Full length article

An evaluation of socioeconomic factors that influence fishers' discard behaviour in the Greek bottom trawl fishery

Maria Christou[a,b,*], John Haralabous[b], Konstantinos I. Stergiou[a,b], Dimitrios Damalas[b], Christos D. Maravelias[b]

[a] *Laboratory of Ichthyology, Department of Zoology, School of Biology, Aristotle University of Thessaloniki, PO Box 134, 541 24, Thessaloniki, Greece*
[b] *Institute of Marine Biological Resources and Inland Waters, Hellenic Centre for Marine Research, 46.7km Athens-Sounio, PO Box 712, 190 13, Anavissos, Attica, Greece*

ARTICLE INFO

ABSTRACT

A newly introduced regulation renders the discarding of certain commercially important species illegal within the European waters progressively until 2019 (Article 15, EC Regulation 1380/2013). Thorough research is required in order to understand fishers' perceptions and to achieve effective implementation of the regulation, as it is possible that certain implications might arise within the fishing industry and the associated communities after the shift to the new management regime. In this paper, fishers' socio-economic behaviour is analyzed in relation to discarding practices under the "discrete choice" framework. Specifically, a variety of socioeconomic attributes, in the form of principal components that may affect the choices of the Greek bottom trawl fishers on three key discards' drivers are analyzed to identify possible links between these. Utilizing the same attributes, eight hypothetical management tools that can be adopted for a smoother implementation of the discard ban are examined and the main results are discussed afterwards. Consistent patterns were revealed regarding fishers' behaviour. An association of vessels' efficiency with the probability to discard due to market limitations was evident, along with the association of different socioeconomic factors, such as the fishers' age and the vessel's crew size, with the incentives proposed regarding the introduction of awareness seminars. It is important to study these patterns carefully to understand the drivers and fishers' motivation towards discarding. Their preferences on management tools that can be adopted by the EU member will also be considered, which can lead to a successful introduction of the regulation and a meaningful contribution into an effective management framework within which stakeholders can behave sustainably.

1. Introduction

The catch of unwanted species (UWC) suggests the incidental capture of non-targeted organisms that are discarded to the sea, either dead or alive. Discards can occur due to many factors (Eliasen et al., 2014). Habitat, season, gear type, protection status, age and thereby size structure of the stocks are some of them (Gullestad et al., 2015). Other studies reported that discards are mainly a product of market forces and legal obligations that fishers face (Eliasen et al., 2014; Damalas, 2015; Catchpole et al., 2014), i.e., species might be discarded because of their low economic value, when they are in poor quality, because of regulatory (rights, TAC, quotas, mesh sizes and minimum landing size regulations), or due to technical reasons (e.g. lack of capacity or sorting time: Vestergaard, 1996; Damalas, 2015).

The practice of discarding is conducted on a regular basis in EU fisheries (de Vos et al., 2016). By catch and species-specific discard rates vary among EU fisheries (Catchpole, 2009; Uhlmann et al., 2013) and derive due to a combination of regulations currently in place (Condie et al., 2014). Regarding the Mediterranean, an intensively exploited region (Tsikliras et al., 2015), discards account to around 20% of the average annual catches. These discards tend to include marketable fish, and trawlers seem to be mainly responsible for them (Tsagarakis et al., 2014). Although discarding is perceived as an unacceptable practice (Catchpole et al., 2014) it has been reportedly increased during the past 70 years in the northern Mediterranean trawl fisheries, accompanied with a shift in species composition (Damalas et al., 2015). Despite the fact that studies on discards have been limited to the past decade and restricted mostly to regional fisheries (Uhlmann et al., 2013), the introduction of the ecosystem approach to fisheries management and the EU data collection programs have enabled a better understanding of the problem at a European level during the past years (Tsagarakis et al., 2014; Catchpole et al., 2014). However, discard
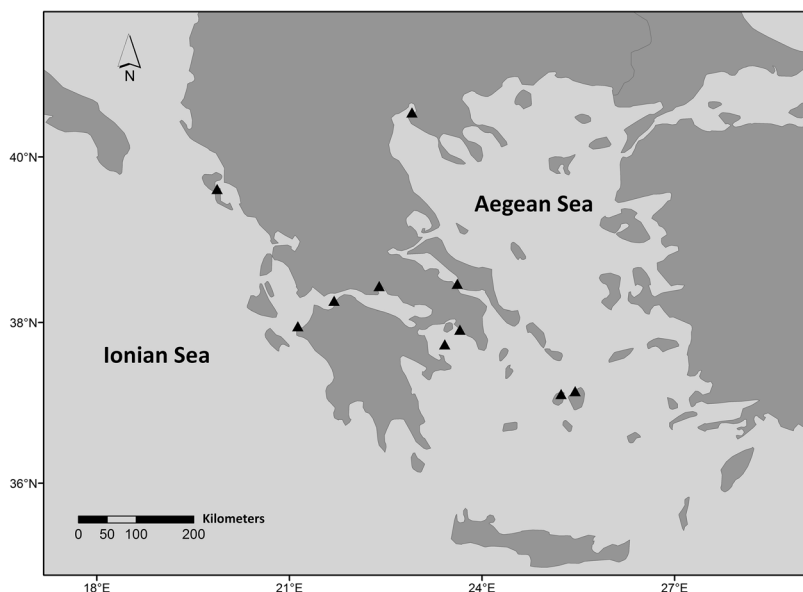
Fig. 1. Study area and ports (triangles) where interviews were held (Eastern Mediterranean Sea).

estimations are perceived as incomplete and inaccurate for the commercial fisheries in EU waters, based on the Data Collection Framework (DCF) (Uhlmann et al., 2013).

Tackling and eliminating discarding is a major challenge on a European level (Catchpole, 2009) with fishers adopting initiatives across Europe sporadically (de Vos et al., 2016) and at personal level (Glass et al., 2015). The rise of public awareness for the marine environment along with fishers' awareness (Borges, 2013), coupled with the need to satisfy the objectives of the Marine Strategy Framework Directive (2008/56/EC) and achieve Good Environmental Status (GES) by 2020 (Salomon and Holm-Müller, 2013) have led to an increased support for minimizing discards. This pressure of minimizing UWC has also led to a "landing obligation" (LO) (Article 15 of the /[EC, 2013] 2013) through the new Common Fisheries Policy (Eliasen and Bichel, 2016). With the newly introduced ban of discarding commercially important species, it is certain that implications will follow across Europe under the new management regime (Vasilakopoulos et al., 2014). Therefore, it would be wise to examine these implications and to set a framework for the affected communities and relevant stakeholders (Ostrom, 2007), before the regulation comes into full force.

The human aspect should be taken into consideration in order to achieve a successful implementation of the discard ban in Europe. Fishers constitute the core of the fishing process, and their behaviour – tactics and attitudes – needs to be examined to understand discarding practices. The diversity and multi-dimensionality of fishers' behaviour is interpreted by either qualitative or quantitative methods, or the integration of both (Boonstra and Hentati-Sundberg, 2016). This diversity is attributed to the fact that fishers operate in a complex decision environment (Asche et al., 2015). Economic, social, and ecological attributes influence the fishers' behaviour towards a management strategy (Bacalso et al., 2013). Fishers adopt strategies and tactics in relation to their personal intentions and the constraints imposed by a plurality of drivers (Salas and Gaertner, 2004). In addition, fishers make decisions about the target species, gear choice, and fishing location on a rather short-term basis, evaluating the profit of each trip separately (Eggert and Martinsson, 2004). Various factors affect the behaviour of fishers, and different attributes influence their decisions: spatial and temporal factors (Eliasen and Bichel, 2016; Tsitsika and Maravelias, 2006), species abundance (Pradhan and Leung, 2004; Katsanevakis et al., 2010), experience (Abusin and Hassan, 2014; Eliasen et al., 2014), regulation (Eliasen et al., 2014; Catchpole et al., 2014), weather (Katsanevakis et al., 2010), risk management (Eggert and Martinsson, 2004), cost and catch expectations (Uda, 2010), community norms and involvement

(Eliasen et al., 2014; Lewison et al., 2011), empirical knowledge, and tradition (Pradhan and Leung, 2004; Bacalso et al., 2013; Abusin and Hassan, 2014). Even conditions on land, e.g., the availability of infrastructure, processing plans or nearby markets, may influence fisher's decisions (Asche et al., 2015; Tsitsika and Maravelias, 2006). Differentiation in fishing gear and technological advances employed by fishers may affect landings in terms of amount, sizes or species and lead to specialization of a fishery (Salas and Gaertner, 2004).

The aim of the present study is to gain a better understanding of fishers' behaviour in an EU Mediterranean fishery, as well as to identify and evaluate factors that may influence their behaviour. The Mediterranean ecosystem is extremely diverse (Coll et al., 2010) and fisheries are managed through fishing effort and technical measures (Maravelias et al., 2014). In order to provide advice for multi-specific fisheries, such as the Greek trawl fishery, its socioeconomic aspects should be examined. In the present work, the drivers behind discarding practices and the fishers' perceptions on several incentives and mitigation measures were explored. It is of significant importance to investigate carefully the observed patterns that reveal the fishers' tactics and preferences, since these patterns will facilitate the design of efficient management measures, or the modification and reinforcement of fisheries management policies currently in place. In this way a smooth shift towards the landing obligation will be feasible and the objectives of CFP can be achieved (Villasante et al., 2016a).

2. Materials and methods

2.1. Study area

The study involved the collection of information by fishers who operate in Greek waters (Fig. 1). The study was based on interviewing fishers at their port of activity, i.e., exerting fishing effort in the Aegean (General Fisheries Commission for the Mediterranean (GFCM) Geographical Sub Area (GSA) 22) and Eastern Ionian Seas (GSA 20). The trawling activity is conducted in accordance to national and European restrictions (Table B1, Appendix), in areas with muddy and sandy bottoms, at depths up to 500m, at consistent and productive fishing grounds ("hotspots") (Maina et al., 2016).

As of 2014, the Greek trawl fleet is represented by 282 vessels (Table B2, Appendix), 250 of which are registered in the Aegean Sea, and the rest of them in the Ionian and Cretan Seas. Bottom trawlers comprise a small part of the total Greek fishing fleet (< 2%). However, their landings in terms of biomass are estimated to be around one-