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STUDY TITLE: Platform Recruited Reef Fish, Phase 1: Do Platforms Provide Habitat That Increase the Survival of Juvenile Reef Fishes?

REPORT TITLE: Proof of Concept for Platform Recruited Reef Fish, Phase 1: Do Platforms Provide Habitat for Subadult Red Snapper?

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SPONSORING OCS REGION: Gulf of Mexico

APPLICABLE PLANNING AREA: Central

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KEY WORDS: red snapper, Essential Fish Habitat, site fidelity, artificial reefs, Gulf of Mexico oil and gas platforms, drilling muds, otolith microchemistry, trace element isotope ratio fingerprints, Inductively Coupled Plasma-Mass Spectrometry

BACKGROUND: The 1996 reauthorization of the Magnuson-Stevens Fisheries Management and Conservation Act contains language calling for understanding and conservation of Essential Fish Habitat (EFH) for federally managed marine finfish and shellfish. One of the most pressing federal fisheries management concerns in the Gulf of Mexico region is the overfished status of the red snapper, *Lutjanus campechanus*. Most evidence suggests that bycatch of juvenile red snapper by shrimp trawling is the primary cause of overfishing. Juvenile red snapper are very abundant in specific locations that are presumed to be EFH. These habitats include naturally-occurring, open-sand bottom and low-relief shell rubble reefs, as well as oil and gas platforms and other artificial reefs (or at least in their proximity). The ways in which different life stages of red snapper utilize these various habitats as they grow, e.g. for feeding, protection or both, once they settle from the plankton as small juveniles, is poorly known. Moreover, some researchers question whether or not artificial reefs (of any type) are a positive influence on reef fish stock dynamics because of doubts about whether they produce or attract fish. Artificial reefs may be useful tools if they increase production; however, if they simply attract fish, they may be promoting overfishing. Consequently, resolution of this question is essential to the management of reef fish

stocks because current knowledge of artificial reefs as EFH is not adequate for managers to consider them as a viable management tools in all situations.

While it has been demonstrated that juvenile red snapper have a strong preference for habitats with some vertical relief, it has been hypothesized that oil and gas platforms and their adjacent footprints or 'shadows' provide exceptionally high quality habitat, such that fishes located there have a survival advantage over conspecifics located in other artificial and natural environments. Increased habitat on, or immediately around, oil and gas platforms is believed to be derived from increased *in situ* food production associated with encrustation by fouling organisms, and by increased physical habitat via structures that extend from the bottom to the surface of the water column.

OBJECTIVES: The main objective of this project was to test the hypothesis that association with oil and gas platforms during early life imparts a detectable 'trace element isotope ratio fingerprint' in the otoliths of juvenile red snapper, i.e., prespawning adults (age 2 to 4). It was hypothesized that the elemental fingerprint specific to platforms would depend upon the specific drilling muds discharged by the platform during its working years. This success of this phase of the project is set the stage for ongoing work (Phase II) that is testing whether adult fishes containing the 'platform fingerprint' in their otoliths contribute disproportionately to adult stocks on nearby natural and artificial reefs. The rationale for the choice of red snapper as a surrogate for reef-associated fish in Phase I of the project is due to their site fidelity, as well as their recreational and commercial importance. Although there are differing conclusions on red snapper site fidelity, we believe that they exhibit the appropriate model life history to prove the concept of this study. Red snapper have been shown to have high site fidelity (70%) during their first years as recruits on offshore habitats, with site fidelity decreasing as fish get older. Based on this work, we have shown that red snapper remain at oil and gas platforms long enough to incorporate a signal into their otoliths. If this signal proves to be temporally and geographically stable in Phase II, determination of the relative value of oil and gas platforms as red snapper EFH will be an important tool for fisheries managers and may help to restore stock size. The determination of the impacts of artificial reefs (of any type) on the demographics of reef-associated fishes is a necessary step in moving towards final resolution of the production vs. attraction debate.

DESCRIPTION: Red snapper were collected from artificial reefs (anything other than oil and gas platforms – controls) in Alabama south of the Hugh Swingle permit area and Louisiana south of Port Fourchon in the South Timbalier Lease Block. Experimental fish collected from oil and gas platforms were fished from platforms in the Grand Isle Lease Block. All fish were collected during the two year period from 2002 to 2004 using hook and line. Fish were measured and their heads removed, frozen and sent to LSU for otolith removal. Otoliths were removed and sent to the University of Hawaii at Manoa where they were analyzed for fifteen (15) isotopes by Inductively Coupled Plasma-Mass Spectrometry. These isotopes, chosen because of their potential presence in drilling muds and platform operations, included Vanadium 51, Cobalt 59, Nickel 62, Zinc 64, Copper 65, Zinc 66, Silver 107, Cadmium 100, Cadmium 114, Lead 206, Lead 207, Lead 208, and Uranium 238. Data were analyzed statistically using stepwise and

canonical discriminant function analyses to compare red snapper otolith fingerprints from on and off platforms and from east and west of the Mississippi River.

SIGNIFICANT CONCLUSIONS: This method was successful; otolith microchemistry can be used to determine the trace element signature of oil and gas platforms in otoliths of red snapper.

Vanadium 51, Lead 206, Lead 207, and Lead 208 may be dissolution products incorporated into red snapper otoliths from oil and gas platform operations and their prior drilling operations.

These result allowed us to move forward (in Phase II funded by MMS) with expanding the geographical and temporal coverage of samples of subadult red snapper (Gulf-wide), and with micromilling a sub-sample of either otolith cores, or increments that are deposited with age progressively out from the core of adult fish, to determine if the new recruits that are now expanding into the eastern Gulf were associated with oil and gas platforms during some portion of their early life, and to determine age-specific habitat affinity.

Phase II results should allow us to determine if there are a disproportionate number of adult red snapper in the eastern Gulf and elsewhere that have acquired this 'oil and gas platform signature' in their otoliths, sometime during their early life history. If this is true, oil and gas platforms may constitute red snapper essential fish habitat and, as such, should be considered as viable tools in management of red snapper.

STUDY RESULTS: The objective of this study was to determine if a trace element isotope ratio fingerprint could be detected and described as unique to red snapper inhabiting the platforms. Stepwise and canonical discriminant function analyses were used to compare red snapper otolith fingerprints from on and off platforms, and from east and west of the Mississippi River. Classification accuracies based on the probability of an individual fish being correctly classified into the habitat from which it was sampled were over 90% for each of the two main comparisons. When comparing the elemental composition of red snapper otoliths from Louisiana oil and gas structures and Louisiana artificial reefs, the classification accuracy was 93.75%. When comparing the elemental composition of red snapper otoliths from Louisiana artificial reefs and Alabama artificial reefs, the classification accuracy was 91.06%. Vanadium 51, Lead 206, Lead 207, and Lead 208 all appear to be linked with oil and gas structures or their prior drilling operations, as the concentrations of these four elements or isotopes were significantly higher in otoliths sampled from platforms in Louisiana than in otoliths sampled from artificial reefs in either Louisiana or Alabama. These platform isotopic fingerprint results indicate that it may be possible to sub-sample from otoliths of adult fish in Phase II of our study to determine age-specific habitat affinity, and to determine if the new recruits now expanding into the eastern Gulf as the red snapper population rebuilds were associated with oil and gas platforms during some portion of their early life.

STUDY PRODUCT: Nowling, L.K., J.H. Cowan, Jr., and R.F. Shaw. 2010. Proof of concept for platform recruited reef fish, Phase 1: Do platforms provide habitat for subadult red snapper? U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2010-002. 80 pp.