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Swordfish harpoon fishery in the Mediterranean Sea: Recent data to implement the Marine Strategy Framework Directive and the EcAp (Ecosystem Approach) process

Teresa Romeo[a,*], Pietro Battaglia[a], Saša Raicevich[b], Patrizia Perzia[c], Franco Andaloro[c]

[a] ISPRA, Institute for Environmental Protection and Research, Laboratory of Milazzo, Via dei Mille 44, 98057 Milazzo, ME, Italy
[b] ISPRA, STS Chioggia, loc. Brondolo, 30015 Chioggia, Italy
[c] ISPRA, STS Palermo, c/o Residence Marbela, Salvatore Puglisi 9, 90143 Palermo, Italy

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ABSTRACT

This paper provides new data on the swordfish harpoon fishery carried out during 1999–2011 in Italian waters (central Mediterranean Sea), concerning fleet structure and its changes over the last decade, spatial distribution of fishing effort and catches, trend of catch rates, size composition of catches as well as fishing of other species. These data were partially used to implement the MSFD Initial Assessment of Descriptor 3 for Italian waters, and could be useful for the forthcoming application of the EcAp (Ecosystem Approach) process, regarding Ecological Objective 3.

Swordfish harpoon fishery is a typical artisanal practice, characterized by selective catches as well as by cherished cultural traditions, being one of the most ancient fisheries in the Mediterranean Sea, with lengthy traditions and close links with local culture. Fishing capacity showed a low, stable level during the sampling period. Fishing effort, in terms of days at sea, was more intense in GSA 19 than in GSA 10, whereas CPUE often resulted higher during June and July in GSA 10 due to the occurrence of fish belonging to pairs during the reproduction period. Over the period 1999–2009, the percentage of females larger than L_{50} increased up to almost 100% of the catch in both GSA 10 and GSA 19, underlining the high selectivity of this fishing practice, and might be the result of enforcing strict management measures on Mediterranean swordfish stock in recent years. This study also provided some information on the catch of *Tetrapturus belone*, whose stock is today regarded as data-poor.

1. Introduction

Swordfish (*Xiphias gladius* Linnaeus, 1758) is one of the most important fish resources in the Mediterranean Sea (FAO, 2011) on account of its great commercial value and has been exploited since ancient times (Palko et al., 1981) in several countries throughout the basin. Swordfish is currently being managed by stock, a procedure which does not necessarily reflect the corresponding population components. Although swordfish is able to carry out long-distance migrations, several distinct populations both within and between oceans have been detected (Alvarado Bremer et al., 1995, 1996, 2005; Rosel and Block, 1996; Chow et al., 1997; Chow and Takeyama, 2000). For instance, the Mediterranean swordfish population is separated from the Atlantic one, although some degree of genetic exchange has been observed (Magoulas et al., 1993; Kotulas et al., 1995; Kotoulas et al., 2007; Alvarado Bremer et al., 1999; Pujolar et al., 2002); however, mixing between stocks is believed to be restricted, being generally limited to the region around the Strait of Gibraltar (ICCAT-SCRS, 2013). A recent study (Viñas et al., 2010) also reported evidence of genetic differentiation between Eastern and Western Mediterranean swordfish populations, suggesting that the current single-stock management unit approach may need to be reconsidered.

Mediterranean swordfish annual catches have fluctuated between 15,569 and 9162 t over the last 15 years with a decreasing trend, possibly caused by enforcing the driftnet ban and other management measures (ICCAT-SCRS, 2013). Moreover, SSB levels showed a lack of any specific trend in the latest assessment (ICCAT-SCRS, 2013). Mediterranean swordfish management is ruled by the International Commission for the Conservation of Atlantic Tunas (ICCAT) (ICCAT, 2012); the results of the latest stock assessment underlined that the swordfish fishery has undergone rapid expansion since the late 1980s, resulting in fishing mortality (F) and catches above those that could support MSY (ICCAT-SCRS, 2013),

* Corresponding author. Tel.: +39 090 9224872; fax: +39 090 9241832.
E-mail address: teresa.romeo@isprambiente.it (T. Romeo).

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thus indicating an overexploitation status. Moreover, the Committee again noted the large catches of small sized swordfish, i.e., less than 3 years old (many of which have probably never spawned) and the relatively low number of large individuals in the catches. Fish less than three years old usually represent 50–70% of the total yearly catches in terms of numbers and 20–35% in terms of weight (ICCAT-SCRS, 2013).

Swordfish fishery in the Mediterranean Sea has undergone significant changes during the last 15–20 years, following implementation of EC Regulations (849/97, 1239/98 and 809/2007) that first limited and then prohibited the use of driftnets for EU fleets, together with ICCAT Rec. 03–04 and General Fisheries Commission of the Mediterranean (GFCM) Rec. 2005/3 that enforced a ban on swordfish driftnets throughout the Mediterranean and Black Seas. At present, the highest proportion of landings is from longline fishing, whereas minor catches are reported from harpoon, trap and recreational fisheries (ICCAT-SCRS, 2013), although an unknown amount is also landed by illegal fishing (ICCAT-SCRS, 2013; Romeo et al., 2014). Indeed, gillnets are still used in some areas, while there are also countries known to be fishing with gillnets but not reporting their catches (ICCAT-SCRS, 2013).

The harpoon is the most ancient fishing gear used to hunt swordfish; this fishing practice is typically artisanal and thus highly relevant in terms of historical, social and cultural tradition (Sisci, 1984). Italian harpoon fishery is carried out in a limited region including the Strait of Messina and the south-eastern Tyrrhenian Sea, one of the most important swordfish spawning areas in the Mediterranean Sea (Palko et al., 1981), together with the Balearic Sea, northern Ionian Sea (Palko et al., 1981) and an area in the Levantine basin (Tserpes et al., 2001a,b, 2008). The development and success of this practice in the area is related both to the particular environmental conditions (e.g., hydrodynamic regime, upwelling currents) and to swordfish reproductive behavior, which brings the fish close to the sea surface to spawn (Romeo et al., 2009b, 2010, 2011b). Harpoon fishery is a seasonal practice carried out during diurnal hours by special vessels equipped with a sighting platform (25 m above the sea level), from which the boat is piloted and swordfish are sighted. To date, data collection on board harpoon vessels has been one of the most important sources of scientific information on the *X. gladius* population in the Mediterranean (Canese et al., 2004, 2006, 2007; Di Natale, 1990; Di Natale et al., 1996, 2005a,b, 2006; Romeo et al., 2008, 2009a,b, 2010, 2011a,b, 2014).

1.1. Marine Strategy Framework Directive and Ecosystem Approach (EcAp)

Recently, the status of swordfish stock together with other commercial stocks and the impact of fisheries on fish and shellfish populations have been under consideration with regard to implementation of the Marine Strategy Framework Directive (MSFD; 2008/56/EC) which aims to achieve Good Environmental Status (GES) for European marine waters by 2020 (ICES, 2012).

One of the MSFD objectives is related to the "populations of all commercially exploited fish and shellfish" that "should be within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock" (Descriptor 3) (Piet et al., 2010; ICES, 2012).

While the MSFD objectives pertain to EU Member States' national waters, the Directive identified Regional Sea Conventions as the tool for enforcing a regional approach, also incorporating non-EU countries. The Barcelona Convention established the so-called Ecosystem Approach (EcAp) within the Mediterranean Sea, as agreed by the Conference of the Parties in 2008 (Decision IG17/6), aiming to achieve GES in the Mediterranean by 2020. Thus, the EcAp process could assure greater trans-boundary cooperation by the Contracting Parties both at a sub-regional and regional level by involving both EU and non-EU Mediterranean coastal countries. The process is still under discussion and will require some fine-tuning by experts (COR-GEST groups, with their five cluster specific meetings with country experts), as regards for example the use of some indicators. Under EcAp, fishery pressure and fish stock status are considered within Ecological Objective 3.

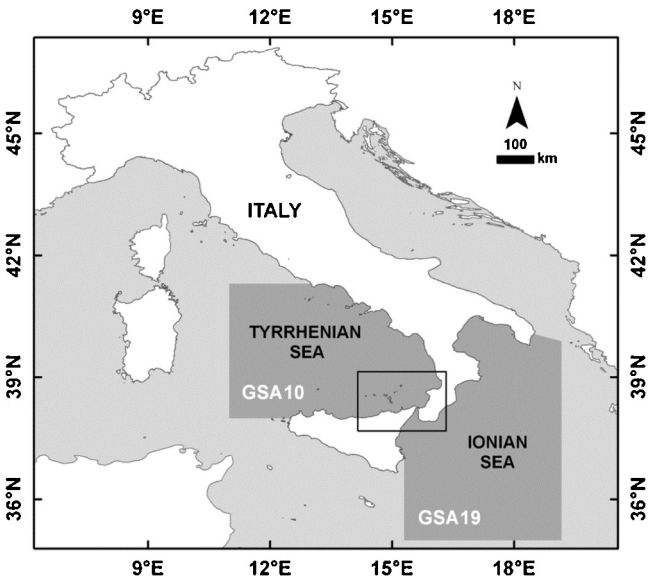

Fig. 1. Study area, including the Strait of Messina, the south-eastern Tyrrhenian Sea and Eolian Islands, within GSA 10 and GSA 19.

1.2. Aim of this paper

The main aim of this paper is to provide new data on the swordfish harpoon fishery, concerning fleet structure and its changes over the last decade, spatial distribution of fishing effort and catches, trend of catch rates, size composition of catches as well as fishing of the Mediterranean spearfish *Tetrapturus belone* Rafinesque 1810. These data were partially used to implement the MSFD Initial Assessment of Descriptor 3 for Italian waters and will be useful for further implementation of the MSFD. Moreover, they will be considered in the forthcoming application of the EcAp process, regarding Ecological Objective 3. Finally, the importance of the harpoon fishery for collecting information on Mediterranean swordfish population, biology and ecology is discussed.

2. Material and methods

2.1. Study area

The study area (Fig. 1) is located in the central Mediterranean Sea and includes the Strait of Messina and the south-eastern Tyrrhenian Sea (from the southern coasts of Calabria to Cape Milazzo and Aeolian Islands). According to the GFCM management units (Resolution GFCM/31/2007/2), these two areas fall within Geographical Sub-Areas (GSA) 19 and 10, respectively. Furthermore, consistently with the MSFD Mediterranean sub-regions, the Strait of Messina belongs to the "Ionian Sea and Central Mediterranean" sub-region, whereas the south-eastern Tyrrhenian Sea belongs to the "Western Mediterranean" sub-region.

As already shown by Romeo et al. (2011b), the different physical and oceanographic features of these basins can influence swordfish distribution and behavior during the harpoon fishing season.