Impact of Artificial Reef Deployment on Reef Fish Movement and Community Assemblages

Impacto del Despliegue de Arrecifes Artificiales en el Movimiento de Peces de Arrecife y Ensambles Comunitarios

Impact du Déploiement de Récifs Artificiels sur le Mouvement des Poissons de Récif et les Assemblages Communautaires

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EXTENDED ABSTRACT

Artificial reefs, as well as oil and gas platforms, have been deployed widely across the Gulf of Mexico (GofM). The complex structure of platforms provides habitat throughout the water column and can support large populations of fish. As of 2016, there were 4,176 artificial reefs and nearly 2,200 active platforms in the GofM, many nearing the end of their production capability and being repurposed as artificial reefs or removed entirely2. The Coastal Conservation Association R.E.E.F Louisiana project is a conservation effort to replace removed platforms with artificial reefs to maintain habitat for important fishery species. This effort provided a unique opportunity to study the overall response of reef fish to a newly deployed artificial reef. In this study, we examined the before-after impacts of artificial reef deployment on fish assemblages using video surveys and characterized the movement dynamics of important reef fish species between the new artificial reef and existing nearby structure using acoustic telemetry to increase our understanding of how fish recruit to new artificial reef sites.

In October 2021, an artificial reef was deployed 20km offshore of Timbalier Island, LA in water 20m deep. The reef site is surrounded by existing platforms, including three multi-legged platforms within 2km of the reef. Baited remote underwater video (BRUV) surveys were performed to characterize changes in fish abundance and community assemblages at the artificial reef, the three nearby platforms, and open-bottom controls for comparison. A drop camera array of two action cameras (Go-Pro Hero9) suspended mid-water column was used, one camera 3 m and the other 9 m off the seafloor, with a small bait pouch attached beneath the submersible housing of each camera. Each survey consisted of multiple 5-minute soaks at the artificial reef site (n=3), nearby platforms (n=3) and randomly selected control (open bottom) sites (n=3). Surveys were conducted once prior to artificial reef deployment then seasonally throughout the following year. Movement of two reef fish species (Red Snapper, Lutjanus campechanus; Gray Snapper Lutjanus griseus) between the artificial reef and the adjacent platforms was monitored using acoustic telemetry. Prior to artificial reef deployment, a total of 40 fish (Red Snapper n=20; Gray Snapper n=20) were caught by hook and line at the platforms and tagged with a surgically implanted acoustic transmitter (V9-2x, Vemco). Transmitters each emitted a uniquely coded signal every 70-130 seconds which was recorded by acoustic receivers (VR2Tx, Vemco) as tagged fish swam nearby. Receivers (n=3) were attached to each platform initially with additional receivers (n=5) placed at the artificial reef following its deployment.

Observed specimens in the BRUV surveys were identified to the lowest taxonomic level possible and relative abundance was estimated using MaxN3. Using the MaxN counts, changes in species richness and abundance were analyzed across seasons and structure type. Red and Gray Snapper were only observed at the platforms, and their abundance, both overall and by species, was also characterized across season and depth. Acoustic telemetry data was analyzed for migration from platforms to the artificial reef site as well as overall emigration of any tagged fish from the study area.

Species richness and abundance were greatest at the platforms ($P<0.001$) and remained consistently low at the artificial reef, which did not significantly differ from the control. Gray snapper were more abundant than red snapper at the platforms ($P=0.006$) and were observed higher in the water column ($P=0.008$). Trends in red and gray snapper abundance across depth are likely explained by the presence of hypoxic water, which seasonally affects this area, as fish increasingly utilized the upper water column during the spring and summer when hypoxia typically peaks off the Mississippi River Delta. Acoustic telemetry analysis revealed no tagged fish migrated to the artificial reef during the initial 9 months post-deployment. A total of 13 tagged fish remained in the study area at the end of June 2022, with most individuals emigrating in the first 2 months of the study. Approximately 60% of the fish had left the study area by November 2021, which was likely due to Hurricane Ida passing by the study site in September. Following this event emigration, (calculated for each 2-month period) was relatively rare and remained less than 7% for the remaining portion of the study.

Lack of migration to the artificial reef as well as low species richness and abundance at the reef site may reflect poor habitat suitability. Given the vulnerability of this region to benthic hypoxia, the reef structure may fail to provide sufficient complexity or vertical relief to support fish populations and allow individuals to escape hypoxic conditions. However, the

reef's late fall deployment may have also precluded recruitment of newly settled fish in 2021 causing the low observed abundance. Further studies examining the effect of alternative reef structures (e.g., higher vertical relief) on reef fish community assemblages in areas prone to benthic hypoxia could be beneficial in improving artificial reef design and efficacy.

KEYWORDS: Artificial Reef, BRUV, Acoustic Telemetry, Movement

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