www.trjfas.org
ISSN 1303-2712
Turkish Journal of Fisheries and Aquatic Sciences 14: 825-830 (2014) DOI: 10.4194/1303-2712-v14_3_25

SHORT PAPER

On the Turkish Surface Longline Fishery Targeting Swordfish in the Eastern Mediterranean Sea

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Received 26 February 2014
Accepted 1 July 2014

Abstract

This study presents the results based on catch per unit effort (CPUE) and incidental catch ratios of surveys on the Turkish swordfish longliners during the fishing seasons between 2008 and 2013. A total of 50 surveying operations were carried out, including 45 in Fethiye, 5 in Özdere in the southern Aegean coasts along the eastern Mediterranean Sea. A total of 217 (4061 kg) swordfish were obtained during 50 operations. The mean CPUEs for swordfish by number and weight were computed as 10.8±1.59 specimens and 179.6±21.48 kg per 1000 hooks, respectively. Although, there was no significant differences among means of CPUEs by number of swordfish (P>0.05), the CPUEs by weight of swordfish were significantly different among years (P<0.05). A total of 14 species, belonging to 12 families (276 specimens; 5535 kg) were caught. The target swordfish had the highest ratio both in number (78.6%) and in biomass (73.3%), followed by *Mobula mobular*, *Alopias vulpinus*, *Prionace glauca*, *Isurus oxyrinchus*, *Ruvettus pretiosus*, *Coryphaena hippurus*, *Thunnus alalunga* by weight, respectively. Biomass and number ratios of the non-target species to the target swordfish were 1:0.27 and 1:0.36, respectively. A total of two specimens of which *P. glauca* (10 kg) and *M. mobular* (300 kg) were released lively and the others were retained due to commercial value. A significant difference was not found between weight of by-catch species and weight of the swordfish according to years (P>0.05).

Keywords: Swordfish, *Xiphias gladius*, surface longline, incidental catch, Aegean Sea, Eastern Mediterranean.

Doğu Akdeniz'de Kılıç Balığı Hedefleyen Türk Yüzey Paraketa Balıkçılığı Üzerine

Özet

Bu çalışma, 2008-2013 arasındaki balıkçılık sezonu boyunca Türk kılıç balığı paraketa tekneleri üzerine olan araştırmaların birim çaba başına düşen av (CPUE) verileri ve tesadüfü av oranları sonuçlarını vermektedir. Doğu Akdeniz boyunca Güney Ege'de 45'i Fethiye ve 5'i Özdere'de olmak üzere toplam 50 operasyon için gözlemler yapılmıştır. 50 operasyon boyunca toplam 217 (4061 kg) kılıç balığı elde edilmiştir. Kılıç balığının sayıca ve ağırlıkça ortalama CPUE değerleri sırasıyla 10,8±1,59 birey/1000 iğne ve 179,6±21,48 kg/1000 iğne olarak hesaplanmıştır. Kılıç balığının yıllar arasında sayıca CPUE ortalamaları arasında önemli bir fark bulunmamasına (P>0,05) rağmen, ağırlıkça CPUE'leri arasında önemli bir fark bulunmuştur (P<0,05). Toplam 12 familyaya ait 14 tür (276 birey, 5535 kg) yakalanmıştır. Hedef tür kılıç balığı hem sayıca (%78,6) hem de ağırlıkça (%73,3) en yüksek orandaydı; onu ağırlıkça *Mobula mobular*, *Alopias vulpinus*, *Prionace glauca*, *Isurus oxyrinchus*, *Ruvettus pretiosus*, *Coryphaena hippurus*, *Thunnus alalunga* izlemiştir. Kılıca karşın hedef dışı türlerin biyokütle ve sayıca oranları sırasıyla 1:0,27 ve 1:0,36'ydı. *P. glauca* (10 kg) ve *M. mobular* (300 kg) bireyleri denize canlı olarak geri bırakılmış ve diğerleri ticari amaçla alıkonulmuştur. Yıllara göre kılıç balığının ağırlığı ile hedef dışı türlerin ağırlığı arasında önemli bir fark bulunmamıştır (P>0,05).

Anahtar Kelimeler: Kılıç balığı, *Xiphias gladius*, yüzey paraketası, tesadüfi av, Ege Denizi, Doğu Akdeniz.

Introduction

The swordfish (*Xiphias gladius*) is a commercially important fish in all over the world and it has been exploited since ancient times. Ward *et al.* (2000) expressed that the swordfish fishing by mostly using harpoon existed in thousands of years ago as near shore subsistence activities in subtropical area.

Mediterranean swordfish fisheries are characterized by high catch levels. It should be noted that average annual reported catches are similar to those of the North Atlantic, though the Mediterranean is a much smaller body of water compared to the North Atlantic. However, the potential reproductive

area in the Mediterranean is probably relatively larger than that in the Atlantic. Further, the productivity of the Mediterranean Sea is thought to be very high (Anon., 2011).

Surface drifting longline is used worldwide by fisheries targeting large pelagic fish, mainly swordfish (Baez *et al.*, 2009). In this way, most of the Mediterranean countries operate longline fisheries (79% of the total catch) to catch the swordfish (Anon, 2011). Nowadays, there are two fishing methods, harpooning and longlining for swordfish in Turkey since strictly banned of gillnetting in 2011. The catch statistics indicated that there were unstable catch amounts between 7 tons in 1976 and 589 tons in 1988 (FAO, 2011). After banning the gillnet fishery in Turkey since July 2011, the catch statistics indicated that there were dramatically decreasing in catch amounts of swordfish. In 2012, the catch amount of swordfish was only 79.7 tons (TUIK, 2013).

Despite examining, few studies on the biology of swordfish (Demir *et al.*, 1956; Artüz, 1963; Alıçlı and Oray, 2001; Alıçlı, 2008; Alıçlı *et al.*, 2012, Akyol and Ceyhan, 2013) and few studies on driftnet fishery (Öztürk *et al.*, 2001; Akyol *et al.*, 2005, 2008; Ceyhan and Akyol, 2009; Akyol and Ceyhan, 2011; Akyol, 2013) for swordfish in Turkish seas, studies on longline fishery are very limited (Erdem and Akyol, 2005; Akyol and Ceyhan, 2007, 2010). Moreover, there is no by-catch study on sub-surface longlining in Turkish seas.

In this paper, we attempted to present the results based on catch per unit effort (CPUE) and incidental catch ratios of surveys carried out on the Turkish swordfish longliners during the fishing seasons between 2008 and 2013.

Materials and Methods

We monitored randomly the daily fishing activity of 9 representative longliners based at the ports of Fethiye and Özdere (Figure 1) during 2008-2013. A total of 50 surveying operations were carried out, including 45 in Fethiye, 5 in Özdere in the southern Aegean coasts along the eastern Mediterranean Sea. On each fishing trip, data were based on: (1) date, location, and depth; (2) fishing boat characteristics such as overall length, gross tonnage, and propelling engine power; (3) fishing gear aspects such as total number of hooks, total length of the main line; and (4) the capture of both target and non-target species by weight and number.

The formulas from De Metrio and Megalafonou (1988) were used to describe two parameters important for this study: Fishing effort (F): $F = D \times a' \times 1000^{-1}$ where: D is the number of fishing days and $a' \times 1000^{-1}$ represents the mean number of hooks placed daily in the sea divided by the unit of the effort considered in 1000 hooks; and the Catch Per Unit of Effort (CPUE), in relation to the fish number per 1000 hooks of the gear: $CPUE_N = N \times F^{-1}$ where: N in the fish number; and the Catch Per Unit of Effort (CPUE), in relation to the fish biomass per 1000 hooks of the gear: $CPUE_B = B \times F^{-1}$ where: B is the fish biomass. Estimates of incidental catches were made from the by-catches, and retained portion of target catches at the species level.

To test for normality and homoscedasticity, each dataset was evaluated using tests of: Kolmogorov–Smirnov (Zar 1999) and Bartlett (Bartlett 1937a, b). If the datasets passed the normality test, parametric procedures were employed; otherwise, data were transformed using an appropriate transformation

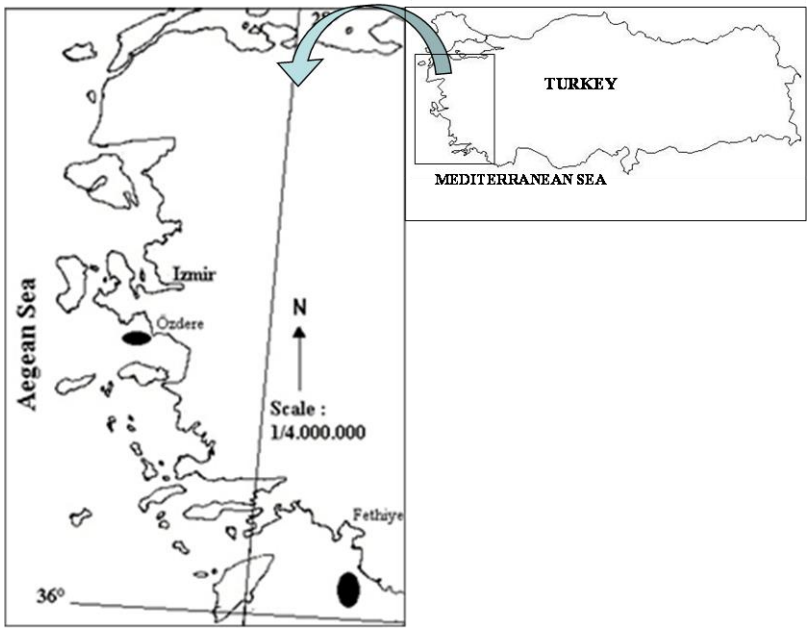

Figure 1. Sampling area.

process (e.g., $\sqrt{x+1}$) to meet the underlying assumptions of normality (Zar 1999). Differences among means CPUEs by number and biomass of swordfish were tested using ANOVA on transformed data. Comparisons of differences between by-catch ratios according to weight (kg) by years were tested by Kruskall-Wallis H test. All of the means were given with standard error (± SE).

Results

The Turkish sub-surface longline fishery for swordfish is mostly carried out in Fethiye region towards to Kaş (Antalya) and some Sığacık Bay (southern Aegean Sea). The fishing usually performs at night time during the whole year (except the closed seasons between 1 October and 30 November, and 15 February and 15 March).

The Turkish swordfish longline fleet has more than ten boats, nowadays. The sampled boats ranged from 6 to 14 m (average: 9.8±1.0 m) in length (LOA); 9 to 360 hp (average: 106.9±37.3 hp) in machine power.

A total of 50 sets were deployed during the observation periods that could not catch the swordfish in only three operations. Total length of longlines observed was 1238.6 km with ranged from 1.8 to 30 km (average: 24772 ±1243 m).

A total of 217 (4061 kg) swordfish were obtained during 50 operations. The mean CPUEs for swordfish by number and weight were computed as 10.8±1.59 specimens and 179.6±21.48 kg per 1000 hooks, respectively (Table 1). Although, there was no significant differences among means of CPUEs by number of swordfish ($P>0.05$), The CPUEs by weight of swordfish were significantly different among years ($P<0.05$).

A total of 14 species, belonging to 12 families (276 specimens; 5535 kg) were caught during 50 operations off Fethiye and Özdere (Izmir). The target swordfish had the highest ratio both in number (78.6%) and in biomass (73.3%), followed by *Mobula mobular*, *Alopias vulpinus*, *Prionace glauca*, *Isurus oxyrinchus*, *Ruvettus pretiosus*, *Coryphaena hippurus*, *Thunnus alalunga* by weight, respectively. Biomass and number ratios of the non-target species to the target swordfish were 1:0.27 and 1:0.36, respectively (Table 2). A total of two specimens of which *P. glauca* (10 kg) and *M. mobular* (300 kg) were released lively and the others were retained due to commercial value. A significant difference was not found between weight of by-catch species and weight of the swordfish according to years ($P>0.05$).

Non-target fish ratios were 66.4% Chondrichthyes and 33.6% Osteichthyes (except target swordfish) according to two main groups. On the other hand, two of the three non-target fish are cartilaginous fish from the swordfish longline fishery in the eastern Mediterranean.

Table 1. Fishing effort (F) and CPUEs in longline fishery for swordfish by number and weight during 50 operations in the eastern Mediterranean Sea

n=50	Number of hooks	SWO (number)	SWO (kg)	F	$CPUE_N$	$CPUE_B$
Minimum	130	0	0	0.13	0	0
Maximum	600	11	280	0.60	73.3	700
Average	474.0±21.40	4.3±0.44	81.2±9.69	0.47±1.59	10.8±1.59	179.6±21.48

Table 2. Total catch of swordfish and non-target species, ant their ratios by number and weight during 50 operations in the eastern Mediterranean Sea

	Number		Weight	
Species	n	%	kg	%
CHONDRICHTHYES				
Alopias vulpinus (Bonnaterre, 1788)	3	1.1	252.0	4.6
Carcharhinus plumbeus (Nardo, 1827)	1	0.4	5.5	0.1
Isurus oxyrinchus Rafinesque, 1810	4	1.4	172.0	3.1
Mobula mobular (Bonnaterre, 1788)	1	0.4	300.0	5.4
Prionace glauca (Linnaeus, 1758)	4	1.4	249.0	4.5
OSTEICHTHYES				
Coryphaena hippurus Linnaeus, 1758	11	4.0	133.8	2.4
Lepidopus caudatus (Euphrasen, 1788)	2	0.7	1.0	0.0
Lobotes surinamensis (Bloch, 1790)	1	0.4	1.2	0.0
Muraena helena Linnaeus, 1758	3	1.1	9.0	0.2
Ruvettus pretiosus Cocco, 1833	12	4.3	159.0	2.9
Tetrapturus belone Rafinesque, 1810	6	2.2	66.5	1.2
Thunnus alalunga (Bonnaterre, 1788)	10	3.6	70.0	1.3
Thunnus thynnus (Linnaeus, 1758)	1	0.4	55.0	1.0
Xiphias gladius Linnaeus, 1758	217	78.6	4061.0	73.3
Total	276	100.0	5535.0	100.0
Swordfish : non-target fish	1:0.27		1:0.36	

Discussion

Since 2011, the swordfish fishery in Turkish waters is carried out by harpoon and longline, and some swordfish is also caught incidentally by purse-seiners. According to Turkish fishery regulation circular, the seasonal closure for swordfish fishery is between October 1 and November 30 and also between February 15 and March 15 in all of Turkish waters, and each fishing boats have to get registration licence for swordfish fishing (Anon. 2008). When not fishing for swordfish and during the closed season, many of swordfish fishermen are occupied with doing to the other coastal fisheries and trawling, and tourism or farming.

Before banning the using of gillnet, the Turkish swordfish fleet had been with averages 12.4±0.6 m in length (LOA), 162.4±13.7 hp in machine power and 20.2±3.1 GT in gross tonnage, especially deployed in Sivrice, Sığacık and Fethiye ports (Akyol and Ceyhan, 2011). Up to now, the fleet has been thoroughly decreasing until about ten boats with averages 9.8±1.0 m LOA and 106.9 ±37.3 hp. Most of vessels in the fleet were withdrawn from the swordfish fishery. These boats used to use both gillnet in summer season and longline in autumn and winter seasons. After gillnet banning, most of fishermen argue that their incomes dramatically decreased and they stopped to catch swordfish. Consequently, the annual swordfish catch strongly reduced (about 80%) in Turkish waters in 2012.

In the study, CPUEs for swordfish by number and weight were computed as 10.8±1.6 specimens and 179.6±21.5 kg per 1000 hooks, respectively. De Metrio and Megalofonou (1988) calculated the CPUE between 41.1 kg and 98.3 kg/1000 hooks in the Gulf of Taranto from 1978 to 1986. Di Natale *et al.* (1995) reported 101 kg/1000 hooks as average for Tyrrhenian Sea and Strait of Sicily in 1992; Damalas *et al.* (2007) computed as 8.96 specimens/1000 hooks for eastern Mediterranean; Relini *et al.* (2008) reported the CPUE of swordfish longline as 116.5 kg/1000 hooks for northwestern Mediterranean. Cambiè *et al.* (2013) also reported it from the southern Italy for both 2007 and 2011 as 3.2 specimens/1000 hooks and 0.4 specimens/1000 hooks, respectively. In Fethiye region (southern Aegean Sea), Erdem and Akyol (2005) computed CPUE of the swordfish ranged from 15.6 to 27.8 kg/1000 hooks for sampled 14 boats in 2001. These results indicate that the swordfish existing in the eastern Mediterranean was more abundant than those of northwestern Mediterranean and Italian waters. However, ICCAT catch effort database from surface longline fishery in the Mediterranean Sea indicated that catch amount of swordfish in 2010 were 1420 tons by 2567873 hooks for Spain, 160.5 tons by 228000 hooks for Morocco (ICCAT, 2014). Low CPUE of swordfish in Fethiye region (Erdem and Akyol, 2005) might be explained with bad meteorological conditions, low abundance of fish in that year and/or missing declaration of fishermen during the dock samplings. However, analysis with the other environmental factors such as wind, currents, water temperatures, moon phases, etc. should be investigated in order to the better understand their influence on swordfish CPUEs in the next time.

In the presently reported study, the swordfish by number and biomass comprised ~79% and 73% of the total observed catch, respectively. A total of 13 species, belonging to 11 families were recorded as non-target catch of which five cartilaginous fish species. The biomass ratio of cartilaginous fish was ~18%. *P. glauca, I. oxyrinchus* and *A. vulpinus* in Chondrichtyes, vs. *R. pretiosus, C. hippurus* and *T. alalunga* in Osteichtyes had the highest numbers during the observation period. *Muraena helena*, living in rocky caves was astonishing finding. Presumably, when the end of the longline drifted to the some islets, these demersal fish must be jumped the bait while the fisherman was hauling the longline.

Especially, *P. glauca* and *I. oxyrinchus* seem to predominant shark species as bycatch in the Mediterranean. De la Serna *et al.* (2002) reported that a total of 17759 pelagic sharks were caught of which 91% was *P. glauca* from the Spanish Mediterranean surface longline fishery. The other sharks were *I. oxyrhinchus* (8%), *A. vulpinus* (0.8%), *A. superciliosus* (0.05%) and *Sphyrna zygaena* (0.05%) during 1997-1999. Megalafonou *et al.* (2005) stated that data on shark catches were rare and most of the recent data concern shark by-catch in the western Mediterranean Sea where the catch rates were high. The authors reported 75.2% swordfish, 8.3% *T. thynnus*, 5.6% *T. alalunga*, 3.8% sharks of which 71.1% *P. glauca*, 13.3% *Galeorhinus galeus*, 9.6% *I. oxyrinchus*, 3% *A. vulpinus* and 3% others from swordfish and albacore longlining in the eastern Mediterranean during 1998-2001. Findings of Megalafonou et al (2005)'s study seems close ratios of both swordfish catch (~79 in this study vs. ~71%) and total shark group catch by number (~4.7% in this study vs. ~3.8%). Besides, *Galeorhinus galeus, Alopias superciliosus, Carcharadon carcharias, Heptranchias perlo* and *Hexanchus nakamurai* species, caught from eastern Mediterranean Sea (Megalafonou *et al.*, 2005) and *A. superciliosus* and *Sphyrna zygaena* from western Mediterranean Sea (De la Serna *et al.*, 2002) were not observed in this study.

In Alboran Sea, a total of 8 species (*T. thynnus, P. glauca, I. oxyrinchus, A. vulpinus, C. hippurus, Dasyatis pastinaca, G. galeus* and *Caretta caretta*) were caught as by-catch with the highest ratios of *D. pastinaca* and *P. glauca* by artisanal swordfish longline fishery (Baez *et al.*, 2009). Additionally, in southern Italy, the by-catch species composition was analyzed with two types of longlines as surface and mid-water by Cambié *et al.* (2013). The authors classified that *X. gladius, T. thynnus, C. hippurus, T.*

belone and *Brama brama* were commercial, while *C. caretta, Mola mola, Pteroplatytrygon violacea, P. glauca, Centrolophus niger, R. pretiosus, Zu cristatus* and *Stenella coeruleoalba* were by-catch. In addition, *T. thynnus* and *C. caretta* had the highest ratio (in number) for surface longline in both 2007 and 2010-2011, whereas *C. niger* and *R. pretiosus* had the highest ratio for mid-water longline in 2010-2011. As seen in both study, by-catch species *D. pastinaca, G. galeus, B. brama, C. caretta, M. mola, P. violacea, C. niger, Z. cristatus* and *S. coeruleoalba* were not observed in this study. However, especially *C. caretta, M. mola, C. niger* and *S. coeruleoalba* may be potential by-catch species for Turkish subsurface longline swordfish fishery in terms of occurrence of the fish in the fishing area.

In terms of loggerhead turtle's (*C. caretta*) bycatch in the western Mediterranean, Baez *et al.* (2014) reported that the number of sea turtles was 3940 (CPUE=0.499 loggerhead turtles/1000 hooks). Whereas, no loggerhead turtles were caught in the study.

In the study, when the almost of all non-target fish were sold due to commercial value, only *M. mobular* and *P. glauca* was thrown back to the sea. Although, driftnets caused to high ratio of by-catch problem affecting sea mammals, sea birds, sea turtles, sharks and the other fish, only five cartilaginous and eight bony fish caught by longline were found reasonable. On the other hand, the longlining is fairer in terms of by-catch than the drift-netting. Northridge (1991) reported 44 different by-catch species from drift-netting in the Mediterranean, and most of them were sea mammals. Hall *et al.* (2000) pointed to interactions between longlines and sea birds/sea turtles in many ocean areas of the world to catch a variety of species including tunas, swordfishes, sharks and toothfishes, etc. Yet, none of them were caught during the survey.

In conclusion, the Turkish swordfish longline fishery is carried out with lower fishing effort and high CPUE value in the patches of the coasts of eastern Mediterranean. To avoid the vanish; it needs to stimulate and modernize of this traditional fishery which dates back to the early 1950's (Artüz, 1956; Demir *et al.*, 1956). The fisheries authority strongly encourages the transition to the using pelagic longline to the fishermen, given up the swordfish fishery after gillnet banning. The number of observations in this study is rather low, and current findings should be considered as preliminary; thus, further studies should be made in the future.

Acknowledgements

This study was funded by Turkish Scientific and Technological Research Council (TUBITAK Project No.108O210) and Ege University Science and Technology Center (EBILTEM Project no: 2009/BIL/019). Also, the authors thank M.Sc. students, Tolga Tüzen and Can M. Özkan for their assistance onboard samplings and skippers of swordfish boats *Salih Reis-I* and *Kayalı Osman* for giving us the opportunity to work freely onboard.

References

Akyol, O., Erdem, M., Ünal, V. and Ceyhan, T. 2005. Investigations on drift-net fishery for swordfish (*Xiphias gladius* L.) in the Aegean Sea. Turkish Journal of Veterinary and Animal Sciences, 29: 1225-1231.

Akyol, O. and Ceyhan, T. 2007. Characteristics of Three Various Types Longline for Swordfish (*Xiphias gladius* L.) in Datça-Bozburun Peninsula, Southern Aegean Sea. The ICES/FAO Meeting of Working Group on Fishing Technology and Fish Behaviour, 22-27 April, ICES CM 2007/FTC:06 Ref. ACFM, Dublin, Ireland, 191 pp.

Akyol, O., Karakulak, F.S., Ceyhan, T. and Dede, A. 2008. Driftnets used in Turkish seas and their regulations [in Turkish]. E.Ü. Su Ürünleri Dergisi, 25(2): 153–157.

Akyol, O. and Ceyhan, T. 2010. Pelagic longlines for swordfish used in Turkish seas [in Turkish]. E.Ü. Su Ürünleri Dergisi, 27(4): 149–156.

Akyol, O. and Ceyhan, T. 2011. The Turkish swordfish fishery. Collect. Vol. Sci. Pap. ICCAT, 66(4): 1471–1479.

Akyol, O. 2013. The Influence of the Moon Phase on the CPUEs of Swordfish Gillnet Fishery in the Aegean Sea, Turkey. Turkish Journal of Fisheries and Aquatic Sciences, 13(2): 355-358. doi: 10.4194/1303-2712-v13_2_18

Akyol, O. and Ceyhan, T. 2013. Age and Growth of Swordfish (*Xiphias gladius* L.) in the Aegean Sea. Turkish Journal of Zoology, 37: 59-64. doi:10.3906/zoo-1204-3

Alıçlı, T.Z. 2008. Biometric relationships and condition factor of swordfish, *Xiphias gladius* L., 1758. İ.Ü. Su Ürünleri Dergisi, 23: 29–39.

Alıçlı, T.Z. and Oray, I.K. 2001, Age and growth of swordfish (*Xiphias gladius* L., 1758) in the eastern Mediterranean Sea. Collect. Vol. Sci. Pap. ICCAT, 52(2): 698–707.

Alıçlı, Z., Oray, I.K., Karakulak, S.F. and Kahraman, A.E. 2012. Age, sex ratio, length–weight relationships and reproductive biology of Mediterranean swordfish, *Xiphias gladius* L., 1758, in the eastern Mediterranean. African Journal Biotechnolgy, 11: 3673–3680. doi: 10.5897/AJB11.2189

Anonymous 2008. Fisheries regulation for marine and inland waters for commercial fishery, 2008-2012 fishing period No:2\1, Ministry of Agriculture and Rural Affair of Turkey, Ankara, 112 pp.

Anonymous 2011. Report of the 2010 ICCAT Mediterranean Swordfish Stock Assessment Meeting. Collect. Vol. Sci. Pap. ICCAT, 66(4): 1405-1470.

Artüz, M.İ. 1956. Türkiye pelajik balıkçılığına bakış. Balık ve Balıkçılık Dergisi, 4(9): 38–54.

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

Baez, J.C., Real, R., Caminas, J.A., Torreblanca, D. and Garcia-Soto, C. 2009. Analysis of swordfish catches and by-catches in artisanal longline fisheries in the

Alboran Sea (western Mediterranean Sea) during the summer season. Marine Biodiversity Records, 157(2): 1-4.

Baez,C., Macias, D., Garcia-Barcelona, S. and Real, R. 2014. Interannual differences for sea turtles bycatch in Spanish longliners from western Mediterranean Sea. The Scientific World Journal, Hindawi Publ. Corp., 2014: 1-7. doi: 10.1155/2014/861396.

Bartlett, M.S. 1937a. Properties of sufficiency and statistical tests. Proceedings of the Royal Society of London, 160(901): 268–282.

Bartlett, M.S. 1937b. Some examples of statistical methods of research in agriculture and applied biology. Supplement to the Journal of the Royal Statistical Society, 4 (2): 137–183.

Cambié, G., Muino, R., Mingozzi, T. and Freire, J. 2013. From surface to mid-water: Is the swordfish longline fishery "hitting rock bottom"? A case study in Southern Italy. Fisheries Research, 140: 114-122. doi: 10.1016/j.fishres.2012.12.014

Ceyhan, T. and Akyol, O. 2009. Swordfish (*Xiphias gladius* L.) fishery in Turkish Aegean Sea. Collect. Vol. Sci. Pap. ICCAT, 64(6): 2069-2078.

Damalas, D., Megalafonou, P. and Apostolopoulou, M. 2007. Environmental, spatial, temporal and operational effects on swordfish (*Xiphias gladius*) catch rates of eastern Mediterranean Sea longline fisheries. Fisheries Research, 84(2): 233–246. doi:10.1016/j.fishres.2006.11.001

De la Serna, J.M., Valeiras, J., Ortiz, J.M. and Macias, D. 2002. Large pelagic sharks as by-catch in the Mediterranean longline fishery: some biological aspects. Scientific Council Meeting, Sept. 2002, Atlantic Fisheries Organization, NAFO SCR, NW:1-8.

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

Demir, M., Acara, A. and Arım, N. 1956. Investigations on swordfish (*Xiphias gladius* L.) [in Turkish]. Hidrobiologi Mecmuası, İ.Ü. Fen Fak. Hidr. Araş. Enst. Yayınlarından, 3(A): 137–143.

Di Natale, A., Mangano, A., Navarra, E., Schimmenti, G. and Valastro, M. 1995. Swordfish (*Xiphias gladius* L.) longline fishing in the Tyrrhenian Sea and in the Strait of Sicily: 1992 Report. Col. Vol. Sci. Pap. ICCAT, 44(1):249-254.

Erdem, M. and Akyol, O. 2005. A preliminary study on longlining of swordfish (*Xiphias gladius* L., 1758) in Fethiye Region (Mediterranean) [in Turkish]. E.Ü. Su Ürünleri Dergisi, 22: 201-204.

FAO 2011. Fisheries and Aquaculture Department, Statistics and Information Service FishStatJ: Universal software for fishery statistical time series. Copyright 2011.

Hall, M.A., Alverson, D.L. and Metuzals, K.I. 2000. By-catch: Problems and solutions. Marine Pollution Bulletin, 41: 204-219.

ICCAT 2014. ICCAT Task II. Catch-Effort Database. http://iccat.es/en/t2ce.asp (accessed June 03, 2014)

Megalofonou, P., Damalas, D. and Yannapoulos, C. 2005. Composition and abundance of pelagic shark by-catch in the eastern Mediterranean Sea. Cybium, 29(2):135-140.

Northridge, S.P. 1991. Driftnet fisheries and their impact on non-target species: A worldwide review. FAO Fish. Tech. Paper, No. 320, Rome, 115 pp.

Relini, L.O., Palandri, G., Garibaldi, F., Cima, C., Lanteri, L. and Relini, M. 2008. A time series of swordfish longline CPUE in the Nothwestern Mediterranean: Search for exploitation and/or climatic factors influencing fish abundance. Collect. Vol. Sci. Pap. ICCAT, 62(4): 1097-1106

Öztürk, B., Öztürk, A. and Dede, A. 2001. Dolphin by-catch in the swordfish driftnet fishery in the Aegean Sea. Rapp. Comm. Int. Medit., 36: 308 pp.

TÜİK 2013. Fishery Statistics 2012. Turkish Statistical Institute Official Webpage. Available at http://tuikapp.tuik.gov.tr/balikcilikdagitimapp/balikcilik.zul (accessed 12.12.2013).

Ward, P., Porter, J.M. and Elscot, S. 2000. Broadbill swordfish: status of established fisheries and lessons for developing fisheries. Fish and Fisheries, 1: 317–336.

Zar, J.H. 1999. Biostatistical analysis. 4th Edn. Prentice-Hall, Upper Saddle River, New Jersey, 662 pp.