

STATUS OF HIGHLY MIGRATORY FISHERIES IN THE MEDITERRANEAN SEA, TURKEY

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1. Introduction

The Mediterranean, which owes its name to the Latin “Medius terrae”, meaning “in the middle of land”, is a sea according to oceanography definitions. The Mediterranean Sea, known as a semi-enclosed sea characterized by high salinities, temperatures and densities, is a landlocked sea with limited exchange with the world ocean. (Tanhua *et al.* 2013).

The Mediterranean Sea is an important area due to the highly migratory nature, widespread distributions, and global economic importance. Highly migratory species (HMS) is a term which has its origins in Article 64 of the United Nations Convention on the Law of the Sea (UNCLOS). This is a legal definition rather than a scientific definition based on the actual migratory behaviour of the species. It refers to fish species or stocks that carry out extensive migrations and can occur in both Exclusive Economic Zones (EEZ) and high seas and also have wide geographic distributions. About 200 species have been identified as being fished on the high seas either as highly migratory species, straddling fish stocks. Although there is insufficient scientific information to determine the actual number of stocks involved in these fisheries, 226 species (or species group) statistical area combinations have been reported on as stocks hitherto. The number of species and stocks are similar since many species occur in multiple stocks, but many stocks are made up of groups of more than one species. They include tuna and tuna-like species, oceanic sharks, marine turtles, pomfrets, sauries, and dolfinfish (Maguire *et al.* 2006).

Highly migratory fish species, according to the 1982 convention listed under Annex I, are following legally defined as; Albacore tuna (*Thunnus alalunga*), Bluefin tuna (*Thunnus thynnus*), Bigeye tuna (*Thunnus obesus*), Skipjack tuna (*Katsuwonus pelamis*), Yellowfin tuna (*Thunnus albacares*), Blackfin tuna (*Thunnus atlanticus*), Little tuna (*Euthynnus alletteratus*; *Euthynnus affinis*), Southern bluefin tuna (*Thunnus maccoyii*), Frigate mackerel (*Auxis thazard*; *Auxis rochei*), Pomfrets (Family Bramidae), Marlins (*Tetrapturus angustirostris*; *Tetrapturus belone*; *Tetrapturus pfluegeri*; *Tetrapturus albidus*; *Tetrapturus audax*; *Tetrapturus georgei*; *Makaira mazara*; *Makaira indica*; *Makaira nigricans*), Sail-fishes (*Istiophorus platypterus*; *Istiophorus albicans*), Swordfish (*Xiphias*

gladius), Sauries (*Scomberesox saurus*; *Cololabis saira*; *Cololabis adocetus*; *Scomberesox saurus scombroides*), Dolphin (*Coryphaena hippurus*; *Coryphaena equiselis*), Oceanic sharks (*Hexanchus griseus*; *Cetorhinus maximus*; Family Alopiidae; *Rhincodon typus*; Family Carcharhinidae; Family Sphyrnidae; Family Isuridae). There are 16 Osteichthyes fish species occurring in the Mediterranean Sea. The species which are commercially caught in Turkey are summarized in Table 1 according to their fishing methods and landings including the other countries for comparison. Other highly migratory species which are not included in Table 1 and have no high commercial interest but fished in the Turkish coast of Mediterranean Sea are *Tetrapturus belone*, Rafinesque, 1810 and *Coryphaena hippurus*, Linnaeus, 1758 (Bilecenoglu *et al.* 2002). Both of these species are caught by sportive fishing or by-catch.

Fisheries for highly migratory species are important in the Mediterranean Sea since they have high market value. The species found in Turkey contributes 7.34% in the Mediterranean Sea. In the last decades their catch was approximately four million tonnes, which represents about 1.04 % of the total catch of all tuna and tuna-like species, in Turkey (FAO 2014).

This paper provides the required background information on fisheries in Turkey for HMS which includes bony fish species in the Mediterranean Sea, using the best available information. The list of presented species is also evaluated in this paper, including their short description e.g., reproduction, habitat and distribution associated with fisheries for HMS.

Table 1. HMS fish species commercially caught in Turkey including the other Mediterranean countries according to last five years.

Scientific name	Fisheries	Country	Landing (Years-tonnes)					State of Exploitation
			2010	2011	2012	2013	2014	
<i>Thunnus alalunga</i>	All	All Mediterranean	2852*	5310*	2728*	2184*	3106*	Not known ¹
	Purse seine	HRV, ITA, TR	-	34**	68**	15**	14**	
	Longline	HRV, CYP, ESP, FRA, GRC, ITA, MLT, SYR	1720**	2341**	1965**	1399**	2326**	
	Drifnet	TR	402**	1396**	-	71**	-	
	Handline	HRV	2**	4**	5**	11**	15**	
	Trap	ESP	-	-	-	-	5**	
	Trawl	HRV	-	-	-	-	3**	
	Troll	ESP	1**	-	6**	-	3**	
	Unclassified	FRA, ITA, ESP	-	845**	3**	6**	11**	
<i>Thunnus thynnus</i>	All	All Mediterranean	6862*	6229*	7116*	9079*	8926*	Overfishing ¹
	Purse seine	ALB, DZA, HRV, CYP, ESP, FRA, CRC, ITA, MLT, PRK., LBY, MAR, SYR, TUN, TR, ISL, EGY, ICCAT(RMA)	5058**	4307**	6185**	7981**	8197**	
	Longline	DZA, PRC T, HRV, CYP, ESP, FRA, GRC, ITA, MLT, PRT, JPN, PRK., LBY, MAR, SYR, TR, ICCAT(RMA)	877**	867**	588**	604**	584**	

	Handline	DZA, HRV, CYP, ESP, GRC, ITA, MAR, TUN	158**	136**	164**	172**	220**	
	Trap	DZA, ITA, LYG, MAR, ICCAT (RMA)	281**	165**	125**	222**	231**	
	Baitboat	FRA, ICCAT (RMA)	-	-	2**	2**	-	
	Sport	HRV, ESP, FRA, ITA, MLT, PRT	195**	90**	13**	17**	19**	
	Trawl	FRA	1**	1**	1**	2**	1**	
	Troll	FRA, MLT, ICCAT(RMA)	-	-	-	18**	28**	
	Unclassified	ESP, FRA, GRC, ITA	273**	223**	25**	51**	51**	
<i>Euthynnus alletteratus</i>	All	All Mediterranean	5342 [†]	5173 [†]	5592 [†]	5375 [†]	4657 [†]	Not known ²
	Purse seine	DZA, HRV, FRA, GRC, ITA, MAR, TUN, TUR, EGU	1467**	2876**	3197**	3699**	2775**	
	Longline	DZA, HRV, ESP, ITA	129**	173**	204**	407**	349**	
	Trap	ESP	125**	177**	64**	78**	82**	
	Drifnet	HRV, MLT	7**	2**	5**	9**	3**	
	Handline	HRV, FRA	2**	1**	4**	4**	6**	
	Haul seine	HRV	-	-	1**	1**	1**	
	Trammel net	MLT	-	-	6**	2**	-	
	Trawl	HRV, ITA	-	1**	-	6**	7**	
	Troll	MLT	-	-	13**	2**	3**	
	Unclassified	DZA, ESP, ITA, MLT, SYR	437**	437**	693**	426**	214**	
Scientific name	Fisheries	Country	Landing (Years-tonnes)					State of Exploitation
			2010	2011	2012	2013	2014	
<i>Auxis rochei</i> , <i>Auxis thazard</i>	All	All Mediterranean	9604*	8985*	5731*	6499*	4011*	Not known ²
	Purse seine	DZA, HRV, GRC, IRA, MAR, TUR, TUN, PRT	1811**	4791**	3140**	2496**	2477**	
	Longline	DZA, ITA, MAR	220**	282**	234**	302**	115**	
	Driftnet	DZA, HRV, ITA, MLT, MAR	355**	523**	438**	63**	2**	
	Handline	DZA, ITA, MAR	16**	4**	11**	17**	97**	
	Haul seine	HRV	-	-	1**	1**	-	
	Trammel net	MLT	-	-	2**	3**	-	
	Trap	ESP	39**	128**	156**	236**	135**	
	Trawl	DZA, ITA, FRA	-	5**	150**	3**	4**	
	Troll	MLT	10**	23**	1**	16**	14**	
Unclassified	DZA, ESP, ITA, MLT, SYR	4753**	3221**	1601**	3355**	600**		
<i>Xiphias gladius</i>	All	All Mediterranean	13322*	11493*	9916*	10120*	9807*	Overexploited ¹
	Longline	DZA, HRV, CYP, EGY, GRC, FRA, ITA, JAP, LYB, PRK, MLT, MAR, PRT, ESP, SYR, TUN	11585**	21824**	9066**	9197**	20939**	
	Drifnet	DZA, FRA, ITA, MAR, TUR	745**	578**	66**	869**	773**	
	Handline	DZA, HRV, FRA	1**	1**	2**	4**	3**	
	Harpoon	ITA	921**	-	-	-	-	
	Purse seine	DZA, HRV, ITA, SYR, TUR	3**	2**	34**	14**	6**	
	Trammel net	FRA	1**	-	-	1**	3**	
	Trap	ESP, FRA, ITA	2**	3**	2**	1**	1**	
Trawl	DZA, FRA, ITA	3**	25**	15**	24**	10**		

<i>Scomberesox saurus</i>	Unclassified	GRC, FRA, ITA	6	745	724	5	55	Not known ¹
	All	All Mediterranean	264*	151*	2072*	116*	175*	
	Unclassified	ESP	264*	151*	2072*	116*	175*	
	Unclassified	TUR	565***	319.2***	283.3***	191.1***	218.8***	

*According to FAO; **According to ICCAT; ***According to TUIK; ¹ICCAT, 2006; ²Maguire *et al.* 2006.

(Croatia: HRV, Italy: ITA, Turkey: TR, Malta: MLT, Syria: SYR, France: FRA, Spain: ESP, Lybia: LBY, Chinese Taipei: PRC T, Kore Republic: PRK, Albania: ALB, Algeria: DZA, Morocco: MAR, Tunisia: TUN, Iceland: ISL, Greece: GRC, Japan: JPN, Egypt: EGY; Portugal: PRT)

2. Highly Migratory Fish Species and Their Fisheries in Turkey

2.1. *Thunnus alalunga* (Bonnaterre, 1788)

Common name : Albacore [En]

Family : Scombridae

Albacore is found from the Azores and Canaries north to Ireland and occurs in the western Mediterranean and in the northern part of the eastern Mediterranean, including the Adriatic but not the Black Sea. The size of fork length is up to 127 cm but commonly 100 cm, and 40 kg in weight. This species is commonly found in mixed schools with *Katsuwonus pelamis*, *Thunnus albacares* and *Thunnus maccoyii*. *T. alalunga* has been reported that it is often extending into cooler waters than most tunas and spawned in the summer in the Mediterranean (Collette and Nauen 1983; Whitehead *et al.* 1986; Froese and Pauly 2016). Maximum lifespan of albacore in the Atlantic is 13 years; while it is only 9 years in the Mediterranean (Megalofonou, 2000). According to Saber *et al.* (2015) the spawning season in the western Mediterranean Sea is from June to August and minimum length at sexual maturity of females was 56 cm FL. The Albacore reproductive season extends from May to July in the eastern Mediterranean Sea (Akaylı *et al.* 2013).

Fisheries: It is an important species in many commercial fisheries around the world. The Mediterranean albacore fisheries are characterized by high spatio-temporal variability in landings and fishing patterns. Albacore fishing is a traditional activity for a number of fleets including those of Cyprus, Greece, Italy, Spain, and Malta (Collette *et al.* 2011). There are four basic types of fishing operations such as longlining, live-bait fishing, trolling, and purse seining for Albacore fisheries. The driftnet fishery for albacore has been banned since January 2002 in the EU countries and from 2004 in all the ICCAT Mediterranean countries, but it is known that illegal fishing activity still occurs in some areas (STEF 2007; Collette *et al.* 2011). However driftnet has been prohibited in Turkey since 2006 by the Turkish Ministry of Food, Agriculture and Livestock (Anon, 2006). Besides Turkish fisheries authorities have given a limited permission for traditional pelagic driftnet fishery until the July 2011. The general characteristics of driftnets used for albacore fisheries in Turkey are 170 mm stretched mesh size with rigged from 2000 to 7200 m in length and 300 to 600 mesh deepness (Akyol and Ceyhan 2012). Recently, purse seine, long

line and line fishing are used for the fisheries of this species in Turkey. According to FAO worldwide landing data, there is an increasing trend are observed from 103678 t in 1950 to 202346 t in 2005 and reported total landings for this species as 238279 t in 2014 (FAO 2014). The largest landing area for this species in Turkey is the Aegean Sea with the amount of 57.8 tonnes and it follows the Mediterranean Sea with the amount of 12.8 tonnes in 2013 (TUIK 2013) and 53.3 tonnes in 2015 in the Mediterranean Sea (TUIK 2015). The total landings of Mediterranean Sea and Turkey are illustrated in Figure 1. Figure 2 also shows the total landings of Turkey for Black Sea, Sea of Marmara, Aegean and Mediterranean Seas.

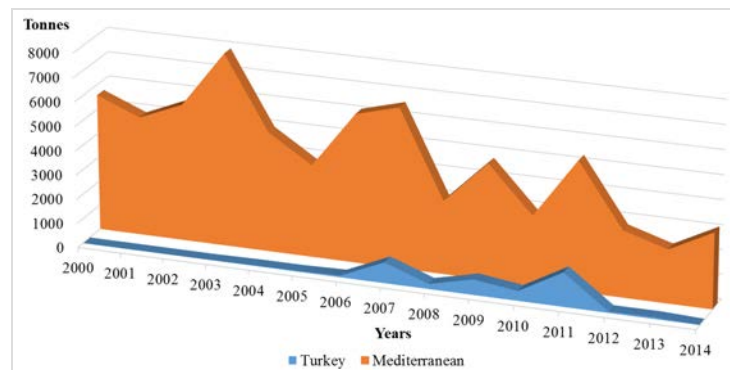


Figure 1. Total catch amount of *T. alalunga* in 2000-2014 (FAO 2014).

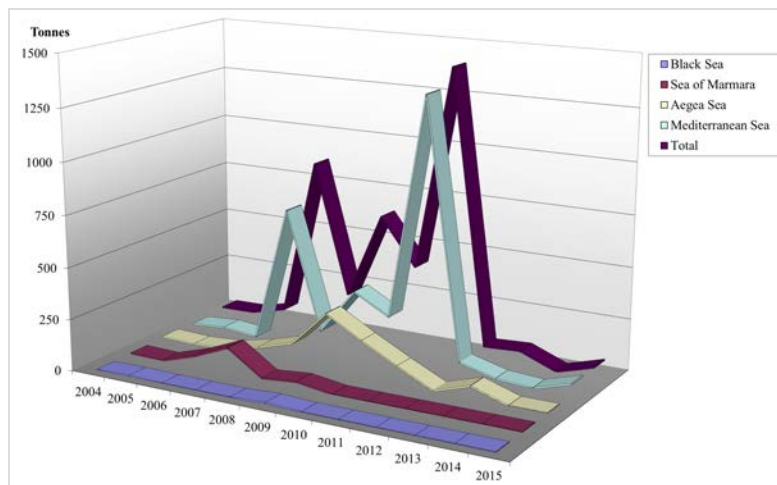


Figure 2. Total landings of *T. alalunga* in Turkey according to TUIK (2015).

2. 2. *Thunnus thynnus* (Linnaeus, 1758)

Common name : Atlantic bluefin tuna [En]
Family : Scombridae

Atlantic Bluefin tuna are the largest members of the family Scombridae and longevity is at least 35 years and possibly to 50 years (Santamaria *et al.* 2009). According to Santamaria *et al.* (2009) indicate a theoretical maximum length of 382 for males and 349 cm FL for females and, commonly 200 cm, 684.0 kg in weight. Atlantic Bluefin tuna exists in throughout the North Atlantic Ocean and adjacent seas, including the Mediterranean Sea and the southern part of the Black Sea. The sexual maturity reaches almost at 103.6 cm (FL), and females weighing between 270 and 300 kg produce as many as 10 million eggs per spawning season in the Mediterranean Sea (Corriero *et al.* 2005). The spawning season in in the Mediterranean are observed between May and July (Rodríguez-Roda, 1967; Susca *et al.* 2001; Medina *et al.* 2002; Corriero *et al.* 2003) where the fisheries are performed in the Mediterranean. Based on spawning sites ICCAT regulates the Bluefin tuna fishery currently recognizes two stocks: those of the west and the east Atlantic (the latter including the Mediterranean Sea), separated by the 45^oW meridian (Nemerson *et al.* 2000).

Fisheries: This species usually are taken by longline, trap and baitboat in the east Atlantic while purse-seine, longline and traps in the Mediterranean also recreational fishing may also be used. In Turkish waters, fisheries of this species have been particularly made by purse-seine. Very little longline catch was also used but mostly it was captured using by swordfish longlines as by catch (Ceyhan and Akyol 2014). However, it was fished using these nets as by catch until driftnets have been prohibited (Akyol *et al.* 2008). Because of its commercial importance, bluefin tuna is intensely fished and actually overexploited. Since 1970 the biomass of bluefin tuna broodstocks declined by 77% and 14% in the western and eastern populations, respectively (ICCAT 2005). *Thunnus thynnus* is known the most expensive among the tuna species. There are some regulations which have been made by ICCAT for tuna fisheries based on the regions since 1982. According to these regulations every country should be responsible for the conservation of tunas and tuna-like species in the Atlantic Ocean and adjacent seas. Furthermore, there is still a considerable overfishing observed. The total catch reported for this species to FAO for 2014 was 14336 t. The countries with the largest catches were Spain (2446 t) and France (2419 t). The Mediterranean Sea is the majority of the catch area for the *Thunnus thynnus* as 62 percent of the global catch landed. The total landings of Mediterranean Sea and Turkey are illustrated in Figure 3. Figure 4 also shows the total landings of Turkey for Black Sea, Sea of Marmara, Aegean and Mediterranean Seas.

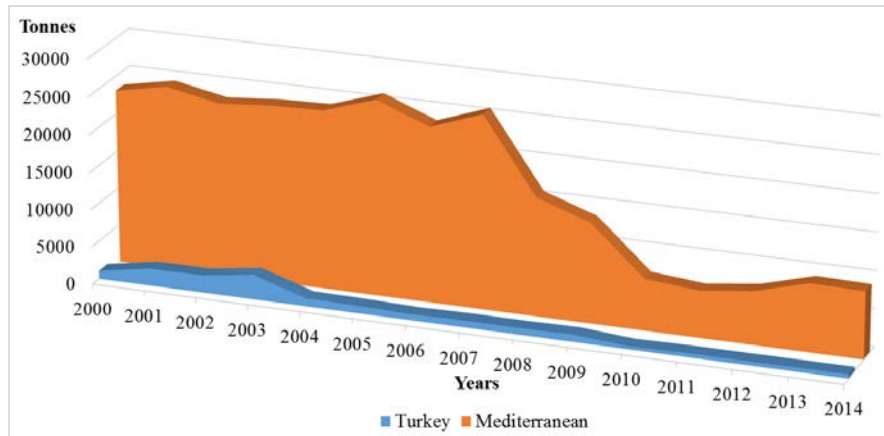


Figure 3. Total catch amount of *T. thynnus* in 2000-2014 (FAO, 2014).

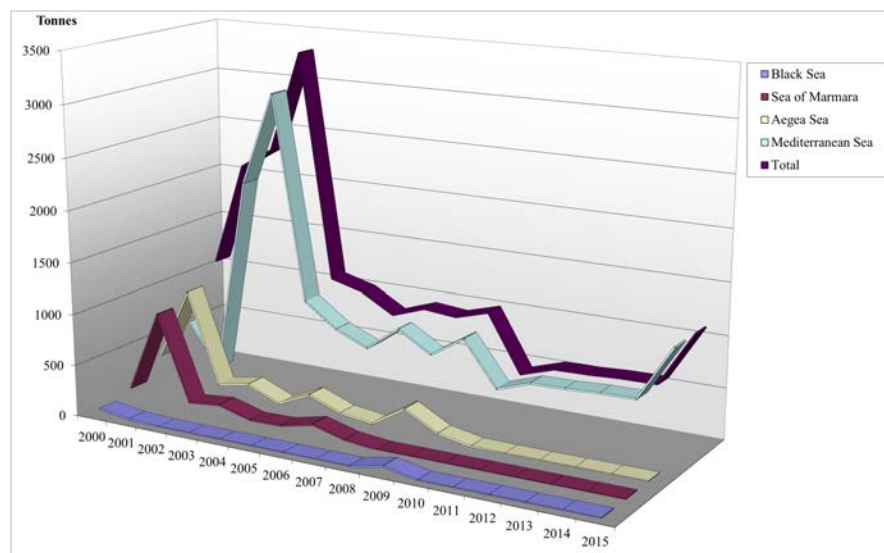


Figure 4. Total landings of *T. thynnus* in Turkey according to TUIK (2015).

2.3. *Euthynnus alletteratus* (Rafinesque, 1810)

Common name : Little tunny [En]
 Family : Scombridae

E. alletteratus is schooling and less migratory than *Katsuwonus pelamis* or other tunas. This warm-water epipelagic Atlantic species is usually found in coastal areas with swift currents, near shoals and offshore islands and it is also found far offshore in the

Mediterranean including throughout the southern part of area except in the Black sea; rarely occurs north of the Iberian Peninsula; with a few isolated catches from Scottish and Scandinavian coasts. The size of fork length is up to 100 cm but commonly 85 cm, and 12 kg in weight (Whitehead *et al.* 1986; Froese and Pauly 2016). Little tunny spawns extensively, both geographically and temporally, throughout its respective range (Schaefer 2001). It has been reported that the spawning period extended from April to November (Whitehead *et al.* 1986). The spawning season of the little tunny in the Mediterranean is generally between May and September (Valerias and Abad 2006; Kahraman *et al.* 2008) but the most intensive spawning occurs between July and August (Hajjej *et al.* 2010). In the central Mediterranean Sea, the spawning period runs from June to September and minimum length at first sexual maturity are for male and female 42.8 and 44.8 cm and FL, respectively (Hajjej *et al.* 2010).

Fisheries: This commercial species is a part of multispecies fishery. In open waters it is taken with purse seines and trolling lines; juveniles are also taken with beach seines (Collette *et al.* 2011). Specialized traps (Madragues) are used in Tunisia and Morocco (Nobrega *et al.* 2009). Since several countries from the Mediterranean and Black Sea did not report catches to the ICCAT, it is commonly believed that catches of small tunas are strongly affected by unreported or underreported data in all areas (ICCAT 2009). The fisheries of small tunas are made mainly by coastal fisheries and often by artisanal fisheries also made, either as target species or as bycatch, by purse seiners, mid-water trawlers, handlines, troll lines, driftnets, surface drifting long-lines and small scale gillnets including several recreational fisheries. Almost all the commercial catches (99%) in the world are taken by purse-seiners (2067 t retained and 1434 t discarded) (STECF, 2009). Likewise commercial catch of the little tunny are fished by purse-seines in Turkey. According to FAO worldwide landing report the total catch amount of this species is 17053 t in 2014. Figure 5 shows the total landings of Mediterranean Sea and Turkey. Figure 6 also shows the total landings of Turkey for Black Sea, Sea of Marmara, Aegean and Mediterranean Seas.

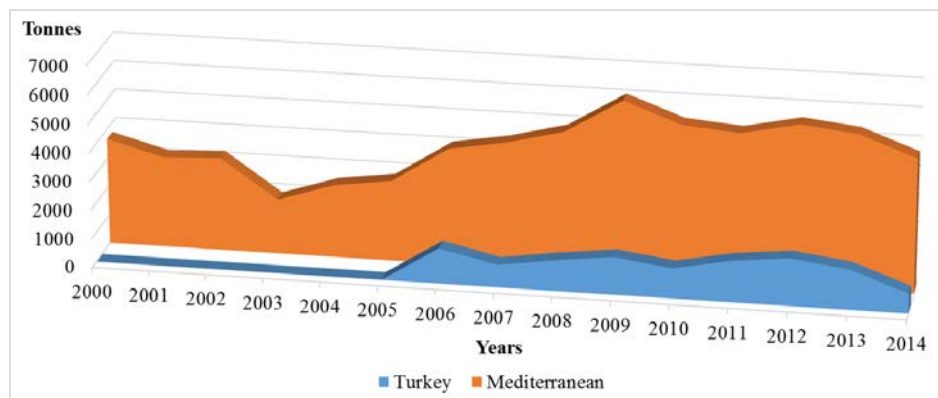


Figure 5. Total catch amount of *E. alletteratus* in 2000-2014 (FAO 2014).

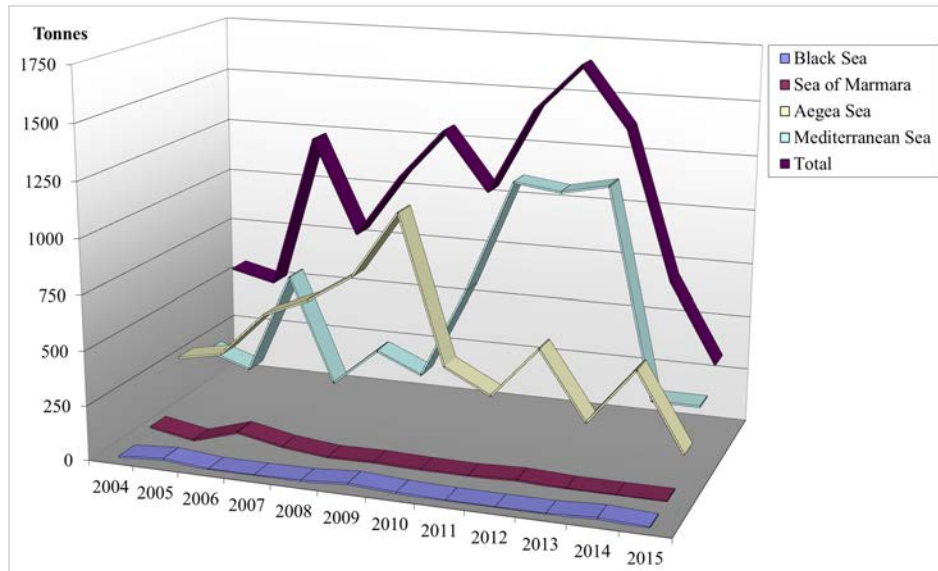


Figure 6. Total landings of *E. alletteratus* in Turkey according to TUIK (2015).

2.4. *Auxis rochei* (Risso, 1810)

Common name : Bullet tuna [En]

Family : Scombridae

A. rochei which forms large schools of similar sized individuals is an epipelagic species in inshore waters and near islands. This species is cosmopolitan in warm waters and present in the Atlantic, Indian, and Pacific oceans, including the Mediterranean Sea, widely distributed in the southern part of area and rarely north of the Iberian coast, except in the Black Sea (Collette 1986). The spawning season may vary from region to region depending on the hydrographical regime. In many parts of the Mediterranean and in the Straits of Gibraltar, maturing fish are common from May onwards, and more than 30% are spent by September. Extended spawning period is from November to August (Vassilopoulou *et al.* 2008). Bullet tuna are largely coastal spawners and spawning is thought to occur off Turkish water from May and September (Kahraman *et al.* 2010). Minimum and maximum catch length of this species reported that 28.5-44.5 cm and 34-48 cm from Aegean Sea and eastern Mediterranean Sea (Bök and Oray 2001; Kahraman *et al.* 2011).

Fisheries: It is caught mostly by purse seine, set surface gill nets, and small drift nets (the later was banned in EU countries in 2002), hand and troll lines, and traps. FAO does not report statistics for this species as *Auxis* spp. catches are generally not identified to species due to the similarity between *A. rochei* and *A. thazard*. Worldwide reported landings

for *Auxis* spp show a gradual increase from 22 981 tonnes in 1950 to 480 971 in 2014 (FAO 2014). In the Mediterranean, this is a common species in fisheries and abundance changes from place to place every year. No assessment summary is given for this species from the Mediterranean because *Auxis* sp. catches are generally not identified to species due to the similarity between *A. rochei* and *A. thazard* (Collette *et al.* 2011). The statistics of ICCAT and FAO covers *A. rochei*, *A. thazard* and both of *A. rochei* and *A. thazard*. Over the period of 1999-2008, landings fluctuated between 288 128 and 366 559 t. Figure 7 shows the total landings of Mediterranean Sea and Turkey. Figure 8 also shows the total landings of Turkey for Black Sea, Sea of Marmara, Aegean and Mediterranean Seas.

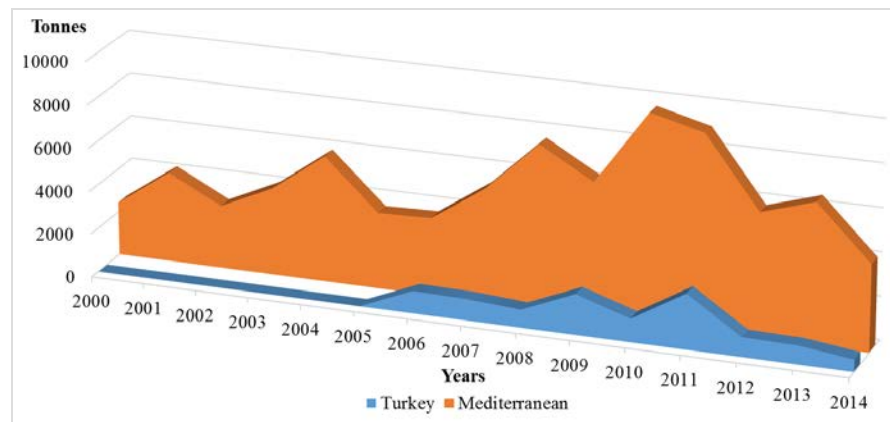


Figure 7. Total catch amount of *A. rochei* and *A. thazard* in 2000-2014 (FAO, 2014).

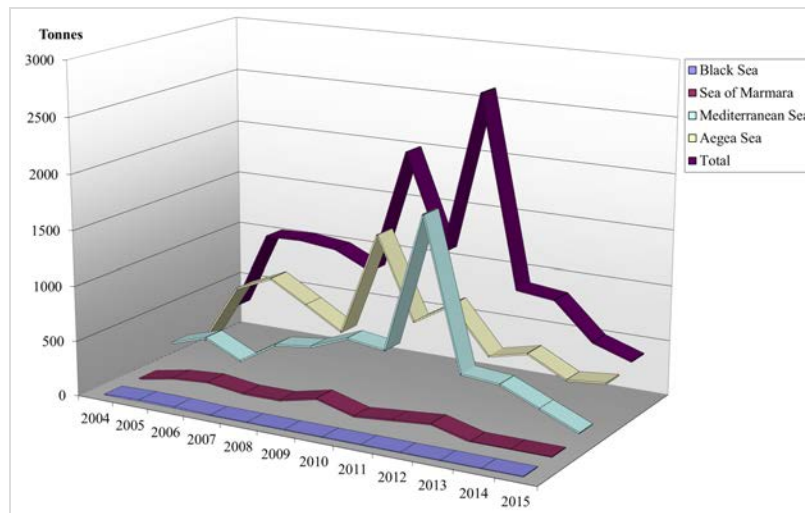


Figure 8. Total landings of *A. rochei* and *A. thazard* in Turkey according to TUIK (2015).

2.5. *Scomberesox saurus* (Walbaum, 1792)

Common name : Atlantic saury [En]
Family : Scomberesocidae

S. saurus is schooling and gregarious species which oceanic, epipelagic (usually in very upper layers) with a depth range of zero to 30 m and occasionally shoals close to shore in large numbers. This species is widely distributed in the subtropical and temperate areas of the north Atlantic including the Mediterranean Sea between 30° and 45° latitudes. *S. saurus* which is highly mobile is widespread in the Mediterranean Sea region, including in the Adriatic and Aegean Seas out to Israel, the coast of Tunisia and Morocco (Sauskan and Semenov 1968; Parin 1986; Wisner 1990; Frimodt 1995) and make large seasonal migrations. The species is more commonly present in late spring and summer in the north part of the Mediterranean Sea, and is more common in the south part in the winter (Collette, 2015). The size of total length is up to 50 cm (Robins and Ray 1986) but commonly 32 cm (Bauchot 1987), and mature at about 25 cm (Parin 1986; Froese and Pauly 2016). Atlantic Saury is a very fast-growing, short-lived species (Agüera and Brophy 2001). The reproductive period is extended all year long in the spawning areas, with characteristic spawning peaks at different locations occurring in slope waters and larvae have the potential to be broadly dispersed (Garcia 2011). Saury are likely batch spawners (Dudnik *et al.* 1981) accordingly intra-Mediterranean migration occurs for spawning (Fischer *et al.* 1987). It is also known to spawn in the central Mediterranean Sea from November to February (Potoschi 1996). Previously, it was reported that between 26 and 27 cm total length at least the fifty per cent of saury is already mature (L_{50}), for the north western Atlantic and the central Mediterranean Sea (Dudnik *et al.* 1981; Potoschi 1996; Collette 2002; Garcia 2011). Very little information is available on biology or population dynamics of Atlantic saury in Turkey (Deniz and Ateş 2015).

Fisheries: Atlantic saury has a minor commercial species in the Mediterranean Sea i.e. no substantial fishery. This species has an enormous fishing potential during several weeks in the spawning season due to its migratory behaviour. (García 2011; Collette 2015). Because the migratory character of the species with the timing of the fishing season varies geographically saury fisheries depends on season. Atlantic saury (García 2011) is mainly fished for human consumption as well as fresh and tinned and also used for bait. Saury have traditionally been targeted by a small scale fishing in southern Italy (Potoschi 1996) and have also supported a small scale industrial fishery on the Mediterranean coast of southern Spain as well as a seasonal fishery in the south Mediterranean (Abad and Giraldez 1990; Giraldez and Abad 1991). For instance, saury which is the object of a small scale fishery in the Bay of Biscay and in the Mediterranean Sea catches up to 2000 metric tonnes per year (García 2011). Small catches are also reported from Morocco, although it may be of potential commercial interest (Collette 2015). However driftnets have been banned in the Mediterranean Sea since 2002 for some species, including *S. saurus* (Collette 2015). In Turkey, saury which moves rarely with a small school of fish can be caught generally by surrounding nets, gill nets and occasionally by beach seines and baited longlines. Because

there is no mass catching of these rarely fishing species, caught along with mass catching species throughout the year, regular marketing can not be done. The total landings of Mediterranean Sea and Turkey are illustrated in Figure 9. Figure 10 also shows the total landings of Turkey for Black Sea, Sea of Marmara, Aegean and Mediterranean Seas.

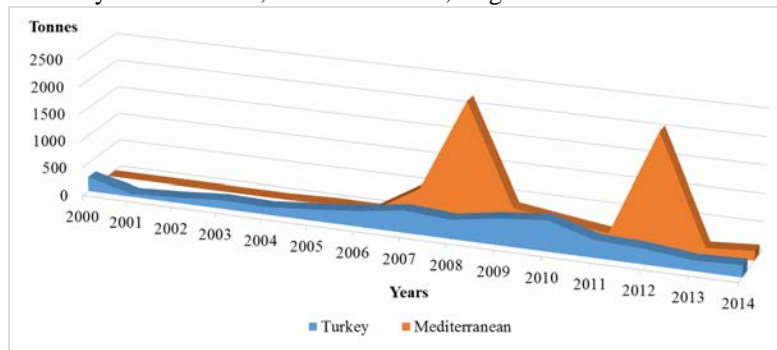


Figure 9. Total catch amount of *S. saurus* in 2000-2014 (FAO, 2014).

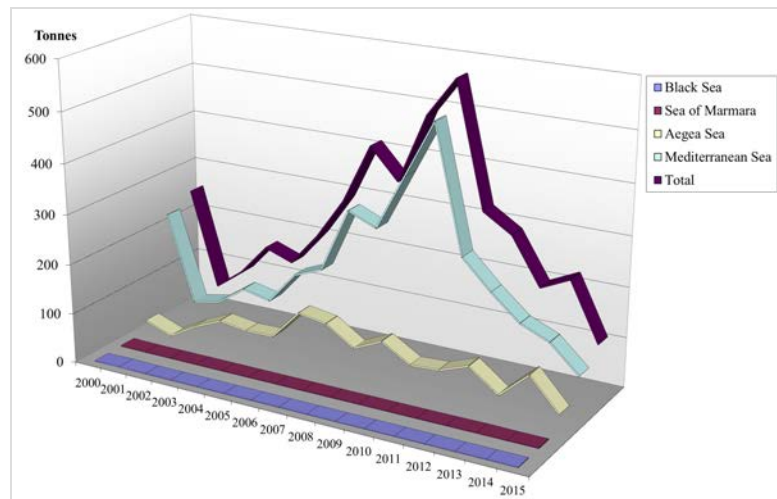


Figure 10. Total landings of *S. saurus* in Turkey according to TUIK (2015).

2.6. *Xiphias gladius* Linnaeus, 1758

Common name : Swordfish [En]
 Family : Xiphiidae

X. gladius which is aggressive and strongly migratory exists in tropical and temperate waters down to 800 m as a solitary for the most part. The swordfish is a pelagic and oceanic species occurring in the Pacific, Indian and Atlantic Ocean, including the

Mediterranean Sea, Sea of Marmara, the Black Sea, and the Sea of Azov. The size of fork length is up to 455 cm but commonly 300 cm and 540 kg in weight. The weight of adults is rarely 230 kg in the Mediterranean and generally females are larger than males (Nakamura, 1985). Most of papers reported that its spawning occurs in the summer months, begins in June and continues until September (De Metrio and Megalofonou 1987; Tserpes and Tsimenides 1995; Orsi Relini *et al.* 1999; Tserpes *et al.* 2008) and migrates in the eastern Mediterranean toward the eastern Levantine Sea for spawning, concentrating in specific areas during the peak of spawning season (Tserpes *et al.* 2008). It was previously estimated that 50% of female swordfish in the Mediterranean Sea mature at 142 cm (De la Serna *et al.* 1996). In the Mediterranean Sea, sexual maturity of this species occurs at 2-5 year of age (De Metrio *et al.* 1989). In Turkish waters sexual maturity of this species reaches at 139.5 cm (Aliçlı *et al.* 2014) while in the Mediterranean, this size varies between 125 cm and 142 cm (de la Serna *et al.* 1996; Di Natale *et al.* 2002).

Fisheries: The fisheries of *X. gladius* in the Atlantic, Indian and Pacific oceans plays an important role especially regarding food and game species. Longline, harpoon, driftnet, set net and other fishing gear in commercial fisheries are widely used for swordfish fishery but swordfish is also taken as a bycatch in tuna longline fisheries. In the Mediterranean Sea, the fisheries of this species are performed by driftnets, long lines, harpoons, tuna traps as well as sport and recreational fisheries. Currently, fisheries of this species are widely made using by longline and harpoon (especially in the Aegean Sea) in Turkish waters. The average weight of the commercial swordfish caught by longliners ranges from 115 to 160 kg in the Mediterranean Sea and known as a good food fish, marketed fresh or frozen. Comparison of landings for the years it can be clearly seen that there is an increasing trend up to date from 1950. The highest amount of swordfish in the Mediterranean Sea is caught by, in the order, Italy, Greece, Spain and Morocco in the recent years. While it can be caught as a target in Algeria, Cyprus, Malta, Portugal, Tunisia and Turkey, catches of swordfish have also been incidentally taken by Albania, Croatia, France, Japan, and Libya in the Mediterranean. Another point of view it can be observed a high and growing trend as a fresh consumption for swordfish fisheries in most Mediterranean countries. The total landings of Mediterranean Sea and Turkey are illustrated in Figure 11. Figure 12 also shows the total landings of Turkey for Black Sea, Sea of Marmara, Aegean and Mediterranean Seas.

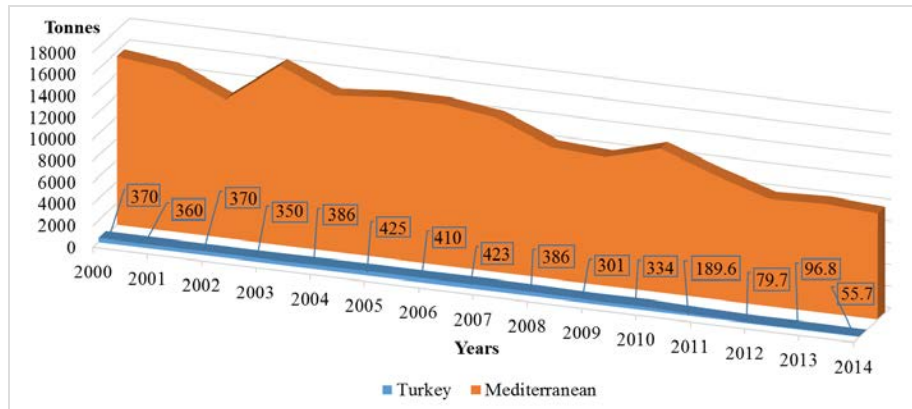


Figure 11. Total catch amount of *X. gladius* in 2000-2014 (FAO, 2014).

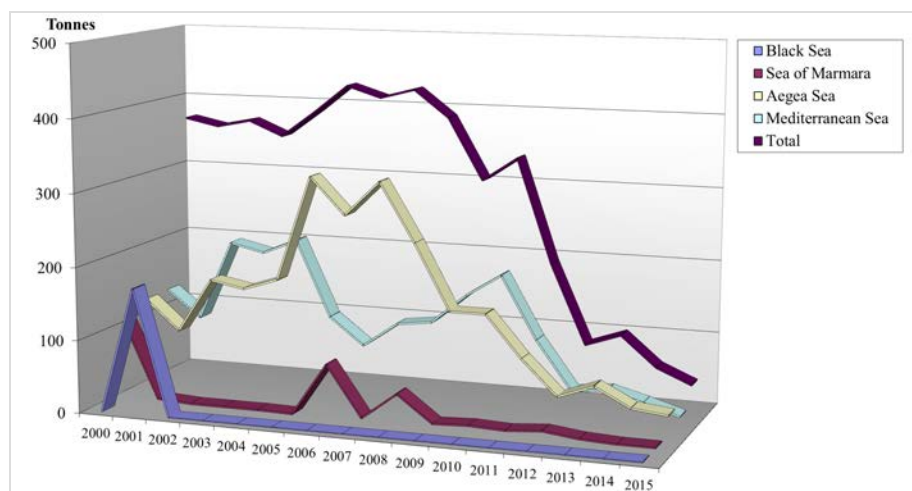


Figure 12. Total landings of *X. gladius* in Turkey according to TUIK (2015).

3. Conclusion

This paper deals with the highly migratory fish species observed in the Mediterranean Sea regarding to their short description e.g., reproduction, habitat and distribution associated with the commercial fisheries. HMS has the great value in the world and European commercial fisheries. There is limited number of studies on these species. Among 16 highly migratory bony fish species, only 4 or 5 species have been studied especially in the Mediterranean Sea related to Turkish HMS fisheries. Although these species are fished by longline, purse seine, driftnet, handline, haul seine, trammel net, trawl and troll in the Mediterranean, purse seine and longline are used in Turkey. All species cited here play an important role because of their volume of landings and high economic value for

Mediterranean Basin. However the total catch amount of these species is recorded approximately 1% (according to TUIK data) in the total fish landing of Turkey.

Highly migratory species which are commercially caught are *Thunnus alalunga*, *Thunnus thynnus*, *Euthynnus alletteratus*, *Auxis rochei/Auxis thazard*, *Xiphias gladius* and *Scomberesox saurus* in Turkey. Among them *T. thynnus* and *X. gladius* that are exported as fishery products have an importance economic contribution approximately with 39102935 \$ (TUIK 2013). *T. alalunga*, *T. thynnus*, *E. alletteratus*, and *A. rochei/A. thazard* are commercially taken by purse-seine and they are also caught by longlines which are used for swordfish and leerfish fisheries as by catch. The swordfish fisheries are especially made by longline but the harpoon is still used in catching. There is no study reported on fishing gears and the fisheries of *S. saurus* which is caught mostly by-catch as well as recreational fishing. Besides all these, driftnets have been extensively using for the fisheries of *X. gladius*, *T. alalunga* and *E. alletteratus* for a long time until it was banned totally in 2011. In addition, HMS are generally caught by mutually as by-catch and evaluated economically i.e. Atlantic bluefin tuna caught in swordfish longline.

Fishing is a vibrant system that moves based on many different dynamics such as social, economic, environmental conditions etc. Therefore, fishery landings data are affected by various factors that lead to fluctuations of catch amounts. These fluctuations can be clearly seen from TUIK data according to the years. For instance, the drift nets, which were banned in 2006 but continued to be modified until 2011 and completely banned from this date, was a highly effective and widely used fishing gear for the fisheries of *X. gladius*, *T. alalunga* and *A. rochei/A. thazard*. It is thought that the removing of driftnetes from the marine environment resulted in a decrease in the landings of *X. gladius*, *T. alalunga* and *A. rochei/A. thazard* from 97.4 tons to 31 tons, from 1308 tons to 59.3 tons and from 1741.6 tons to 382.9 tons, respectively. However, Atlantic bluefin tuna fishery is performed in Turkey depending on the country quotas determined by ICCAT (International Commission for the Conservation of the Atlantic Tunas), where Turkey is also a member. Therefore, ICCAT determines and implements prohibitions such as minimum landing size, time and catch amount related to fisheries for this species in the Mediterranean. Swordfish fishery is also regulated by ICCAT. Among other tuna and tuna-like species, the prohibitions to be implemented with the ICCAT's recommendation are left to the countries.

Fisheries targeting highly migratory fish must be managed at community level notably in the framework of the relevant regional fisheries organisations, namely the International Commission for the Conservation of the Atlantic Tunas (ICCAT) and the General Fisheries Commission for the Mediterranean (GFCM). The community will actively promote multilateral management of these stocks, including as necessary catch limitations, technical measures and effort limitations (COM 2002). It is well known the methodology of fish stock assessment and prediction changes according to increasing availability of data. Assessing a fish stock has different steps which can be summarized to define the objectives of the assessment according to the development phase of the fisheries and the available information. Especially, fisheries commercial statistics are based on total

and resource landings, catch per unit effort, fishing effort (number of trips, days, tows, spending time of fishing, etc.) and characteristics of the gears used. Types of operation of the fleets, fishing gears etc., and biological samplings are also necessary to assess on board commercial and research vessels in the landing area (Sparre and Venema 1998; Cadima 2003). The GFCM Scientific Advisory Committee on Fisheries (SAC) considers that several stocks are overexploited, some with a high risk of collapse, and that sustainable management requires that measures aimed at limiting the capture of juveniles are implemented (GFCM, 2016). Concerning on management of HMS species in Turkey is needed to be more updated scientific and statistical data for further sharing stock management regulated by international committees such as ICCAT, GFCM to get right owner of Turkish fisheries.

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