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The Influence of the Moon Phase on the CPUEs of Swordfish Gillnet Fishery in the Aegean Sea, Turkey

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Abstract

This paper provides the analysis the moon phase's on CPUE (Catch per Unit Effort) related to Turkish Aegean swordfish (*Xiphias gladius*) gillnet fishery during 2009-2010 fishing seasons. Mean CPUE (kg/km) was 47.0 ±14.5 during the dark period, against 24.1 ±3.8 in light period in 2009. Besides, mean CPUE was 56.3 ±10.2 during the dark period, whereas 45.1 ±7.8 in light period in 2010. In the two years periods (2009-2010) examined, the mean CPUE was 50.5 ±9.7 during the dark period, while 32.8 ±4.1 in light period. All the CPUE peaks were clearly close to each new moon phase and the highest peak (300 kg/km) was computed in May 2009 during the dark period. The results obviously indicate the increasing of the swordfish landings during the dark periods.

Keywords: Swordfish, *Xiphias gladius*, CPUE, moon phases, Aegean Sea.

Ege Denizi'nde Kılıç Balığı Solungaç Ağları Avcılığının CPUE'leri Üzerine Ayın Evrelerinin Etkisi

Özet

Bu çalışma 2009–2010 balıkçılık sezonunda Ege Denizi kılıçbalığı (*Xiphias gladius*) solungaç ağları balıkçılığıyla ilgili CPUE (birim çaba başına av) üzerine ayın evrelerinin analizini vermektedir. 2009 yılında ortalama CPUE (kg/km) karanlık dönem boyunca 47,0 ±14,5, aydınlık dönem boyunca ise 24,1 ±3,8 idi. Buna karşılık, 2010 yılında karanlık dönem boyunca 56,3 ±10,2; aydınlık dönem boyunca 45,1 ±7,8 idi. İncelenmiş iki yıllık (2009–2010) dönemde ise, karanlık dönem 50,5 ±9,7 iken, aydınlık dönem 32,8 ±4,1 idi. Tüm CPUE pikleri belirgin olarak hep karanlık fazdaydı ve en yüksek pik (300 kg/km) Mayıs 2009'da hesaplanmıştır. Sonuçlar açıkça karanlık dönemler boyunca kılıç avının arttığını göstermektedir.

Anahtar Kelimeler: Kılıç balığı, *Xiphias gladius*, ayın evreleri, Ege Denizi.

Introduction

Swordfish (*Xiphias gladius*) is a large, pelagic, oceanodromous species of high commercial value that is heavily exploited in the Atlantic Ocean and the Mediterranean Sea. It migrates toward temperate or cold waters in the summer and back to warm waters in the fall at a depth range of 0–800 m (Tserpes et al., 2003; Froese and Pauly, 2012). Swordfish frequent the upper layers above 100 m where they feed intensely at night, whereas they descent to deeper at daylight and also illumination is a determining factor for the vertical shifts of swordfish (Carey and Robinson, 1981; Draganik and Cholyst, 1988).

Swordfish are captured using traditional pelagic gillnet (i.e. driftnet; the EU enforced a regulation prohibiting the use of driftnets in 2002, and this gear has been banned since 2006 in Turkey as well as other Mediterranean countries), pelagic longline, harpoon, and some purse seines (Akyol, 2012). The catch statistics for swordfish in Turkey indicated that there were unstable catch totals ranging between 7 t in 1976 and 589 t in 1988 (FAO, 2011). In 2010, the total catch of swordfish was 13764 t in the Mediterranean Sea (FAO, 2011) and 334 t in Turkey (TÜİK, 2012).

Catch and effort data are typically analyzed in the form of catch per unit effort (CPUE), which expresses the quantity of fish caught (in numbers or weight) by a given amount of fishing effort. In general, CPUE is used as an index of abundance,

meaning that a proportional change in CPUE is expected to represent the same proportional change in stock size (FAO, 1999). The CPUE data are often influenced by several factors, some of them environmental, which strongly affect the availability of the target species (Di Natale and Mangano, 1995).

The CPUE data from driftnet fishery is a good stock abundance index and it needs to be checked and validated, but the influence of some external factors seems to heavily affect it (Di Natale and Mangano, 1995). The authors had given a first analysis the moon phase's influence on CPUE as an external factor in Italian swordfish driftnet fleets.

Turkish fishermen as well as Italian driftnet fishermen (Di Natale and Mangano, 1995) are also know very well the effects due to different moon phases on commercial catches. They prefer moonless (darkness) nights for the higher catch. Akyol and Ceyhan (2012) reported firstly the lunar survey on CPUE of the Turkish albacore (*Thunnus alalunga*) gillnet fishery. Thus, this paper provides the second analysis (after from the albacore) the moon phase's influence on CPUE related to Turkish swordfish gillnetting in the Aegean Sea.

Materials and Methods

The daily fishing activity from 21 representative swordfish gillnetters were monitored randomly based at the ports of Sivrice and Sığacık (Figure 1) from April to September 2009, and April, May and August 2010. The operation depths were between 150 m and 700 m (average: 309 m ±10). The overall length (LOA), gross tonnage (GT) and machine power (hp) of the sampled gillnetters were ranged from 8 to 17 m (average: 11.3 m ±0.7), 2.7 to 47 GT (average: 12.8 ±2.6), 28 to 380 hp (average: 142 ±21), respectively. The details of swordfish gillnet characteristics, fishing methods and discards were given by Akyol (2012).

A total of 91 swordfish landings (33 Sivrice and 58 Sığacık) were sampled. On each fishing trip, dock samplings and some logbook data were on (1) date, location, depth and moon phases, (2) fishing boat characteristics, (3) fishing gear aspects of the fishing operation such as mesh size, total length of the net, (4) the catch of swordfish as round weight (RWT).

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) × g, 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, weight per km of the net was computed with the formula CPUE = kg/f.

The lunar cycle was divided to two periods as light and dark (according to the fishermen), and assumed the demilunes (first/last quarters), and waning gibbous and full moon as light period; new moon and crescent as dark period. All of the means were given with standard error (± SE).

Results and Discussion

A total of 91 sets, 55 in 2009 and 36 in 2010 were recorded. Total length of gillnets was reaching 245 km in 91 operations, ranged from 700 to 6000 m

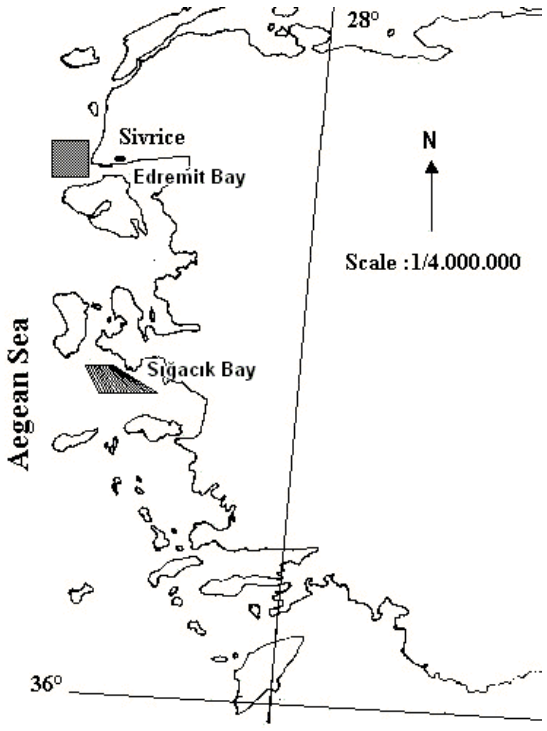

Figure 1. Sampling area.

with average: 2692 ±116 m.

The first strong evidence of moon phase's influence had been shown in 2009. Mean CPUE (kg/km) was 47.0 ±14.5 during the dark period, against 24.1 ±3.8 in light period. Besides, mean CPUE was 56.3 ±10.2 during the dark period in 2010, whereas 45.1 ±7.8 in light period. In the two years periods (2009-2010) examined, the mean CPUE was 50.5 ±9.7 during the dark period, while 32.8 ±4.1 in light period (Table 1). All the CPUE peaks were clearly close to each new moon phase and the highest peak (300 kg/km) was computed in May 2009 during the dark period (Figure 2). However, there were no statistical differences between mean CPUE and years according to the moon phases (*t*-test, P>0.05).

Di Natale and Mangano (1995) reported that the means of CPUE of swordfish driftnet fishery were 12.9 kg/km in the dark period, while 7.6 kg/km in the light period during 1990-1992 seasons in all the western Italian Basins (Ligurian and Tyrrhenian Seas). These CPUE data show that the Aegean swordfish is more abundant than those of Ligurian and Tyrrhenian Seas. However, the mean CPUE variation ratios between the dark and light periods in both studies were close to each other (i.e. -41% for western Italian Basins and -35% for the Aegean Sea).

The Turkish swordfish fishermen usually give up the operation during the full moon phase. They occasionally fished short time during the dawn while disappearing of the moon in the light period. In a similar, the large part of Italian swordfish gillnet fleet was stayed in the harbors, usually from 3 to 5 days in the full moon phases (Di Natale and Mangano, 1995).

Some previous studies proved the relationships between moon phases and swordfish/albacore catchability. For instance, Draganik and Cholyst (1988) obtained the highest catch ratios during full moon phase for the Central Atlantic swordfish longline fisheries, as well as Santos and Garcia (2005) for the Atlantic Portuguese pelagic longline fishery. In contrast, Di Natale and Mangano (1995) attained the highest catch rates in the new moon phase for the Mediterranean Italian driftnet fishery, as well as Akyol and Ceyhan (2012) for the Eastern Mediterranean Turkish albacore driftnet fishery. Thus, for the higher catchability in both fishing gears, the full moon phase is effective for pelagic longlining owing to increase the visibility of the bait; whereas, new moon phase is effective for driftnetting owing to reduce the visibility of the net.

In conclusion, the results of this study obviously indicate the increasing of the swordfish landings during the dark period in both 2009 and 2010. However, analysis associating moon phase with the

Table 1. Yearly mean CPUE (kg/km) values and swordfish landings from sampled boats in the Aegean Sea

	CPUE (kg/km)					
Moon Phase	∑ L	2009	∑ L	2010	∑ L	2009–10
●	2968	47.0±14.5	2971	56.3±10.2	5939	50.5±9.7
◑	1402	24.1±3.8	2498	45.1±7.8	3900	32.8±4.1
Mean CPUE variation (%)		-48.7		-18.5		-35.0
∑ Landings (kg)	4370		5469		9839	

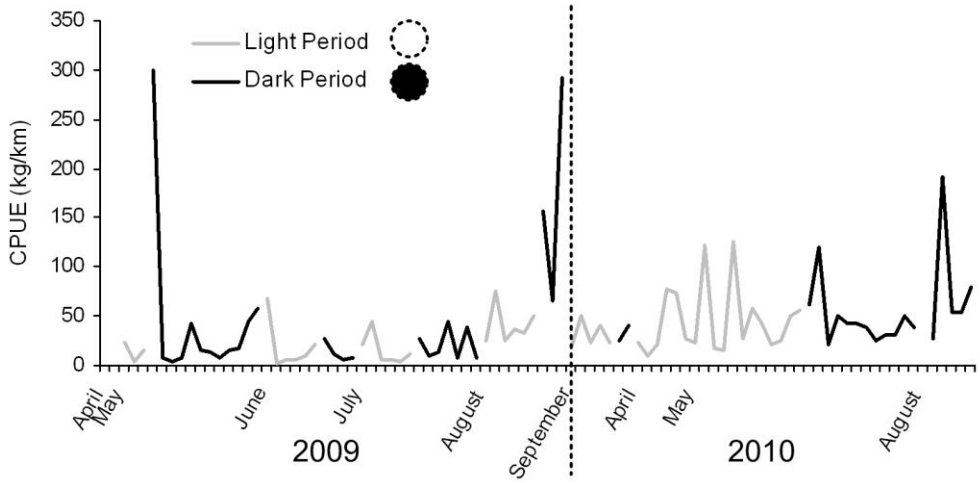

Figure 2. Daily CPUE (kg/km) swordfish data (RWT) from the gillnet fishery in the Aegean Sea in 2009–2010 fishing seasons according to the moon phases.

other environmental factors such as wind, currents, water temperatures, etc. should be investigated in order to the better understand their influence on swordfish CPUEs.

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References

Akyol, O. 2012. Swordfish (*Xiphias gladius*, Linnaeus, 1758) fishery. In: A. Tokaç, A.C. Gücü and B. Öztürk (Eds.), The State of the Turkish Fisheries, Publication No. 35, TÜDAV, İstanbul: 364–371.

Akyol, O. and Ceyhan, T. 2012. Moon phase's influence on CPUE of Turkish albacore gillnet fishery. Collect. Vol. Sci. Pap. ICCAT, 68(2):499-502.

Carey, F.G. and Robinson, B.H. 1981. Daily patterns in the activities of swordfish, *Xiphias gladius*, observed by acoustic telemetry. Fish.Bull. 79(2): 277-292.

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 Fish. Rep. No. 394, Rome: 91-102.

Di Natale, A. and Mangano, A. 1995. Moon phases influence on CPUE: A first analysis of swordfish driftnet catch data from the Italian fleet between 1990 and 1991. Col.Vol.Sci.Pap. ICCAT, 44(1):264-267.

Draganik, B. and Cholyst, J. 1988. Temperature and moonlight as stimulators for feeding activity by swordfish. Col.Vol.Sci.Pap. ICCAT, 27:305-314.

FAO. 1999. Guidelines for the routine collection of capture fishery data. FAO Fish. Tech. Pap., No. 382, Rome.

FAO. 2011. FAO Fisheries and Aquaculture Department, Statistics and Information Service FishStatJ: Universal Sotware for Fishery Statistical Time Series. FAO, Rome.

Froese, R. and Pauly, D. Editors. 2012. FishBase. World Wide Web electronic publication. www.fishbase.org, version (12/2012) (accessed December 03, 2012).

Santos, M.N. and Garcia, A. 2005. The influence of the moon phase on the CPUEs for the Portuguese swordfish (*Xiphias gladius* L., 1758) fishery. Col.Vol.Sci.Pap. ICCAT, 58(4):1466-1469.

TÜİK. 2012. Fishery Statistics 2010. Turkish Statistical Institute Official Webpage. Available at http://tuikapp.tuik.gov.tr/balikcilikdagitimapp/balikcilik.zul (accessed 13 June 2012).

Tserpes, G., Peristeraki, P. and Di Natale, A. 2003. Swordfish abundance trends in the Mediterranean. CIESM Workshop Monographs No. 22. Mediterranean Biological Time Series, pp. 101–108.