The First Steps: Determining Essential Fish Habitat for Queen Snapper (*Etelis oculatus*) in Puerto Rico Using Ensemble Species Distribution Modeling

Los Primeros Pasos: Determinando el Hábitat Esencial de Peces Para el Pargo Reina (*Etelis oculatus*) en Puerto Rico Utilizando Modelos de Distribución de Especies por Conjuntos

Les premières étapes: déterminer l'habitat essentiel du poisson pour le vivaneau royal (*Etelis oculatus*) à Porto Rico à l'aide de la modélisation de la distribution des espèces d'ensemble

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EXTENDED ABSTRACT

As the third most landed finfish species (by total pounds – as determined by Puerto Rico commercial landings 2012-2017), queen snapper (*Etelis oculatus*) is of interest from an ecological and management perspective yet little is known about its detailed distribution patterns and the habitats it utilizes. As a relatively deep-water species (100–500 m), it is difficult to develop expansive occurrence datasets due to limited opportunities and costly field sampling. With fishing activities progressively expanding into deeper waters, it is critical to gather data on deep-water fish populations to identify essential fish habitats (EFH). The first step in determining EFH requires simple presence/absence data for a species for either some or all portions of its geographic range. However, in the U.S. Caribbean, the critically data-deficient nature of this species has made this challenging.

In this work, we investigated the use of ensemble species distribution modeling to predict queen snapper distribution along the coast of Puerto Rico, specifically the western, northeastern, and southeastern regions. Terrain attributes derived from multibeam bathymetric data were combined with occurrence data collected through a NOAA National Marine Fisheries Service fishery-independent video and hook and line survey to develop ensemble models unique to each sampling region. Furthermore, we developed ensemble SDM models to analyze fish distribution, and contrast habitat classifications and fish-habitat relationships at different spatial scales using the three highest performing algorithms in each region.

Study results show that the ensemble models for the three target regions in Puerto Rico provided 'excellent' predictive capability, with AUC values all >0.8 (Hosmer and Lemeshow, 2000). Additionally, all ensemble models depicted 'substantial agreement' with Kappa values all >0.7 (Landis and Koch, 1977). Variable importance differed across spatial scales of 30 m (west region) and 8m (northeast and southeast region). In the west, the three most valuable predictors were bathymetry (depth), slope, and vector rugosity metric (VRM) in predicting queen snapper probability, whereas in the northeast the most valuable predictors were bathymetry (depth), northerness, and plan curvature, and in the southeast, bathymetry (depth), slope, and fine-scale bathymetric position index (BPI). The models facilitate the analysis of fish distribution and fish-habitat relationships at different spatial scales. Our results are a first step in determining EFH and distribution of this species in Puerto Rico, and further highlight the importance of investigating the role spatial scale and other contributing factors play in our understanding of species-environment relationships.

KEYWORDS: deep-water snapper, essential fish habitat, habitat suitability, ensemble species distribution modeling, Puerto Rico

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