A TROPHODYNAMIC APPROACH FOR THE EVALUATION OF FISHERY MANAGEMENT PLANS IN THE GULF OF GABES (SOUTHERN TUNISIA)

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Abstract

An Ecopath with Ecosim food web model of the Gulf of Gabes (southern Tunisia) was constructed in order to describe its trophic structure and functioning. To assess the impacts of fisheries, an Ecosim routine was applied to predict temporal variation of catches. The model was fitted with time series data of landings for the period 1995-2008. Then, several fishery management plans were simulated by implementing different biological rest-periods. To a better evaluation of each management plan, ecological and socio-economic indicators were calculated. These indicators were used to i) establish a ranking between the fishery management plans, ii) study the effects of conservation measures on the ecosystem.

Keywords: Fisheries, Food webs, Models, Gulf of Gabes

Introduction

The Mediterranean Sea is under natural and anthropic threats and is consequently subject to great changes on its biodiversity and functioning [1]. Fishing activity is one of the factors affecting the Mediterranean ecosystems [2] and especially the gulf of Gabes which is the most important fishing area in Tunisia. Thereby, it would be relevant to quantify fishing activities impacts on the structure and functioning of this ecosystem to further asses fishery management plans (FMPs). The Ecopath with Ecosim (EwE) modelling approach has been used to study the trophic structure of the Gulf of Gabes. Thus, a mass-balance model was developed using Ecopath 6.2 to characterize interactions between resources, to identify keystone species and to evaluate the level of exploitation of the fishery [3]. The trophic model represents an average annual situation of the ecosystem (2000-2005), including 41 functional groups [4]. Among these groups, sharks, zooplankton and benthic molluscs were identified as keystone groups. Furthermore, an important bentho-pelagic coupling has been highlighted. This study revealed that the Gulf of Gabes is unlikely to be sustainably fished and was subject to a high level of exploitation such as other Mediterranean ecosystems [4].

Method

Based on initial parameters inherited from the Ecopath of the Gulf of Gabes an Ecosim model was applied to provide temporal dynamic simulations [3]. This model was fitted to available data of landings for the period 1995-2008. To this end, time series of fishing effort by fishing gear type, catches data and biomasses of main functional groups as well as primary production in the study area (1997-2007) were used to calibrate the Ecosim model. The outputs were compared to the time series of landings to assess the goodness of fit. Then, several fishery management plans were implemented by simulating different rest-periods to analyse the ecosystem feedbacks (Fig. 1). This methodology is part of the integrative approach "Back to the Future" [5], which consists of modelling past ecosystem and simulating management plans as policy goals for the future. For this purpose, ecosystemic indicators (Trophic Level of catches, Kempton Q, Fishing In Balance) and socio-economic indicators (landings and total value of catches by fishing activity) were calculated for each measure throughout the period 1995-2008. Thereafter, an overall ranking between the fishery management plans was established based on the results of these indicators (Fig. 1).

Results and discussion

Results showed that conservation measures involving restriction on the activity of benthic trawls (e.i. Sc5, Sc6, Sc7 and Sc8) were more effective than those requiring a complete closure of the fishery (e.i. Sc1, Sc2, Sc3 and Sc4), (Fig. 1). Indeed, the reduction of bottom-trawling fishing effort has positive impacts on the coastal fishing (20% increase in coastal catches), thus leading to the improvement of the social indicator of these fishing management plans. Furthermore, the contribution of each management measure in terms of catch occurs mainly (up to 80%) during the first two years after the end of the fishing management plan. The exponential decrease of this contribution can be explained by the resiliency of the ecosystem. Besides, according to the Ecosim model, the increase in catches due to the application of conservation measures is not proportional to the duration of the management plan. In fact, comparing two similar scenarios Sc1 and Sc2 corresponding to a closure of the fishery respectively 1 and 2 years has shown that the contribution of the second year in terms of gains in catches is about 50% lower than the first year. Which means that, multiplying the duration of the closure 2 times is equivalent to increasing benefits of the conservation measure by a factor of 1.5. In this perspective, Ecosim could be a relevant modeling tool to evaluate and develop management plans aiming the sustainability of fisheries.

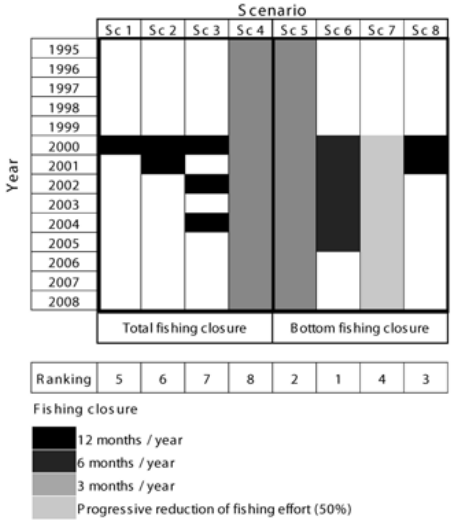

Fig. 1. Fisheries management plans and their ranking

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