Exploring factors driving the diversity of fishes across lagoonal habitats of the Great Reef of Toliara (SW Madagascar)

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Size-spectra and taxonomic diversity constitute an important ecological indicators and biodiversity components to inform management and conservation in aquatic ecosystems. To date, few studies aimed to model the distribution of reef fish diversity at small spatial scales. Based on a one-year data collection, we described the patterns of fish diversity and their size spectra across various coastal habitats covering different environmental gradients in the Toliara reef system (SW Madagascar). We also modeled their distribution across the environmental and geographical gradients using the machine learning algorithm Random Forest for alpha-diversity and size-spectra and Generalized Dissimilarity Modelling for beta-diversity. Our results revealed a significant spatial and seasonal change of species richness and Shannon diversity index. Fish size slope emphasized the high dominance of small-sized fish on the sites close to the shoreline indicating their potential nursery zones. Beta-diversity was mainly contributed by species replacement or turnover with up to 75%, indicating the important conservation value of the sampled sites. The geographic position of the sampled sites and habitat features were the foremost drivers of alpha-diversity and size spectra patterns, explaining 48 to 60% of their variations. On the other hand, only habitat features were the main predictor of species turnover patterns explaining up to 62% with a rapid increase of species replacement within the first 2 km from the coast. Our study helped to identify nurseries grounds across the lagoon of the Great Reef of Toliara and revealed strong variation in the structure of fish assemblages along coastal habitats.