Modelling the Population Dynamics of Caribbean Parrotfish

Modelar la Dinamica de Poblaciones de los Peces Loro en el Caribe

Modéliser la Dynamique des Populations des Poissons Perroquets dans les Caraïbes

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EXTENDED ABSTRACT

Parrotfish (family: Scaridae) are the dominant herbivores and a major source of ecological resilience on present-day Caribbean reefs. Parrotfish limit the growth and colonization of macroalgae, therefore facilitating coral growth and recruitment. Unfortunately, parrotfish populations have been depleted on many Caribbean reefs by intense trap fishing. As a result, there are growing concerns about the maintenance of functional levels of herbivory on reefs that are facing a rapidly changing climate. This calls for increased knowledge on population dynamics of parrotfish for effective management of reef resilience in the Caribbean.

With this objective in mind, we developed a simple demographic model that permits exploration of the effects of fishing on the stoplight parrotfish (*Sparisoma viride*). The model is structured by size and is calibrated using life-history data and time-series of fish abundances in Bonaire and Bermuda. Fish recruit at a constant rate (i.e., no stock-recruitment relationship) at different size classes (1 - 5 cm). Growth is modeled according to the von Bertalanffy growth equation. Three sources of size-dependent mortality are included:

i) Due to predation,
ii) Due to senescence, and
iii) Due to fishing.

This simple model is able to predict the size distribution of an unfished (Bonaire) stoplight population, with an instantaneous mortality rate that closely matches published estimates for that species. The model also predicts recovery from an over-exploited state with similar timing and magnitude as observed in Bermuda following a trap-fishing ban.

Overall, this model is a first step towards the development of a robust modelling tool for user-specified management strategies of Caribbean reef resilience. The model can be used to predict the response of the stoplight parrotfish to different catches rates, with particular focus on population size structure and grazing rate. Further work will expand the model to other important species of Caribbean parrotfish, in order to investigate the impact of increased/reduced catch rates on fish herbivory and determine sustainable catch levels. Because restoring and protecting parrotfish population is likely to mitigate the negative effects of climate change-induced disturbances on corals, we stress that effective management for functional herbivory is key for the maintenance of coral reef resilience in the Caribbean.

KEY WORDS: *Sparisoma viride*, demographic model, growth transition matrix, size-dependent mortality, fisheries management