

Swordfish (*Xiphias gladius* L.) Fishery in Turkish Aegean Sea

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Abstract: The results of investigations on swordfish fishery in Turkish Aegean Sea are presented. A total of 65 boats (6-14 m in length and 11.5-135 hp in engine power) were participated to this fishery from two main fishing ports, Sivrice and Fethiye, and Datça-Bozburun Peninsula. This fishery is also carried out off Antalya Bay. Total annual swordfish catch was 425 t in 2005. The fishing period for swordfish normally takes place 8 months. However, the main activity is concentrated in Spring and Summer seasons at moonless nights, because of closed season (between Oct, 1 and Jan. 31) and bad meteorological conditions. Although, there are various fishing gears and techniques for swordfish, two main fishing gears are used in the Aegean Sea: longline and drift-net. About 10 non-target species, bluefin tuna, Atlantic black skipjack, albacore, mediterranean spearfish, bullet tuna, dolphinfish, manta ray, sunfish, sharks and dolphins were determined from both longlining and drift-netting.

Key Words: Swordfish, *Xiphias gladius*, fishery, Aegean Sea.

Introduction

The exact time when swordfish fishery starts in Turkey is unknown. But Turkish swordfish fishery dates back to early of the 1900's. Deveciyan (1915), the old director of the Istanbul fish market, stated that the fishing season for swordfish in the Sea of Marmara had been carried out by using harpoon and drift net in Bosphorus from 15 August to 8 November, and then swordfishes were disappeared due to the colder weather conditions in formerly. Afterwards Onat (1970) reported that in the late 1960s, swordfish fishery by using harpoon started in April, May and June, and also swordfish were caught by using drift nets in the Bosphorus on moonless nights between September and November. Nowadays, fishers meet by chance to swordfish in Marmara and the Black Sea, no longer.

There are two main fishing methods, drift-netting and longlining for swordfish in the Turkish Aegean Sea. Swordfish fishery in Turkey has only been carried out in the Aegean and

the Mediterranean seas since swordfish were disappeared about last two decades in the Sea of Marmara and the Black Sea (Akyol & Ceyhan, 2007).

Only fragmentary information on swordfish fishery in Turkey exists, such as the studies by Onat (1970), Artüz (1971), Tokaç *et al.* (1991), Gökoğlu & Oray (1992), Alıçlı (1996), Akyol *et al.* (2005), Erdem & Akyol (2005) and Akyol & Ceyhan (2007).

The aim of this article is to contribute to the management of the swordfish stocks in the Mediterranean with the cooperation of all member countries involved of ICCAT. In order to do so, we detail the current national regulations regarding the fishery, and we present an information on the technical characteristics of the Turkish swordfish fleet, fishing gears and fishing effort.

2. Swordfish fishery: landings and regulations

2.1. Fishing ports and grounds

The swordfish fishery in the Aegean Sea is limited to seven main fishing ports, Sivrice, Yeni Foça, Sığacık, Datça, Palamutbükü, Selimiye and Fethiye (Fig. 1). This fishery is also carried out eastwards to Antalya Bay.

Swordfish fishing by using drift-netting and longlining occurs in practice between Sivrice and the Lesvos Island, named the Müsellim Strait, and in both national and international waters between Fethiye and Rhodes Island. Fishery takes place at a depth range of 150 to 350 m in Müsellim Strait, and 1000 to 3000 m in the Fethiye Region (Akyol *et al.* 2005). And also depth of the other areas, using only longlines is ranged from 100 to 250 m.

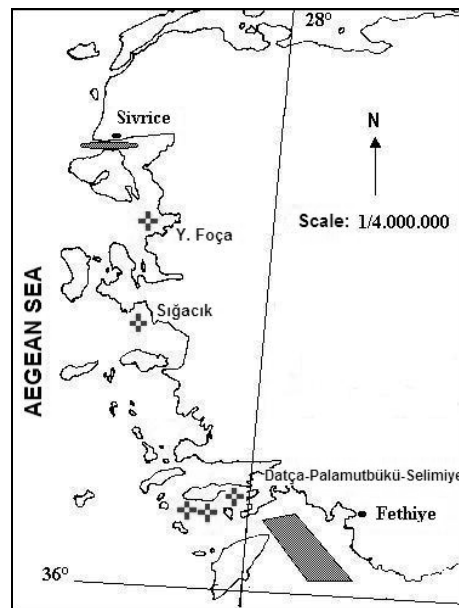


Fig. 1. Distribution of fishing activities for swordfish in the Aegean Sea

2.2. Fishing Period

According to Turkish fishery regulation circular (TFRC), the seasonal closure for swordfish fishing is between Oct, 1 and Jan. 31 (totally 4 months) in all of Turkish territorial waters (Anon., 2006). The rest of the year, fishing is carried out only about 4 months a year due to the meteorological conditions and phase of the moon. Fishing for swordfish takes place only on moonless nights. Thus, the fishing season becomes shorter.

2.3. Total catch of swordfish in Turkey

Among the large pelagic exploited in Turkey, the swordfish catch was sharply fluctuated from 7 tones (1976) to 589 tons (1988) (Fig. 2). These relative low annual landings may cause shorter fishing season, limitations (size, season) and/or unreported catch. Finally, in 2005, the amount of swordfish was only 425 t (FAO, 2000).

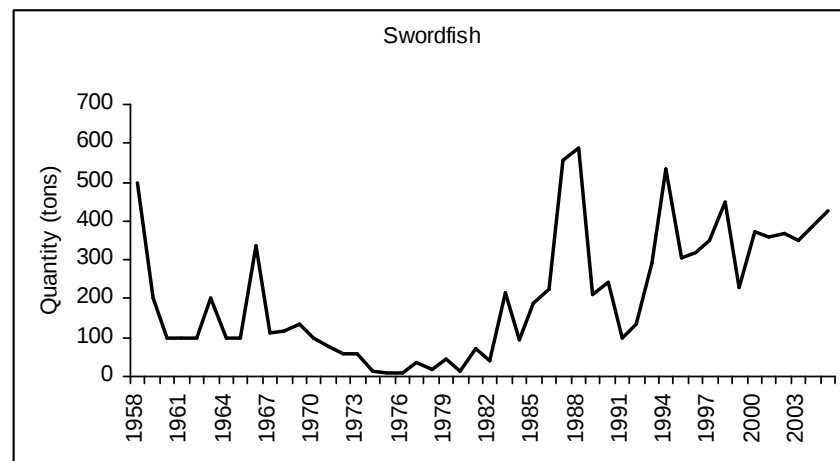


Fig. 2. Total catch of swordfish in Turkey since 1958

2.4. Fishing effort and CPUE

In the two major areas, the fishing effort and CPUE according to sampled boats and fishing gears are shown in Table 1.

Table 1. Comparison of fishing effort and CPUE according to fishing gears (Akyol *et al.* 2005; Erdem & Akyol, 2005)

Fishing port	Gear	Sampled boats	Means of fishing days	Means of yield (kg.year ⁻¹)	Fishing effort (f)*	CPUE
Sivrice	Drift-net	25	53±5	325±60	44±6	7,7±1,3
Fethiye	Longline	14	135±4	1832±96	83±6	22,6±1,0

*f_(drift-net) : for 100 unit nets (6600 m); f_(longline) : for 1000 hooks

2.5. Size distribution

Lower jaw fork length (LJFL) of 115 swordfish caught by using drift-nets off Fethiye was measured in 2001 and 2002 fishing season. The catch was ranged from 110 to 190 cm,

whereas, length distribution of 60 swordfish fished by using longline in the same area was between 60 and 240 cm. The percentage of individuals longer than 130 cm, the minimum landing size (MLS) for swordfish (Anon., 2006), were 90% for drift netting and 55% for longlining (Fig. 3).

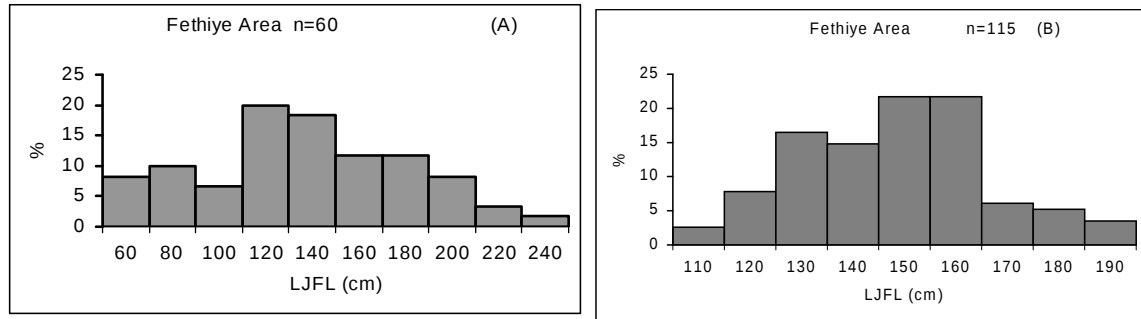


Fig. 3. Length frequency distribution of swordfish in Fethiye region according to fishing gears; (A) longline, (B) drift-net (Akyol *et al.* 2005 and Erdem & Akyol, 2005).

2.6. Length-weight relationship

Length- weight relationship (LWR) parameters were given in Table 2.

Table 2. LWR parameters of *Xiphias gladius* in Turkish seas

Author	Area	Length	N	Parameters of LWR		
				<i>a</i>	<i>b</i>	<i>r</i> ²
Alıçlı (1996)	SE Medit.	LJFL	794	6.10^{-7}	3.617	0.983
Akyol <i>et al.</i> (2005)	Fethiye	LJFL	115	7.10^{-8}	3.532	0.949
Erdem & Akyol (2005)	Fethiye	LJFL	60	0.0075	3.087	0.992

2.7. Current regulations on swordfish fishery

There had been a general ban for drift-netting from 1 April 1999 to 16 August 2005. Later, the using of driftnet was set free between 16 August 2005 and 31 August 2006 due to EU regulations (no 894/97) about the using of driftnet which was length limited to maximum 2.5 km. However, the driftnets, identified comprehensively in TFRC to prevent the confusions between driftnets and the other gillnets, were banned again in 2006, depends on ICCAT recommendations.

Currently, the minimum landing size (MLS) for swordfish is 130 cm and closure of season is between Oct, 1 and Jan. 31 (totally 4 months) in all of Turkish territorial waters in the Turkish Fishery Regulation Circular (TFRC, 37/1) (Anon., 2006).

3. Technical characteristics of fishing gears and vessels

3.1. Fishing boats

Table 3 shows that Sivrice is the area with the greatest number of boats, followed by the fleet of Fethiye. Among these major areas the higher number of boats between 6-10 meters in length and 11.5-280 hp in engine power was in Sivrice area while the highest number of boats between 10-14 meters and 85-135 hp in engine power was in Fethiye area. Almost, all of the boats were made of wooden material, but only one boat (17 m long; 280 hp) was made of steel material in Sivrice area. Two or three persons work in each boat. Concerning the engine power of the fishing boats, Fethiye fleet has higher engine power than Sivrice fleet. This is obviously due to boats from Fethiye area extend their activities much further from port (Akyol *et al.*, 2005).

Table 3. Division of vessels according to the size and engine power (Akyol *et al.*, 2005)

Fishing Ports	Number of Boats	Length (m)			Engine Power (hp)			
		6-10	10-14	14-18	Min.	Max.	Mean	Sum
Sivrice	25	19	5	1	11.5	280	68±11	1700
Fethiye	20	6	10	4	11	135	101.6±16.2	2032
Total	45	25	15	5	11	280	83±9.7	3732

3.2. Fishing gears

Although, there are various fishing gears and techniques for swordfish, two main fishing gears use in the Aegean Sea: longline and drift-net. Harpooning was the earliest fishing activity in Turkey. But only a few fishermen for harpooning were remained in Bosphorus and Gökçeada.

3.2.1. Long-lining

Longline is now dominant fishing method, and there are now four types of longline for swordfish in Turkey. Fishers have used pelagic longline (*see*, part 3.2.1.1), a series of baited 400-750 hooks attached to mainline suspended buoys at the sea surface, to catch swordfish in the Aegean Sea. Illuminated buoys are attached to both sides of the mainline. A total of the length of the gear is ranged from 20 to 37 km (Erdem & Akyol, 2005). In addition, Akyol & Ceyhan (2007) reported that the three various types longline for swordfish had also determined in Datça-Bozburun Peninsula, SE Aegean Sea. These were rather different from the traditional pelagic longlines.

3.2.1.1. Traditional pelagic longline

Main line: mono, 1.2-1.5 mm Ø, PA; total length 20000-37000 m

Branch line: mono, 1.5 mm Ø, PA, each length 5 m, interval of two branch line is 45-55 m.

Hooks: 1/0-2/0 and 20 pieces 1000 m^{-1}

Buoys: a buoy with 15 m (1.5 mm $\varnothing$) rope being connected after each sixty branch line and each side of the longline is attached with illuminated buoys (Fig. 4).

Fishing season: all of the year (except closure season).

Fishing area: from Sivrice to Fethiye at depth of 150-3000 m.

Methods: more than 20 boats are participated to the fishery in the Aegean Sea and they are observed to longline with helping illuminated buoys, and checked the hooks in two times a night and baited repeat if necessary.

Baits: sardine, chub mackerel, mackerel, bonito and grey mullets, etc.

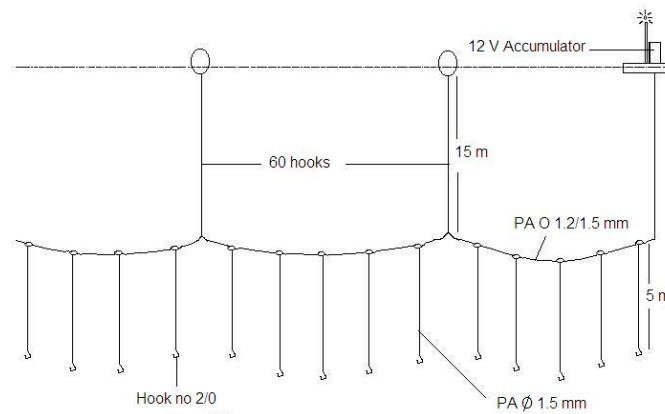


Fig. 4. Traditional pelagic longline for swordfish in the Aegean Sea (Erdem & Akyol, 2005).

3.2.1.2. *Datça type swordfish longline*

Main line: mono, 1.2-1.5 mm $\varnothing$, PA; total length 2000-3000 m

Branch line: mono, 0.9-1 mm $\varnothing$, PA, each length 2-3 m, interval of two branch line is 18 m.

Hooks: 1/0-2/0 and 50-60 pieces 1000 m^{-1}

Buoys/anchors: a buoy with 20-25 m (1.5 mm $\varnothing$) rope being connected after each five branch line and each side of the longline is attached with 10 -15 kg anchor (Fig. 5).

Fishing season: February - April.

Fishing area: deep waters between Simi Island and Datça.

Methods: a total of 10 boats are participated to the fishery and they are checked the hooks in two times a day and baited repeat during the season.

Baits: sardine, twaite shad, grey mullet.

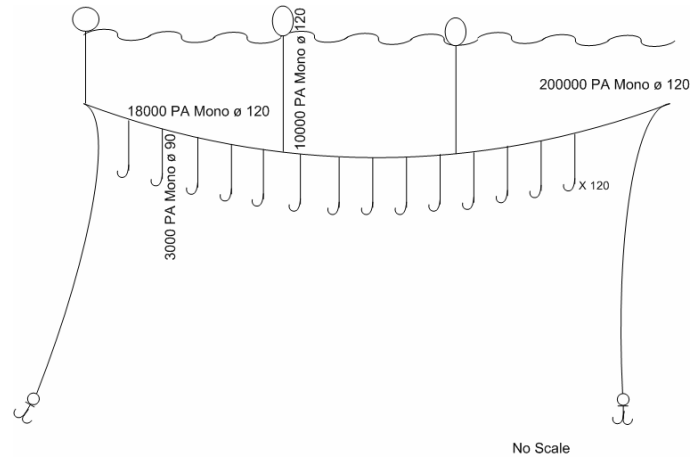


Fig. 5. Datça type swordfish longline (Akyol & Ceyhan, 2007)

3.2.1.3. Palamutbükü type swordfish longline

Main line: mono, 1.2-1.5 mm Ø, PA; total length 2000-3000 m

Branch line: mono, 1.1-1.2 mm Ø, PA, each length 4 m, interval of two branch line is 32 m.

Hooks: 1/0-2/0 and 30-35 pieces 1000m⁻¹

Buoys/anchors: a buoy with 20-25 m (1.5 mm Ø) rope being connected after each five branch line and each side of the longline is attached with 10 -15 kg anchor (Fig. 6).

Fishing season: January - March.

Fishing area: 2-3 nm off Palamutbükü at depth 160-250 m.

Methods: a total of 3 boats are participated to the fishery and they are checked the hooks in two times a day and baited repeat during the season.

Baits: chub mackerel, bogue, twaite shad.

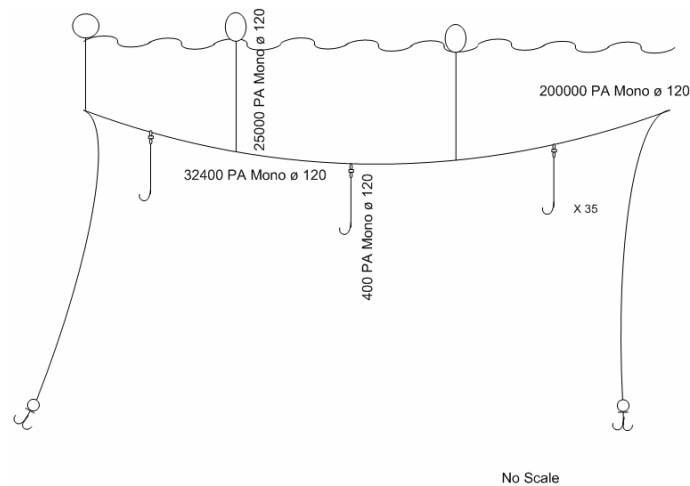


Fig. 6. Palamutbükü type swordfish longline (Akyol & Ceyhan, 2007)

3.2.1.4. Selimiye type swordfish longline

Main line: mono, 1.5 mm Ø, PA; total length 1000-2000 m

Branch line: mono, 1.2 mm Ø, PA, each length 9 m, interval of two branch line is 18 m.

Hooks: 1/0-2/0 and 50 pieces 1000m⁻¹

Buoys/anchors: a buoy with 9 m (1.5 mm Ø) rope being connected each branch line and each side of the longline is attached with 10-15 kg anchor (Fig. 7).

Fishing season: June - August.

Fishing area: 500 m off Cape Atabol (Hisarönü Bay) at depth 180 -200 m.

Methods: a total of 5 boats are participated to the fishery and they are checked the hooks in two times a day and baited repeat during the season.

Baits: sardine.

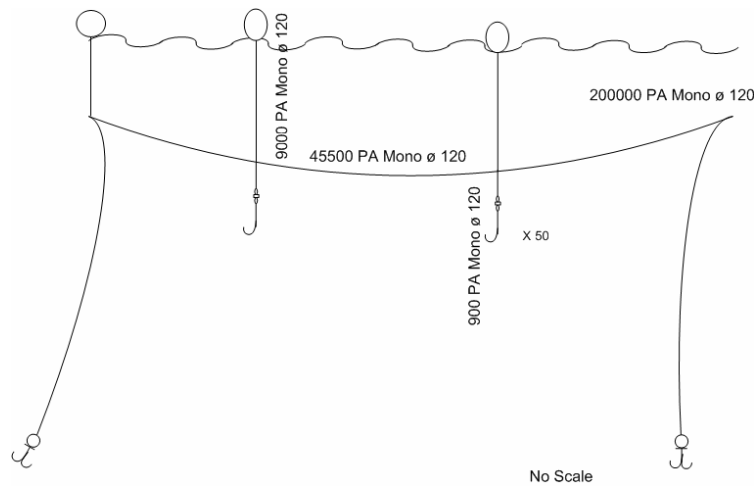


Fig. 7. Selimiye type swordfish longline (Akyol & Ceyhan, 2007)

3.2.2. Drift netting

Northridge (1991) stated that drift gillnets (or drift -nets), in common with other types of gillnet, were among the simplest and oldest methods of fishing. Such nets operate by gilling or entangling fish in the meshes of a sheet of netting.

Currently, small scale drift-net fishery is especially carrying out in Sivrice Region, NE Aegean Sea, and some in Fethiye Region, SE Aegean Sea. Total length of the nets, made of the multiflament polyamide (PA) netting yarn, 23tex/54-60 no and 440-500 mm stretched mesh size were determined as 3-4 and/or 7 km in both region (Akyol *et al.*, 2005)(Fig. 8).

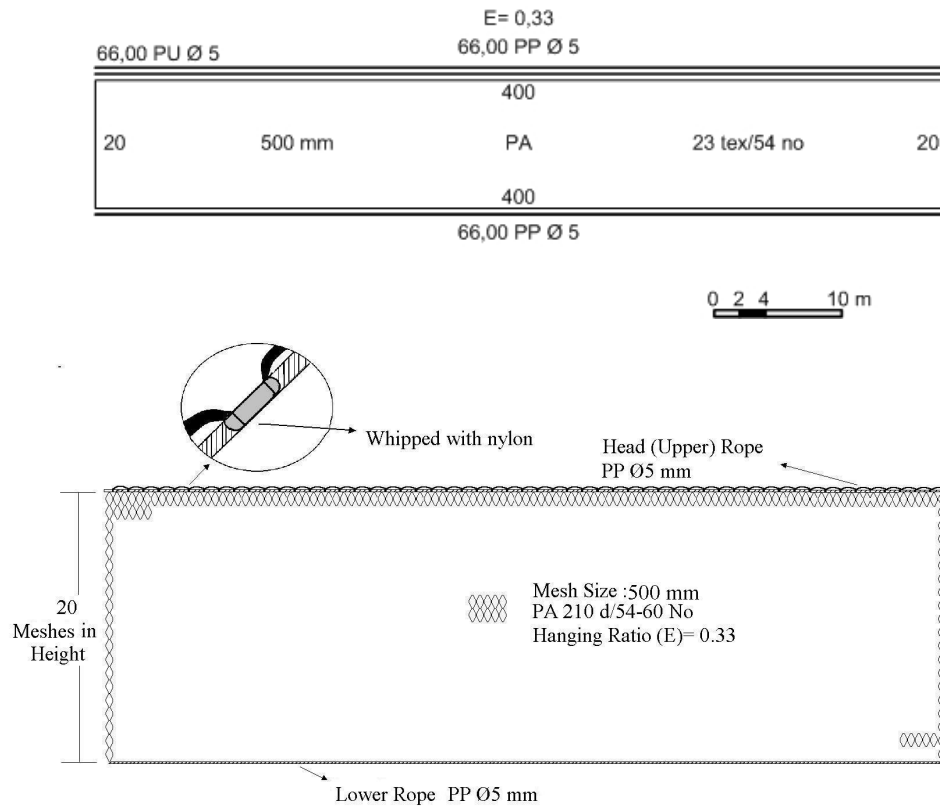


Fig. 8. Technical characteristics of swordfish drift-net in the Aegean Sea (Akyol *et al.*, 2005)

4. Non-target species from drift netting and longlining

The non-target species list without by-catch ratio was compiled from the various publications (Akyol *et al.*, 2005; Erdem & Akyol, 2005; Akyol & Ceyhan, 2007; Karakulak *et al.*, 2007). Akyol *et al.* (2005) determined that a total of 2141 kg landings captured by 23 boats, in 17 fishing days in 2001 were separated as 1260 kg (59%) swordfish and 881 kg (41%) bluefin tuna and small fraction of Mediterranean spearfish as non-target catches in Sivrice. However, Öztürk *et al.* (2001) reported that the only 10 individuals of dolphins, *Stenella coeruleoalba* (7), *Tursiops truncatus* (2), *Grampus griseus* (1) as by-catch from swordfish drift-net fishery in the Aegean Sea were examined in May and June, 1999 and 2000.

For drift-net:

- bluefin tuna (*Thunnus thynnus*)
- Atlantic black skipjack (*Euthynnus alletteratus*)
- albacore (*Thunnus alalunga*)
- mediterranean spearfish (*Tetrapturus belone*)

- bullet tuna (*Auxis rochei*)
- dolphinfish (*Coryphaena hippurus*)
- manta ray (*Mobula mobular*)
- sunfish (*Mola mola*)
- sharks and dolphins

For longline:

- bluefin tuna (*Thunnus thynnus*)
- mediterranean spearfish (*Tetrapturus belone*)
- bullet tuna (*Auxis rochei*)
- sharks

5. Discussion

Although the swordfish fishery is a relatively old activity in Turkey, there are a few studies on swordfish fishery and bio-ecology. However, this review provides a comprehensive information on both longline and drift-net fisheries of swordfish.

Two main fishing ports, Sivrice and Fethiye are concentrated by 45 boats (6-14 m in length and 11.5-135 hp in engine power) to swordfish fishery in the Aegean Sea. And about 20 boats from the other areas (*i.e.* Yeni Foça, Sığacık, Datça, Palamutbükü, Selimiye) are also participated to the longline fishery. This fishery is also carried out eastwards to Antalya Bay.

The fishing period for swordfish normally takes place 8 months. However, the main activity is concentrated in Spring and Summer seasons at moonless nights, because of closed season (between Oct, 1 and Jan. 31) and bad meteorological conditions. When not fishing for swordfish most of fishermen are engaged in other coastal fisheries, tourism and farming.

In 2005, the amount of swordfish was only 425 t (FAO, 2000). This is about 3% of total landings from GFCM area. This low yearly amount may be caused by the size-season limitations and the lacking declaration of fishermen. The real amount of the catch is probably more.

From data on Fethiye port, it is easy to see that the drift-net caught with the highest percentage (90%) of large individuals (longer than 130 cm), whereas, longline has the highest percentage (45%) of small ones (smaller than 130 cm).

Finally, drift-netting in Turkey was banned in 2006 (Anon., 2006). However, most of swordfish fishermen claim that drift-netting is more size selective than long-lining. According to them, young swordfish can pass through the mesh easily. Indeed, few undersized fish by drift-nets were given by Akyol *et al.* (2005). Fishermen are shown the reaction againsts to the

drift-net prohibition. They said that this type fishery, dates back to early of the 1900's was traditional and it was uncomparable with the large scale Mediterranean drift-nets. Really, according to Northridge's (1991) review, at least 44 non -target fish species and turtles and marine mammals had been recorded in Mediterranean drift -net fisheries. It is clear that the about 10 recorded non-target species in the Aegean Sea is lesser than the Mediterranean ones. Therefore, there should be give a limited permission for traditional small scale drift-net fishery in the Aegean Sea, until the American-style longlines, more effective and selective than the traditional longlines (Tserpes & Peristeraki, 2004) have common use. Meanwhile, further investigations of drift-net and longline's impacts on non-target species and observation programs for sustainable swordfish fishery should be planning by fishery management authority.

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