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Status and rebuilding of European fisheries

Rainer Froese[a,*], Henning Winker[b,c], Gianpaolo Coro[d], Nazli Demirel[e], Athanassios C. Tsikliras[f,*], Donna Dimarchopoulou[f], Giuseppe Scarcella[g], Martin Quaas[h], Nele Matz-Lück[i]

[a] GEOMAR Helmholtz Centre for Ocean Research, Düsternbrooker Weg 20, 24105 Kiel, Germany
[b] DAFF - Department of Agriculture, Forestry and Fisheries, Private Bag X2, Rogge Bay 8012, South Africa
[c] Centre for Statistics in Ecology, Environment and Conservation, Department of Statistical Sciences, University of Cape Town, Rondebosch, Cape Town, South Africa
[d] Institute of Information Science and Technologies "A. Faedo" - National Research Council of Italy (ISTI-CNR), via Moruzzi 1, 56124 Pisa, Italy
[e] Institute of Marine Sciences and Management, Istanbul University, Istanbul 34134, Turkey
[f] Laboratory of Ichthyology, School of Biology, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece
[g] Institute of Marine Science - National Research Council of Italy (ISMAR-CNR), L.go Fiera della Pesca, 60125 Ancona, Italy
[h] Institute of Economics, Kiel University, Wilhem-Seelig-Platz 1, 24118 Kiel, Germany
[i] Walther Schücking Institute of International Law, Kiel University, Westring 400, 24118 Kiel, Germany

A B S T R A C T

Since January 2014, the reformed Common Fisheries Policy (CFP) of the European Union is legally binding for all Member States. It prescribes the end of overfishing and the rebuilding of all stocks above levels that can produce maximum sustainable yields (MSY). This study examines the current status, exploitation pattern, required time for rebuilding, future catch, and future profitability for 397 European stocks. Fishing pressure and biomass were estimated from 2000 to the last year with available data in 10 European ecoregions and 2 wide ranging regions. In the last year with available data, 69% of the 397 stocks were subject to ongoing overfishing and 51% of the stocks were outside of safe biological limits. Only 12% of the stocks fulfilled the prescriptions of the CFP. Fishing pressure has decreased since 2000 in some ecoregions but not in others. Barents Sea and Norwegian Sea have the highest percentage (> 60%) of sustainably exploited stocks that are capable of producing MSY. In contrast, in the Mediterranean Sea, fewer than 20% of the stocks are exploited sustainably. Overfishing is still widespread in European waters and current management, which aims at maximum sustainable exploitation, is unable to rebuild the depleted stocks and results in poor profitability. This study examines four future exploitation scenarios that are compatible with the CFP. It finds that exploitation levels of 50–80% of the maximum will rebuild stocks and lead to higher catches than currently obtained, with substantially higher profits for the fishers.

1. Introduction

Overexploitation of fish stocks occurs at global scale [1], and some stock depletions have received prominent media coverage (e.g. cod *Gadus morhua* in Canada: [2]). Despite this overall overexploitation pattern, current exploitation and biomass trends differ between few well-managed regions where stocks are recovering, and many badly managed regions where stocks continue to decline [3]. For example, the majority of fish stocks in North American and Australian waters are currently stable with the prospect that reduced exploitation will lead to rebuilding of their biomass [3]. In the rest of the world, fish biomass is, on average, declining due to overexploitation [4] or low fisheries management capacity [3,5].

The Common Fisheries Policy (CFP) of the European Union (EU) [6] calls for rebuilding all commercially used fish stocks above levels that are capable of producing the maximum sustainable yield (MSY) as its explicit objective in Art. 2, §2 of the legally binding Basic Regulation of 11 December 2013. As a first step to achieve this goal, fishing pressure (F) shall be reduced to the maximum sustainable level (F_{msy}) by 2015, latest by 2020. Rebuilding the biomass (B) of stocks above the MSY-level (B_{msy}) requires further reduction of fishing pressure, i.e., F must be smaller than F_{msy}, but the extent of this reduction is left unspecified in the CFP and is thus a matter of controversy among fisheries scientists and managers [7]. Three possible indicators for helping in the selection of adequate fishing pressure are the time required for rebuilding, the expected catches, and the profitability of the fisheries during and after the rebuilding phase. These indicators are functions of the current status of the stocks (B/B_{msy}), the remaining level of exploitation (F/

* Corresponding authors.
E-mail addresses: rfroese@geomar.de (R. Froese), atsik@bio.auth.gr (A.C. Tsikliras).

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F_{msy}), and the net productivity or intrinsic rate of population increase (r) of the stock [8]. The monitoring of the CFP implementation is of great importance for the European Union (EU), European Commission (EC) and its Directorate-General for Maritime Affairs and Fisheries (DG MARE). The Scientific, Technical and Economic Committee for Fisheries (STECF) is the main scientific advisory body on fisheries policy to the EC and has the task of reporting on the CFP implementation through the estimation and publication of a series of indicators [9].

Within EU waters, the proportion of stocks that are routinely and regularly assessed is higher in the northeast Atlantic [10] compared to the Mediterranean and Black Seas [11,12] partly due to the multi-specific nature of fisheries in the southern areas [13] and partly due to the higher fisheries management capacity in the wealthy countries of northern Europe. With respect to the Atlantic fisheries, Cardinale et al. [10] evaluated the status and exploitation of 41 demersal, pelagic and benthic fish stocks of the Northeast Atlantic, Gascuel et al. [14] examined the catches of major stocks in the European waters of the Atlantic Ocean, and Fernandes and Cook [15] reviewed recent stock assessments in the Northeast Atlantic. Recent evaluations of Mediterranean and Black Sea fisheries have been based on data from landings [16], scientific surveys [17], or stock assessments [18–22] and ecosystem models [23]. However, these studies did not use a coherent MSY framework as required by the CFP and covered only a fraction of the exploited stocks.

The purpose of this study was to examine all European stocks for which at least catch data were available and to determine stock status (B/B_{msy}) and exploitation (F/F_{msy}) in the context of the legal CFP requirements. This was done with an advanced implementation of a surplus production model [24] to assess how rebuilding time, catch and profitability depend on the rebuilding strategy, as determined by the chosen level of future exploitation. In summary, this study is meant to help European fisheries managers in the selection of future exploitation levels that are sustainable, profitable, ecologically sound, and compatible with the CFP.

2. Methods

2.1. Dataset

Fish and invertebrate stocks from ten ecoregions of the European Seas were assessed. Six of the ecoregions were located in the northeast Atlantic Ocean (Barents Sea and Norwegian Sea; Iceland, Faroes and Greenland; Greater North Sea; Baltic Sea; Celtic Seas and Rockall; Bay of Biscay, Iberian Coast and Azores), three in the Mediterranean Sea (western Mediterranean: includes Gulf of Lions, Balearic Sea and Sardinia; central Mediterranean: includes Adriatic and Ionian Seas; eastern Mediterranean: includes Aegean Sea and Cyprus waters), while Black Sea was assessed as a single ecoregion (Fig. 1). Overall, 397 fish and invertebrate stocks were assessed, of which 357 (90%) were being exploited within their respective ecoregions, whereas 40 of them were wide-ranging stocks.

For the northeast Atlantic, catch and biomass trajectories or relative abundance indices from formal stock assessment were extracted from the advice documents published by the International Council for the Exploration of the Seas (ICES) and the International Commission for the Conservation of Atlantic Tunas (ICCAT). For the Mediterranean, the landings were acquired from the Food and Agriculture Organization-General Fisheries Commission for the Mediterranean (FAO-GFCM) database (1970–2014) for each ecoregion [25] and the biomass or relative abundance data from the Data Collection Framework (DCF) programme. The reports from the regular assessments of STECF were used in some cases [20,26–30]. For the Black Sea, latest available stock assessment reports were used [31]. The aforementioned reports were also used as officially accepted independent stock assessments for comparison with the findings of the present work.

2.2. Estimation of reference points

The open-source CMSY stock assessment tool [24] was used to estimate the stock status for European stocks. The CMSY catch-only

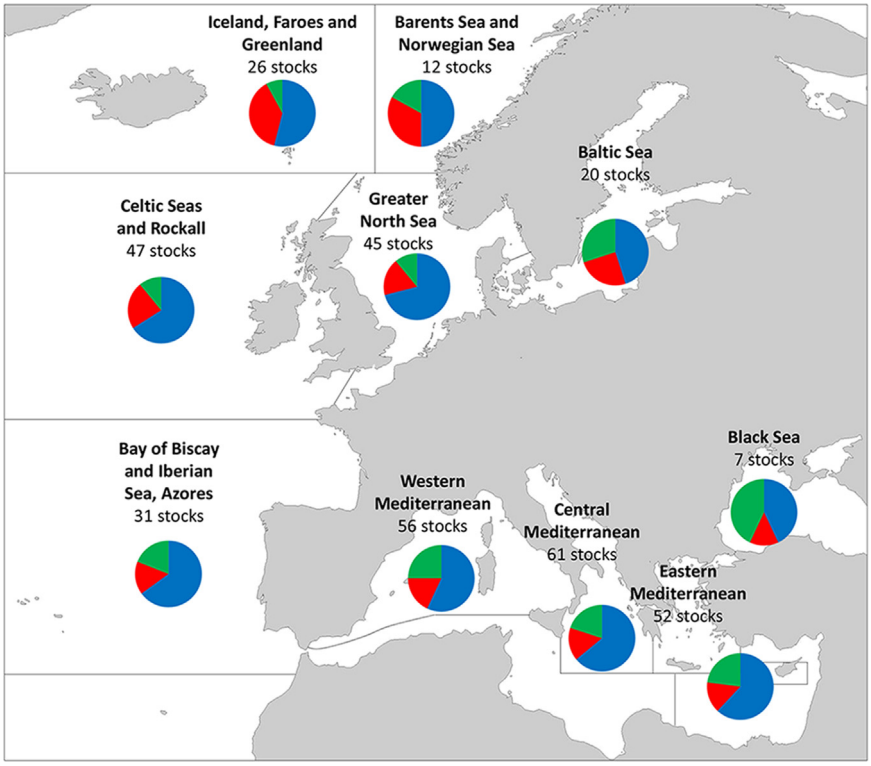

Fig. 1. Map with the ten ecoregions and the percentage of stocks per functional group (large predators: red; pelagic plankton feeders: green; benthic organisms: blue). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)