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RESEARCH ARTICLE

Turkish pelagic gillnet fishery for swordfish and incidental catches in the Aegean Sea

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Abstract

This study was carried out with 20 representative gill-netters based at the port of Sivrice and Sığacık from June 2008 to August 2010. The average length, gross tonnage (GT), machine power (hp) and number of personnel of the gill-netters were 10.4±0.6 m, 10.5±2.3 GT, 121.4±19.9 hp and 3.4±0.2 persons, respectively. Total length of all observed gillnets was reaching 339 km, ranged from 700 to 6000 m with average 2672 ±93 m. The mean CPUEs for swordfish by number and weight were calculated as 1.0 ±0.1 and 37.7 ±4.2 kg per km net, respectively. A total of 12 species, belongs to nine families were caught. The target species, swordfish had the highest ratio both in number (39.2%) and weight (73.1%) followed by *Auxis rochei* > *Euthynnus alletteratus* > *Thunnus thynnus* > *Thunnus alalunga* by number; *Thunnus thynnus* > *Mola mola* > *Euthynnus alletteratus* > *Mobula mobular* by weight. Biomass and number ratios of the non-target species to the target swordfish were 1:0.37 and 1:1.55, respectively. Four species, *Caretta caretta, Dasyatis violacea, Mobula mobular, Mola mola* were thrown back to the sea and the others were retained due to commercial value.

Keywords: Aegean Sea, gillnet fishery, incidental catch, swordfish, *Xiphias gladius*

Introduction

Pelagic gillnets (driftnets) hang vertically like curtains in the open water. They are set out in the open sea to catch pelagic fish and usually several nets are joined together to form a 'fleet' which may be up to a kilometer long. Driftnets function as gillnets, the fish swimming into them, becoming entangled and caught (Muus and Dahlstrom 1974). However, large scale pelagic driftnets are surface or sub-surface driftnets of large dimensions (exceeding 2.5 km and up to 50 km) the use of which is banned by a UN resolution (Nedelec and Prado 1990). Resolution 44/225 and 46/215 adopted in 1989 and 1991 by the General Assembly of the UN recommended a moratorium on all large-scale pelagic driftnet fishing by 30 June 1992. In 1992, the European Community prohibited

driftnet fishing in the Mediterranean with nets more than 2.5 km in length, as did the General Fisheries Commission for the Mediterranean (GFCM) in 1997 under a binding resolution. A total ban on driftnet fishing on large pelagic species by the EU fleet in the Mediterranean entered into force from 1st January 2002; the same decision was adopted by ICCAT by means of a binding recommendation in November 2003 (Tudela *et al*. 2005).

The gillnet fishery for swordfish in Turkey is a traditional activity. Deveciyan (1926) stated that the fishing for swordfish in the Sea of Marmara in the early 1900's had been carried out by using harpoons and gillnets in the Istanbul Strait (Bosphorus) from 15 August to 8 November. Afterwards Artüz (1963) and Onat (1970) also reported that in the 1960s, swordfish fishery in the same area was done with gillnet and the other gears such as longline, traps, harpoons; and gillnetting was carried out on moonless nights between September and November in the Bosphorus. This fishery was effectively being used in Bosphorus the between 1900 and the 1960s, and then gillnetting was abandoned due to the increase of maritime traffic in the Bosphorus. At that time, the gillnet, made of cotton material was about 110 m long and it was used by 20-25 boats in moonless nights of summer time (N. Taşcı, pers.comm.). Since the declining of swordfish in the Sea of Marmara in the 1980s, the fleet has especially been turned to the Aegean Sea between May and September.

EU and ICCAT enforced a recommendation prohibiting the use of drift-nets in the Mediterranean. Afterwards, drift-netting in Turkey was also banned in 2006 (Anon. 2006). As a result, pelagic gillnetting has currently been tended to decrease due to the banning since 2006. However, most of fishermen have made some modifications in their nets and put some weights and buoys on both sides of the nets in order to get out of scope of conventional drift net definition in Notification 2/1 Regulating Commercial Fishing (Akyol and Ceyhan 2011). So, the Turkish fisheries authority and ICCAT have given a limited permission for traditional pelagic gillnet fishery in Turkish seas until July 2011, and finally, this fleet stopped its activity in July 2011.

There are only a few studies on driftnet fishery for swordfish in Turkish seas. Öztürk *et al*. (2001) determined the dolphin bycatch in the swordfish driftnet fishery in the Aegean Sea. Akyol *et al*. (2005, 2008) reported the swordfish driftnet fishery, detailed on fishing ports, grounds, fishing periods, fishing effort, fish size, technical characteristics of various types of driftnets, and discussed the effects of the regulations concerning with banning. Lastly, Akyol and Ceyhan (2011) have given the most comprehensive information on the Turkish swordfish fishery, including gillnet fishery as well.

This paper presents the results based on catch per unit effort (CPUE) and incidental catch ratios of surveys carried out on the Turkish swordfish gill-netters during the fishing seasons in 2008, 2009 and 2010.

Materials and Methods

We monitored randomly the daily fishing activities of 20 representative gill-netters based at the port of Sivrice and Sığacık (Figure 1) from June 2008 to August 2010, which included fishing seasons between May and September. The average length, gross tonnage (GT), machine power (hp) and number of crew of the gill-netters were 10.4±0.6 m, 10.5±2.3 GT, 121.4±19.9 hp and 3.4±0.2 persons, respectively. A total of 131 operations, 51 Sivrice and 80 Sığacık areas were recorded. On each fishing trip, observers and/or skippers logbook data on (1) date, some meteorological conditions (wind speed and direction, clear or cloudy), location and depth, (2) fishing boat characteristics such as length, gross tonnage, machine power (hp), (3) fishing gear aspects of the fishing operation such as mesh size, total length of the net, (4) the capture of both target and non-target species by weight and number.

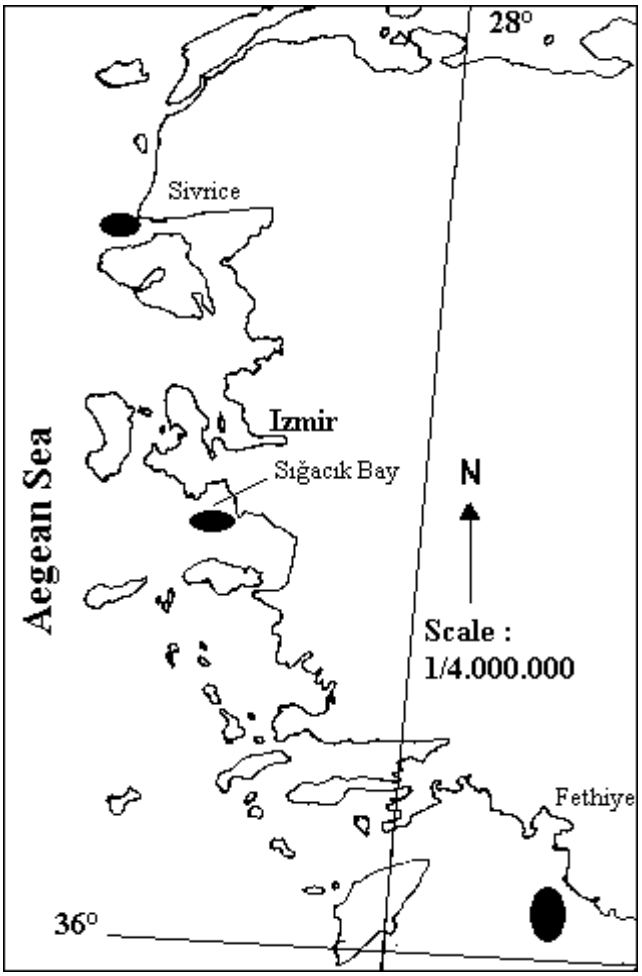

Figure 1. Main swordfish fishing grounds of the Turkish gillnet fleet.

Fishing effort (f) and catch per unit of effort (CPUE) were calculated using the following formula, modified from De Metrio and Megalafonou (1988): f=(a'/1000)xg where (a'/1000) represents the mean length of the net placed daily in the sea divided by the 1 km net unit; g is the number of fishing days. The CPUE, number and weight per km of the net was computed with the formula CPUE=kg/f.

Estimates of incidental catches were made of the by-catches, retained portion of target catches at the species level. All of the means were given with standard error (±SE). Comparisons of differences between target and non-target fish according to number and weight (kg) by depth intervals were tested by Kruskal-Wallis H test. The differences among means of CPUEs both number and biomass of swordfish were tested by Student *t*-test.

Results and Discussion

The Turkish swordfish gillnet fishery is mostly carried out in certain areas, Sivrice, Sığacık and off Fethiye, of the Aegean Sea. The gillnet fleet consisted of 53 vessels, ranged from 7.6 to 36 m (average: 12.5 ±0.7 m) in length (LOA), 9 to 858 hp (average: 183.2 ±23.2 hp) in machine power. Generally, they fish at moonless nights between May and September. Akyol *et al*. (2005) reported that there were 45 boats, ranged from 6 to 18 m LOA and 11 to 335 hp (average: 83 ±9.7 hp) in machine power in only Sivrice and Fethiye fishing ports during 2001-2002 fishing seasons. It shows that the LOA and machine powers of gill-netters increased in the last decade. Also, Sığacık Bay as a new fishing area for swordfish has been used for the last five years.

A total of 131 sets were deployed during the observed fishing operations, but swordfish catch was just obtained from 118 operations. Total length of all gillnets was reaching 339 km, ranged from 700 to 6000 m with average: 2672 ±93 m. The mean CPUEs for swordfish by number and weight were calculated as 1.0 ±0.1 and 37.7±4.2 kg per km net, respectively (Table 1). There were no significant differences among means of CPUEs both number and biomass of swordfish ($p>0.05$).

Table 1. Fishing effort (f) and CPUE in gillnet fishery for swordfish by number and weight.

n=118	Length of the net (m)	Swordfish (number)	Swordfish (kg)	f (Σnet length /1000)xg	CPUE (number/f)	CPUE (kg/f)
Minimum	700.0	1.0	6.0	0.7	0.2	2.5
Maximum	6000.0	13.0	700.0	6.0	5.4	300.0
Mean	2672 ±92.7	2.4 ±0.2	98.1±10.4	2.7 ±0.1	1.0 ±0.1	37.7 ±4.2

A total of 12 species, belonging to nine families (699 specimens; 15324 kg) were caught; four Scombridae, one Cheloniidae, one Centrolophidae, one Coryphaenidae, one Dasyatidae, one Mobulidae, one Moliidae, one Istiophoridae and one Xiphiidae. The target species, swordfish had the highest ratio both in number (39.2%) and weight (73.1%) followed by *Auxis rochei* > *Euthynnus alletteratus* > *Thunnus thynnus* > *Thunnus alalunga* by number; *Thunnus thynnus* > *Mola mola* > *Euthynnus alletteratus* > *Mobula mobular* by weight. Biomass and number ratios of the non-target species to the target swordfish were 1:0.37 and 1:1.55, respectively (Table 2). Four species, *Caretta caretta, Dasyatis violacea, Mobula mobular, Mola mola* were thrown back to the sea and the others were retained due to commercial value.

Table 2. Total catch of swordfish and non-target species and their ratios by number and weight during 131 operations.

	Number		**Weight**	
Species	**N**	**%**	**kg**	**%**
Auxis rochei (Risso, 1810)	144	20.60	187	1.22
Caretta caretta (Linnaeus, 1758)	1	0.14	80	0.52
Centrolophus niger (Gmelin, 1788)	3	0.43	6	0.04
Coryphaena hippurus Linnaeus, 1758	2	0.29	12	0.08
Dasyatis violacea (Bonaparte, 1832)	9	1.29	17	0.11
Euthynnus alletteratus (Rafinesque, 1810)	131	18.74	452	2.95
Mobula mobular (Bonnaterre, 1788)	2	0.29	300	1.96
Mola mola (Linnaeus, 1758)	5	0.72	555	3.62
Tetrapturus belone Rafinesque, 1810	3	0.43	50	0.33
Thunnus alalunga (Bonnaterre, 1788)	37	5.29	287	1.87
Thunnus thynnus (Linnaeus, 1758)	88	12.59	2184	14.25
Xiphias gladius Linnaeus, 1758	274	39.20	11194	73.05
Total	699	100.0	15324	100.0
Swordfish : non-target fish	1:1.55		1:0.37	

Figure 2 shows the distribution of most abundant target and non-target species according to number and weight by depth intervals. The means of number and weight were rising with depth (except 150-250 m) for swordfish, while declining for non-target catches. Depend on depth, swordfish biomass values

differed significantly (KW=22.2, $p<0.05$), while no significant differences were identified between non target fish biomass (KW=8.9, $p>0.05$).

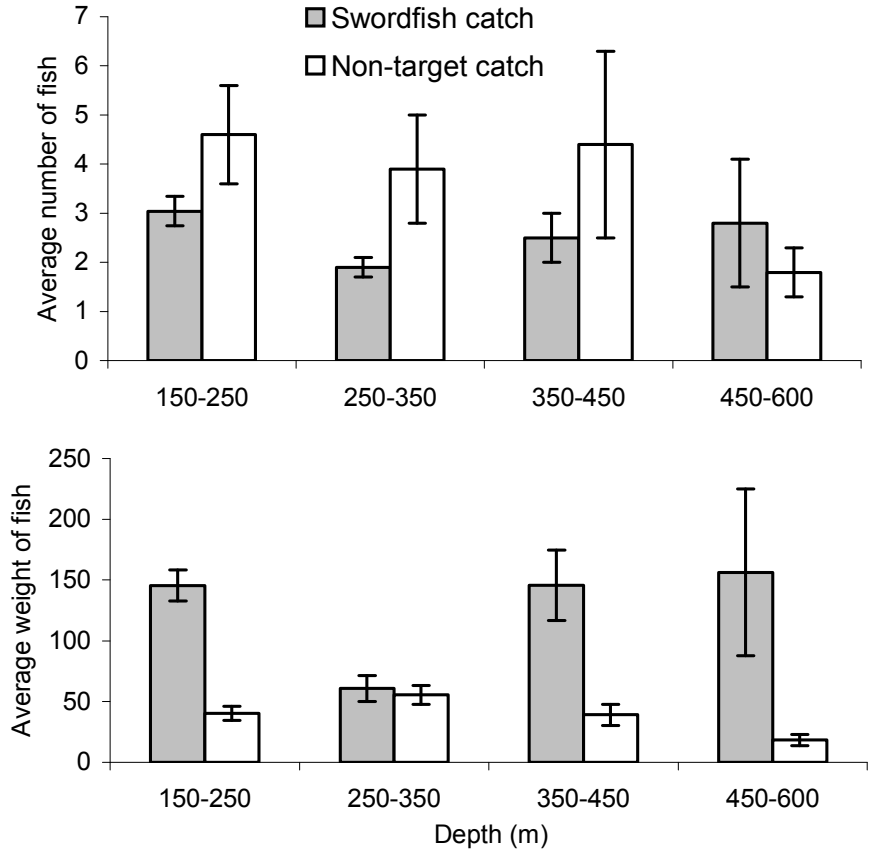

Figure 2. Average catches (with ±SE) of target and non-target species according to number and weight (kg) by depth intervals.

In this study, the mean CPUEs by number and biomass of swordfish were found as 1.0 ±0.1 specimen and 37.7±4.2 kg per km net, respectively. Akyol *et al*. (2005) computed that the mean CPUE for 6.6 km net unit was 7.7 ±1.3 kg off Sivrice fishing area in 2001 fishing season, and the authors attributed that the low CPUE was the result of unstable meteorological conditions and the reduced number of fishing days. In the western Italian seas, Di Natale *et al*. (1993) reported that 1990 CPUE values were higher in the Central Tyrrhenian and in the Ligurian Sea than in the Southern Tyrrhenian Sea and mean daily CPUE value was 9.1 kg per km net, while in 1991 CPUE values were quite more stable, with very high peaks in autumn in the Ligurian Sea; mean daily CPUE value was 10.5 kg per km net. Additionally, Di Natale *et al.* (1995) notified that 1992 CPUE values were higher in the Central Tyrrhenian Sea (20.4 kg) than those in the Southern Tyrrhenian Sea (11.1 kg), with mean daily CPUE value was 14.1 kg per km net.

CPUE value in this study is quite higher than the others. This situation may be connected with high density of swordfish stock, good weather conditions and skills of fishermen. Di Natale *et al*. (1993) stated that the CPUE values are extremely variable, depending on environmental factors, presence of the species, interference by other vessels and capacity of fishermen.

A total of eleven fish species were recorded as non-target catch. However, we have never seen any sea mammals during the sampling period, while solely one *C. caretta* was caught. Gillnet fishermen claimed that even if, dolphins and sea turtles were tangled to the net incidentally, they could save their life mostly. According to them, dolphin and sea turtle casualties are occasionally met by chance and they had never seen any whale and sea birds entangled. Öztürk *et al*. (2001) verified this state that only 19 specimens of dolphins, *Stenella coeruleoalba* (13), *Tursiops truncatus* (4), *Grampus griseus* (2) in the Aegean Sea were reported from swordfish gillnet fishery during May and June 1999 and 2000. Fishermen in the Fethiye region had reported 23 dolphins, of which 18 died, entangled in 2002 season (Akyol *et al*. 2005). However, increasing of sea mammal casualties is likely towards to the eastern Mediterranean Sea.

The fishing depth range was found important in terms of biomass of swordfish. Namely, the deeper fishing zone, especially >350 m provides an advantage for fishermen due to increasing swordfish biomass.

In conclusion, pelagic gill-netters in Turkish seas have currently been tending to decrease due to the first banning since 2006. Moreover, the Turkish traditional swordfish gillnet fishery ended in July 2011. But many of fishermen, used pelagic gillnet for swordfish has been showing the reaction against the prohibition. Moreover, they have started the struggle for their rights (usage or appropriate funds) since 2006. They argued that the pelagic gillnet fishery, dates back to as early as the 1900's was traditional and it was uncomparable with the large scale Mediterranean drift-net fishery. As a matter of fact, the fisheries authority encourages the transition to the pelagic longline as recommended by ICCAT. For the sustainability of swordfish fishery in the Mediterranean the collaborations between stakeholders is required.

Ege Denizi'nde kılıç pelajik uzatma ağları balıkçılığı ve tesadüfi yakalanan türler

Özet

Bu çalışma, Haziran 2008 - Ağustos 2010 tarihleri arasında, Sivrice ve Sığacık limanlarında 20 kılıç avı teknesiyle yürütülmüştür. Pelajik uzatma ağı teknelerinin ortalama boyu, gros tonajı (GT), makine gücü (hp) ve personel sayısı sırasıyla 10,4±0,6 m, 10,5±2,3 GT, 121,4±19,9 hp ve 3,4±0,2 kişidir. Gözlenmiş bütün ağların (700-6000 m arasında) toplam boyu 339 km'ye ulaşmaktadır (ortalama 2672 ±93 m). Sayıca ve

ağırlıkça kılıç balıklarının ortalama birim çabaya düşen av miktarları (CPUE) sırasıyla 1,0±0,1 ve 37,7±4,2 kg/km ağ olarak hesaplanmıştır. Toplam dokuz familyaya ait 12 tür yakalanmıştır. Hedef tür kılıç balığı hem sayıca (%39,2) hem de ağırlıkça (%73,1) en yüksek orana sahipti ve onu sayıca *Auxis rochei* > *Euthynnus alletteratus* > *Thunnus thynnus* > *Thunnus alalunga*; ağırlıkça *Thunnus thynnus* > *Mola mola* > *Euthynnus alletteratus* > *Mobula mobular* izlemiştir. Hedef kılıç balığına karşı hedef dışı avın biyokütle ve sayıca oranı sırasıyla 1:0,37 ve 1:1,55'tir. Yakalanan dört tür (*Caretta caretta, Dasyatis violacea, Mobula mobular, Mola mola*) denize geri atılmış ve diğer türler ticari değerleri nedeniyle alıkonulmuştur.

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References

Akyol, O., Ceyhan, T. (2011) Turkish swordfish fishery. *Col. Vol. Sci. Pap., ICCAT*, 66(4): 1471-1479.

Akyol, O., Erdem, M., Unal, V., Ceyhan, T. (2005) Investigations on drift-net fishery for swordfish (*Xiphias gladius* L.) in the Aegean Sea. *Turk J. Vet. Anim. Sci*. 29**:** 1225-1231.

Akyol, O., Karakulak, F.S., Ceyhan, T., Dede, A. (2008) Driftnets, used in Turkish seas and the regulations. *E.U. Su Ürünleri Dergisi* 25: 153-157. (in Turkish).

Anon. (2006) Turkish Fishery Regulation Circular (37/1) for Marine and Inland Commercial Fisheries in Fishing Season 2006-2008, T.C. TKB-KKGM, R.G. Sayı: 26269 Ankara, 108 pp. (in Turkish).

Artuz, M.I. (1963) Contribution to the knowledge of the biology of the swordfish (*Xiphias gladius* L.) in the Sea of Marmara. *Proc.Gen.Coun.Medit*. 7: 459-471.

De Metrio, G., Megalafonou, P. (1988) Catch, size distribution, growth and sex ratio of swordfish (*Xiphias gladius* L.) in the Gulf of Taranto. FAO Fish. Rep. No. 394, Rome, 91-102 pp.

Deveciyan, K. (1926) Fish and Fisheries in Turkey. (original title: Pèche et Pècheries en Turquie, in French). Çeviri: Erol Üyepazarcı, 2006, Aras Yayıncılık, 2. Baskı, Nisan 2006, Istanbul, 574 pp. (in Turkish).

Di Natale, A., Mangano, A., Maurizi, L., Montaldo, L., Navarra, E., Pinca, S., Schimmenti, G., Torchia, G., Valastro, M. (1993) Swordfish (*Xiphias gladius* L.) driftnet fishery in the Western Italian Seas: 1990-1991 Report. *Col. Vol. Sci. Pap. ICCAT*, 40: 184-193.

Di Natale, A., Mangano, A., Navarra, E., Schimmenti, G., Valastro, M. (1995) Swordfish (*Xiphias gladius* L.) driftnet fishery in the Tyrrhenian Sea: 1992 Report. *Col. Vol. Sci. Pap. ICCAT*, 44: 236-241.

Muus, B.J., Dahlstrom, P. (1974) Collins Guide to the Sea Fishes of Britain and North-western Europe. Wm. Collins Sons and Co. Ltd., 244 pp.

Nedelec, C., Prado, J. (1990) Definitions and Classification of Fishing Gear Categories. FAO Fisheries Technical Paper 222 (Rev. 1): 92 pp.

Onat, S. (1970) Pelagic fishes and their catching periods. *Balık ve Balıkçılık Dergisi*, EBK Yayınları, İstanbul, 18**:** 39-40. (in Turkish).

Ozturk, B., Ozturk, A.A., Dede, A. (2001) Dolphin by-catch in the swordfish driftnet fishery in the Aegean Sea. *Rapp. Comm. int. Mer Medit.* 36: 308.

Tudela, S., Kai Kai, A., Maynou, F., El Andalossi, M., Guglielmi, P. (2005) Driftnet fishing and biodiversity conservation: the case study of the large-scale Moroccan driftnet fleet operating in the Alboran Sea (SW Mediterranean). *Biological Conservation* 121: 65-78.

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