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RESEARCH ARTICLE

Turkish harpoon fishery for swordfish *Xiphias gladius* in the Aegean Sea (Gökçeada Island)

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Abstract

This study reports the catch per unit effort (CPUE) of swordfish harpoon fishery for the first time in the Turkish Aegean Sea. This research was carried out with commercial harpooners for swordfish in Kaleköy fishing port, Gökçeada Island, a unique harpooning area in Turkish waters during fishing seasons in 2009 and 2010. Catch data (number of specimens and weight of each fish) were recorded on daily basis by both scientific observers and questionnaire with skippers. The effective fishing days at sea were used as a unit of fishing effort. The harpooning data collected during the two seasons (2009-2010) from 21 vessels in Saros Bay showed a total of 20555 kg and 544 specimens. The average CPUEs were 49.7 ± 8.5 kg and 1.3 ± 0.2 in number of fish per day for 2009, and 25.7 ± 12.5 kg and 0.8 ± 0.3 in number of fish per day for 2010. There was no significant difference in the means of swordfish CPUE values both in number and weight between two fishing seasons (2009-2010) ($P>0.05$).

Keywords: Swordfish, *Xiphias gladius*, harpoon fishery, CPUE, Gökçeada, Aegean Sea

Introduction

Harpoons are defined by FAO as a fishing gear "consisting of a pointed dart or iron attached to the end of a line several hundred feet in length, the other end of which is attached to a floatation device. Harpoon gears are attached to a pole or stick that is propelled by hand or mechanical means into the body of the aquatic animal" (FAO, Online Fisheries Global Information System-FIGIS). This method can be used commercially on large species having high individual value, such as the swordfish (Sainsbury 1986). In this type of fishery, the vessels are modified with bow extending 7-12 m forward and the masthead for an observer (i.e. crow's nests).

Swordfish fishing started thousands of years ago as a near-shore subsistence activity in subtropical areas, where fishermen hunted large, female swordfish basking at the sea surface by harpoon (Ward 2000). Harpoon gear for swordfish

has been used in the Mediterranean since 1000 BC (Ward *et al.* 2000). During the 1900s, harpoon fishing became more sophisticated in many areas. Most harpoon fisheries declined during the 1980s as a result of decreased abundance of basking swordfish, increased labour costs and the availability of more efficient fishing gear, such as longlines and driftnets (Ward *et al.* 2000). At present, harpoon fishery is still carried out by only two countries in the Mediterranean, Italy and Turkey.

In Turkey, swordfish harpooning began along the Istanbul Strait (Bosphorus) in 1935 (Üner 1968). Thereafter, it had been the most popular activity during the 1950-1970s in the entire Marmara Sea (Akyol and Ceyhan 2011). Demir *et al.* (1956) reported firstly the harpoon fishery and explained the relationship between water temperature and basking of swordfish in the Marmara Sea. Artüz (1963) and Onat (1970) also mentioned that the swordfish harpoon fishery was carried out in April, May and June during the calm and sunny days in the Istanbul Strait and the Sea of Marmara. Since the 1980s, Saros Bay in the northern Aegean Sea has been the unique area for catching swordfish by harpoon and approximately 30 fishing boats from Marmara and Gökçeada Islands participate to the harpoon fishery between April and June (Akyol 2012).

Although there are some documents on catch per unit effort (CPUE) of harpoon fishery in the central Mediterranean, especially Messina Strait (Romeo *et al.* 2001, 2010; Di Natale *et al.* 2005), there is no document for the eastern Mediterranean.

The aim of this study was to determine CPUE for swordfish harpoon fishery, the oldest method for swordfish fishing, in the Aegean Sea.

Materials and Methods

This study was carried out onboard of 21 commercial harpooners for swordfish in Kaleköy fishing port, Gökçeada Island (Figure 1) during fishing seasons between April and June in 2009 and 2010. Catch data (number of specimens and weight of each fish) were recorded on daily basis by both scientific observers and questionnaire with skippers. Daily catch records were obtained for 19 days in 2009 and for 10 days in 2010. The effective fishing days at sea were used as a unit of fishing effort, as suggested by Di Natale *et al.* (2005). In questionnaire, we asked the fishermen *i*) how many effective fishing days did you spend in the season?; *ii*) how many fish did you catch (number and weight) in a day?; and *iii*) where? (locality, depth). CPUE were computed in relation to the number (n) and weight (kg) of fish / fishing days in 2009 and 2010.

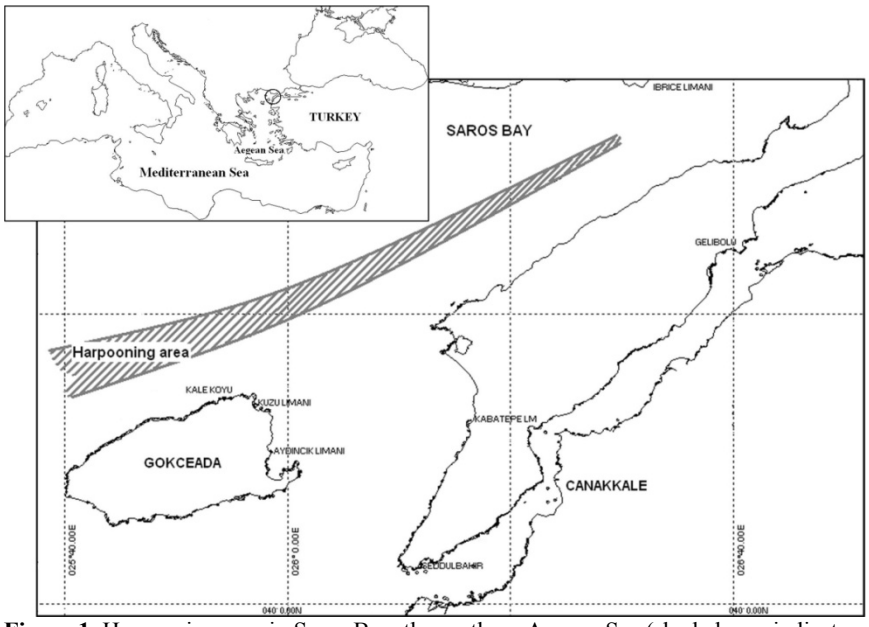

Figure 1. Harpooning area in Saros Bay, the northern Aegean Sea (shaded area indicates the channel at a depth of 400-500 m, effective area to find swordfish).

To test for normality and homoscedasticity, each dataset was evaluated using Kolmogorov–Smirnov's (Zar 1999) and Bartlett's (Bartlett 1937a, b) tests. If the datasets passed the normality test, parametric procedures were employed; otherwise, data were transformed using an appropriate transformation process to meet the underlying assumptions of normality (Zar 1999). The differences among means of CPUEs both number and biomass of swordfish for both seasons were tested by Student *t*-test. All of the means were given with standard error (± SE). All calculations were performed using the SPSS 16.0 software package.

Results

Harpoon boats were relatively small (mean length and machine power: 11 ± 0.62 m; 99 ± 11.40 KW, respectively), having a wooden bowsprit platform (7-12 m length). Fleet characteristics are indicated in Table 1. The fishing area, along the deep sea channel at about 500 m in Saros Bay is not far from the ports. Although, the main port was Kaleköy (Gökçeada), other ports (e.g. Kuzu Limanı, Ibrice and Kabatepe) were occasionally used. No boat was equipped with a refrigerator, which means that fresh fish was sold to the merchants to reach the Istanbul fish market on the same day of the catch.

Table 1. Fleet characteristics of harpooners (LOA, length of overall; GT, gross tonnage; KW, kilowatt; l, litter; Σ, total).

Characteristics	n	min-max	Mean ± SE	Σ
Boat length (LOA, m)	21	7 – 20	11 ± 0.62	231
Tonnage (GT)	17	3 – 24	22 ± 1.22	140
Machine power (KW)	21	24 – 284	99 ± 11.40	2081
Age of boat	21	8 – 36	22 ± 1.71	464
Fuel consumption ($l.day^{-1}$)	21	20 – 150	77 ± 7.54	1610
Number of personnel	21	2 – 4	3 ± 0.11	59

The harpooning data collected during the two seasons (2009-2010) from 21 vessels in the area of Saros Bay yielded a total of 20555 kg derived from 544 specimens.

The average total CPUEs were 49.7 ± 8.5 kg and 1.3 ± 0.2 in number of fish per day for 2009, and 25.7 ± 12.5 kg and 0.8 ± 0.3 in number of fish per day for 2010 (Table 2).

There was no significant difference in the means of swordfish CPUE values both in number and weight between two fishing seasons (2009-2010) ($P>0.05$).

Table 2. Swordfish catch, fishing effort and CPUEs in the number and weight in 2009 and 2010 in the Aegean Sea
(n: total effective fishing days; Σn: total number of fish specimens).

2009					
n=19	Σ n	Σ kg	Fishing days	CPUE ($n.day^{-1}$)	CPUE ($kg.day^{-1}$)
Minimum	3	72	10	0.2	4.8
Maximum	60	2655	30	4.0	164.0
Mean ± SE	24 ±3.7	947 ± 170	18 ± 1.5	1.3 ± 0.2	49.7 ± 8.5
2010					
n =10	Σ n	Σ kg	Fishing days	CPUE ($n.day^{-1}$)	CPUE ($kg.day^{-1}$)
Minimum	1	15	10	0.1	1.5
Maximum	30	1350	30	3.0	135.0
Mean ± SE	11 ± 2.8	352 ± 135	16 ± 1.9	0.8 ± 0.3	25.7 ± 12.5

Discussion

This study focused on a very specific and localized harpoon fishery that differs from others in the Mediterranean Sea. In the Strait of Messina (Italy), the average CPUE of swordfish harpooning was 31.2 kg and 0.65 specimens per day during 1976-2003 (Di Natale *et al*. 2005). These values were lower than our value in 2009, whereas higher than that in 2010. However, the fishermen in Gökçeada expressed that the bad meteorological and turbid water conditions

caused lower catch in 2010. The fishing method is similar to those used in Italian seas (southern Thyrrhenian Sea and Ionian Sea); however, the fishing season in Italy is longer than in Turkey, and it extends to August (Romeo *et al.* 2010).

Additionally, bluefin tuna (*Thunnus thynnus*), Mediterranean spearfish (*Tetrapturus belone*), dolphinfish (*Coryphaena hippurus*), sunfish (*Mola mola*), albacore (*Thunnus alalunga*), leerfish (*Lichia amia*), greater amberjack (*Seriola dumerilii*), blue shark (*Prionace glauca*) and smooth hammerhead (*Sphyraena zigaena*) were hunted with harpoon in the Strait of Messina (Di Natale *et al.* 2005), whereas the Turkish harpoon fishermen only target swordfish. This phenomenon could be expressed as despite having a small portion of catch during a limited season, harpooning is more an excitement activity for Turkish fishermen rather than an essential commercial fishery. Turkish fishermen consider this an enjoyable pursuit for hunting swordfish, and usually do not prefer to catch other large pelagics, rare in the area. However, Mediterranean spearfish is occasionally hunted. Eventually, the harpooning for swordfish is very selective fishing activity, where the harpooner makes a precise choice for only one target species; all the catches have been considered as target species.

Further studies on this specific harpoon fishery in the area together with the environmental factors (i.e. moon phase, wind, currents, water temperature), in order to better understand the swordfish distribution and migratory pattern over the years. Romeo *et al*. (2010) expressed that harpoon fishing was carried out during the day; therefore, the moon effect was not related to the light, but rather to its effect on the water mass. Finally, this very selective fishing activity should be carried out in the area for the sustainable use of fish resource and the harpooning as an ancient fishing technique may be useful for the tourism (i.e. *pesca turismo*). In this way, fishermen's income can be increased and this exciting activity will be introduced.

Ege Denizi'nde (Gökçeada) kılıç balığı *Xiphias gladius* için zıpkın balıkçılığı

Özet

Bu çalışma, Ege Denizi'nde kılıç zıpkın balıkçılığından birim çabaya düşen av (CPUE) miktarını ilk kez rapor etmektedir. Bu araştırma, 2009–2010 sezonları boyunca Türkiye sularının yegâne zıpkın alanı olarak Gökçeada Kaleköy limanında ticari zıpkıncılarla yürütülmüştür. Günlük av verileri (birey sayısı ve her balığın ağırlığı) hem bilimsel gözlemler hem de tekne reisleriyle anket yoluyla kaydedilmiştir. Denizde etkili balıkçılık günleri balıkçılık çabasının bir ünitesi olarak kullanılmıştır. Toplam 20555 kg ve 544 bireyden oluşan, Saroz Körfezi alanında 21 tekneden elde edilmiş zıpkın avı verileri iki sezona (2009–2010) aittir. Ortalama CPUE 2009 için günde 49,7 ± 8,5 kg ve 1,3 ± 0,2 adet; 2010 için ise günde 25,7 ± 12,5 kg ve 0,8 ± 0,3 adettir. Her iki sezonda (2009–

2010), kılıç CPUE ortalamaları arasında sayıca ve ağırlıkça istatistikî fark önemli bulunmamıştır (P>0.05).

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