Marine Policy xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Marine Policy

journal homepage: www.elsevier.com/locate/marpol

Who gets to fish for sea bass? Using social, economic, and environmental criteria to determine access to the English sea bass fishery☆

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ARTICLE INFO

Keywords:
Fisheries allocation
Fisheries management
Sea bass
Common Fisheries Policy
Multi-criteria decision analysis
Decision Support

ABSTRACT

Transparent, performance-based approaches to allocating fishing opportunities are required for signatories to the Aarhus Convention and the European Union's (EU) Member States via the Common Fisheries Policy. The lack of an operational framework to support this requirement means such a system is seldom explicitly used. Using the English commercial sea bass (*Dicentrarchus labrax*) fishery as a case study, operationalisation of this policy requirement is evaluated using a Multi-criteria decision analysis (MCDA) framework. MCDA is a decision-making tool allowing users to explicitly evaluate complex, potentially conflicting, criteria, enabling wider costs and benefits to be considered. The sea bass fishery was selected as the dramatic stock decline since 2010 has meant difficult policy choices regarding the allocation of scarce fishing opportunities between different user groups. To inform the MCDA, the three main English sea bass fishing methods (nets, hooks, and trawls) are evaluated across thirteen social, economic, and environmental criteria to generate a performance score. Importance weightings for each criterion, developed from 50 surveys of fishers, industry representatives, managers, non-governmental organisations, and the wider public, are used to combine these performance scores generating an overall score for the MCDA. Results show that regardless of stakeholder group questioned, hooks achieve the highest MCDA performance, followed by nets, and then trawls. This suggests that taking a performance-based approach to the allocation of fishing opportunities in the English fishing fleet have a prioritisation by fishing type. MCDA could be used to promote transparency, objectivity and social, environmental and economic sustainability into European and UK fisheries.

1. Introduction

Fisheries resources are finite in supply but desired by many users (they are rivalrous). Limited fishing opportunities must therefore be allocated to users with competing demands based on a framework to avoid over-exploitation which may result from the divergence between individual and collective interests [1]. In accordance with international obligations [2] to avoid over exploitation of resources, the sustainable management of fish stocks is required. In Europe, the Common Fisheries Policy (CFP, REGULATION (EU) No 1380/2013) [3] and Marine Strategy Framework Directive (MSFD) [4] provide the legislative framework setting out the goal of achieving Maximum Sustainable Yield (MSY) and Good Environmental Status (GES) by 2020 for all commercially exploited fish stocks [5]. Accordingly, allocations of fishing opportunities by the European Commission are, in principle if not in practice, made to EU Member States in line with these objectives for the major shared fisheries [6].

The national distribution of fishing opportunities should follow Article 17 of the CFP which specifies that Member States use "transparent and objective criteria including those of an environmental, social and economic nature [7]". Article 17 requires fleets that deliver best value to society to be given preferential access to fishing opportunities. However, the practical application of this broad policy objective is not specified and the current allocation of fishing opportunities often relies on piecemeal historic decisions. This presents the potential for conflict with the provisions of the United Nations Aarhus Convention which provides the public with rights regarding access to information, public participation and access to justice, in governmental decision-making processes on matters concerning the local, national and transboundary environment with a focus on interactions between the public and public authorities.

When considering fisheries management objectives and developing allocation criteria, a number of studies have examined options for allocation (including criteria and indicators), beyond the widespread

☆ This manuscript has not been published and is not under consideration for publication elsewhere. We have no conflicts of interest to disclose and no external funding to report.

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https://doi.org/10.1016/j.marpol.2018.02.011
Received 7 November 2017; Received in revised form 10 February 2018; Accepted 10 February 2018

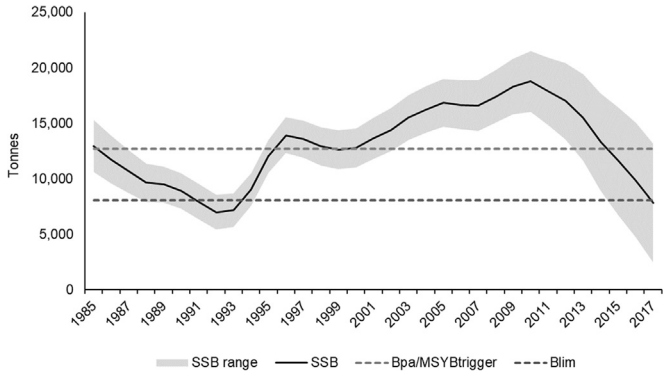

Fig. 1. Spawning stock biomass of the Northern European stock of sea bass (Reconstructed from ICES data [22]). Abbreviations: SSB – spawning stock biomass, Bpa – precautionary reference point for SSB, MSYBtrigger – the lower 95% confidence limits (of SSB) with exploitation at FMSY from long-term simulations, Blim – limit reference point for SSB.

'historic share' approach [8–11]. However, a significant gap remains in the peer-reviewed academic literature with no practical guidance on how to turn potential criteria into the allocation of fishing opportunities.

Using the English sea bass (*Dicentrarchus labrax*) fishery as a case study, multiple-criteria decision analysis (MCDA) is explored as a tool for transparently allocating fishing opportunities in a non-total allowable catch (TAC) operated fishery. Sea bass was exemplified because it is an important commercial and recreational stock [12] that has undergone a severe decline in recent years, following a period of poor recruitment due to adverse environmental conditions (Fig. 1) coupled with unchecked expansion of fishing effort and unsustainable catch levels [13]. In brief, the commercial sea bass fishery is split between an offshore fishery on spawning aggregations, mainly using pelagic trawls and drift nets, and an inshore fishery using a variety of gears (fixed nets, rods, and lines) targeting sea bass after spawning and/or juvenile fish [14]. The fishery is mainly exploited by fleets from France, the UK, and the Netherlands with equal landings from the UK and France in 2016, despite France previously catching two thirds of the EU total (see Fig. S1) [15]. Since 2015, following steep declines in spawning stock (Fig. 1) the (EU) has introduced Emergency Measures, closing the fishery, limiting recreational angling and commercial catches, and increasing the minimum legal landing size [16]. This study does not consider the question of allocation between commercial and recreational take, but the methodology could also be applied between these sectors. A full history of the sea bass fishery is provided in the Supplementary material.

Continued debate regarding further fishing opportunities amongst Member States, the commercial and recreational sectors, and different fishing gear operators within the commercial sector is expected. With so few fishing opportunities available for sea bass, great care must be made that opportunities maximise social and economic value while minimising environmental damage and several reports on EU fisheries have advocated a criteria-based approach to quota allocation [17,18]. Based on this a set of social, economic and environmental objectives for use in the UK sea bass fishery were developed. While the UK will be leaving the CFP following Brexit (the departure of the UK from the European Union as a result of a referendum held in June 2016) [19], the approach of Article 17 is consistent with the UK Government's Marine Policy Statement of promoting good governance and achieving a sustainable economy [20]. The findings of this study can therefore be used to inform fisheries allocation across the EU and in the UK post-Brexit

2. The English sea bass fishery

2.1. Stock decline

Sea bass is an important commercial and recreational stock [21]. Owing to its popularity on menus and availability to fishers as a non-quota species, increased catches between 2000 and 2010 proved unsustainable and the Northern European stock has undergone a severe decline in recent years (Fig. 1) [22] and the Southern stock appears to be following the same trajectory [23].

Sea bass grow slowly, do not mature until 4–7 years of age, and have been recorded up to 28 years of age [24]. Juvenile sea bass up to three years of age occupy nursery areas in estuaries whilst adults undertake seasonal migrations from inshore habitats to offshore spawning sites where they are targeted by pelagic trawlers [25]. After spawning, sea bass tend to return to the same coastal sites each year [26]. The combination of slow growth, late maturity, spawning aggregation, and strong site fidelity, increase the vulnerability of sea bass to over-exploitation and localized depletion [27].

2.2. The fishery

France has long been responsible for the majority of sea bass landings since the fishery started at a scale to be recorded. The winter pelagic trawl fishery was conducted only by French vessels with UK vessels excluded by UK-specific regulations due to concerns over cetacean bycatch [28]. Starting in January 2015 the EU introduced Emergency Measures for sea bass (described in Section 2.4), closing the spawning fishery, limiting recreational angling and commercial catches by gear type and area, as well as increasing the minimum legal landing size. In the past few years, the UK share of the fishery has increased as a result of Emergency Measures closed the French offshore fishery.

UK vessels landed 501 t of sea bass in 2016 with a first sale value of £5 million. Of that volume, 487 t were from English vessels and 61 t were from Welsh vessels [29]. Over 42% of English landings were from six ports, which are listed in Table 1.

The English sea bass fishery can generally be categorized into three gear types: nets, hooks, and trawls. In 2016, vessels using nets landed 223 t of sea bass (465), vessels using hooks landed 181 t (37%) and vessels using trawls landed 81 t (17%) (Fig. 2) [30].

2.3. Current management challenges

The recent decline in sea bass has been linked to multiple factors: overfishing of the spawning stock during winter spawning aggregations, a minimum size that could not guarantee enough sea bass were reaching spawning size before capture (i.e. recruitment overfishing), and environmental conditions which had impacted the survival of recent sea bass cohorts leading to poor recruitment. Scientific advice from the International Council of the Sea (ICES) had not been followed by European fisheries ministers ever since a precautionary cut in landings by 20% was advised in 2012 [31,32]. The resulting negative trend of the stock meant urgent action needed to be taken in December 2014 for the 2015 fishing year [33]. ICES continued to advise more stringent reductions in landings, culminating in the advice for zero landings (commercial and recreational) for 2017 and 2018 (when applying a precautionary approach [34,35]).

Sea bass does not have a total allowable catch (TAC). Resistance to catch limits largely emerge from a disagreement between Member States on the appropriate reference period to use to calculate relative shares [36]. This absence of total catch limits has led to increased

Table 1
Major ports for the English sea bass fishery (MMO [30]).

Port	Weight (kg)	Value (£)
Weymouth	49,920	562,470
Brixham	41,163	397,003
Plymouth	31,535	359,197
Eastbourne	33,421	325,731
Portsmouth	26,676	245,115
Newhaven	24,127	208,309
England total	487,109	4,502,050