as an estimate of the acoustic biomass; without extensive groundtruthing those estimates are not precise, but relative. Similarly, estimates of target strength are an average of all the acoustic returns during the sample period in a particular depth stratum. Consequently, when the acoustic biomass is divided by the average target strength to estimate fish density, one must recognize that the error associated with that estimate is fairly large.

The results of this multiyear research project continue to reinforce our earlier conclusions that there is a relatively high fish biomass associated with operating oil and gas platforms when compared to other habitats in the northern Gulf of Mexico. We continue to observe the general trend that fish biomass around platforms is consistently higher than that of the adjacent soft bottom habitat from the coastal waters of Louisiana out to the edge of the continental shelf. This general pattern was true along the east, central, and west transects. We also found that species composition transitions from a coastal reef associated community nearshore, to a semi-tropical reef associated community in the mid-shelf region, to a blue water pelagic community at the near shelf edge.

Unlike previous techniques used to assess fish biomass in specific habitats, hydroacoustics affords us the ability to be very specific in spatial and temporal perspectives. We continue to find fish around oil and gas platforms vary predictably with depth, platform side, and time of day. Fish biomass is highest near the surface waters and declines with increased water depth. At water depths greater than 100 m, fish biomass is not statistically different from zero. This continues to reinforce the fishery value of platforms, in particular platforms at water depths less than 50 m. Platform side also significantly affected fish biomass; in the current study fish biomass was consistently and statistically higher on the west side. Fish biomass was highest at

midnight and dawn and lowest at noon. The fact that fish biomass is highest during the hours of darkness is evidence either that the lights at a platform create a halo effect attracting fishes to the platform or crepuscular fish emerge from within the confines of the platform at night and become acoustically visible.

We did observe a difference in fish biomass across the three transects. Fish biomass per unit area was highest throughout the central transect and lowest along both the east and west transects. The lower sample size along the west transects lead to higher variability of this estimate. Although there are few published data to support this observation, intuitively one would expect standing stock biomass to be lower off of the Texas coast away from the influence of the productivity associated with the Mississippi River.

It was interesting to note that a number of variables were not significant in the various models. Several sites had been on location for over 20 years, yet platform age was not significant in statistical models. We also did not observe a statistical effect of number of legs, or number of conductor guides, although these variables were confounded by platform identity and depth.

Our experimental design allowed us to analyze a change in acoustic fish biomass with distance away from the platforms sampled. Our objective is to gain some insight into the "reef effect": how far all way from a platform (artificial reef) is there a measurable effect of the artificial habitat. We found that fish biomass was highest within 20 m of the platforms sampled and that biomass decreased with increased distance. However, we report that the range of influence of platforms over those sampled extends out beyond the 20 m reported in previous studies and is more on the order of 50 m. This may in fact be a visual cue that varies with water clarity.

We also compared target strength, which is an acoustic estimate of fish size. Although the target strengths reported are five minute averages of fish size over 10 m depth range, we did observe some statistical differences worth reporting. Average acoustic fish size varied across regions and was highest along the central transect and lowest along the west transect. In fact, targets along the west transect averaged 30% smaller than those of the central or east transects. Targets along the east transect were slightly smaller than target size along the central transect. Mean target size varied with the depth and was largest near the bottom and smallest near the surface. The larger reef associated species tend to be near the bottom. Mean target size also varied with platform side and targets were largest on the east side and smallest on the north side; this is an observation we cannot explain. Mean target size was statistically lower at midnight and greatest at dusk. The higher biomass and smaller target size at midnight suggests that the smaller, crepuscular organisms were, in fact, emerging from the confines of the platform at night.

A mobile hydroacoustic survey has allowed us, for the first time, to compare hydroacoustic biomasses of a natural, high-profile hard bottom feature (Sonnier Bank pinnacle) with that of an adjacent oil and gas platform (VR 279). Although similar in form

in many respects, the obvious difference between the Sonnier Bank pinnacle and VR 279 is their respective profiles in the water column: the summit of the Sonnier Bank pinnacle is at a depth of about 20 m while VR 279 spans from the bottom to the surface. Unlike the most of the platforms surveyed to date, including VR 279, acoustic biomass at the Sonnier Bank pinnacle was highest near the bottom and lowest at the surface (Figure 21 and 26). Biomass near the surface at the pinnacle was, in fact, very close to zero due to the lack of structure-oriented, epipelagic species, such as blue runner, that were found in abundance at VR 279. Not only are fish biomasses at all depths at the Sonnier Bank pinnacle of lesser magnitude than at VR 279, but also the fish communities associated with the two habitats are considerably different. The Sonnier Bank ichthyofauna is dominated by species such as sea basses, chubs and angelfishes while that of VR 279 is composed of jacks and snappers. Despite their similarities in physiognomy, the natural habitat and the artificial habitat are quite different in both quantity and quality of the fishes that inhabit them.

This research continues to support the premise that standing oil and gas platforms do make useful artificial reefs because they support fish densities that can be from 10 to 1000 times greater than the densities found over adjacent sand and mud bottom habitats. Also, fish densities at standing platforms almost always exceed those found both at artificial reefs (both partially removed and toppled) and at natural habitats such as Sonnier Bank and the West Flower Garden Bank. However, the fish species associated with artificial reefs (including standing platforms) differ from those found on natural habitats. Future research efforts might be directed toward determining the reasons for this difference.

STUDY PRODUCTS: Wilson, C.A., M.W. Miller, Y.C. Allen, K.M. Boswell, and D.L. Nieland. 2005. Effect of depth, location, and habitat type, on relative abundance and species composition of fishes associated with petroleum platforms and Sonnier bank in the northern Gulf of Mexico. Prepared by the Coastal Fisheries Institute, School of the Coast and Environment. Louisiana State University. U.S. Dept. of the Interior, Minerals Mgmt. Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2006-037. 97 pp.

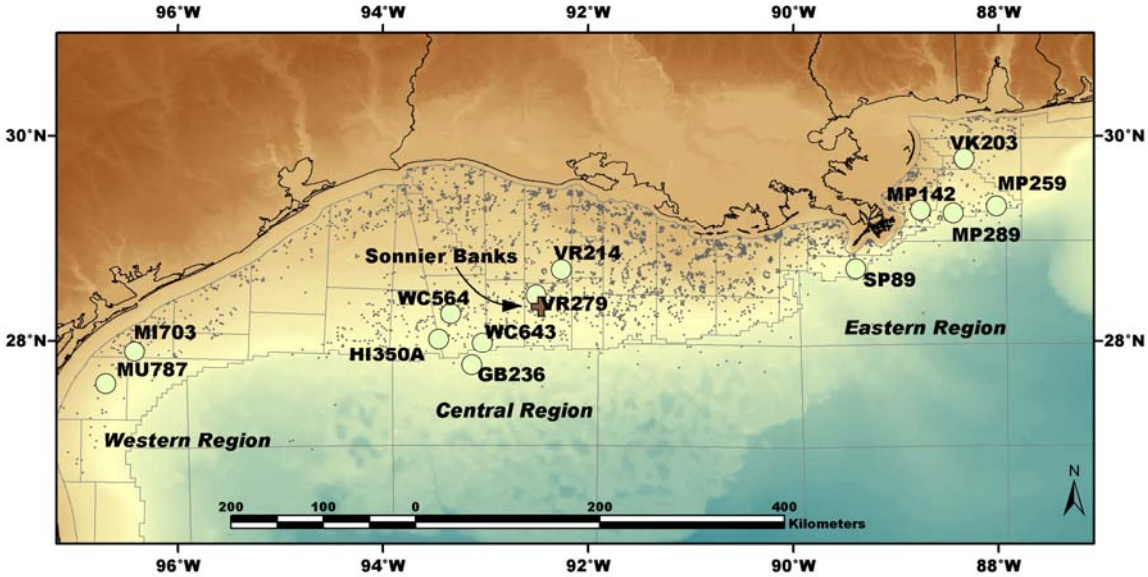


Figure 1. Map of study platforms in the eastern, central and western Gulf regions. The location of a natural reef area (Sonnier Banks) is indicated with a cross.