

Ensemble modeling of the potential distribution of the whale shark in the Atlantic Ocean

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The whale shark (*Rhincodon typus*) is an endangered marine fish species which can be adversely affected by the fishing activities of the industrial purse seine fleet targeting tropical tuna. Tuna tend to aggregate around all types of floating objects, including whale sharks. We analyzed and modeled the spatial distribution and environmental preferences of whale sharks based on the presence and absence data from fishing observations in the Atlantic Ocean. We used a thorough multialgorithm analysis, based on a new presence-absence dataset, and endeavored to follow the most recent recommendations on best practices in species distribution modeling. First, we selected a subset of relevant variables using a generalized linear model that addressed multicollinearity, statistical errors, and information criteria. We then used the selected variables to build a model ensemble including 19 different algorithms. After eliminating models with insufficient performance, we assessed the potential distribution of whale sharks using the mean of the predictions of the selected models. We also assessed the variance among the predictions of different algorithms, in order to identify areas with the highest model consensus. The results show that several coastal regions and warm shallow currents, such as the Gulf Stream and the Canary and Benguela currents, are the most suitable areas for whale sharks under current environmental conditions. Future environmental projections for the Atlantic Ocean suggest that some of the suitable regions will shift northward, but current concentration areas will continue to be suitable for whale shark, although with less productivity, which could have negative consequences for conservation of the species. We discuss the implications of these predictions for the conservation and management of this charismatic marine

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