Mediterranean Marine Science

Vol 25, No 2 (2024)

Mediterranean Marine Science

Towards Cross-Border Fisheries Management: An Analysis of Fleet Structures and Species-Specific Regulatory Measures in the Aegean Sea

HAKKI DERELİ, VAHDET ÜNAL, AYLIN ULMAN, IOANNIS GIOVOS, ZAFER TOSUNOĞLU, GEORGE PRODROMITIS, DIMITRIOS K. MOUTOPOULOS

doi: 10.12681/mms.35526

Research Article

Mediterranean Marine Science
Indexed in WoS (Web of Science, ISI Thomson) and SCOPUS
www.hcmr.gr
DOI: https://doi.org/10.12681/mms.35526

Towards Cross-Border Fisheries Management: An Analysis of Fleet Structures and Species-Specific Regulatory Measures in the Aegean Sea

Hakkı DERELİ[1], Vahdet ÜNAL[2], Aylin ULMAN[3], Ioannis GIOVOS[4,5,6], Zafer TOSUNOĞLU[2], George PRODROMITIS[4,7] and Dimitrios K. MOUTOPOULOS[4]

[1] Faculty of Fisheries, İzmir Katip Çelebi University, İzmir, Türkiye
[2] Faculty of Fisheries, Ege University, Bornova, İzmir, Türkiye
[3] Mersea Marine Consulting, Fethiye, Türkiye
[4] University of Patras, Department of Fisheries & Aquaculture, 30200, Mesolongi, Greece
[5] iSea, Environmental Organization for the Preservation of the Aquatic Ecosystems, Thessaloniki, Greece
[6] University of Padova, Department of Biology, Padova, Italy
[7] Ministry of Shipping and the Aegean, Hellenic Coast Guard, Peireaus 18510, Greece

Corresponding author: Hakkı Dereli; hakkidereli@gmail.com

Contributing Editor: Konstantinos TSAGARAKIS

Received: 28 September 2023; Accepted: 27 June 2024; Published online: 12 July 2024

Abstract

Intrinsic differences in the applied management measures of shared stocks in transboundary waters inhibit the ability of either state to benefit from such measures, as one state may benefit in lieu of the other, thus reducing the efficacy of both. This study compares for the first time the fleet structure, specific management measures applied to species-specific regulations for commercial fishing, species listed in official monitoring schemes, and protected taxa between Greece and Türkiye for the Aegean Sea. A comparative analysis utilizing the official data was sourced from both countries. Large-scale Greek and Turkish fishing fleets have been modernized within the last 30 years (1991-2021). Greek and Turkish large-scale fishing fleets included smaller trawlers with lower tonnage and slightly higher engine horsepower, while purse seines of both states included larger vessels with higher horsepower and tonnage. This indicates that the fishing pressure on the demersal resources in the Aegean Sea has partially decreased, but the fishing pressure on pelagic resources has increased despite the decrease in the number of vessels. Only 11 out of 74 minimum conservation reference sizes (MCRS) are sufficiently set above the Lm_{50} sizes they should be based on, whereas 18 species need reproductive studies, and 22 are set below the $Lm_{50,}$ and could benefit from an increase. The application of specific closed seasons for commercial species was used by both states with the intent to protect the reproductive periods of some stocks. However, several of these closure periods did not fully or even partially cover the spawning periods of the respective species. Species-specific closures were applied to 13 species in Greece and 23 species in Türkiye, with only two fish species (*Xiphias gladius* and *Thunnus thynnus*) listed for both countries. Only 14 species (out of 34 protected by Greece and 46 by Türkiye) are protected by both states, most of which are listed as critically endangered by the International Union for Conservation of Nature and Natural Resources (IUCN). Harmonization of fisheries management measures currently does not align between the two neighbouring states, and the General Fisheries Commission of the Mediterranean is the competent authority that would be able to restructure such measures, especially as Türkiye has been aligning their measures with that of the EU for the accession process. This contribution highlights the clear differences between Greece and Türkiye, and provides advice for developing a unified management regime for the Aegean Sea.

Keywords: Transboundary management; MCRS; closed seasons; protected species; non-EU member states.

Introduction

Current stock assessments for the Mediterranean and Black Sea fisheries resources indicate that 58 percent of stocks are overexploited and that exploitation levels vary amongst subregions (FAO, 2023). Stock assessments from the Central and Western parts of the Mediterranean are well documented, whereas most stocks in the eastern part lack coherent fisheries data imperiling the ability to provide management advice on sustainable targets (Mannini & Simmonds, 2021). Such issues are exacerbated by illegal, unreported, and unregulated (IUU) fishing (Sumaila *et al.*, 2020). The situation becomes even more complex for transboundary shared stocks that cross the political boundaries of two bordering coastal states that apply heterogeneous data monitoring and fisheries man-

agement measures (Palacios-Abrantes *et al.*, 2020).

Transboundary fisheries that target shared common resources complicate fisheries management and potentially reduce the effectiveness of policies to achieve their stated objectives (Miller & Munro, 2002; Englander, 2019). Moreover, fish stocks shared between two states have a 9% higher chance of being overfished and are 19% more likely to be depleted than stocks fished by only one country (McWhinnie, 2009), adding fuel to the already declining state of fisheries resources. An accurate understanding of the fishing fleet, distribution and scale of transboundary fish stocks, as well as their associated fisheries, is important for establishing effective fisheries management, including detecting and stopping IUU fishing. In the Mediterranean Sea, important transboundary shared stocks that cross political boundaries exist in the Aegean Sea between Greece and Türkiye. Greek-Turkish fisheries in the Aegean Sea are characterized as multispecies fisheries using multiple gear types targeting both demersal and pelagic fish stocks, as in most other Mediterranean states (Ünal & Göncüoğlu, 2012). However, commercial catch-per-unit-efforts (CPUE) have also been consistently declining in both Greece and Türkiye, demonstrating the declining resources (Tsikliras *et al.*, 2015; Ulman & Pauly, 2016; GFCM, 2021).

Currently, the main fisheries management strategy adopted by Greece and Türkiye applied to the Aegean Sea fisheries in the Eastern Mediterranean is the control of fishing effort combined with specific technical measures. A recent study (Dereli *et al.*, 2022) has shown that there are many differences between Greek and Turkish fisheries management regulations regarding some of the technical measures, such as gear regulations and closed areas.

The present study aims to provide a first basis for discussion of future harmonization possibilities of fisheries management measures applied by Greece and Türkiye towards fleet structure and species-specific fisheries management in the Aegean Sea. These results will help to understand where the differences lie between both regulatory frameworks, which may be used as a reference for future co-management initiatives in the Aegean Sea to be used by decision-makers, stakeholders and the scientific community. More specifically, we compared the species-specific differences related to the minimum conservation reference size (MCRS) and species-specific closed seasons along with some recommendations for unifying and/or improving these measures for Greece and Türkiye in the Aegean Sea. In addition, given that there is the need to gather, analyze, and exchange information about the status of fisheries in transboundary waters, we evaluated the long-term trends of the technical characteristics of the fishing fleet between the two neighbouring states per fishery component. Furthermore, all high trophic level taxa, such as sharks and marine mammals, are currently depleted to very alarming levels across the Mediterranean (Ferretti *et al.*, 2008; Piroddi *et al.*, 2020; Dulvy *et al.*, 2021; Walls & Dulvy, 2021; Fernández-Corredor *et al.*, 2024); hence we highlight which species should be protected by both states here by comparing the prohibited catch lists of each.

Materials and Methods

Study Area and Fishing Gear Types

The study covers the Aegean Sea, shared by Greece and Türkiye and identified as GSA 22 by the GFCM. Greek marine fisheries use a high diversity of gears operating in the Aegean Sea (GSA 22), representing the focus of this study, as well as in the Ionian (GSA 20) and Cretan (GSA 23) Seas, with most of their vessels being polyvalent (Fig. 1). Fishing gear types were categorised as otter bottom trawlers (OTB), and purse seiners with encircling nets (PS) for the large-scale fleet, and the small-scale fleet including trammel and gill netters, drifters, long-liners, traps, etc., operating along the coasts.

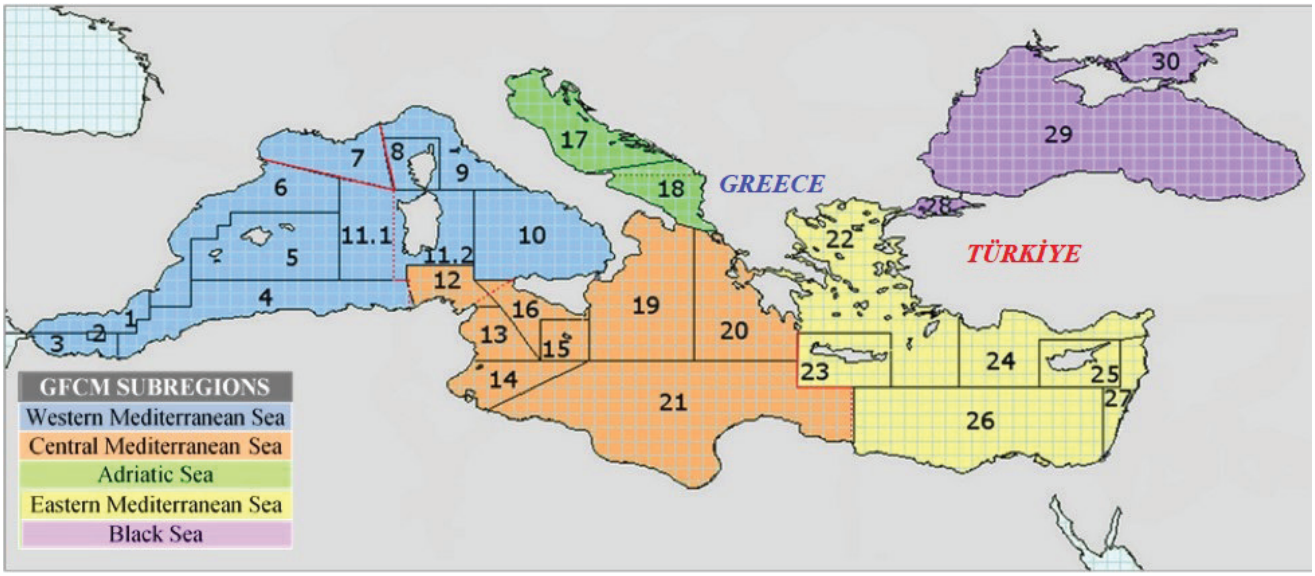
Turkish marine fisheries use a variety of fishing gears in the Black Sea (GSA 29), Marmara Sea (GSA 28), North Levant (GSA 24), and Aegean Sea (GSA 22). Large-scale fishing vessels are usually comprised of sheet metal, using otter bottom trawlers (OTB), and purse seiners with encircling nets (PS), with small-scale fishing vessels, most of which are wooden, including trammel and gill netters, long-liners, traps, beam trawls, etc., operate along all the coasts.

Data Sources

Data on national fisheries landings in GSA 22 were obtained from official statistical institutions (HELSTAT: Hellenic Statistical Authority and TURKSTAT: Turkish Statistical Institute) of both states (HELSTAT, 2022; TURKSTAT, 2022).

With respect to Greek official fisheries landings data, since 2016 HELSTAT began to incorporate landings from professional licensed fishing vessels with engine power less than 19 HP with information on spatially allocated taxa. As a result, from 2016 onwards, the catch data from HELSTAT are the total reported landings (Moutopoulos, 2020). Every month, a questionnaire with the quantities of catches, employment indicators and vessel characteristics (one statistical unit) is submitted by the professional fisher at the local Customs Authorities of HELSTAT. Thereafter, the questionnaires are sent to the Regional Statistical Services of HELSTAT, which, after initial checks, are carried forward to the Directorate of Agriculture, Livestock, Fisheries and Environment Statistics of HELSTAT for a final check and then incorporation into the digitized system of HELSTAT.

Turkish fisheries landing data has been collected by TURKSTAT through surveys with professional fishers once a year from January to May since 1967, and since 2000, catch data by species are available online (TURKSTAT, 2022). In 2011, the "National Fisheries Data Collection Program" was initiated. Since 2014, landings data have been collected in cooperation with the Ministry of Agriculture and Forestry (MAF) and TURKSTAT through monthly surveys for large-scale fishers and seasonally for small-scale fishers (vessel length <10 m) per taxon (i.e., 78 species or taxonomic groupings: Table S1)



GFCM GSAs

01 - Northern Alboran Sea	07 - Gulf of Lion	13 - Gulf of Hammamet	19 - Western Ionian Sea	25 - Cyprus
02 - Alboran Island	08 - Corsica	14 - Gulf of Gabes	20 - Eastern Ionian Sea	26 - South Levant Sea
03 - Southern Alboran Sea	09 - Ligurian Sea and Northern Tyrrhenian Sea	15 - Malta	21 - Southern Ionian Sea	27 - Eastern Levant Se
04 - Algeria	10 - South and Central Tyrrhenian Sea	16 - Southern Sicily	22 - Aegean Sea	28 - Marmara Sea
05 - Balearic Islands	11.1 - Sardinia (west) 11.2 - Sardinia (east)	17 - Northern Adriatic Sea	23 - Crete	29 - Black Sea
06 - Northern Spain	12 - Northern Tunisia	18 - Southern Adriatic Sea	24 - North Levant Sea	30 - Azov Sea

Fig. 1: GFCM geographical subareas (GSAs) and study area (Aegean Sea-GSA 22).

and subarea (5 Turkish subareas). Since 2016, the data were digitized using tablets in survey studies and are published electronically by TURKSTAT at the end of each year (GDFA, 2022; TURKSTAT, 2022).

For fishing effort (fishing vessel numbers) data in GSA 22, obtained from the Common Fleet Register (CFR) (CFR, 2022; STECF, 2024) and TURKSTAT (TURKSTAT, 2022) for Greece and Türkiye, respectively. In addition, data on vessel age, tonnage (GRT), length and engine power (HP) of large-scale fishing vessels (trawl and purse seine) available for Greece since 1991 and for Türkiye since 2011 were obtained from the CFR (CFR, 2022; STECF, 2024) and the SUBIS systems (GDFA, 2022), respectively.

Legislations relating to technical fisheries management measures applied to commercial marine taxa in Greece and Türkiye were compiled through a literature review. The measures specifically applied to various taxa in the Aegean Sea fisheries were collected by examining the EU (EU, 2019), Greek (National Legislations: Royal and Presidential Decrees (RP and PD, respectively)) and Turkish (last Fishing Notification 5/1 published in 2020) Fisheries Legislations (Papaconstantinou *et al.*, 2007; EU, 2019; Anonymous, 2020).

Minimum conservation reference sizes (MCRS) are regulated by the EU (EU Regulation 2019/1241; Annex IX-Part A), Greek (National legislations) and Turkish (Notification 5/1) Legislations (Papaconstantinou *et al.*, 2007; EU, 2019; Anonymous, 2020).

Interpreting and Presenting Data

The historical evolution of fleets registered in the Aegean Sea ports of both countries were revealed by determining the changes in the number of fishing vessels (SSF: small-scale fishing, LSF: large scale fishing- OTB and PS) and the age, tonnage, length and engine power of OTB and PS.

The methodology and historical evolution of obtaining landings data of Greece and Türkiye were analyzed. Species reported were categorised to the following families; Fish, Cephalopods, Crustaceans and Molluscs. The top ten landed commercial species were determined for each country and their percentage share of the total landings of country was calculated.

The current regulations of both states regarding their MCRS, closed seasons for the species and protected species in the Aegean Sea were compared. Species were grouped as Fish, Crustaceans, Mollusc bivalves, Cephalopods, Gastropods, Holothuroidea, and Florideae according to MCRS, and specific closed season comparisons were examined. Common names for marine taxa were taken from www.fishbase.de and www.sealifebase.de (Froese & Pauly, 2020; Palomares & Pauly, 2020). Where scientific names have been updated and differ from EU or national legislations, the currently accepted name is presented here, with a footnote of the change.

All available data on the length at 50% maturity (Lm_{50}) of each species from the Aegean Sea, if any, or from the adjacent region were extracted from peer-reviewed published sources. Thus, the differences between the Lm_{50} and MCRS were determined based on the cur-

rent MCRS listings of the species for both states, and recommendations are provided to improve the capabilities of this measure. The specific closure seasons were also compared for the spawning seasons of each species, where data were available, to determine if the closures are sufficient or need improving on.

Lists of protected species were compared from the Greek, EU and Turkish measures. The International Union for Conservation of Nature and Natural Resources (IUCN) Red List Categories of species were used by IUCN (2021) to classify threat levels. The nine threat indices of the IUCN Red List are: Not Evaluated (NE), Data Deficient (DD), Least Concern (LC), Near Threatened (NT), Vulnerable (VU), Endangered (EN), Critically Endangered (CR), Extinct in the Wild (EW), and Extinct (EX).

Results

Fleet Structure in the Aegean Sea

In 2021, 8,404 Greek vessels and 4,117 Turkish vessels were registered in the Aegean Sea ports. Of those, 95.0% of the Greek vessels and 96.1% of the Turkish vessels were of a small-scale nature (STECF, 2024; TURKSTAT, 2022), far greater than the 82% Mediterranean average for the entire small-scale fleet (FAO, 2023). Greece exhibited a remarkable reduction by almost 39% of its small-scale fleet reaching 7987 vessels in 2021 (Fig. 2a). In Türkiye, the number of registered small-scale fisheries (SSF) vessels increased from 3,762 in 2000, to peak at 5,806 in 2003, and in 2021 was 3957 (Fig. 2a).

The other Turkish commercial vessels registered in the Aegean Sea aside from SSF consist of PS (1.8%), OTB (1.3%) and carrier vessels (0.8%) (TURKSTAT, 2022), while in Greece they are comprised of bottom trawls (2.7%) and purse seine vessels (2.2%), representing 84.9% of the total Greek OTB and 83.5% of the PS fleet (STECF, 2024) (Fig. 2, 3).

The number of large-scale fishing vessels in the Greek fleet exhibited a considerable decline over the last 30 years with the numbers of OTB and PS decreasing by 46.3% and 41.0% up to 230 and 187 vessels, respectively between 1991 and 2021 (Fig. 2b, c). On the other hand, the number of OTB in the Turkish fleet, which was 20 in 1991, increased to 220 in 2000 and then decreased to 54 in 2021, exhibiting a downward trend, aside from a peak in 2006 (Fig. 2b). The number of PS in the Turkish fleet fluctuated considerably, increasing from 51 in 1991 to 114 in 2007, then decreased to 55 in 2019, before increasing again to 74 in the last two years (Fig. 2c). OTB and PS licensed vessels in the Turkish fleet (shown by the black dashed line in Fig. 2c) both peaked at 59 in 2006 and dropped to two in 2012 between 2001-2012.

The Greek OTB fleet has historically progressed to using newer but smaller vessels with lower tonnage and slightly higher engine horsepower (grey line in Fig. 3a). Similarly, the Turkish OTB fleet has progressed to using newer, and smaller vessels, with HP and tonnage values increasing at first, before decreasing in recent years (black line in Fig. 3a). Although both fleets have become newer over time, the Greek OTB fleet has always been older than the Turkish OTB fleet and is almost twice as old as of 2021 (Fig. 3a). From 2011 to 2021, the Greek OTB fleet had higher values in tonnage and length than the Turkish OTB fleet, while the Turkish fleet had higher HP (Fig. 3a).

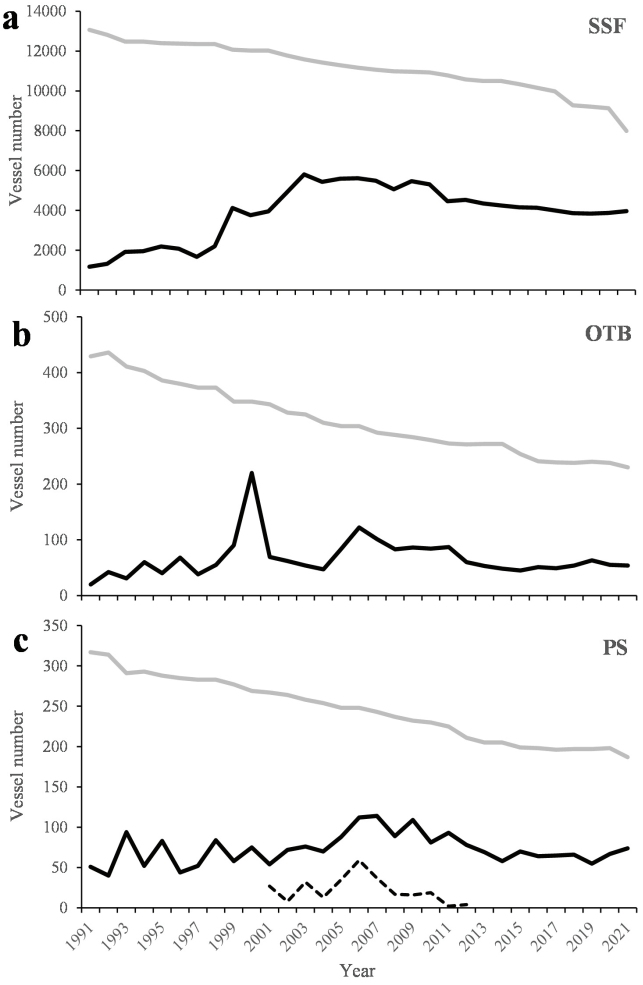


Fig. 2: Temporal variation of Greek (grey line) and Turkish (black line) commercial fishing fleets registered in Aegean Sea ports: (a) small-scale fishing vessels (SSF), (b) single boat bottom otter trawler (OTB), and (c) purse seine (PS). Vessels with both OTB and PS licenses in the Aegean Sea Turkish fleet between 2001 and 2012 are shown with a black dashed line.

The Greek PS fleet has historically progressed to using vessels with a lower age, higher average length and slightly higher horsepower and tonnage (grey line in Fig. 3b). Similarly, the Turkish PS fleet has also started to use vessels with larger and higher HP and tonnage in the last ten years (black line in Fig. 3b). The Turkish purse seine fleet had higher tonnage values from 2011-2021, but had over three times higher HP values from 2012-2021, while the Greek purse seine fleet is almost twice the age of the Turkish purse seine fleet. In terms of length, the Greek purse seine fleet has not changed much over the last decade (21 m average length), while the Turkish purse seine fleet has increased its average vessel length from 18 to 21 m from 2012 to 2021 (Fig. 3b).

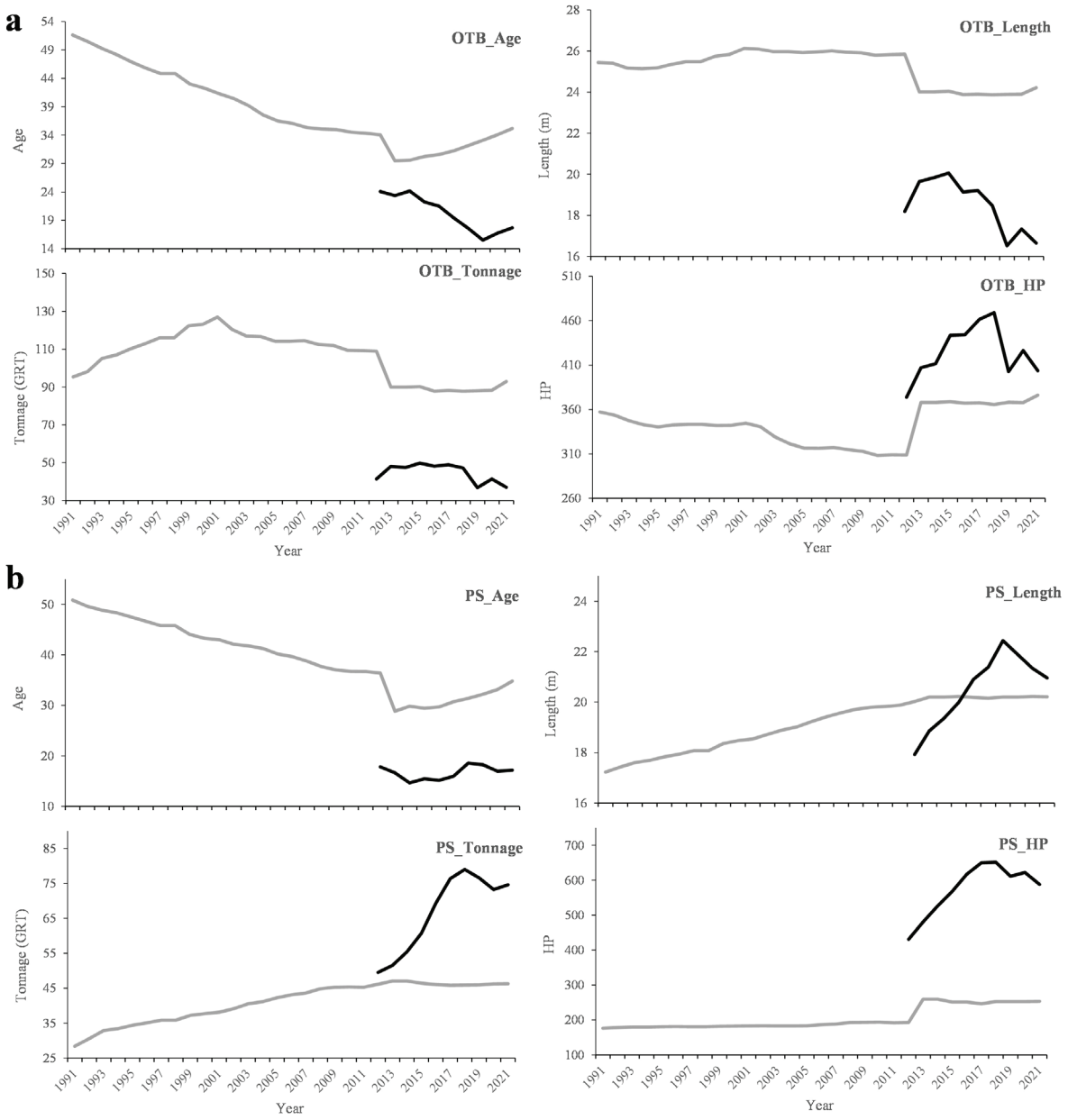


Fig. 3: Annual evolution of the mean age, vessel length, vessel tonnage and engine horsepower (HP) of the single boat bottom otter trawl (OTB) (a) and the purse seine (PS) (b) fishing fleet operating in the Aegean Sea of Greece (grey line) and Turkish (black line).

Reporting Species

In Greece, landing records in 2021 are available for 73 species, including 57 fish, five cephalopods, six crustaceans and five molluscs (Table S1). The top 10 commercial taxa (*Engraulis encrasicolus*, *Sardina pilchardus*, *Natantia*, crabs, *Merluccius merluccius*, *Octopus vulgaris*, *Boops boops*, *Mugilidae*, *Mullus barbatus*, *Sepia offcinalis*) with the highest landings provided 65.4% of total landing from the Aegean Sea in 2021, and none of these taxa had specific closed seasons applied to them (Fig. 4). In Türkiye, landing records in 2021 are available for 78 species from the Aegean Sea, including 59 fish, three cephalopods, eight crustaceans, and eight molluscs (Table S1). The top 10 commercial species (*Engraulis encrasicolus*, *Sardina pilchardus*, *Boops boops*, *Sardinella aurita*, *Trachurus mediterraneus*, *Parapenaeus longirostris*, *Trachurus trachurus*, *Scomber colias*, *Merluccius merluccius*, *Mullus surmuletus*) with the highest landings provided 80.7% of Türkiye's 37,077 tons total landing from the Aegean Sea in 2021, and interestingly, as in Greece, none of these species had specified closed seasons applied to them. The total catch amount of 24 species with applied closed seasons was 1,582 tons, representing 4.3% of the total catch amount of the Aegean Sea (Fig. 4). The comparison of the species reported by the official authorities between the two neighbouring states showed that (Table S1) 50 out of 73 species reported for Greece were also reported for Türkiye. In contrast, 28 species were not reported by Greek authorities and 23 species reported in Greece were not reported in the Turkish statistics (Table S1).

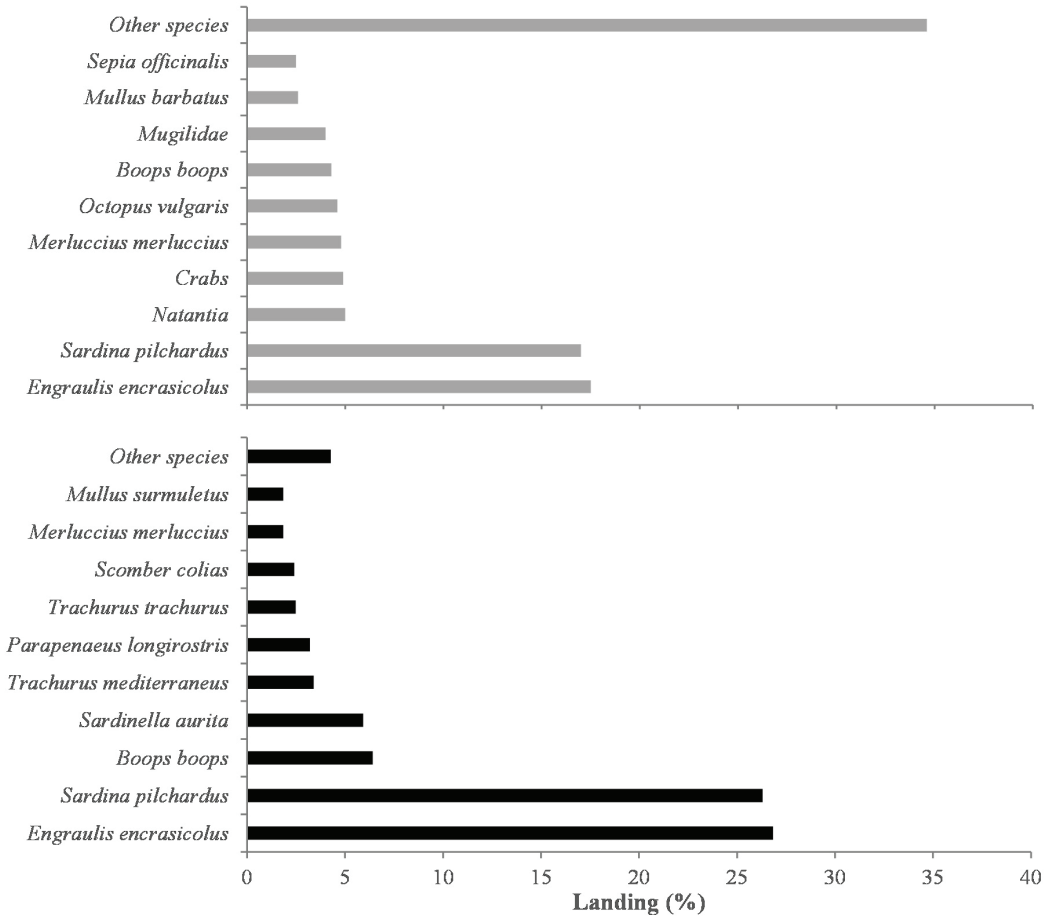


Fig. 4: Greek (upper-grey columns) and Turkish (down-black columns) landings from the Aegean Sea based on the highest 10 landed commercial taxa (for Greece) and species (for Türkiye) and other species (other species in Turkish landings represents the 24 species with closed season) (TURKSTAT, 2022; HELSTAT, 2022).

Minimum Conservation Reference Size (MCRS)

Under the MCRS for the listed species, these are protected from being caught, held onboard, transhipped, landed, transported, stored, sold, displayed or offered for sale. MCRS's were determined in Turkish legislation for 33 of 56 fish species (Table 1), two of eight crustacean species, one of two mollusc bivalves, and one of three cephalopod species, which are landed from the Aegean Sea.

Greek and EU MCRS overlap for 10 species. For 6 taxa (*Dicentrarchus labrax*, *Diplodus sargus, Pagellus erythrinus, Trachurus* spp., *Homarus gammarus, Palinuridae*), Greece has to apply the EU MCRS limits, which are of larger sizes than their national legislations (Table 1). Also, for three species (*Diplodus annularis*, *Epinephelus marginatus*, *Venus* spp.), the national MCRSs are more sensitive than EU MCRSs and are applied. In addition, MCRS's in Greek national legislation are valid for 46 species (28 fish, 13 mollusc bivalves, one cephalopod and four gastropods), which are not represented under EU legislation (Table 1). Moreover, for the commercial species not covered under EU regulations (e.g. *Dentex dentex*, *Oblada melanura*, *Serranus cabrilla* and *Spondyliosoma cantharus*), MCRS was arbitrarily set 68 years ago (National Royal Degree FEK 25A/26-1-1954) at 10 cm for *B. boops* and 8 cm for the other twenty species which have no biological basis (Table 1).

When the EU and NL are evaluated together, Greece applies MCRS for a total of 53 species, (excluding the very outdated 20- 8 cm MCRS's) 28 fish, 4 crustaceans, 16 mollusc bivalves, one cephalopod and four gastropods. In contrast, Türkiye applies a total of 49 MCRSs, 39 fish, three crustaceans, six mollusc bivalves, and one cephalopod. Türkiye has a higher number of MCRS applications only in fish, with this trend reversing in Greece for other groups, except cephalopods, which have *Octopus vulgaris* listed for both states (Table 1).

When the MCRSs of Greece and Türkiye (Table 1) are compared, from a total of 74 species with MRCS limits, 25 species are listed only in Greek legislation and one species (*Callinectes sapidus*) only in Turkish legislation. MCRS is determined for 48 species in both states and 10 of them (*D. labrax*, *Diplodus vulgaris*, *Engraulis encrasicolus*, *Epinephelus* spp., *Merluccius merluccius*, *P. erythrinus*, *Sardina pilchardus*, *Solea vulgaris*, *Sparus aurata*, *Thunnus thynnus*) have the same minimum limits applied. Greece has higher (more sensitive) MCRS values for nine species (*Chamelea gallina*, *D. sargus*, *Donax trunculus*, *H. gammarus, Ostrea edulis*, *Ruditapes decussatus*, *Trachurus* spp., *Veneridae* and *Venus* spp.), while Türkiye has higher MCRS values for 29 species (*Lichia amia*, *Mugil cephalus*, *O. vulgaris*, *Sardinella aurita*, *S. colias*, *X. gladius* and the fish species with 8 cm MCRS

Table 1. Minimum conservation reference sizes (MCRS) in legislations of EU, Greece (Gr) and Türkiye (Tr) (The valid sizes in EU and Greece National Legislation (NL) are shown in bold). Length at 50% maturity (Lm_{50}) from the Aegean Sea or adjacent region found in the literature (m: male; f: female; c: combined; NA: Not available) and recommendation for MLS according to Lm_{50} (+: should be increased; **S**: should be set; ND: Need Lm_{50} data). (MCRS and Lm_{50} values are given as total length. In case of different size, information is provided below the table)

Taxa		MCRS			Lm_{50}			Recommendation	
		Gr							
Scientific name	**Common name**	**EU**	**NL**	**Tr**	**Aegean Sea**	**Adjacent region**	**Reference**	**Gr**	**Tr**
Fish									
Argyrosomus regius	Meagre	-	8 cm	25 cm		48 cm (m) 58 cm (f)	Abou Shabana *et al.* (2012)	+ 50 cm	+ 33 cm
Boops boops	Bogue	-	10 cm	-	9.35 cm (m) 12.96 cm (f)		Soykan *et al.* (2015)	+ 3 cm	**S**
Chelidonichthys lucerna	Tub gurnard	-	8 cm	18 cm		18 cm (m) 20 cm (f)	İşmen *et al.* (2004)	+ 12 cm	+ 2 cm
Chelon labrosus	Thicklip grey mullet	-	8 cm	20 cm		25 cm (m) 29.5 cm (f)	Campillo (1992)	+ 11.5 cm	+ 9.5 cm
Dentex dentex	Common dentex	-	8 cm	35 cm		52 cm (m) 34.6 cm (f)	Morales-Nin and Moranta (1997)	+ 26.6 cm	
Dicentrarchus labrax	European seabass	**25 cm**	23 cm	25 cm		20 cm (m) 29 cm (f)	Wassef and El Emary (1989)	+ 4 cm	+ 4 cm
Diplodus annularis	Annular seabream	12 cm	**15 cm**	-	10.53 cm (m) 10.02 cm (f)		İlkyaz *et al.* (2018)		**S**
Diplodus puntazzo	Sharpsnout seabream	18 cm	-	-		21.5 cm (c)	Mouine *et al.* (2012)	+ 3.5 cm	**S**
Diplodus sargus	White seabream	**23 cm**	15 cm	21 cm		20.4 cm (m) 21.2 cm (f)	Mouine *et al.* (2012)		
Diplodus vulgaris	Two-banded seabream	18 cm	-	18 cm	13.37 cm (m) 12.87 cm (f)		Soykan *et al.* (2015)		
Engraulis encrasicolus	European anchovy	9 cm[(1)]	9 cm	9 cm[(2)]		7.5 cm (m) 8.17 cm (f)	Ferreri *et al.* (2021)		
Epinephelus spp.	Groupers	45 cm	**50 cm**[(3)]	50 cm[(4)]		49.1 cm (f)[(3)]	Renones *et al.* (2006)		
Euthynus alletteratus	Little tunny	-	8 cm	45 cm		44.8 cm (c)[(5)]	Mohamed *et al.* (2014)	+ 36.8 cm	
Lichia amia	Leerfish	-	14 cm	40 cm	NA			ND	ND
Lithognathus mormyrus	Sand steenbras	20 cm	-	-	16.21 cm (m) 19.04 cm (f)		Kallianiotis *et al.* (2005)		**S**
Liza aurata	Golden grey mullet	-	8 cm	30 cm		26.2 cm (m) 24.1 cm (f)	Kesiktaş *et al.* (2020)	+ 16 cm	
Liza ramada	Thinlip grey mullet	-	8 cm	20 cm	33 cm (m)[(6)] 31.8 cm (f)[(6)]		Koutrakis (2011)	+ 24 cm	+ 12 cm
Liza saliens	Leaping mullet	-	8 cm	20 cm	22.6 cm (m)[(6)] 23.8 cm (f)[(6)]		Koutrakis (2011)	+ 15.8 cm	+ 3.8 cm
Lophius spp.	Anglerfish	-	30 cm	-	42.5 cm (m)[(7)] 58.8 cm (f)[(7)]		Yigin *et al.* (2015)	+ 28.8 cm	**S**

Continued

Table 1 continued

Taxa		MCRS			Lm_{50}			Recommendation	
		Gr							
Scientific name	**Common name**	**EU**	**NL**	**Tr**	**Aegean Sea**	**Adjacent region**	**Reference**	**Gr**	**Tr**
Merlangius merlangus	Whiting	-	8 cm	13 cm		13.9 cm (m) 14.6 cm (f)	Bilgin *et al.* (2012)	+ 6.6 cm	+ 1.6 cm
Merluccius merluccius	European hake	20 cm	-	20 cm	29.4 cm (m) 38.9 cm (f)		Apostologamvrou *et al.* (2023)	+ 9.4 cm	+ 9.4 cm
Mugil cephalus	Flathead grey mullet	-	16 cm	30 cm		42 cm (m) 47.5 cm (f)	Brusle and Brusle (1977)	+ 31.5 cm	+ 17.5 cm
Mugil soiuy	So-iuy mullet	-	8 cm	35 cm	NA			ND	ND
Mullus spp.	Red mullets	11 cm	11 cm	11 cm[8]; 13 cm[9]	13.7 cm (m)[8] 13.2 cm (f)[8] 11.56 cm (m)[9] 12.33 cm (f)[9]		Arslan and İşmen (2013)[8] İlkyaz *et al.* (2018)[9]	+ 2.2 cm	+ 2.2 cm[8]
Oedalechilus labeo	Boxlip mullet	-	8 cm	20 cm		12.9 cm (m) 12.8 cm (f)	Matić -Skoko *et al.* (2012)	+ 4.8 cm	
Pagellus acarne	Axillary seabream	17 cm	-	-	13.91 cm (m) 14.45 cm (f)		Soykan *et al.* (2015)		**S**
Pagellus bogaraveo	Blackspot seabream	33 cm	-	-		26.4 cm (m) 32.3 cm (f)	Krug (1998)		**S**
Pagellus erythrinus	Common pandora	**15 cm**	12 cm	15 cm	14.52 cm (m) 11.90 cm (f)		Yapici and Filiz (2019)		
Pagrus pagrus	Red porgy	18 cm	18 cm	-	35.6 cm (f)[10]		Vassilopoulou and Papaconstantinou (1992)	+ 17.6 cm	**S**
Pleuronectes spp.	Right-eye flounders	-	8 cm	20 cm	14 cm (m)[11] 15 cm (f)[11]		Cengiz *et al.* (2014)	+ 7 cm	
Polyprion americanus	Wreckfish	45 cm	45 cm	-		90 cm (c)	Carbonara *et al.* (2003)	+ 45 cm	**S**
Pomatomus saltatrix	Bluefish	-	8 cm	18 cm		27.7 cm (f)[12]	Ceyhan *et al.* (2007)	+ 19.7 cm	+ 9.7 cm
Sarda sarda	Atlantic bonito	-	8 cm	25 cm		36.8 cm (m) 42.5 cm (f)	Kahraman *et al.* (2014)	+ 34.5 cm	+ 17.5 cm
Sardina pilchardus	European pilchard	11 cm[13][14]	-	11 cm[2][15]	11.37 cm (m) 11.65 cm (f); 12.1 cm (c)		Tsikliras and Koutrakis (2013); Akyol *et al.* (1996)	+ 0.6 cm	+ 0.6 cm
Sardinella aurita	Round sardinella	-	10 cm	11 cm	16.8 cm (m) 15.6 cm (f)		Tsikliras and Antonopoulou (2006)	+ 5.6 cm	+ 4.6 cm
Sciaena umbra	Brown meagre	-	8 cm	35 cm		19.5 cm (m) 21.97 cm (f)	Engin and Seyhan (2009)	+ 14 cm	
Scomber colias	Chub mackerel	-	12 cm	18 cm	18 cm (c)		Cengiz (2012)	+ 6 cm	
Scomber spp.	Mackerels	18 cm	18 cm	20 cm[16]		23.2 cm (m)[11] 23.4 cm (f)[11]	AO El-Aiatt (2020)	+ 5.4 cm	+ 3.4 cm

Continued

Table 1 continued

Taxa		MCRS			Lm_{50}			Recommendation	
		Gr							
Scientific name	**Common name**	**EU**	**NL**	**Tr**	**Aegean Sea**	**Adjacent region**	**Reference**	**Gr**	**Tr**
Scopthalmus maximus	Turbot	-	8 cm	45 cm		24.68 cm (m) 20.38 cm (f)	Eryılmaz and Dalyan (2015)	+ 12.4 cm	
Scorpaena scrofa	Red scorpionfish	-	8 cm	15 cm		24.9 cm (m) 29 cm (f)	Matić-Skoko *et al.* (2015)	+ 21 cm	+ 14 cm
Seriola dumerili	Greater amberjack	-	8 cm	30 cm		93.7 cm (m) 95.3 cm (f)	Sley *et al.* (2014)	+ 87.3 cm	+ 65.3 cm
Solea vulgaris	Common sole	20 cm	20 cm	20 cm[17]	15.4 cm (f)[17]		Cerim and Ateş (2019)		
Sparus aurata	Gilthead seabream	20 cm	20 cm	20 cm		29.1 cm (m) 34.8 cm (f)	Cetinić *et al.* (2002)	+ 14.8 cm	+ 14.8 cm
Thunnus thynnus	Atlantic bluefin tuna	-	115 cm[18] - 30 kg[19]	115 cm[18] - 30 kg[19]		103.6 cm (f)[18]	Corriero *et al.* (2005)		
Trachurus spp.	Horse mackerels	**15 cm**	12 cm	13 cm[20][2]	17 cm (m) 17 cm (f)		Abaunza *et al.* (2003)	+ 2 cm	+ 4 cm
Umbrina cirrosa	Shi drum	-	8 cm	45 cm	NA			ND	ND
Upeneus moluccensis	Goldband goatfish	-	8 cm	10 cm		11 cm (m) 11.4 cm (f)	Özyurt *et al.* (2014)	+ 3.4 cm	+ 1.4 cm
Xiphias gladius	Swordfish	-	120 cm[21]	125 cm[18]		140 cm (f)[18]	Macías *et al.* (2005)	+ 20 cm	+ 15 cm
Crustaceans									
Callinectes sapidus	Atlantic blue crab	-		13 cm		11.85 cm (f)	Sumer *et al.* (2013)	**S**	
Homarus gammarus	European lobster	**105 mm CL**[22]	85 mm CL-420 g	25 cm TL	NA			ND	ND
		300 mm TL[22]	240 mm TL-420 g						
Nephrops norvegicus	Norway lobster	20 mm CL[22]	20 mm CL	-	33 mm (f)		Relini *et al.* (1998)	+ 13 mm	**S**
		70 mm TL[22]	70 mm TL	-	119 mm (f)[23]		Relini *et al.* (1998)	+ 49 mm	**S**
Palinuridae	Spiny lobsters	**90 mm CL**[22]	240 mm TL	25 cm TL[24]		86 mm CL (f) [24] 24,6 cm TL (f) [24][25]	Hunter (1999)		
Parapenaeus longirostris	Deep-water rose shrimp	20 mm CL	-	-	24.6 mm CL (f)		Dereli and Erdem (2011)	+ 4.6 mm	**S**
Mollusc bivalves									
Aequipecten opercularis	Queen scallop	-	5 cm	-	NA			ND	**S**
Arca noae	Noah's ark	-	5 cm	-	NA			ND	**S**
Barbatia barbata	Hairy ark	-	5 cm	-	NA			ND	**S**
Callista chione	Brown venus	-	4.5 cm	-		3,03 cm (c)	Galimany *et al.* (2015)		**S**

Continued

Table 1 continued

Taxa		MCRS			Lm_{50}			Recommendation	
		Gr							
Scientific name	**Common name**	**EU**	**NL**	**Tr**	**Aegean Sea**	**Adjacent region**	**Reference**	**Gr**	**Tr**
Cerastoderma glaucum	Olive green cockle	-	4 cm	-		1.51 cm (m) 1.68 cm (f)	Derbali *et al.* (2009)		**S**
Chamelea gallina	Striped venus clam	-	3.5 cm	1.7 cm		1.15 cm (m) 1.1 cm (f)	Bargione *et al.* (2021)		
Donax trunculus	Truncate donax	-	3 cm	2.5 cm		1.91 cm (c)	Deval (2009)		
Dosinia exoleta	Mature dosinia	-	4 cm	-	NA			ND	**S**
Flexopecten glaber	Smooth scallop	-	4.5 cm	-	NA			ND	**S**
Gari depressa	Depressed sunset clam	-	4 cm	-	NA			ND	**S**
Modiolus barbatus	Bearded horse mussel	-	5 cm	-	NA			ND	**S**
Ostrea edulis	Edible oyster	-	7 cm	6 cm	NA			ND	ND
Pecten jacobaeus	Great Mediterranean scallop	10 cm	10 cm	-	NA			ND	**S**
Ruditapes decussatus	Grooved carpet shell	-	4.5 cm	24 mm	NA			ND	ND
Veneridae	Carpet shells	25 mm	25 mm	24 mm[26]	NA			ND	ND
Venus spp.	Venus clams	25 mm	**4.5 cm**	30 mm[27]		2.58 cm (c)	Popović *et al.* (2013)		
Cephalopods									
Octopus vulgaris	Common octopus	-	500 g	750 g		250 g (m) 580 g (f)	Silva *et al.* (2002)	+ 80 g	
Gastropods									
Bolinus brandaris	Purple dye murex	-	6 cm	-		5.46 cm (m) 5.64 cm (f)	Elhasni *et al.* (2013)		**S**
Haliotis tuberculata	Tuberculate abalone	-	6 cm	-	NA			ND	**S**
Phyllonotus trunculus	Banded dye-murex	-	5 cm	-	NA			ND	**S**
Stramonita haemastoma	Red-mouthed rock shell	-	5 cm	-	NA			ND	**S**

(1) EU Member States may convert the minimum conservation reference size into 110 specimens per kg.
(2) Small sizes are permitted, provided that they are less than 15% of the product by weight. This rate is 5% in seafood other than European anchovy, European sardine and horse mackerel.
(3) For dusky grouper (*Epinephelus marginatus*)
(4) For white grouper (*Epinephelus aeneus*)
(5) Total length was calculated from fork length according to Allaya *et al.* (2017)
(6) Total length was calculated from standard length according to Kara *et al.* (2020)
(7 For blackbellied angler (*Lophius budegassa*)
(8) For striped red mullet (*Mullus surmuletus*)
(9 For red mullet (*Mullus barbatus*)
(10) Total length was calculated from fork length according to Moutopoulos and Stergiou (2002)
(11) For spotted flounder (*Citharus linguatula*)
(12) Total length was calculated from standard length according to Özpiçak *et al.* (2017)
(13) EU Member States may convert the minimum conservation reference size into 55 specimens per kg.
(14) This minimum conservation reference size shall not apply to fries of sardine landed for human consumption if caught by boat seines or shore seines and authorised in accordance with national provisions established in a management plan as referred to in Article 19 of Regulation (EC) No 1967/2006, provided that the stock of sardine concerned is within safe biological limits.
(15) For European pilchard (*Sardina pilchardus*) and round sardinella (*Sardinella aurita*)
(16) For Atlantic mackerel (*Scomber scombrus*)
(17) For common sole (*Solea solea,* synonym of *Solea vulgaris*)
(18) Fork length
(19) Bluefin tuna between 8-30 kg or 75-115 cm are allowed in maximum 5% as numerical.
(20) For Atlantic horse mackerel (*Trachurus trachurus*) and Mediterranean horse mackerel (*Trachurus mediterraneus*)
(21) Swordfish fish less than 11.4 kg (whole weight) or 10.2 kg (gilled and gutted weight) or less than 100 cm in length are allowed in maximum of 5% as a number or weight.
(22) CL - carapace length; TL - total length.
(23) Total length was calculated from carapace length according to Aydın and Aydın (2011)
(24) For European spiny lobster (*Palinurus elephas*)
(25) Total length was calculated from carapace length according to Quetglas *et al.* (2004)
(26) For Japanese carpet shell (*Tapes philippinarum*)
(27) For warty venus (*Venus verrucosa*)

applied by Greece long ago- see Table 1). See Supplementary Material in Yildiz & Ulman (2020) for the development of Turkish MLS regulation sizes for details on each species by publication notification period.

While some MCRS values have been prescribed at the genus level (*Mullus* spp. at 11 cm, and *Scomber* spp. at 18 cm) under Greek legislation, the MCRS values were assigned to these taxa at species level in Türkiye. *Mullus barbatus* is slightly higher at 13 cm, while *Mullus surmuletus* (11 cm) is the same as in Greece. *Scomber scombrus* with 20 cm is slightly higher compared to the 18 cm that is applied for *Scomber* spp. in Greece. *S. japonicus* is the same in both states. Also, MCRS values are provided for *Palinuridae* as carapace length (CL) in EU legislation, but use a similar total length (TL) in Greece and Türkiye.

When comparing the Lm_{50} values reported from the Aegean Sea, where available, or from the nearest region in the literature, only 11 out of 74 species have MCRS values equal to or higher than the Lm_{50} values of both states. Lm_{50} information could not be found in the literature for 18 species (three fish, one crustacean, 11 mollusc bivalves and three gastropods), and hence, no evaluation could be made for these species. For 22 fish species, MCRS values of both states were found to be below Lm_{50}. Türkiye's MCRS values were found to be sufficient for seven fish species (*Euthynus alletteratus*, *Liza aurata*, *Oedalechilus labeo*, *Pleuronectes* spp., *Scopthalmus maximus*, *Sciaena umbra*, *S. japonicus*) and *O. vulgaris*. On the other hand, the findings showed that Türkiye has no MCRS limits in its legislation for 26 commercial species, while Greece was only lacking this for one species (Table 1).

Closed Seasons

Closed seasons are applied to specific species in the Aegean Sea fisheries by Greece and Türkiye (Notification 5/1) under national legislation (Papaconstantinou *et al.*, 2007; Anonymous, 2020). Greece only has a closed season for *X. gladius* and *T. thynnus* for fish, and for *H. gammarus* and *Palinurus elephas* for crustaceans (PD 237/1996). For *X. gladius*, fishing is not allowed between 1st of January and 31st of March each year in Greece (in Annex ID of Regulation (EU) 2023/194 of 30 January 2023 and in Art. 10(1) of Regulation (EU) 2019/1154). In Türkiye *X. gladius* fishery is closed for a total of three months but from 15 February - 15 March and 1 October - 30 November, with only half the period overlapping (Anonymous, 2020). For *H. gammarus* and *P. elephas* fishing is prohibited from 1 September - 31 December (4 months) in Greece and on 1 September - 15 April (7.5 months) in Türkiye. In addition to these species, closed seasons were assigned for seven fish and three crustacean species only under Turkish legislation (Table S2) (Anonymous, 2020).

Closed seasons were determined for seven mollusc bivalve species in both states with similar prohibition periods from about 1 April - 31 October in Greece and a shorter period in Türkiye (15 April - 31 August) (Anonymous, 2020). *Callista chione* has a closed season (1 April – 30 June) only in Greece, and *Gracilaria* spp. and seven fish species (moss) have closed seasons only in Türkiye (Table 2 and Table S2) (Anonymous, 2020). For cephalopods, a species-specific closed season is issued for Türkiye for *O. vulgaris* (April to October) (Anonymous, 2020), whereas for Greece there is a closed season for the primary fishing gear used to target this species (fishing pots) (July to September). *Holothuria* spp. and *Rapana venosa* fishing are prohibited between 1 April and 31 October (7 months) in Greece, and their closed seasons in Türkiye are between two to 2.5 months shorter (Anonymous, 2020).

The species-specific closed seasons of Greece and Türkiye are compared to the spawning periods for those species with available spawning season data (Table 2). Both states have specific closed seasonal fisheries for three species (i.e., *D. trunculus*, *Rapana venosa*, *Holothuria* spp.) based on their spawning periods. Furthermore, Türkiye also has closed seasons for *Epinephelus aeneus*, *Sarda sarda* and *C. sapidus* based on their spawning periods. However, closed-season regulations for 11 species do not cover their entire spawning periods; Four of which (i.e., *R. decussatus*, *Venus verrucosa*, *O. vulgaris*, *O. edulis*) are under the legislations of both states, one (i.e., *C. chione*) is under Greek legislation, and four (i.e., *Coryphaena hippurus*, *Platichthys flesus*, *Solea solea*, *Palinurus elephas*) are under Turkish legislation. Surprisingly, the closed season applied to *X. gladius* does not include the spawning period (between May and September) of the species in both states. Although the spawning periods are not yet known for many species, four species (i.e., *H. gammarus*, *C. gallina*, *Mytilus galloprovincialis*, *Pecten jacobaeus*) are hypothesized to be managed by closed season regulations of both states. Nonetheless, Türkiye applies a closed season for the *Lichia amia* and *Gracilaria* spp., although no data could be found to support the spawning periods for these species (Table 2).

Protected Species

Protected species in the Aegean Sea fisheries are regulated by the EU (EU Regulation 2019/1241; Annex I) and the Presidential Decree no 67/1981 "On the protection of native flora and fauna" and Türkiye (Notification 5/1) Legislations (EU, 2019; Anonymous, 2020). Lists of protected species are compared for Greece and Türkiye including their associated IUCN Red List Categories in Table 3. Only 14 taxa (*Acipenser naccarii*, *Acipenser sturio*, *Caretta caretta*, *Chelonia mydas*, *Cetaceans*, *Cetorhinus maximus*, *Corallium rubrum, Dermochelys coriacea, Mobula japonica, Mobula mobular, Monachus monachus, Pinna nobilis, Posidonia oceanica and Squatina squatina*) are protected in both states (34 protected by Greece and 46 by Türkiye) (Table 3). Thirty-two species (two of them in DD, two of LC, three of NT, 11 of VU, one of EN and six of CR categories of IUCN Red List) are protected only under Turkish legislation. Twenty species (one of them in LC, four of VU, nine of EN, three

Table 2. Closed seasons for species in Greece (blue line) and Türkiye (red line) and spawning seasons shown (grey fill) by month.

Taxa		Spawning and closed season												
Scientific name	**Common name**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**	**Reference**
Fish														
Coryphaena hippurus	Common dolphinfish													Gatt *et al.* (2015)
Epinephelus aeneus	White grouper													Gökçe *et al.* (2003)
Lichia amia	Leerfish													-
Platichthys flesus	European flounder													Çiloğlu (2005)
														Güneş *et al.* (2011)
Sarda sarda	Atlantic bonito*													Kahraman *et al.* (2014)
Solea solea	Common sole													Cerim and Ateş (2019)
														Türkmen (2003)
Thunnus thynnus	Atlantic bluefin tuna													Karakulak *et al.* (2004)
Xiphias gladius	Swordfish													Nakamura (1986)
														Tserpes *et al.* (2001)
Crustaceans														
Callinectes sapidus	Atlantic blue crab													Sumer *et al.* (2013)
Homarus gammarus	European lobster													-
Palinurus elephas	European spiny lobster													Goñi *et al.* (2003)
Scyllarides latus	Mediterranean slipper lobster													-
Mollusc- Bivalves														
Callista chione	Brown venus													Metaxatos (2004)
														Galimany *et al.* (2015)
Chamelea gallina	Striped Venus clam													-
Donax trunculus	Truncate donax													Deval (2009)
Mytilus galloprovincialis	Mediterranean mussel													-
Ostrea edulis	Edible oyster													Acarli *et al.* (2015)
Pecten jacobaeus	Scallop													-
Ruditapes decussatus	Clam													Serdar and Lök (2010)
Venus verrucosa	Warty venus													Çolakoğlu and Palaz (2015)
Mollusc-Gastropod														
Rapana venosa	Rapa whelk													Sağlam *et al.* (2009)
Cephalopods														
Octopus vulgaris	Octopus													Sánchez and Obarti (1993)
Holothuroidea														
Holothuria spp.	Sea cucumbers													Dereli *et al.* (2016)**
														Kazanidis *et al.* (2014)**
Florideae														
Gracilaria spp.	Moss													-

* Set longline fishing is allowed from 15 to 31 August in Türkiye ** for *Holothuria tubulosa*

Table 3. Protected species under Greek (from EU and National Legislations) and Turkish Legislations, with the accompanying IUCN Red List Categories (DD: Data Deficient; LC: Least Concern; NT: Near Threatened; VU: Vulnerable; EN: Endangered; CR: Critically Endangered) (+: Indicates that the taxa is protected: -: Indicates that the taxa is not protected).

Taxa		Greece	Türkiye	IUCN Red List Categories
Scientific Name	**Common name**			
Acipenser naccarii	Adriatic sturgeon	+	+(1)	CR
Acipenser sturio	Common sturgeon	+	+(1)	CR
Alopias superciliosus	Bigeye thresher	-	+	VU
Alopias vulpinus	Thresher	-	+	VU
Anoxypristis cuspidata	Narrow sawfish	+	-	EN
Asterina pancerii	Cushion star	-	+	-
Caretta caretta	Loggerhead turtle	+	+	VU
Carcharhinus falciformis	Silky shark	-	+	VU
Carcharhinus longimanus	Oceanic whitetip shark	-	+	CR
Carcharhinus plumbeus	Sandbark shark	-	+	VU
Carcharodon carcharias	White shark	+	-	VU
Cetaceans		+	+	-
Centrostephanus longispinus	Hatpin urchin	+	-	-
Cerithium vulgatum	Common cerithe	-	+	-
Cetorhinus maximus	Basking shark	+	+	EN
Chelonia mydas	Green sea turtle	+	+	EN
Corallium rubrum	Sardinia coral	+	+	EN
Dermochelys coriacea	Leatherback turtle	+	+	VU
Epinephelus marginatus	Dusky grouper	-	+	VU
Galeorhinus galeus	Tope shark	-	+	CR
Gourmya yulgata		-	+	-
Haliotis tuberculata lamellosa	Ormer	-	+	-
Hippocampus hippocampus	Short snouted seahorse	-	+	DD
Homarus gammarus	European lobster	+(2)	-	LC
Huso huso	Beluga	-	+	CR
Isurus oxyrinchus	Shortfin mako	-	+	EN
Lamellaridae		-	+	-
Lamna nasus	Porbeagle	-	+	VU
Lithophaga lithophaga	European date mussel	+	-	-
Maja squinado	Spinous spider crab	-	+	-
Manta alfredi(3)	Alfred manta	+	-	VU
Manta birostris	Giant manta	+	-	EN
Mobula eregoodootenkee(3)	Longhorned mobula	+	-	EN
Mobula hypostoma(3)	Lesser devil ray	+	-	EN
Mobula japonica(3)	Spinetail mobula	+	+	-
Mobula kuhlii(3)	Shortfin devil ray	+	-	EN
Mobula mobular	Devil fish	+	+	EN
Mobula munkiana(3)	Munk's devil ray	+	-	VU
Mobula rochebrunei(3)	Lesser Guinean devil ray	+	-	EN
Mobula tarapacana	Chilean devil ray	+	-	EN
Mobula thurstoni	Smoothtail mobula	+	-	EN
Mola mola	Ocean sunfish		+	VU
Monachus monachus	Mediterranean monk seal	+	+	EN
Oxynotus centrina	Angular roughshark	-	+	VU

Continued

Table 3 continued

Taxa		Greece	Türkiye	IUCN Red List Categories
Scientific Name	**Common name**			
Palinurus spp.	Spiny lobsters	+[2]	-	VU[4]
Pholas dactylus	Common piddock	+	-	-
Pinna nobilis	Noble pen shell	+	+	CR
Posidonia oceanica	Mediterranean tapeweed	+	+	LC
Prionace glauca	Blue shark	-	+	NT
Pristis clavata	Dwarf sawfish	+	-	EN
Pristis pectinate	Smalltooth sawfish	+	-	CR
Pristis pristis	Common sawfish	+	-	CR
Pristis zijsron	Longcomb sawfish	+	-	CR
Raja clavata	Thornback ray	-	+	NT
Rhinobatos cemiculus	Blackchin guitarfish	-	+	CR
Rhinobatos rhinobatos	Common guitarfish	-	+	-
Salmo trutta labrax	Black Sea salmon	-	+	LC
Savalia savaglia	Gold coral	-	+	NT
Sphyrna zygaena	Smooth hammerhead	-	+	VU
Squalus acanthias	Piked dogfish	-	+	VU
Squalus blainville	Longnose spurdog	-	+	DD
Squatina aculeata	Sawback angelshark	-	+	CR
Squatina oculata	Smoothback angelshark	-	+	CR
Squatina squatina	Angel shark	+	+	CR
Trionyx triunguis	Nile softshell turtle	-	+	VU
Zostera nolti	Dwarf eel-grass	-	+	LC

[1] *Acipencer* spp.
[2] Except when used for direct restocking or transplantation purposes
[3] Not present in European or Mediterranean waters
[4] for *Palinurus elephas*

of CR categories of IUCN Red List) are protected only under Greek (EU) legislation. Sixteen shark species are protected only in Türkiye and five sawfish species are protected only in Greece show some key differences, although sawfish are extinct in the eastern Mediterranean Sea. Two lobster taxa, *H. gammarus* and *Palinurus* spp., of high commercial value are protected only in Greece. In addition, many ecosystem-important taxa (i.e., *Hippocampus hippocampus*, *Myliobatidae*, *Trionyx triunguis*, *Savalia savaglia*, *Zostera nolti*) are protected only in Türkiye (Table 3).

The fishing of all pufferfish taxa (*Tetraodontidae*, *Diodontidae* and *Canthigasteridae*) are prohibited under Greek Regulations (EC 853/2004 and EC 854/2004). Similarly, under Turkish legislation, the fishing and landing of pufferfish species were completely prohibited in the previous legal regulation (Notification 4/1) from 2016 onwards due to the high toxicities of some species. However, in order to combat their abundances, all pufferfish species: *Lagocephalus sceleratus*, *Lagocephalus spadiceus*, *Lagocephalus suezensis*, *Lagocephalus guentheri*, *Lagocephalus lagocephalus*, *Sphoeroides pachygaster*, *Tylerius spinosissimus*, *Torquigener flavimaculosus* in the current Notification 5/1, can now be fished with special permissions granted from the Ministry of Agriculture and Forestry of Türkiye, the competent authority, and collected tails can now be returned to the government as an economic incentive.

Discussion

The present study for the first time details the existing differences for technical measures applied to commercial and protected species for shared stocks in the Mediterranean Sea. The study provides a comparison of fleet structure and three important traditional fisheries management measures in transboundary waters for Greece and Türkiye; minimum conservation reference sizes (MCRS), commercial species, seasonal closures and protected species. Despite that fisheries management measures in the Aegean Sea have undergone a harmonization process for the corresponding states (i.e., logbook system, VMS data; more details are provided below) in order to close loopholes and improve their overall effectiveness, this study demonstrates that many loopholes still exist, which seriously undermines regional management effectiveness.

The Greek fleet has gradually been reducing its number of SSF vessels since 1991. Turkish SSF similarly decreased since 2003 due to the impact of national buyback programs which mostly retired small-scale rather than large-scale fishing vessels (Ekmekci & Ünal, 2019;

Ünal & Göncüoğlu-Bodur, 2020a, b). Both states exhibited similar percentages of their total fleet as small-scale vessels in the Aegean Sea (more than 90%). Likewise, Greek large-scale fisheries (OTB and PS) have declined over the years, like the SSF, whereas the Turkish large-scale fisheries initially declined from 2003, but later increased back to the same amount as in 1991. The renewed Greek large-scale fishing fleet included slightly smaller trawlers with lower tonnages and slightly higher HP and purse seines with higher HP and tonnages, while Turkish trawls were smaller, with lower tonnages and Turkish purse seines became larger with more HP and higher tonnages. This indicates that the fishing pressure on the demersal resources in the Aegean Sea (species percentage contribution of the total trawl reported catches in Greek Aegean Sea: *Trachurus mediterraneus* (12.0%), *M. merluccius* (7.5%), and *M. barbatus* (6.0%): Moutopoulos, 2020) has partially decreased, but the fishing pressure on the pelagic resources has increased in effort despite the decrease in the number of vessels. Tsikliras *et al.* (2015) reported that 87% of the fisheries resources in the Aegean Sea have problems in terms of sustainability (25% in fully exploited, 40% in overexploited and 22% in collapsed). The declining catches of the Aegean Sea correlate to the recent decline of fishing effort, as reported by Ulman and Pauly (2016), as it was approximately 15 kW*day*10^{-6} in the 1990s, approached 70 kW*day*10^{-6} in the early 2000s and then decreased to 40 kW*day*10^{-6} in the 2010s, although we know that the purse seine fleet has increased in effort with other sectors responsible for the overall decline. Tunca *et al.* (2021) reported the high associated costs of technological inputs, including gross tonnage, engine power, total generator power, lamp vessel generator power for the Turkish Aegean PS fleet. Similarly, Tsitsika *et al.* (2008) reported that the Greek purse seine fisheries in the Aegean Sea show similar trends in overcapacity with the higher technological inputs and a proportional reduction in fleet size is required to achieve desired exploitation levels in the Aegean Sea.

Due to the increase in total effort, the CPUE of the Turkish fleet in the Aegean Sea showed a decrease of 67% from the early 1990s (about 6 kg* kW*day^{-1}) to the 2010s (about 2 kg* kW*day^{-1}) (Ulman & Pauly, 2016). In addition, the ratio of initial to current CPUE (initial: the year fishers commenced fishing; current: the year 2013) of artisanal and bottom trawl fishers marked a significant decline from the 1960s to 2013 (Ulman & Pauly, 2016). The decline in employment, landings, and CPUE (HELSTAT, 2022; TURKSTAT, 2022), combined with more and more overexploited stocks (FAO, 2020) indicate that technical measures in fisheries are currently insufficient at protecting the resources and need revamping. The co-operation amongst stakeholders and research organisations between the two neighboring states towards the establishment of an efficient licence-control system will beneficially improve fisheries data quality (Moutopoulos & Koutsikopoulos, 2014). An important future step towards the sustainable management of the Aegean fisheries resources is the estimation of total CPUE from both Greek-Turkish catch data for the Aegean Sea, taking into account the reconstructed fisheries catches produced by Sea Around Us, whereby previously unreported catches are accounted for (Moutopoulos *et al.*, 2015; Ulman & Pauly, 2016, respectively). In line with the above, a major shortfall of the analysed national data sets is the absence of discarded amounts, which comprise a considerable amount of unreported catches (e.g., bottom trawls, longlines for example) as well as the decrease of bias for inshore fisheries (Moutopoulos & Koutsikopoulos, 2014), which both highly contribute to the total fisheries catches for both countries (Moutopoulos *et al.*, 2015; Ulman & Pauly, 2016). Furthermore, one major limitation of this study is the deficiency of stock assessment data to enable a comparative analysis of the Aegean Sea fisheries. Such data would beneficially improve our capabilities to perform a comprehensive Aegean fish stock assessment and address missing gaps in cross-border fisheries management.

A comparison of MCRS regulations for Türkiye and Greece for a total of 74 species, showed that 48 species are protected under both states, but 38 of these different MCRS sizes have been issued. Twenty-five species are only protected under Greek legislation, and one species only under Turkish legislation. It should be stressed that the seemingly arbitrary 8 cm length limits applied by Greece (10 cm for *Boops boops* and 8 cm for the remaining species) in the 1950s urgently needs reassessment as these values show the largest discrepancies compared with Turkish regulations. A total of 20 fish taxa exhibited MCRS differences of 10 cm or greater between Greece and Türkiye mostly owing to this 8 cm assignment. Another key issue is that MCRS values have only been determined only for a small percentage of the landed species, and are not applied to the most valuable species in Türkiye. MCRS regulations can be ineffective if they are set lower than the Lm_{50} of the species; as our results show, only 11 out of 74 species have proper MCRS values set, demonstrating the ineffectiveness of this measure. In contrast, 22 out of 74 species have MCRS values set too low, while 18 species did not have data on length of maturity.

The application of closed seasons for commercial species is used by both states in principle to protect the reproductive periods of the stocks, yet we found many of these periods do not fully or even partially cover the spawning periods of the respective species. Closed seasons cover the spawning periods of only three species (i.e., *D. trunculus*, *Rapana venosa*, *Holothuria* spp.) applied by both states. Interestingly, for five species (i.e., *R. decussatus*, *V. verrucosa*, *O. vulgaris*, *O. edulis*, *X. gladius*) the closed seasons of both states do not coincide at all with their spawning periods. A total of seven species whose spawning periods have not yet been regionally studied, still have closed seasons applied by both states. Thus, the effectiveness of closed seasons measures on commercial fish stocks strongly needs to be reassessed using reproductive/spawning periods (hence science) as the basis. Harmonization of closed seasons using the best available data, with targeted research for the many species missing this information would improve this measure's success. A very small proportion of commercial species of both states are subject to the closed season practices and spe-

cies with closed seasons applied only account for a very small fraction of the total annual landings in the Aegean Sea (4.3% for Türkiye; almost 5% for Greece) (HELSTAT, 2022; TURKSTAT, 2022).

Alternatively, ten species which are not prescribed closed seasons and targeted by large-scale fishing methods (trawl and purse seine) accounted for 80.7% of Türkiye's total catch in the Aegean Sea in 2021. Four pelagic species (*E. encrasicolus*, *S. pilchardus*, *S. aurita* and *S. japonicus*) are mostly targeted by purse seiners, while three demersal species (*P. longirostris*, *M. merluccius* and *M. surmuletus)* are mostly targeted by trawlers. In both states, aside from closed seasons applied to individual species, the spawning periods of demersal and pelagic commercial species not included in these specific lists are thought to be somewhat protected by a seasonal prohibition period for the large-scale sector (trawl and purse seine), which provide most of the catches. Yildiz *et al.* (2020) provides a nice synopsis of what commercial species spawning periods are not covered by the industrial fishing ban from the adjacent Marmara Sea region. The overall cumulative timespan for seasonal closures for trawl gear is roughly the same in both states, amounting to approximately 4.5 months covering late spring and summer (Dereli *et al.*, 2022). Most of the fish species are known to spawn in the spring-summer period in the Aegean Sea, a temperate sea (Tsikliras *et al.*, 2010; İlkyaz *et al.*, 2018; Froese & Pauly, 2020). However, with Mediterranean Sea warming much faster than other seas (WWF, 2021), the effects of sea warming on stocks will likely continue to alter their spawning seasons, so the collection of ongoing reproductive information is needed to update the science in rapidly changing seas.

Only fourteen species are protected by both states, a total of 32 species are protected only under Turkish legislation, and 20 species only under Greek, the latter which mainly follows EU regulation. It is inevitable that wherever protected species and fishing activities co-exist, interactions will continue. Thirty-two species (11 of them VU, one of EN and six CR categories of IUCN Red List) are protected only under Turkish legislation, while twenty species (four of them VU, nine of EN, three of CR categories of IUCN Red List) are protected only under Greek legislation. Sixteen shark species are protected only in Türkiye, and five sawfish species are protected only in Greece, which highlights some key differences, although sawfish are now regionally extinct in the Eastern Mediterranean anyways. There are also some erroneous species within some regulations, which were explained in Table 3, in that there are 11 manta ray species listed as protected species under the EU regulations, however, there is only one confirmed species in the Mediterranean *M. mobular*, and only three others which exist in the Eastern Atlantic which are *Mobula birostris, Mobula tarapacana, Mobula thurstoni* (FAO, 2009; Ebert & Dando, 2021), which would benefit from a correction.

The Mediterranean hosts elevated extinction risks for over half (53.6%) of its elasmobranchs, about 20 of which critically endangered (Dulvy *et al.*, 2016). Three elasmobranch families have all their species listed as critically endangered: Alopiidae, Rhinobatidae and Squatinidae. It is imperative that critically endangered species might be listed as protected across the entire Mediterranean to ensure their recovery and localized survival. Their declines are nearly totally attributable to overfishing and time is running out to reverse the damage (Walls & Dulvy, 2021). Both Greece and Türkiye have presented regional action plans in place for angel shark recovery in the Aegean Sea and Crete (GSA 22 and 23), the Northern Levant (GSA 24), which have been put into action (Gordon *et al.*, 2020; Fakıoğlu *et al.*, 2021). In addition, many ecosystem-important taxa (*Hippocampus hippocampus*, *Myliobatidae*, *Trionyx triunguis*, *Savalia savaglia* and *Zostera nolti*) are protected only in Türkiye. Again, the two states need to better align common policies towards the development of sustainable fisheries.

Apart for the harmonization of the MCRS, Lm_{50} and protected species lists between the two neighbouring states, two other important points should be considered for the sustainability of the commercial stocks in the Aegean Sea. The first point is that the fishing gear used by the fishing fleet must be selective to support the MCRS's. In trawl fishing targeting demersal resources in the Aegean Sea, the minimum mesh size for the codend is 40 mm for the square mesh (S40) in both states, 50 mm for the diamond mesh (D50) in Greece and 44 mm in Türkiye (Dereli *et al.*, 2022). From selectivity studies in the Aegean Sea, it was shown that the use of 44 mm diamond mesh in the codend was not selective enough for the high value target species *M. barbatus* (Tosunoğlu *et al.*, 2003a; Özbilgin *et al.* 2011; Dereli & Aydın, 2016) and *M. merluccius* (Aydın &Tosunoğlu, 2010; Dereli & Aydın, 2016), and the 50% retention total length values (L_{50}) were under the MCRS of the species. The use of D50 in the codend increased L_{50} for these species, but was still insufficient to increase catch lengths above the MCRS values (Tosunoğlu *et al.*, 2008; Dereli & Aydın, 2016). L_{50} values have been increased in many species with an increase in mesh sizes and the use of square mesh in the codend (Dereli & Aydın 2016). However, due to the differences in body shapes and sizes of the caught species, the mesh size and body shape that is suitable for one species is not suitable for many other species (Stergiou *et al.*, 1997; Tosunoğlu *et al.*, 2003b; Sala *et al.*, 2008), making these measures ineffective in the context of mixed-species fisheries. Secondly, the use of S40 or D50 in Mediterranean trawlers codend have not been adequate in significantly increasing its selectivity and eliminating discards, undersized and/or unwanted catches (Brčić *et al.*, 2015; Mytilineou *et al.*, 2018). Furthermore, incorporating the use of S40 or D50 results in 17% and 21%, respectively, economic losses in landings (Özbilgin *et al.*, 2015). Further increasing codend mesh sizes would result in increased catch losses and hence economic losses, but would increase the species caught above MCRS. Thanks to MCRS and the strong enforcement needed to accompany it from the authorities, fish are prevented from being caught at a young age/small size before they grow up, in other words, growth overfishing is prevented. Rebuilding fisheries will come at a cost at present, but will yield

much higher rewards in the future, so the future potential of the resources need to properly valued to account for this. In the context of mixed-species fisheries, advanced species separation tools (use of grids, etc.) are recommended in addition to mesh size regulation for improved fisheries management (Stewart, 2002; Memarzadeh *et al.*, 2019). To ensure the sustainability of multispecies Mediterranean demersal fisheries without causing major social problems, Fiorentino & Vitale (2021) suggested choosing the optimal fishing effort of the small and medium-sized species (crustaceans, cephalopods, fish) that comprise most of the trawling catch using the "pretty good yield" concept.

The two most commercially important species in the Aegean Sea (*Engraulis encrasicolis* and *Sardina pilchardus*) are not protected under species-specific seasonal bans, but are assumed to be protected under the seasonal industrial fishing (purse seine) bans (15 April–31 August in Türkiye and 1 July-31 August, for daytime and 15 December to 28 February, for night purse seines in Greece). Thus, these stocks are unprotected during winter spawning season for *S. pilchardus* (Cihangir, 1991; Akyol *et al.*, 1996) for Türkiye (Dereli *et al.*, 2022), and during the summer spawning season for *E. encrasicolis* for Greece (as this species is also targeted by the night purse seines). In addition, the closed season for the Greek night purse seine during winter has no effect on anchovy, and a displacement towards September-November will be beneficial both to sardine and anchovy stocks, by protecting at the same time the young anchovy of the year and the onset of the sardine spawning season (Somarakis *et al.*, 2007). One additional remedy for key commercial species proposed by Fiorentino & Vitale (2021) is to adopt individual catch quotas, leaving a calculated amount of the stock left to replenish their populations.

Another additional application in the Aegean Sea to protect spawning habitats and juveniles from the effects of fishing is the assignment of Special Protected Areas (SPAs) and Marine and Coastal Protected Areas (MCPAs) where fishing is partially or permanently restricted for some sectors. Approximately more than 100 Special Protected Areas (SPAs) in Greece have been defined (Aegean and Ionian Sea: Petza *et al.*, 2017 and Moutopoulos *et al.*, 2020, respectively) and 15 MPA's exist in Türkiye (Aegean Sea: Güçlüsoy, 2015). In addition to these, many protected areas, mainly gulfs and bays, have been specifically restricted from OTB and PS fishing in Türkiye (Dereli *et al.*, 2022) and Greece (Moutopoulos *et al.*, 2016, 2020). However, for these areas to be effective, they must be complemented with adequate monitoring, control and surveillance capabilities instead of just being 'paper parks'.

These results clearly demonstrate the key differences and few similarities between Greece and Türkiye regarding the implementation of species-specific fisheries management measures, which highlights the inequities of the measures for shared stocks and biodiversity. As both states are active members of GFCM, a regional fisheries management organization that has been working since 1949 to develop coherent fisheries policies and harmonized management measures for sustainable fishing in the Mediterranean and Black Seas, we suggest the GFCM could play an integral role to help harmonize the regulations in this sea between the two neighbouring states in the future, to help improve the efficacy of such policies. In this context, the implementation of a logbook system to record catches and trip-related information, which is mandatory for vessels greater than 12 meters in Türkiye since 2012 and 10 meters in Greece since 2014, could beneficially improve the quality of fisheries data on both sides of the Aegean Sea. The same requirement applies also to VMS data, which has been mandatory since 2016 in Türkiye and for much longer in Greece. Additionally, Greece operates a national monitoring program that collects biological data from fisheries under the EU Data Collection Framework. However, taken into account the lack of robust fisheries data in Aegean stocks and the lack of many missing points in the DCF dataset (STECF, 2023) there is a need for reliable fisheries data through a decent stratified statistical survey for monitoring the official fisheries statistics (Moutopoulos & Koutsikopoulos, 2014). In this context, a harmonisation of the DCF and HELSTAT fisheries data should be taken place to reduce the uncertainty of the reported data. Also, the newly established alien species in the region should be incorporated into the statistics platforms as soon as possible, to better understand their trends. Lack of collaboration may threaten sustainability, reduce economic performance and increase conflicts between the two neighbouring states.

Management measures should focus on stock rebuilding, which is the necessary step towards achieving sustainable fisheries, as many stocks have been depleted to alarmingly low levels (Demirel *et al.*, 2020; Tsikliras *et al.*, 2021). When rebuilding fisheries from critical levels, every attempt should be made to ensure that important early life stages are provided the best chance of survival, specifically that species are able to spawn at least once before caught, that their spawning season is protected and that their recruits have a fair chance of survival.

Naturally rare species and species with poor conservation statuses may require special protection or management through measures such as a prohibition on catch, injury and interference, or critical areas applied to them. A relatively recent development on this front is the identification and protection of their essential and critical habitats, a new initiative taking shape for cetaceans and elasmobranchs under the IUCN's Important Marine Mammal Areas (IMMA's) and Important Shark and Ray Areas (ISRAs), which are (to be) placed to protect known feeding, mating, spawning or transit routes. Statutes and regulations governing commercial fishery/protected species interactions provide for the conservation and recovery of protected marine species. Some species of marine mammals, sea turtles, and fish are listed under the Endangered Species Act of 1973, and all marine mammals are managed under the Marine Mammal Protection Act of 1972 (Allen, 2000).

Considering the connections drawn between the findings and the broader realm of fishery management, it is pertinent to underscore that the management measures

outlined herein necessitate the concurrent implementation of joint effective monitoring, rigorous enforcement, and improved governance, constituting fundamental prerequisites for ensuring efficacious fisheries management.

Furthermore, pivotal to the attainment of comprehensive fisheries management is the imperative of fostering a spirit of compromise and concerted endeavors to accord due valuation to the natural resources of the region. Through the cultivation of collaborative frameworks and the adoption of holistic management paradigms, Greece and Türkiye seem to be more obliged than ever to stand poised to advance endeavors aimed at fostering the enduring sustainability of shared fisheries resources in the Aegean Sea, thereby fortifying both environmental robustness and socioeconomic resilience.

Conclusions

Although data gaps and coherence issues are frequently mentioned as serious discrepancies in Aegean stock assessment methods (STECF, 2022), certain approaches implemented in the area have shown that 70% of the 20 stocks targeted by the Greek fleet in the Aegean Sea and 43% of the 54 non-targeted stocks are unsustainable (Tsikliras *et al.*, 2021). Similarly, 85% of 54 stocks along Turkish coasts are overfished (Demirel *et al.*, 2020). As a solution, fishing mortality rates should first be reduced and this should be complemented by other effective management measures such as improving MCRS effectiveness and incorporating the Ecosystem Approach to Fisheries (EAF) (Demirel *et al.*, 2020). Recently, encouraging and successful cases in the Aegean and Mediterranean regarding the transition to EAF stand out (Vasconcellos & Ünal, 2022). On the other hand, many experiences and studies have shown that sustainable fisheries cannot be achieved through monitoring and control measures unless there is an agreed Multiannual management plan (MAP) that aligns management objectives and resulting management (technical measures) (Cochrane & Garcia, 2009). The lack of MAP in the Aegean Sea fisheries should be resolved by agreement between Greece and Türkiye. The management system needs to be revamped so that it prioritizes the rebuilding of wild marine fisheries, so there is a chance of sustaining the resources for future food security and livelihoods. In the transboundary waters of the Aegean Sea, sharing knowledge and streamlined measures between Greece and Türkiye contributes towards harmonized fisheries management in the context of the ecosystem approach to fisheries. However, ensuring sustainability for the shared stocks as well as comprehensive fisheries management requires more than the above-mentioned, it will require some compromise now in lieu of reversing the decline of most commercial stocks, and perhaps properly valuating the potential of the future resources can help assign more importance to these natural resources (Sumaila, 2021).

Acknowledgements

The authors would like to thank the editor and referees for their comments to improve the paper and also express their gratitude to Dr. N. Demirel Erol and Dr. E. M. Tıraşın for valuable suggestions and guidance in the initial stages of the study.

References

Abaunza, P., Gordo, L., Karlou-Riga, C., Murta, A., Eltink, A.T.G.W. *et al.*, 2003. Growth and reproduction of horse mackerel, *Trachurus trachurus* (Carangidae). *Reviews in Fish Biology and Fisheries*, 13, 27-61.

Abou Shabana, N.M., Abd El Rahma, S.H., Al Absawy, M.A., Assem, S.S., 2012. Reproductive biology of *Argyrosomus regius* (Asso, 1801) inhabiting the south eastern Mediterranean Sea Egypt. *Egyptian Journal of Aquatic Research*, 38, 147-156.

Acarli, S., Lök, A., Kirtik, A., Acarli, D., Serdar, S. *et al.*, 2015. Seasonal variation in reproductive activity and biochemical composition of flat oyster (*Ostrea edulis*) in the Homa Lagoon, Izmir Bay, Turkey. *Scientia Marina*, 79 (4), 487-495.

Akyol, O., Tokaç, A., Ünsal, S., 1996. A study on the growth and reproduction of sardine (*Sardina pilchardus* Walbaum, 1792) distributed in the Gulf of İzmir (Aegean Sea). *Ege Journal of Fisheries and Aquatic Sciences*, 13 (3-4), 383-394.

Allaya, H., Faleh, A.B., Rebaya, M., Zrelli, S., Hattour, A. *et al.*, 2017. Morphological differences between two populations of the little tunny, *Euthynnus alletteratus* (Rafinesque, 1810) in Tunisian Waters (Central Mediterranean Sea). *Pakistan Journal of Zoology*, 49 (5), 1621-1629.

Allen, L.K., 2000. Protected species and New England fisheries: an overview of the problem and conservation strategies. *Northeastern Naturalist*, 7 (4), 411-418.

Anonymous, 2020. *Notification 5/1. The commercial fish catching regulations in 2020-2024 fishing period (in Turkish). Republic of Türkiye Ministry of Food, Agriculture and Livestock, General Directorate of Fisheries and Aquaculture, Ankara.* https://www.tarimorman.gov.tr (Accessed 01 February 2023).

AO El-Aiatt, A., 2020. Reproductive biology of the Atlantic mackerel *Scomber scombrus* Linnaeus, 1758 in Mediterranean coast of Sinai, Egypt. *Egyptian Journal of Aquatic Biology and Fisheries*, 24 (1), 189-201.

Apostologamvrou, C., Vlachou, M., Theocharis, A., Ntavaros, C., Klaoudatos, D., 2023. Reproductive aspects of European hake, (*Merluccius merluccius*, Linnaeus, 1758) based on histological depiction of both sexes in the Eastern Mediterranean (Aegean Sea). *Regional Studies in Marine Science*, 68, 103281.

Arslan, M., İşmen, A., 2013. Age, growth and reproduction of *Mullus surmuletus* (Linnaeus, 1758) in Saros Bay (northern Aegean Sea). *Journal of Black Sea/Mediterranean Environment*, 19 (2), 217-233.

Aydin, I., Aydin, C., 2011. Length-length and length-weight relationships in *Nephrops norvegicus* from the Aegean Sea (Linnaeus, 1758). *Mediterranean Marine Science*, 12

(1), 121-128.

Aydın, C., Tosunoğlu, Z., 2010. Selectivity of diamond, square and hexagonal mesh codends for Atlantic horse mackerel *Trachurus trachurus*, European hake *Merluccius merluccius*, and greater forkbeard *Phycis blennoides* in the eastern Mediterranean. *Journal of Applied Ichthyology*, 26 (1), 71-77.

Bargione, G., Donato, F., Barone, G., Virgili, M., Penna, P. *et al.*, 2021. *Chamelea gallina* reproductive biology and Minimum Conservation Reference Size: implications for fishery management in the Adriatic Sea. *BMC Zoology*, 6 (1), 1-16.

Bilgin, S., Bal, H., Taşçı, B., 2012. Length based growth estimates and reproduction biology of whiting, *Merlangius merlangus euxinus* (Nordman, 1840) in the Southeast Black Sea. *Turkish Journal of Fisheries and Aquatic Sciences*, 12, 871-881.

Brčić, J., Herrmann, B., De Carlo, F., Sala, A., 2015. Selective characteristics of a shark-excluding grid device in a Mediterranean trawl. *Fisheries Research*, 172, 352-360.

Brusle, J., Brusle, S., 1977. Les muges de Tunisie: pêche lagunaire et biologie de la reproduction de trois espèces (*Mugil capito*, *Mugil cephalus* et *Mugil chelo*) des lacs d'Ichkeul et de Tunis. *Bulletin de la Commission Internationale pour l'Exploration Scientifique de la Mer Mediterranee*, 24 (5), 101-130.

Campillo, A., 1992. *Les pêcheries françaises de Méditerranée: synthèse des connaissances.* IFREMER, France.

Carbonara, P., Constantino, G., Giovine, G., Lembo, G., Spedicato, M.T. *et al.*, 2003. Some aspects of the life history of *Polyprion americanus* (Schneider, 1801) along the coasts of the north western Ionian Sea. *Biologia Marina Mediterranea*, 10, 102-112.

Cengiz, Ö., 2012. Age, growth, mortality and reproduction of the chub mackerel (*Scomber japonicus* Houttuyn, 1782) from Saros Bay (Northern Aegean Sea, Turkey). *Turkish Journal of Fisheries and Aquatic Sciences*, 12 (4), 799-809.

Cengiz, O., Ismen, A., Ozekinci, U., 2014. Reproductive biology of the spotted flounder, *Citharus linguatula* (Actinopterygii: Pleuronectiformes: Citharidae), from Saros Bay (northern Aegean Sea, Turkey). *Acta Ichthyologica et Piscatoria*, 44 (2), 123-129.

Cerim, H., Ateş, C., 2019. Reproductive biology of female common sole, *Solea solea* (Linnaeus, 1758) in the southern Aegean Sea. *Acta Biologica Turcica*, 32 (3), 143-148.

Cetinić, P., Soldo, A., Dulĉić, J., Pallaoro, A., 2002. Specific method of fishing for Sparidae species in the eastern Adriatic. *Fisheries Research*, 55, 131-139.

Ceyhan, T., Akyol, O., Ayaz, A., Juanes, F., 2007. Age, growth, and reproductive season of bluefish (*Pomatomus saltatrix*) in the Marmara region, Turkey. *ICES Journal of Marine Science*, 64 (3), 531-536.

CFR, 2022. *EU Common Fleet Register (CFR) System*. https://webgate.ec.europa.eu/fleet-europa/index_en (Accessed 20 January 2023).

Cihangir, B., 1991. *Growth and reproduction of sardine (Sardina pilchardus Walbaum, 1792) in the Aegean Sea*. PhD Thesis. Dokuz Eylül University, Turkey, 84 pp.

Cochrane, K.L., Garcia, S.M. (Eds.), 2009. *A fishery manager's guidebook.* John Wiley & Sons, Oxford, 507 pp.

Corriero, A., Karakulak, S., Santamaria, N., Deflorio, M., Spedicato, D. *et al.*, 2005. Size and age at sexual maturity of female bluefin tuna (*Thunnus thynnus* L. 1758) from the Mediterranean Sea. *Journal of Applied Ichthyology*, 21, 483-486.

Çiloğlu, E., 2005. Determination of the recruitment to stock and reproduction period for flounder (*Platichthys flesus luscus* Pallas, 1811) along the Trabzon-Rize Coast, Eastern Black Sea. *Turkish Journal of Veterinary and Animal Sciences*, 29 (1), 43-48.

Çolakoğlu, S., Palaz, M., 2015. Population structure and dynamics of warty venus, *Venus verrucosa* (Bivalvia, Veneridae), in North Aegean Sea, Turkey. *Journal of Shellfish Research*, 34 (2), 347-354.

Demirel, N., Zengin, M., Ulman, A., 2020. The first large-scale Eastern Mediterranean and Black Sea stock assessment reveals a dramatic decline. *Frontiers in Marine Science*, 7, 103.

Derbali, A., Jarboui, O., Ghorbel, M., 2009. Reproductive biology of the cockle *Cerastoderma glaucum* (Mollusca: Bivalvia) from the north coast of Sfax (Gulf of Gabes, Tunisia). *Ciencias Marinas*, 35 (2), 141-152.

Dereli, H., Erdem, M., 2011. Spawning period and first maturity size of deep water rose shrimp (*Parapenaeus longirostris*) in the Aegean Sea. *African Journal of Biotechnology*, 10 (68), 15407-15415.

Dereli, H., Aydın, C., 2016. Selectivity of commercial and alternative codends for four species in the Eastern Mediterranean demersal trawl fishery. *Turkish Journal of Fisheries and Aquatic Sciences*, 16 (4), 971-992.

Dereli, H., Çulha, S.T., Çulha, M., Özalp, B.H., Tekinay, A.A., 2016. Reproduction and population structure of the sea cucumber *Holothuria tubulosa* in the Dardanelles Strait, Turkey. *Mediterranean Marine Science*, 17 (1), 47-55.

Dereli, H., Ünal, V., Miliou, A., Tsimpidis, T., Trompouki, I. *et al.*, 2022. Comparison of technical measures in the Aegean Sea to support harmonization of fisheries management policies. *Acta Ichthyologica et Piscatoria*, 52 (2), 111-123.

Deval, M.C., 2009. Growth and reproduction of the wedge clam (*Donax trunculus*) in the Sea of Marmara, Turkey. *Journal of Applied Ichthyology*, 25 (5), 551-558.

Dulvy, N.K., Allen, D.J., Ralph, G.M., Walls, R.H.L., 2016. The conservation status of Sharks, Rays and Chimaeras in the Mediterranean Sea [Brochure]. IUCN, Malaga, Spain.

Dulvy, N.K., Pacoureau, N., Rigby, C.L., Pollom, R.A., Jabado, R.W., *et al.*, 2021. Overfishing drives over one-third of all sharks and rays toward a global extinction crisis. *Current Biology*, 31 (21), 4773-4787.

Ebert, D., Dando, M., 2021. *Field Guide to Sharks, Rays & Chimaeras of Europe and the Mediterranean*. Wild Nature Press, Plymouth, 280 pp.

Ekmekci, B., Ünal, V., 2019. Analysis of the second generation buy-back program for fishing vessels in Turkey. *Ege Journal of Fisheries and Aquatic Sciences*, 36 (3), 229-243.

Elhasni, K., Vasconcelos, P., Ghorbel, M., Jarboui, O., 2013. Reproductive cycle of *Bolinus brandaris* (Gastropoda: Muricidae) in the Gulf of Gabès (southern Tunisia). *Mediterranean Marine Science*, 14 (1), 24-35.

Engin, S., Seyhan, K., 2009. Age, growth, sexual maturity and food composition of *Sciaena umbra* in the south-eastern Black Sea, Turkey. *Journal of Applied Ichthyology*, 25 (1), 96-99.

Englander, G., 2019. Property rights and the protection of global marine resources. *Nature Sustainability*, 2, 981-987.

Eryilmaz, L., Dalyan, C., 2015. Age, growth, and reproductive biology of turbot, *Scophthalmus maximus* (Actinopterygii: Pleuronectiformes: Scophthalmidae), from the south-western coasts of Black Sea, Turkey. *Acta Ichthyologica et Piscatoria*, 45 (2), 181-188.

EU, 2019. Regulation (EU) 2019/1241 of the European Parliament and of the Council of 20 June 2019 on the Conservation of Fisheries Resources and the Protection of Marine Ecosystems through Technical Measures. *Official Journal of the European Union* L198, 105-201.

Fakıoğlu, E., Gillham, R., Hood, A., Kabasakal, H., Oruc, A. *et al.*, 2021. *Mediterranean Angel Sharks: Subregional Action Plan (SubRAP) GSA24, Northern Levant Sea*. SharkTrust, 12 pp.

FAO, 2009. *Sharks and Rays of the Mediterranean and Black Sea*. FAO Species Identification Cards, 113 p.

FAO, 2020. *The state of Mediterranean and Black Sea fisheries 2020*. General Fisheries Commission for the Mediterranean, 172 pp.

FAO, 2023. *The state of Mediterranean and Black Sea fisheries 2023-Special edition*. General Fisheries Commission for the Mediterranean, 38 pp.

Fernández-Corredor, E., Ouled-Cheikh, J., Navarro, J., Coll, M. 2024. An overview of the ecological roles of Mediterranean chondrichthyans through extinction scenarios. *Reviews in Fish Biology and Fisheries*, 34 (1), 421-438.

Ferreri, R., Genovese, S., Barra, M., Biagiotti, I., Bourdeix, J.H. *et al.*, 2021. Variability in size at maturity of the European anchovy (*Engraulis encrasicolus)* in the Mediterranean Sea. *Mediterranean Marine Science*, 22 (4), 858-870.

Ferretti, F., Myers, R.A., Serena, F., Lotze, H.K. 2008. Loss of large predatory sharks from the Mediterranean Sea. *Conservation Biology*, 22 (4), 952-964.

Fiorentino, F., Vitale, S., 2021. How can we reduce the overexploitation of the Mediterranean resources? *Frontiers in Marine Science*, 8, 674633.

Froese, F., Pauly, D., 2020. *Fish Base*. www.fishbase.org (Accessed 17 March 2022).

Galimany, E., Baeta, M., Durfort, M., Lleonart, J., Ramón, M. 2015. Reproduction and size at first maturity in a Mediterranean exploited *Callista chione* bivalve bed. *Scientia Marina*, 79 (2), 233-242.

Gatt, M., Dimech, M., Schembri, P., 2015. Age, growth and reproduction of *Coryphaena hippurus* (Linnaeus, 1758) in Maltese waters, Central Mediterranean. *Mediterranean Marine Science*, 16 (2), 334-345.

GDFA, 2022. *SUBIS System of General Directorate of Fisheries and Aquaculture*. https://hbs.tarbil.gov.tr/Main/Main (Accessed 18 March 2022).

GFCM, 2021. *GFCM capture production (1970-2018)*. http://www.fao.org/gfcm/data/capture-production/en/ (Accessed 20 January 2021).

Goñi, R., Quetglas, A., Reñones, O., 2003. Size at maturity, fecundity and reproductive potential of a protected population of the spiny lobster *Palinurus elephas* (Fabricius, 1787) from the western Mediterranean. *Marine Biology*, 143 (3), 583-592.

Gordon, C., Hood, A., Giovos, I., Naasan Aga-Spyridopoulou, R., Öztürk, A. *et al.*, 2020. *Mediterranean Angel Sharks: SubRegional Action Plan (SubRAP) GSAs 22/23 (Aegean Sea and Crete)*, 12 pp.

Gökçe, M.A., Cengizler, İ., Özak, A.A., 2003. Gonad histology and spawning pattern of the white grouper (*Epinephelus aeneus*) from İskenderun Bay (Turkey). *Turkish Journal of Veterinary and Animal Sciences*, 27 (4), 957-964.

Güçlüsoy, H., 2015. Marine and coastal protected areas of Turkish Aegean coasts. p. 669-684. In: *The Aegean Sea*. Katağan, T., Tokaç, A., Beşiktepe, Ş., Öztürk, B. (Eds). Turkish Marine Research Foundation (TUDAV), İstanbul.

Güneş, E., Şahin, T., Düzgüneş, E., 2011. Age, growth and reproduction of Flounder (*Platichthys flesus luscus* Pallas, 1811) in the South-eastern Black Sea. *Turkish Journal of Science & Technology*, 6 (2), 53-59.

HELSTAT, 2022. *Results of the sea fishery survey by motor boats (for the years 1982-2017).* Hellenic Statistical Authority. https://www.statistics.gr/en/home/ (Accessed 10 April 2022).

Hunter, E., 1999. Biology of the European Spiny Lobster, *Palinurus elephas* (Fabricius, 1787) (Decapoda, Palinuridea). *Crustaceana*, 545-565.

İlkyaz, A.T., Metin, G., Soykan, O., Kinacigil, H.T., 2018. Spawning season, first maturity length and age of 21 fish species from the central Aegean Sea, Turkey. *Turkish Journal of Fisheries and Aquatic Sciences*, 18 (1), 211-216.

İşmen, A., İşmen, P., Başusta, N., 2004. Age, growth and reproduction of Tub Gurnard (*Chelidonichthys lucerna* L. 1758) in the Bay of Iskenderun in the eastern Mediterranean. *Turkish Journal of Veterinary and Animal Sciences*, 28 (2), 289-295.

IUCN, 2021. *The International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species*. https://www.iucnredlist.org/ (Accessed 20 March 2021).

Kahraman, A.E., Göktürk, D., Yıldız, T., Uzer, U., 2014. Age, growth, and reproductive biology of Atlantic bonito (*Sarda sarda* Bloch, 1793) from the Turkish coasts of the Black Sea and the Sea of Marmara. *Turkish Journal of Zoology*, 38, 614-621.

Kallianiotis, A., Torre, M., Argyri, A., 2005. Age, growth, mortality, reproduction and feeding habits of the striped seabream, *Lithognathus mormyrus* (Pisces: Sparidae) in the coastal waters of the Thracian Sea, Greece. *Scientia Marina*, 69 (3), 391-404.

Kara, A., Acarli, D., İlkyaz, A.T., Babaoğlu, A.Ö., 2020. Length-weight and length-length relations for 21 fish species caught in Izmir Bay. *Acta Adriatica: International Journal of Marine Sciences*, 61 (2), 197-204.

Karakulak, S., Oray, I., Corriero, A., Aprea, A., Spedicato, D. *et al.*, 2004. First information on the reproductive biology of the bluefin tuna (*Thunnus thynnus*) in the eastern Mediterranean. *Collective Volume of Scientific Papers*, 56 (3), 1158-1162.

Kazanidis, G., Lolas, A., Vafidis, D., 2014. Reproductive cycle of the traditionally exploited sea cucumber *Holothuria tubulosa* (Holothuroidea: Aspidochirotida) in Pagasitikos Gulf, western Aegean Sea, Greece. *Turkish Journal of Zoology*, 38 (3), 306-315.

Kesiktaş, M., Yemişken, E., Yildiz, T., Eryilmaz, L., 2020. Age,

growth and reproduction of the golden grey mullet, *Chelon auratus* (Risso, 1810) in the Golden Horn Estuary, Istanbul. *Journal of the Marine Biological Association of the United Kingdom*, 100, 989-995.

Koutrakis, E.T., 2011. Reproductive biology of two grey mullet species (Actinopterygii: Mugiliformes: Mugilidae) in a northern Aegean Sea estuarine system. *Acta Ichthyologica et Piscatoria*, 41 (1), 37-46.

Krug, H., 1998. Variation in the reproductive cycle of the blackspot seabream, *Pagellus bogaraveo* (Brünnich, 1768) in the Azores. *Arquipélago Life and Marine Sciences*, 16, 37-47.

Macías, D., Hattour, A., De la Serna, J.M., Gómez-Vives, M.J., Godoy, D., 2005. Reproductive characteristics of swordfish (*Xiphias gladius*) caught in the southwestern Mediterranean during 2003. *Collective Volume of Scientific Papers,* 58 (2), 454-469.

Mannini, A., Simmonds, J. (Eds), 2021. *Stock assessments in the Mediterranean Sea 2021 – Adriatic and Ionian Seas (STECF-21-15)*. Scientific, Technical and Economic Committee for Fisheries (STECF), Publications Office of the European Union, Luxembourg, 546 pp.

Matić-Skoko, S., Ferri, J., Kraljević, M., Pallaoro, A., 2012. Age estimation and specific growth pattern of boxlip mullet, *Oedalechilus labeo* (Cuvier, 1829) (Osteichthyes, Mugilidae), in the eastern Adriatic Sea. *Journal of Applied Ichthyology*, 28 (2), 182-188.

Matić-Skoko, S., Stagličić, N., Kraljević, M., Pallaoro, A., Dulčić, J., 2015. The biological traits of the large red scorpionfish, *Scorpaena scrofa*: Temporal and ontogenetic dynamics. *Estuarine, Coastal and Shelf Science*, 152, 91-99.

McWhinnie, S.F., 2009. The tragedy of the commons in international fisheries: An empirical examination. *Journal of Environmental Economics and Management*, 57 (3), 321-333.

Memarzadeh, M., Britten, G.L., Worm, B., Boettiger, C., 2019. Rebuilding global fisheries under uncertainty. *Proceedings of the National Academy of Sciences*, 116 (32), 15985-15990.

Metaxatos, A., 2004. Population dynamics of the venerid bivalve *Callista chione* (L.) in a coastal area of the eastern Mediterranean. *Journal of Sea Research*, 52 (4), 293-305.

Miller, K., Munro, G. 2002. Cooperation and Conficts in the Management of Transboundary Fishery Resources. P. In: *Second World Congress of the American and European Associations of Environmental and Resource Economic, Monterey*, 13-16 June 2002, California, USA.

Mohamed, H., El-Haweet, A.E., Sabry, E., 2014. Reproductive biology of little tunny, *Euthynnus alletteratus* (Rafinesque 1810) in the eastern coast of Alexandria, Egypt. *Egyptian Journal of Aquatic Biology and Fisheries*, 18 (1), 139-150.

Morales-Nin, B., Moranta, J., 1997. Life history and fishery of the common dentex (*Dentex dentex*) in Mallorca (Balearic Islands, western Mediterranean). *Fisheries Research*, 30 (1-2), 67-76.

Mouine, N., Francour, P., Ktari, M.H., Chakroun-Marzouk, N., 2012. Reproductive biology of four Diplodus species *Diplodus vulgaris*, *D. annularis*, *D. sargus sargus* and *D. puntazzo* (Sparidae) in the Gulf of Tunis (central Mediterranean). *Journal of the Marine Biological Association of the United Kingdom*, 92 (3), 623-631.

Moutopoulos, D.K., 2020. Greece (including Crete): Updated catch reconstruction to 2018, p. 179-187. In: *Updating to 2018 the 1950-2010 Marine Catch Reconstructions of the Sea Around Us: Part I – Africa, Antarctica, Europe and the North Atlantic.* Derrick, B., Khalfallah, M., Relano, V., Zeller, D., Pauly, D. (Eds), The University of British Columbia Faculty Research and Publications, Vancouver.

Moutopoulos, D.K., Koutsikopoulos, C., 2014. Fishing strange data in national fisheries statistics of Greece. *Marine Policy*, 48, 114-122.

Moutopoulos, D.K., Prodromitis, G., Katselis, G., Koutsikopoulos, C., 2020. Mapping fisheries hot-spot and high-violated fishing areas in professional and recreational small-scale fisheries. *Aquaculture and Fisheries*, 5 (5), 265-272.

Moutopoulos, D.K., Prodromitis, G., Mantzouni, I., Koutsikopoulos, C., 2016. Quantifying the implementation of Common Fisheries Policy: Patterns of fisheries violations and penalties imposed in Greek waters. *Marine Policy*, 70, 65-76.

Moutopoulos, D.K., Stergiou, K.I., 2002. Length–weight and length–length relationships of fish species from the Aegean Sea (Greece). *Journal of Applied Ichthyology*, 18 (3), 200-203.

Moutopoulos, D.K., Tsikliras, A.C., Stergiou, K.I., 2015. Reconstruction of Greek fishery catches by fishing gear and area (1950-2010). Fisheries Centre, University of British Columbia. Working Paper Series, (2015-11), 1-14.

Mytilineou, C., Herrmann, B., Mantopoulou-Palouka, D., Sala, A., Megalofonou, P., 2018. Modelling gear and fishers size selection for escapees, discards, and landings: a case study in Mediterranean trawl fisheries. *ICES Journal of Marine Science*, 75 (5), 1693-1709.

Nakamura, I., 1986. Xiphiidae. pp. 1006-1007. In: *Fishes of the North-Eastern Atlantic and the Mediterranean.* Whitehead, P.J.P., Bauchot, M.L., Hureau, J.C., Nielsen, J., Tortonese, E. (Eds.). UNESCO, Paris.

Özbilgin, H., Eryaşar, A.R., Gökçe, G., Özbilgin, Y.D., Bozaoğlu, A.S. *et al.*, 2015. Size selectivity of hand and machine woven codends and short term commercial loss in the Northeastern Mediterranean. *Fisheries Research*, 164, 73-85.

Özbilgin, H., Tosunoğlu, Z., Tokaç, A., Metin, G., 2011. Seasonal variation in the trawl codend selectivity of red mullet (*Mullus barbatus*). *Turkish Journal of Fisheries and Aquatic Sciences*, 11 (2), 191-198.

Özpiçak, M., Saygın, S., Polat, N., 2017. The length-weight and length-length relationships of bluefish, *Pomatomus saltatrix* (Linnaeus, 1766) from Samsun, middle Black Sea region. *Natural and Engineering Sciences*, 2 (3), 28-36.

Özyurt, C.E., Çiçek, E., Avşar, D., Yeldan, H., Manaşırlı, M., 2014. The relationship among spawning period, length at first maturity and depth distribution of *Mullus barbatus* and *Upeneus moluccensis* inhabiting the Northeastern Mediterranean coast of Turkey. *International Journal of Aquatic Biology*, 2 (4), 215-222.

Palacios-Abrantes, J., Reygondeau, G., Wabnitz, C.C., Cheung, W.W., 2020. The transboundary nature of the world's exploited marine species. *Scientific Reports*, 10 (1), 1-12.

Palomares, M.L.D., Pauly, D., 2020. SeaLifeBase. www.sealifebase.org (Accessed 27 December 2020).

Papaconstantinou, C., Zenetos, A., Vassilopoulou, V., Tserpes,

G. (Eds.), 2007. *State of Hellenic Fisheries*. HCMR Publ., Athens, 466 pp.

Petza, D., Maina, I., Koukourouvli, N., Dimarchopoulou, Akrivos, D., Kavadas, S. *et al.*, 2017. Where not to fish-Reviewing and mapping fisheries restricted areas in the Aegean Sea. *Mediterranean Marine Science*, 18 (2), 310-323.

Piroddi, C., Colloca, F., Tsikliras, A.C., 2020. The living marine resources in the Mediterranean Sea large marine ecosystem. *Environmental Development*, 36, 100555.

Popović, Z., Mladineo, I., Ezgeta-Balić, D., Trumbić, Ž., Vrgoč, N. *et al.*, 2013. Reproductive cycle and gonad development of *Venus verrucosa* L. (Bivalvia: Veneridae) in Kaštela Bay, Adriatic Sea. *Marine Biology Research*, 9 (3), 274-284.

Quetglas, A., Gaamour, A., Reñones, O., Missaoui, H., Zarrouk, T. *et al.*, 2004. Common spiny lobster (*Palinurus elephas* Fabricius 1787) fisheries in the western Mediterranean: A comparison of Spanish and Tunisian fisheries. *Bolletí de la Societat d'Història Natural de les Balears*, 47, 63-80.

Relini, L.O., Zamboni, A., Fiorentino, F., Massi, D., 1998. Reproductive patterns in Norway lobster (*Nephrops norvegicus* L., Crustacea Decapoda Nephropidae) of different Mediterranean areas. *Scientia Marina*, 62 (S1), 25-41.

Renones, O., Grau, A., Mas, X., Riera, F., Saborido-Rey, F., 2006. Reproductive pattern of an exploited dusky grouper *Epinephelus marginatus* (Lowe 1834) (Pisces: Serranidae) population in the western Mediterranean. *Scientia Marina*, 74, 3.

Sağlam, H., Düzgüneş, E., Öğüt, H., 2009. Reproductive ecology of the invasive whelk *Rapana venosa* Valenciennes, 1846, in the southeastern Black Sea (Gastropoda: Muricidae). *ICES Journal of Marine Science*, 66 (9), 1865-1867.

Sala, A., Lucchetti, A., Piccinetti, C., Ferretti, M., 2008. Size selection by diamond-and square-mesh codends in multi-species Mediterranean demersal trawl fisheries. *Fisheries Research*, 93 (1-2), 8-21.

Sánchez, P., Obarti, R., 1993. The biology and fishery of *Octopus vulgaris* caught with clay pots on the Spanish Mediterranean coast. p. 477-487. In: *Recent Advances in Fisheries Biology*. Tokai University Press, Tokyo.

Serdar, S., Lök, A., 2010. Monthly variations in gonadal development and biochemical composition of the carpet shell clam *Ruditapes* (*Tapes*) *decussatus*, Linnaeus 1758 in Mersin Bay, Aegean Sea, Turkey. *Fresenius Environmental Bulletin*, 19 (6), 1055-1063.

Silva, L., Sobrino, I., Ramos, F., 2002. Reproductive biology of the common octopus, *Octopus vulgaris* Cuvier, 1797 (Cephalopoda: Octopodidae) in the Gulf of Cádiz (SW Spain). *Bulletin of Marine Science*, 71 (2), 837-850.

Sley, A., Hadj Taeib, A., Jarboui, O., Ghorbel, M., Bouain, A., 2014. Reproductive biology of greater amberjack *Seriola dumerili* (Risso, 1810) from the eastern Mediterranean Sea (Tunisia, Gulf of Gabes). *Cahiers de Biologie Marine*, 55 (4), 421-430.

Somarakis, S., Tsianis, D., Nikolioudakis, N., Machias, A., Stergiou, K.I., 2007. Short-term trends in anchovy and sardine catch/day in Greek waters. *Rapport de la Commission Internationale pour l'Exploration Scientifique de la Mer Méditerranée,* 38, 604.

Soykan, O., İlkyaz, A.T., Metin, G., Kinacigil, H.T., 2015. Growth and reproduction of *Boops boops*, *Dentex macrophthalmus*, *Diplodus vulgaris*, and *Pagellus acarne* (Actinopterygii: Perciformes: Sparidae) from east-central Aegean Sea, Turkey. *Acta Ichthyologica et Piscatoria*, 45 (1), 39-55.

STECF, 2022. Scientific, Technical and Economic Committee for Fisheries (STECF) – 71st Plenary report (STECF-PLEN-22-03). Publications Office of the European Union, Luxembourg, 2023, doi:10.2760/016673, JRC132078.

STECF, 2023. Scientific, Technical and Economic Committee for Fisheries (STECF)- Stock Assessments in the Adriatic, Ionian and Aegean Seas and Strait of Sicily (STECF-23-12), Publications Office of the European Union, Luxembourg, 2023, https://stecf.jrc.ec.europa.eu/documents/d/stecf/stecf-23-12-med-asses-adriatic-plus

STECF, 2024. Scientific Technical and Economic Committee for Fisheries (STECF)- Fisheries Dependent Information FDI, Publications Office of the European Union, Luxembourg, 2024, https://stecf.jrc.ec.europa.eu/documents/d/stecf/2023_fdi_capacity

Stergiou, K.I., Politou, C.Y., Christou, E.D., Petrakis, G., 1997. Selectivity experiments in the NE Mediterranean: the effect of trawl codend mesh size on species diversity and discards. *ICES Journal of Marine Science*, 54 (5), 774-786.

Stewart, P.A.M., 2002. *A review of studies of fishing gear selectivity in the Mediterranean*. FAO COPEMED report, No. 9, 57 pp.

Sumaila, U.R., Zeller, D., Hood, L., Palomares, M.L.D., Li, Y. *et al.*, 2020. Illicit trade in marine fish catch and its effects on ecosystems and people worldwide. *Science Advances*, 6 (9), eaaz3801.

Sumaila, R., 2021. *Infinity Fish*. Elsevier Press, San Diego, 284 pp.

Sumer, C., Teksam, I., Karatas, H., Beyhan, T., Aydin, C.M., 2013. Growth and reproduction biology of the blue crab, *Callinectes sapidus* Rathbun, 1896, in the Beymelek Lagoon (Southwestern Coast of Turkey). *Turkish Journal of Fisheries and Aquatic Sciences*, 13 (4), 675-684.

Tosunoğlu, Z., Özbilgin, H., Tokaç, A., 2003a. Effects of the protective bags on the cod-end selectivity in Turkish bottom trawl fishery. *Archive of Fishery and Marine Research*, 50, 239-252.

Tosunoğlu, Z., Doğanyılmaz, Y., Özbilgin, H., 2003b. Body shape and trawl codend selectivity for nine commercial fish species. *Journal of the Marine Biological Association of the United Kingdom*, 83, 1309-1313.

Tosunoğlu, Z., Aydın, C., Özaydın, O., 2008. Selectivity of a 50-mm diamond mesh knotless polyethylene codend for commercially important fish species in the Aegean Sea. *Journal of Applied Ichthyology*, 24 (3), 311-315.

Tserpes, G., Peristeraki, P., Somarakis, S., 2001. On the reproduction of swordfish (*Xiphias gladius* L.) in the Eastern Mediterranean. International Commission for the Conservation of Atlantic Tunas. *Collective Volume of Scientific Papers*, 52, 740-744.

Tsikliras, A.C., Antonopoulou, E., 2006. Reproductive biology of round sardinella (*Sardinella aurita*) in north-eastern Mediterranean. *Scientia Marina*, 70 (2), 281-290.

Tsikliras, A.C., Antonopoulou, E., Stergiou, K.I., 2010. Spawning period of Mediterranean marine fishes. *Reviews in Fish Biology and Fisheries*, 20 (4), 499-538.

Tsikliras, A.C., Dinouli, A., Tsiros, V.Z., Tsalkou, E., 2015. The Mediterranean and Black Sea fisheries at risk from overexploitation. *PLoS One*, 10 (3), 1-19.

Tsikliras, A.C., Koutrakis, E.T., 2013. Growth and reproduction of European sardine, *Sardina pilchardus* (Pisces: Clupeidae), in northeastern Mediterranean. *Cahiers de Biologie Marine*, 54 (3), 365-374.

Tsikliras, A.C., Touloumis, K., Pardalou, A., Adamidou, A., Keramidas, I. *et al.*, 2021. Status and exploitation of 74 un-assessed demersal fish and invertebrate stocks in the Aegean Sea (Greece) using abundance and resilience. *Frontiers in Marine Science*, 7, 578601.

Tsitsika, E.V., Maravelias, C.D., Wattage, P., Haralabous, J., 2008. Fishing capacity and capacity utilization of purse seiners using data envelopment analysis. *Fisheries Science*, 74 (4), 730-735.

Tunca, S., Güleç, Ö., Tosunoğlu, Z., 2021. Techno-economic efficiencies of the purse-seiners in the Aegean Sea (Eastern Mediterranean, Turkey). *Ocean & Coastal Management*, 215, 105943.

TURKSTAT, 2022. *Fisheries statistics of Turkish Statistical Institute (TURKSTAT)*. https://biruni.tuik.gov.tr/medas/?locale=tr, 2022 (Accessed 05 July 2022).

Türkmen, M., 2003. Investigation of some population parameters of common sole, *Solea solea* (L., 1758) from Iskenderun Bay. *Turkish Journal of Veterinary and Animal Sciences*, 27, 317-323.

Ulman, A., Pauly, D., 2016. Making history count: The shifting baselines of the Turkish fisheries. *Fisheries Research*, 183 (Nov. 2016), 74-79.

Ünal, V., Göncüoğlu, H., 2012. Fisheries Management in Turkey. p. 263-288. In: *The State of The Turkish Fisheries.* Tokaç, A., Gücü, A.C., Öztürk, B. (Eds). Turkish Marine Research Foundation (TUDAV), İstanbul.

Ünal, V., Göncüoğlu-Bodur, H., 2020a. Analysis of the third generation buy-back program for fishing vessels in Turkey. *Ege Journal of Fisheries and Aquatic Sciences,* 37 (3), 251-258.

Ünal, V., Güncüoğlu-Bodur, H., 2020b. Analysis of the Fourth Generation Buy-Back Program for fishing vessels in Turkey. *COMU Journal of Marine Sciences and Fisheries*, 3 (1), 38-44.

Vasconcellos, M., Ünal, V., (Eds.) 2022. Transition towards an ecosystem approach to fisheries in the Mediterranean Sea – Lessons learned through selected case studies. FAO Fisheries and Aquaculture Technical Paper No. 681. Rome, FAO, 203p. ISBN: 978-92-5-135617-3.

Vassilopoulou, V., Papaconstantinou, C., 1992. Age, growth and mortality of the red porgy, *Pagrus pagrus*, in the Eastern Mediterranean Sea (Dodecanese, Greece). *Vie et Milieu*, 42 (1), 51-55.

Walls, R.H.L., Dulvy, N.K., 2021. Tracking the rising extinction risk of sharks and rays in the Northeast Atlantic Ocean and Mediterranean Sea. *Scientific Reports*, 11, 15397.

Wassef, E., El Emary, H., 1989. Contribution to the biology of bass, *Dicentrarchus labrax* L. in the Egyptian Mediterranean waters off Alexandria. *Cybium*, 13 (4), 327-345.

WWF, 2021. *The Climate Change Effect in the Mediterranean. Six stories from an over heating sea*. WWF Mediterraean Marine Initiative, Rome, 24 pp.

Yapici, S., Filiz, H., 2019. Biological aspects of two coexisting native and non-native fish species in the Aegean Sea: *Pagellus erythrinus* vs. *Nemipterus randalli*. *Mediterranean Marine Science*, 20 (3), 594-602.

Yigin, C.C., Ismen, A., Arslan, M., 2015. Reproductive biology of *Lophius budegassa* (Lophiidae) in the North Aegean Sea. *Cybium*, 39 (1), 31-36.

Yildiz, T., Ulman, A., 2020. Analyzing gaps in policy: Evaluation of the effectiveness of minimum landing sizes (MLS) regulations in Turkey. *Marine Policy*, 115, 103829.

Yildiz, T., Ulman, A., Demirel, N., 2020. A comparison of market landings during fish spawning seasons to better understand the effectiveness of the temporal fishery closure in Turkey. *Ocean & Coastal Management*, 198, 105353.

Supplementary Data

The following supplementary information is available online for the article:

Table S1. Species reported from Aegean Sea by the official statistical authorities of Greece and Türkiye. (+: Indicates that the species is reported).

Table S2. Closed seasons for species in Greece and Turkish Legislations.