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TITLE: Modelling long-term fisheries data to resolve the attraction versus production dilemma of artificial reefs

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ABSTRACT:

The main role of artificial reefs (ARs) is to enhance the productivity and sustainability of coastal fisheries by creating new fish biomass. From a modelling point of view, the creation of new fish biomass would be realized by a shift to a state of higher carrying capacity of the environment (K) for aquatic populations and communities. However, it has not been possible to demonstrate unequivocally rising K as a result of AR deployment because of the difficulty in disentangling enhancements due to simple distributional changes (the attraction hypothesis) versus total abundance rise (the production hypothesis). Here we develop a modelling framework based on simple, inexpensive fisheries data to quantify the impact of ARs, disentangling attraction from production by assessing the rise in regional K. The rationale is that if attraction to ARs from the wider region was the main driver of increased abundance in the ARs then regional K would have remained constant before, during and after deployment of the ARs. Therefore an increase in regional K disproves the hypothesis of attraction. The study case is the fishery for the two-banded seabream *Diplodus vulgaris* in southern Portugal. Monthly time series of 27 years of landings, 20 years of fishing effort, were available from three small-scale fleets: one was the artisanal fleet operating on the ARs and the other two were semi-industrial fleets operating on the wider continental shelf. The model that we developed and applied incorporated the data from all fleets so it evaluated the change in regional K. We show that regional K for *D. vulgaris* increased by 35% after final deployment of the ARs and it did so in linear fashion during four years. From a fisheries perspective the result was more nuanced because although the deployment succeeded in raising regional K, stock biomass and thereby enhancing the artisanal fishery, it also led to a substantial rise in total fishing mortality and exploitation rate because the semi-industrial fleets operating offshore increased their harvest rate nearly 3-fold. Our modelling framework has wide applicability in other regions due to the elementary nature of the necessary fishing monitoring data.

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