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Economic, social and ecological attributes of marine recreational fisheries in Galicia, Spain

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ABSTRACT

There are growing concerns about the impact of Marine Recreational Fishing (MRF) on marine ecosystems and its combined effects with other human activities, such as commercial fishing, especially on the higher trophic levels. Conversely, recreational fishers provide considerable economic benefits through their expenditure on many things including fishing tackle, boats, licenses, travel, and accommodation. However, research on MRF in Europe is limited, particularly in Southern countries. In Galicia (Northwest Spain) detailed information on MRF is still needed to support management and to reduce growing conflicts between recreational fishers and other stakeholders including the commercial fishing sector. This paper provides the first comprehensive analysis of MRF in Galicia including the economic, social, and ecological impacts, from a survey of 363 recreational fishers. It was estimated that there are 60 000 recreational fishers, comprised of 45 000 shore anglers, 12 000 boat anglers and 3000 spear fishers. Each year, they spend 86 €M on fishing gear and other expenses, while boat owners spend another 11 €M. Fishers' activity is higher in summer and spring, especially in the case of boat anglers. Recreational fishers reported catching 38 species, but the most common were ballan wrasse (*Labrus bergylta*), European seabass (*Dicentrarchus labrax*), and white seabream (*Diplodus sargus*). Annual recreational catch is about 7 500 t (5–13% of commercial and recreational landings of the same species); shore anglers are responsible for 50% of total MRF catches, boat anglers for 40%, and spear fishers for 10%. The results are discussed in the context of management that could improve the socio-ecological sustainability of MRF.

1. Introduction

Marine recreational fisheries have been defined as the activity aimed to the capture of aquatic resources mainly for leisure and / or personal consumption (ICES, 2013). Fishing to meet people's' dietary needs, or for commercial purposes is not usually considered Marine Recreational Fishing (MRF) (FAO, 2012). MRF is a very important pastime in most countries with a coastline, involving high numbers of participants and making a considerable economic contribution (FAO, 2012; Arlinghaus et al., 2014; Hyder et al., 2017b). In Europe, MRF is an activity with high socioeconomic importance, involving almost 9 million fishers and generating annually around 6 € billion in direct expenditures (Hyder et al., 2017b).

Although commercial fishing has been traditionally blamed for overfishing, there is a growing concern about the potential of MRF to impact on fisheries resources (Schroeder and Love, 2002; Cooke and Cowx, 2004). Estimates of global annual catch by recreational fishers may be as high as 47 billion fish, with two-thirds of those fish estimated to be released (Cooke and Cowx, 2006). In the European Union (EU), recreational catches of Atlantic cod *Gadus morhua* (Linnaeus, 1758), European seabass *Dicentrachus labrax* (Linnaeus, 1758), or seabreams (*Diplodus* spp.), are considerable in some areas and should be accounted for in the stock assessments to improve accuracy of the estimates (Veiga et al., 2010; ICES, 2011; Hyder et al., 2017a, b). In fact, the inclusion of

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recreational catch data where it exceeds 10% of commercial catches can considerably affect the assessment outcomes for a particular stock (Griffiths and Fay, 2015). Exclusion of MRF from stock assessment may affect the ability to manage fish stocks sustainably (Hyder et al., 2014, 2017a; b).

Recreational fishing is recognized as an economically important activity, generating jobs and high revenues (Lovell et al., 2013; Veiga, 2013; Hyder et al., 2017a, 2017b). In this sense, it can contribute to the EU 'Blue Growth' initiative that aims to provide policy-makers at European, regional, national, and local management levels with a comprehensive, robust and consistent analysis of possible future policy options to support smart, sustainable, and inclusive growth from the oceans, seas, and coasts (European Commission, 2012). The EU has developed basic indicators to assess the economic contribution and performance of fishing fleets (Scientific, Technical and Economic Committee for Fisheries, STECF, 2017), aquaculture (STEFC, 2015) and processing (STECF, 2013) sectors in Europe. These indicators are based on the current economic information collected under the Data Collection Framework (DCF) (European Commission, 2001).

The latest data needs for MRF in the DCF (European Commission, 2016) vary between regions and specify that annual estimates of catches and releases are required for Atlantic cod, European sea bass, European eel *Anguilla anguilla* (Linnaeus, 1758), Atlantic bluefin tuna *Thunnus thynnus* (Linnaeus, 1758), Atlantic salmon *Salmo salar* (Linnaeus, 1758), and all elasmobranchs. Despite of the increased effort in data collection in the EU, several studies emphasized the need for gathering and including information on MRF in fisheries management to ensure the sustainable use of common fishery resources (Rocklin et al., 2014; Kleiven et al., 2016; Lloret et al., 2016). Accurate data needed for assessment is generally lacking in Europe (ICES, 2011; Veiga, 2013; Veiga et al., 2013; Hyder et al., 2017a), which may impact on the ability to manage sustainably (ICES, 2017a, b). Both harvest related and socioeconomic information about MRF is still far from being complete for most regions, in particular for Southern countries (Hyder et al., 2017a, b; Pita et al., 2017).

The lack of knowledge about MRF is particularly problematic in Galicia because the region is highly dependent on marine ecosystem services, e.g., shellfisheries, industrial, small-scale and recreational fisheries, aquaculture and tourism (Villasante, 2012; Surís-Regueiro and Santiago, 2014; Villasante et al., 2016). Furthermore, the development of MRF (Pita and Freire, 2016), combined with the cumulative impacts of the aforementioned activities, is contributing to the increase of human pressures on Galician marine ecosystems, putting the sustainability and resilience of marine social-ecological systems at risk (Pita and Freire, 2014). In addition, factors such as poor governance (Freire and García-Allut, 2000), unsustainable patterns of exploitation of aquatic resources (Villasante, 2009), increases in the consumer population (MAGRAMA, 2016), growing demand from aquaculture (Villasante et al., 2013), and drivers such as recurrent oil spills (Monaco et al., 2017) and other extensive pollution (Beiras et al., 2003; Franco et al., 2006; Bellas et al., 2008), habitat degradation and destruction (Pita et al., 2008; Doldán-Garcia et al., 2011), and climate change (Bode et al., 2009; Otero et al., 2009) are accelerating the negative impacts of human activities on the Galician natural capital, ecosystem goods and services and related economies (Doldán García and Villasante, 2015). The effects of these confounding changes can be reduced through the development of measures that can adequately assess the health of complex socio-ecological systems, thereby allowing for their sustainable management and the continued availability of marine resources (Arlinghaus et al., 2016). Thus, achieving the 'Blue Growth' objective in Galicia involves monitoring the performance and sustainability of all marine activities (e.g., recreational, industrial and small-scale fisheries) relating to the use of aquatic resources.

Due to the absence of systematic data collection on MRF in Galicia, there is a need to better understand the contribution of the activity in the region (Pita and Freire, 2016; Pita et al., 2017). This paper provides the first comprehensive attempt to describe and analyze the economic, social, and ecological dimensions of MRF. The purpose of this study was to: 1) obtain baseline information on the economic, social and ecological contribution of MRF in Galicia; 2) estimate total marine recreational fishing MRF annual catch and effort by main MRF modes and for MRF overall; 3) analyze the overlap between MRF and commercial fishing in the area, in terms of commonly captured species and their respective volumes; and 4) provide recommendations for future management and monitoring of the activity in this region. To this end, a survey was conducted to collect and analyze key economic, social, and ecological information about MRF in Galicia. The main findings of this study are discussed in the context of future monitoring of MRF in Galicia, and recommendations for a sustainable and resilient management of MRF in the region are provided.

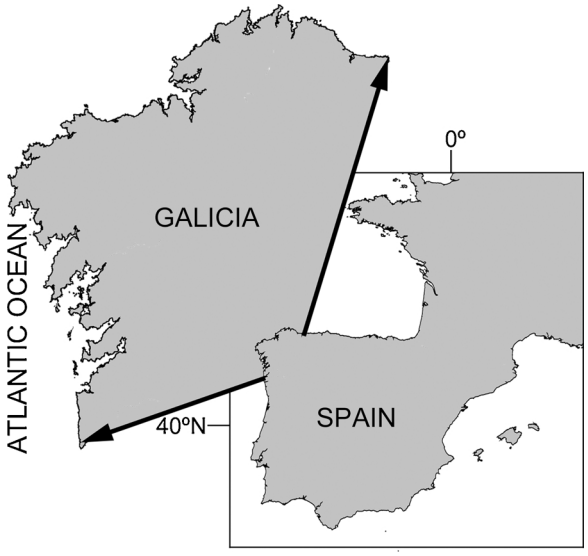

Fig. 1. Map of the study area.

2. Material and methods

2.1. Study area

Galicia in the Northwest of Spain (Fig. 1) is the main commercial fishing region in the country and one of the most important in the EU (Surís-Regueiro and Santiago, 2014; Villasante et al., 2016). The commercial fishing sector strongly contributes to the gross domestic product, with this region accounting for over 40% of the country's commercial fleet and for more than 60% of total employment in the fisheries related sectors. Furthermore, 50% of Spanish catches are landed in Galician ports (Villasante et al., 2016; Xunta de Galicia, 2017; STECF, 2015). Available information suggests that MRF is also relevant in Galicia, with 59,730 licenses to practice this activity issued in 2015 (Xunta de Galicia, *pers. comm.*).

2.2. Data collection

A complementary web-based and onsite survey was conducted between February 2015 and August 2017 to collect key economic, social, and ecological information about MRF in Galicia. In the surveys, fishers were asked to complete a structured questionnaire (the questionnaire is provided in the Supplementary Information, Annex I), which included questions about MRF related expenditures, gears used, seasonal fishing cycle, fishing effort and catches, targeted species, and other aspects that could influence activity including the socio-economic characteristics of fishers. To prevent temporal trends in the responses the fishers were asked to provide averages in their responses for the last 5 years. The