CHAPTER 2.1.10.12 NARROW-BARRED SPANISH MACKEREL	AUTHORS: F. LUCENA-FRÉDOU, R. SIQUEIRA LIMA, T. FRÉDOU (UFRPE)	LAST UPDATE: June 2022 Original: English

2.1.10.12 Description of Narrow-barred Spanish mackerel (COM)

1. Names

1.a Classification and taxonomy

Species name: *Scomberomorus commerson* (Lacepède, 1800)
ICCAT species code: COM
ICCAT names: Narrow-barred Spanish mackerel (English), Thazard rayé indo-pacifique (French), Carite estriado indo-pacífico (Spanish)
Synonyms: *Scomber commerson* (Lacepède, 1800); *Scomber commersoni* (Bloch & Schneider, 1801); *Cybium konam* (Bleeker, 1851); *Cybium commersoni* (Cuvier, 1829); *Cybium multifasciatum* (Kishinouye, 1915); *Scomber maculosus* (Shaw, 1803); *Scomberomorus commersoni* (Jordan & Seale, 1906)

According to Collette and Nauen (1983), narrow-barred Spanish mackerel is classified as follows:

- Phylum: Chordata
- Subphylum: Vertebrata
- Superclass: Actinopterygii
- Class: Teleostei
- Order: Perciformes
- Suborder: Scombroidei
- Family: Scombridae
- Tribe: Scomberomorini Starks, 1930
- Genus: Scomberomorus Lacepède, 1801
- Species: *Scomberomorus commerson* (Lacepède, 1800)

1.b Common names

The list of vernacular names used according to Collette and Nauen (1983) and Fishbase (Froese and Pauly, 2022) is presented below. The list is not exhaustive and some local names might not be included.

Australia: Albacore, Banded tuna, Doggie, Giant mackerel, Kingfish, Leaping tuna, Macko, Narrow-bar, Narrow-barred Spanish mackerel, Snook, Spaniard
Bangladesh: Champa, Matia, চামপা, মাটিয়া
China: 土托, 康氏馬鮫, 康氏马鲛, 梭齿, 马加, 鰆
Chinese Taipei: 鰆
Comoros: Mbassi angou, Mibassi angou (nguu)
Denmark: Indisk kongemakrel
Djibouti: Narrow-barred Spanish mackerel, Thazard rayé
Egypt: Eskomry mkhatat
Estonia: Vöödiline kuningmakrell
Fiji: Walu
France: Thazard rayé indo-pacifique
Germany: Indische Königsmakrele
Greece: Teniopalamida, Ταινιοπαλαμίδα
Hong Kong: Albacore, Banded tuna, Kau yue, Mackerel, Narrow-barred Spanish mackerel

India: Ah-ku-lah, Anjai, Chumbum, King seer, Mah-wu-laachi, Narrow-barred Spanish mackerel, Seela, Seer fish, Surmai, Tharvar, Towar, Vanjiram, Velra, Yellari, अंजरी
Indonesia: Calong, Macko, Narrow-barred Spanish mackerel, Tangige, Tenggiri
Iran: Shir-mahi
Japan: Yokoshima-sawara
Jordan: Shak abu Isnan
Kenya: Nguru, Nguru-mtwane
Korea (South): 동갈삼치
Libya: Balamet yamani, Balameta Yamania, طيملابي يناميد
Madagascar: Ango, Angoa, Angoho, Lamatra, Talafeta
Malaysia: Barred Spanish mackerel, Dengkeh, Iyot, Lamading, Luding, Narrow-barred Spanish mackerel, Narrow-striped king mackerel, Tenggiri
Mozambique: Carita del Indo-Pacifico, Narrow-barred king mackerel, Phuzu, Serra
Papua New Guinea: Barred Spanish mackerel, Dadayasi, Narrow-barred Spanish mackerel
Philippines: Alumahan, Dilis, Maladyong, Narrow-barred Spanish mackerel, Sampangari, Saramulyete, Tangi
Portugal: Serra-tigre
Qatar: Kannad
Russia: Dairek, Ispanskaya makrel, Korolevskaya pyatnistayamakrel, Poperechnopolosataya pelamida, Sierra, Uzkopolosaya pelamida
Saudi Arabia: Derak, Kanad
Solomon Island: Malahau, Spanish mackerel
Somalia: Nguru, Nguru-mtwane
South Africa: Couta, Cuda, Katonkel, King mackerel, Koning-makriel
Spain: Carite estriado Indo-Pacífico
Sri Lanka: Ah-ku-lah, Ahin thora, Anjilava, Arekula, Barred Spanish mackerel, Konam, Spanish mackerel, Thora
St Helena: Narrow-barred Spanish mackerel
Syria: Ghazal, Spanish mackerel
Thailand: Insi, Pla ba ka, Pla be ka, Thu insi, ปลาอินทรีย์บั้ง, ปลาเบกา
Timor-Leste: Sera, Spanish mackerel, Tengiri
Türkiye: Tombak, Tombak balığı
United Arab Emirates: Kana'd, Khabbat
United Kingdom: Barred Spanish mackerel, Commerson's mackerel, Cybium, Seer
United States of America: Barred mackerel, Narrowbarred mackerel, Striped seer

2. Identification

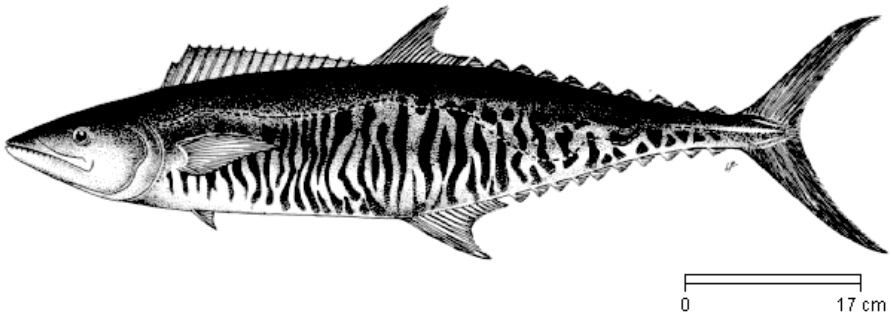

Figure 1. Drawing of an adult narrow-barred Spanish mackerel by Bachout M. L. 1987 (https://www.fishbase.se/photos/PicturesSummary.php?StartRow=8&ID=121&what=species&TotRec=11)

Characteristics of *Scomberomorus commerson* (Figures 1 and 2)

Narrow-barred Spanish mackerel largest recorded size and weight was captured off Scottburgh, KwaZulu-Natal, South Africa: 220 cm fork length (FL) and 44.9 kg respectively. Common captured size is 90 cm FL (Collette and Nauen, 1983).

External characteristics:

- Elongated (depth 4.8 - 5.6 in standard length (SL)) and moderately compressed body.
- First dorsal fin with 15 - 18 spines (usually 16 or 17).
- Second dorsal fin with 15 - 20 soft rays (usually 17 or 18); followed by 8 - 10 finlets.
- Pectoral fin with 21 to 24 soft rays.
- Anal fin with 16 - 21 soft rays (usually 18 or 19); followed by 7 - 12 finlets (usually 9 or 10).
- The lateral line brusquely bends downward below end of second dorsal fin.

Colour:

- Transverse vertical bars coloured in a darker grey mark its silvery grey sides. These bars are slightly way and narrow, which sometimes can break into spots ventrally.
- Adults have 40 to 50 bars, however, this number is usually lower (20) in juveniles up to 45 cm FL.
- First dorsal fin bright blue quickly turning to a blackish blue.
- Pectoral fin has a light grey coloration changing to a blackish blue.
- Second dorsal fin, caudal fin lobes, anal fin, and anal and dorsal finlets are a pale greyish white turning to a dark grey.
- First dorsal fin anterior membranes in juveniles are extremely black, when compared to the white portion found posteriorly.

Internal characteristics:

- First arch of gill rakers: 0 - 2 on upper limb; 1 - 8 on lower limb; and 1 – 8 in total.
- Vertebrae: 19 or 20 precaudal; 23 - 27 caudal, total of 42 - 46.
- Intestine with 2 folds and 3 limbs.

See **Figure 2** for details.

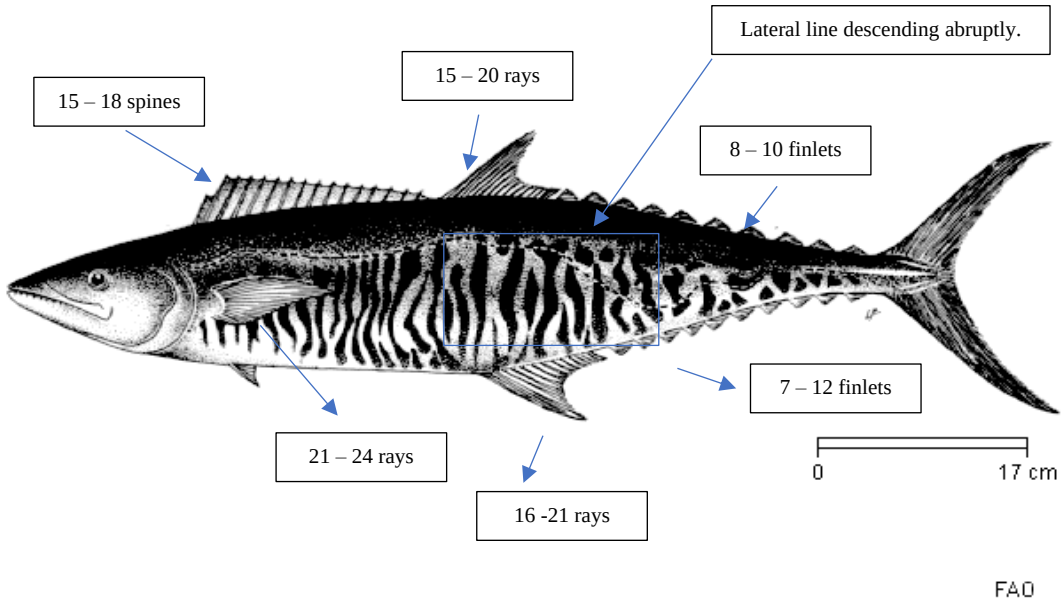

Figure 2. Diagram of the most important characteristics of Scomberomorus commerson (based and adapted from Collette and Nauen, 1983).

3. Distribution and population ecology

3.a Geographic distribution

This species is originally distributed in the Indo-Pacific from the Red Sea and South Africa to Southeast Asia, north to China and Japan and south to Australia (Randall, 1995), being an immigrant to the eastern Mediterranean Sea by way of the Suez Canal (Ben-Tuvia, 1971) (**Figure 3**), opened in 1869, a narrow and shallow water course that acts as a channel between two marine basins (Gruvel, 1936). The Suez Canal is an artificial waterway connecting the tropical Red Sea and the subtropical eastern Mediterranean Sea. This example of human intervention caused a global change in the distribution of native and non-native fishes in Mediterranean waters (Ben-Tuvia, 1985; Golani *et al*., 2002). This pattern, added to their greater tolerance to high salinity, favours the northward migration of Erythrean organisms (Halim and Rizkalla, 2011). Consequently, the biodiversity of the East Mediterranean has been considerably altered since the opening of the Suez Canal in 1869 and several migrant Lessepsian fishes (Por, 1978) are now well-established in the eastern Mediterranean. The process of immigration through the Canal increased alien species of Indo-Pacific origin from 12 species in 1882 to 92 in 2010 (Keller, 1882; Zenetos *et al*., 2010), including *Scomberomomus commerson*. Halim and Rizkalla (2011) published a checklist of 42 immigrant Erythrean fish in the Egyptian Mediterranean, 17 of which are commercially exploited. *S. commerson* can be now considered not only as an original Lessepsian migrant species, but also as a native species, because the large majority of the individuals were clearly born in the Mediterranean Sea (Al Mabruk *et al.*, 2021). Hence, the SCRS Small Tunas Species Group in 2021, and endorsed by ICCAT SCRS, officially included *Scomberomorus commerson* (FAO code: COM) among the list of small tuna species (SCRS, 2022).

The presence of *S. commerson* in the Mediterranean has been extensively reviewed by Di Natale *et al*. (2020). The first record of this species in the literature was in the Ligurian Sea as *Cymbium commersoni* (Bonaparte, 1846) and the first substantiated record was off the coast of Palestine as *Scomberomorus sp*. (Hornell, 1935). The species was first recorded subsequently in several other coastal parts of the eastern and southern Mediterranean Sea: Lebanon and the coast of the Levantine Sea (Ben-Tuvia, 1971; Por, 1978); and in Greece, first documented in

Rhodes (Corsini-Foka and Kalogirou, 2008), then in the Aegean Sea, where the species is now commonly caught (Papacostantinou, 2014). Its presence in Türkiye is widely documented, having been recorded in most areas (Gücü *et al*., 1994; Buhan *et al.*, 1997; Basusta and Erdem, 2000; Torcu Koç and Mater, 2000; Bilecenoğlu *et al*., 2002, 2014; Çinar *et al*., 2005, 2011; Öğretmen *et al*., 2005; Öz *et al*., 2007); in Syria (Saad, 2005); in Cyprus (Katsanevakis *et al*., 2009); in Egypt it was recorded for the first time by El Sayed (1994) and then by El-Haweet (2001) in the Bay of Abu Qir; in Libya it was reported by Shakman and Kinzelbach (2007), while in Tunisia its presence was reported by Bradaï *et al*. (2004) and by Ben Soussi *et al*. (2006). Tortonese (1975, 1987) reported the species in the Ligurian Sea (Italy) and Di Natale *et al*. (2009) reported a few occasional specimens in Sicily.

As regards the ICCAT Convention area, there is one questionable record from St. Helena in the Southeast Atlantic (Froese and Pauly, 2022), while its presence in other areas in the Atlantic Ocean is not documented (Di Natale *et al*., 2020).

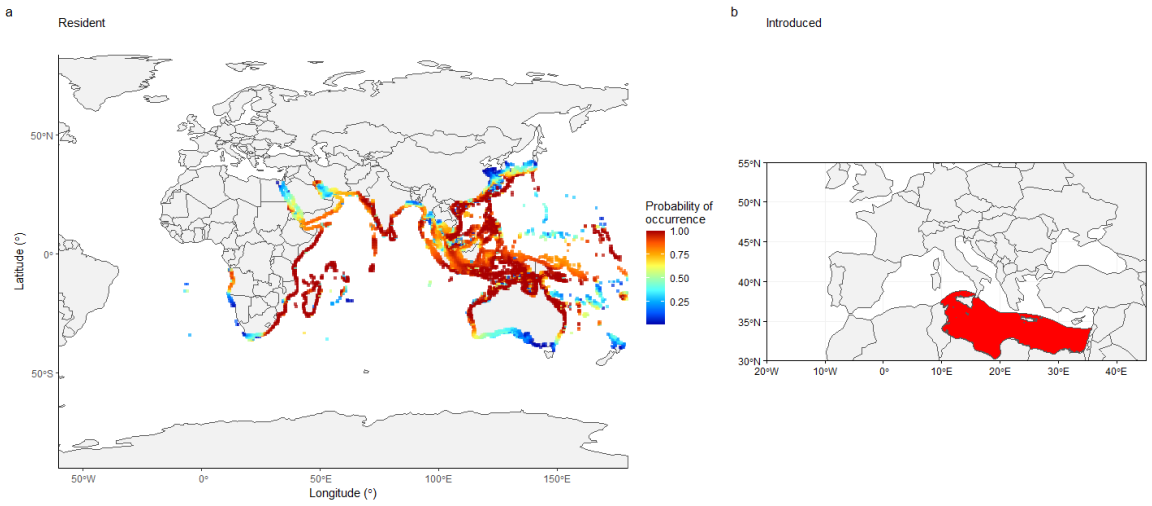

Figure 3. Distribution of narrow-barred Spanish mackerel (a - resident, b - introduced species) based on data available from aquamaps.org (a) and iucnredlist.org (b) website.

3.b Habitat preferences

Scomberomorus commerson is pelagic and oceanodromous species (Riede, 2004), occurring from the edge of the continental shelf to shallow coastal waters, also found in drop-offs, and shallow or gently sloping reef and lagoon waters (Myers, 1991; Kuiter and Tonozuka, 2001). It inhabits depths varying from 10 to 70 m (Pauly *et al*., 1996), but can also be found at depths up to 200 m (Collette, 2001). No specific information concerning this topic in its non-native area, the Mediterranean Sea, is available.

3.c Migrations

In general, this species usually hunts solitarily, swimming in shallow water off the coastal slopes (Kuiter and Tonozuka, 2001). It can either undertake lengthy longshore migrations or remain as a permanent resident. This species migrates from the coastal water in early life toward the deeper areas on reaching maturity (Lee, 2013). However, no information exists at present about the migratory pattern of the narrow-barred Spanish mackerel in the Mediterranean Sea and the possible correlation with other oceans.

4. Biology and life history parameters

4.a. Growth

The growth parameters are mainly available for the areas where the narrow-barred Spanish mackerel has its original distribution. Within this area, $L\infty$ varied from 104 in Australia (Ballagh *et al*., 2006) to 230 cm FL in the Gulf of Aden (Edwards *et al*., 1985) and the K varied between 0.12 year^{-1} in the Gulf of Aden (Edwards *et al*., 1985) to 0.75 year^{-1} in Australia (Ballagh *et al*., 2006). *Scomberomorus commerson* can live more than 20 years (McIlwain *et al*., 2005).

In the Mediterranean area, only one study carried out in the North Sinai Coast in 2017 is available. A total of 462 otoliths were removed and their measurements were used to describe the relationship between the total length and the otolith radius and the growths in length and weight at the end of each year were calculated. The values of L∞, K and t0 were estimated by the Ford-Walford method.

The otolith total length relationship was described by the following equation L= 45.814s-16.99 (where s is the otolith radius and L is the total length). Growths in length at the end of each year were calculated as 36.49, 62.41, 86.15, 101.5 and 114.35 cm TL for the 1st, 2nd, 3rd, 4th, and 5th year of life respectively. The back-calculated weight of *Scomberomorus commerson* were 310.9, 1433.1, 3587.7, 5722.3 and 8032.9 g for age 1, 2, 3, 4 and 5 years, respectively. The growth parameters of the von Bertalanffy equation were obtained as L∞= 161.67 cm TL, k = 0.2436 year^{-1} and t0 = -0.0501 year^{-1}; and the growth performance index was estimated as φ′ = 3.78 (Mohsen *et al.*, 2020).

4.b Length-weight relationship

There are many length-weight relationships of *Scomberomorus commerson* in its native area but in the Mediterranean Sea, only three equations are currently available, all indicating an allometric negative growth, however, only the estimation of Mohsen *et al*. (2020) considers a wide length range and relatively large sample size (**Table 1**).

Table 1. *Scomberomorus commerson* length-weight relationships. W= weight; TL= total length; N= number of samples.

Area	*Equation (size-weight)*	*N*	*Size range (cm)*	*References*
Türkiye	$W=0.567TL^{2.223}$	? (♀+♂)	52-87	Buhan *et al*., 1997
Egypt	$W= 0.0111*TL^{2.8469}$	1189 (♀+♂)	12.0-137	Mohsen *et al*., 2020
Egypt	$W= 0.0092*TL^{2.103}$	33 (♀+♂)	31–43	Bakhoum, 2021

4.c Reproduction

- *Spawning*

Scomberomorus commerson spawns in the water column off the reef slopes and edges, over the continental shelf, forming spawning aggregations in specific areas. The spawning season may be more or less extended (Collette *et al*., 2011). However, no information exists at present about the migratory pattern of the narrow-barred Spanish mackerel in the Mediterranean Sea.

- *Maturity*

The length at first maturity for *Scomberomorus commerson* is only available for the areas where the narrow-barred Spanish mackerel has its original distribution. Within this area, for males, L_{50} varied from 65 to 70.6 cm TL (age 1-2) in Australia (Mackie *et al*., 2003; Mcpherson, 1993); and for females L_{50} varied from 70.1 (age 2-3) in India (Siddeek, 1995) to 89.8 (age 2) in Australia (Mackie *et al*., 2003). However, no current information on this topic is available for the Mediterranean Sea.

- *Sex ratio*

No current information on this topic is available for the Mediterranean Sea.

- *Fecundity*

No current information on this topic is available for the Mediterranean Sea, however, estimates along its native distribution are available and the species is considered highly fecund with estimated batch fecundity of up to 2 million eggs per fish (Weng *et al*., 2020).

4.d First life stages

- *Eggs and larvae*

The parental species examined have pelagic eggs and larvae (Collette, 1986). However, no current information on this topic is available for the Mediterranean Sea.

4.e Diet

A single study carried out in Egypt concerning the diet of *Scomberomorus commerson* is available in the Mediterranean. Results showed that food consumption for this species was higher in summer and autumn. Teleosts (mainly *Engraulis encrasicolus*, *Sardinella aurita* and *Sardina pilchardus*) were the most important food item for *Scomberomorus commerson* of all sizes, although shrimps were also significant in its diet. This species became piscivorous when larger than 40 cm in length (Bakhoum, 2007).

There are some concerns related to the occupation of this species in the Mediterranean and the potential niche overlap with the native species. Invasive species may alter the food web and the community structure and ecosystem function in their newly adopted areas (Almeida and Grossman, 2012; Goren *et al*., 2016). The impacts may include predation or competition with the native biota (Almeida and Grossman, 2012; Hayden *et al*., 2013). Bakhoum (2007) cited the high diet overlap between *Trichiurus lepturus* and *S. commerson*. Gilaad *et al.* (2017) observed high diet overlap between the diets of the two alien piscivores: *Saurida lessepsianus* and *Scomberomorus commerson* and also between *Scomberomorus commerson* and the native *S. saurus*.

4.f Physiology

No current information on this topic is available for the Mediterranean Sea.

4.g Behaviour

This species forms small schools (Collette *et al*., 2011), and lives within temperatures ranging from 13°C to 29°C and salinities from 23-35 (Collette and Russo 1979; Niamaimandi *et al*., 2015). No current information on this topic is available for the Mediterranean Sea.

4.h Natural mortality

There is a single estimate of natural mortality that was obtained in Egypt with a value of 0.3854 yr^{-1} (Mohsen *et al*., 2020).

5. Fisheries biology

5.a Populations/ Stock structure

There are many studies concerning the stock structure of *Scomberomorus commerson* in its original distribution. Ovenden and Street (2007) reported the presence of a distinct genetic stock on the East coast and a single stock on the northern and western Australian coastline, while Hoolihan *et al.* (2006) observed a single stock of *Scomberomorus commerson* in the Gulf of Oman and Arabian Sea and a separate stock in a particular locality in the Arabian Sea. Radhakrishnan *et al.* (2018) evaluated the genetic stock structure of *Scomberomorus commerson* across the Indian region of northern Indian Ocean including the Arabian Sea and Bay of Bengal, indicating a unit of stock of the species in Indian waters which is genetically stable since they do not present evidence of genetic bottle necks. There is no study that investigates the population of Mediterranean Sea and its relations with the native stocks. However, natural hybridization between *Scomberomorus commerson* and the endemic West African Spanish mackerel *Scomberomorus tritor* has been investigated by Bakhoum (2021) in the Egyptian Mediterranean coast and the hybrid index results and univariate and multivariate analysis indicated a natural hybridization between these two species.

5.b Description of fisheries

Worldwide, this species is highly commercial caught primarily with gillnets, but also with purse seines, bamboo stake traps, mid-water trawls, rod-and-reel and trolling (Collette, 2001). *Scomberomorus commerson* is also captured as bycatch by longline, purse seine and gillnet gears targeting larger scombrids. In the Mediterranean Sea, *Scomberomorus commerson* is captured by gillnet, purse seine, and longline but additional catches are made by handlines, and rod-and-reel, mostly by sport and recreational fishermen.

Although the catch of narrow-barred Spanish mackerel in the Mediterranean Sea has been reported since 1935 off the Palestine coasts, the species was recorded afterwards in several other coastal parts of the eastern and southern Mediterranean Sea (Türkiye, Libya, Syria, Tunisia, Greece, Italy, and Cyprus). The current catch statistics available from ICCAT show catches for Algeria (from 1985 to 2005), Egypt (from 1982 to present), Israel (1988, 1992 and from 2009 to 2017) and the Lebanon (from 2014 to present). Furthermore, historical catch data from trade markets are also available from 1964 to 1984. Unfortunately, no distinction between gears is available in the statistics (Di Natale *et al*., 2020; ICCAT Task 1) (**Figure 4**).

Since the 1960s, the total reported landings of *Scomberomorus commerson* have increased considerably from around 320 t on average, to around 850 t, in the 2000s but decreased to 360 t in the last decade. However, it is important to note that some Mediterranean catch data have never been reported to ICCAT, and it is very likely catches are being greatly underestimated (Di Natale *et al*., 2020).

The fishery is primarily associated with small-scale activities, although catches in pelagic longlines targeting other large pelagic species (swordfish and albacore) and purse seines do occur. The species is especially important for recreational and sport fishing using rod-and-reel or trolling hand lines (Di Natale *et al*., 2020).

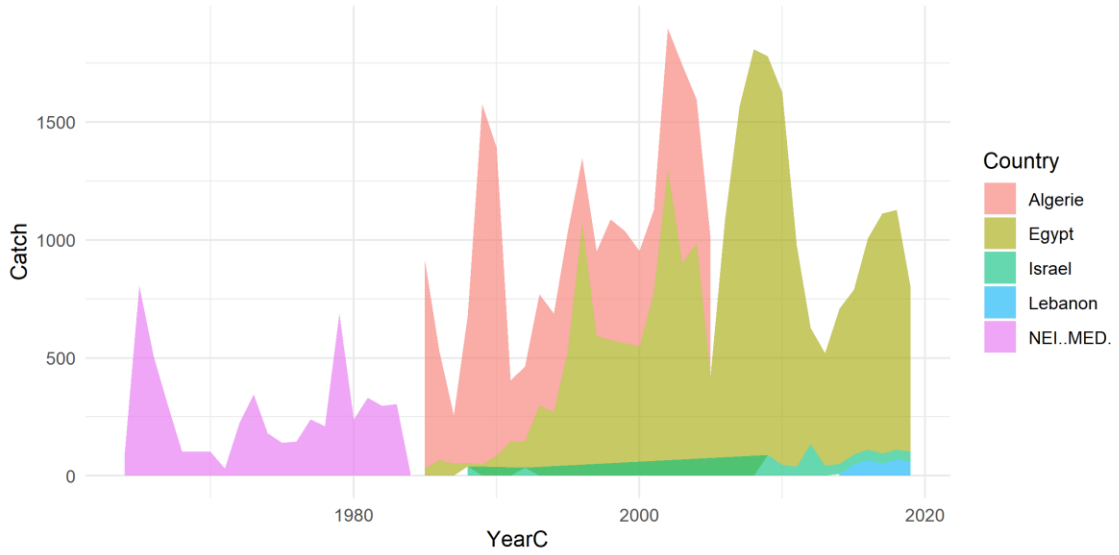

Figure 4. Narrow-barred Spanish mackerel landings reported to ICCAT database, by country, from 1960 to 2019. NEI.MED: Unreported catches estimated from trade data in the Mediterranean Sea.

5.c Size distribution of catches

No information was available on the ICCAT Task 2 database, and there are only a few studies available on the size of specimens caught in the area that report on few individuals (less than five). However, 3 studies compiled data from over 70 individuals. Bakhoum (2007) observed a total length range in Egypt of 4 to 60 cm, Elbaraasi (2014) reported sizes from 23.4 to 140 cm TL in the Libyan waters while Buhan (1997, *as cited in* Akyol and Tosunoğlu, 2019) measured individuals from 52 cm to 87cm (TL) in Turkish waters.

6. Stock assessment

Only one study assessed the Mediterranean stock of this species using data-limited models. Mohsen *et al*. (2020) estimated the total mortality Z= 0.95 $year^{-1}$ on the Mediterranean coast of Sinai during 2017, fishing mortality as F= 0.57 $year^{-1}$ and an exploitation rate as E= 0.60. The length and age at first capture (Lc;Tc) were 34.5 cm (TL) and 0.9 year respectively. The yield per recruit (Y/R) was determined at 727.3 g/recruit at the actual fishing mortality. The maximum sustainable yield was 790.2 g/recruit at F_{MSY} = 0.35 $year^{-1}$, superior than the obtained current F.

7. References

Akyol, O. and Tosunoğlu, Z. 2019. On the occurrence of Lessepsian immigrant *Scomberomorus commerson* (Scombridae) in Izmiz Bay (Aegean Sea, Turkey). Ege Journal of Fisheries and Aquatic Sciences, 36(1): 81-84.

Al Mabruk, S. A. A., Di Natale, A., Zava, B. 2021. Additional data on the narrow-barred Spanish mackerel (*Scomberomorus commerson*, Lacépède, 1800) in Libya and Palestine. Collective Volumes of Scientific Papers, ICCAT, 78(6): 59-66.

Almeida, D. and Grossman, G. D. 2012. Utility of direct observational methods for assessing competitive interactions between non-native and native freshwater fishes. Fisheries Management and Ecology, 19: 157-166.

Bakhoum, S. A. 2007. Diet overlap of immigrant narrow-barred Spanish mackerel *Scomberomorus commerson* (Lac., 1802) and largehead hairtail ribbonfish *Trichiurus lepturus* (L., 1758) in the Egyptian Mediterranean coast. Animal Biodiversity and Conservation, 30(2): 174-160.

Bakhoum, S. A. 2021. Natural hybridization between immigrant narrow-based Spanish mackerel *Scomberomorus commerson* (Lacepède, 1800) and endemic West African Spanish mackerel *Scomberomorus tritor* (Cuvier, 1832) in the Egyptian Mediterranean coast. Animal Biodiversity and Conservation, 44(2): 219-277. https://doi.org/10.32800.abc.2021.44.0219.

Ballagh, A. C., Begg, G. A., Mapleston, A., Tobin, A. 2006. Growth trends of Queensland East coast Spanish mackerel (*Scomberomorus commerson*) from otolith back-calculations. Marine and Freshwater Research, 57: 383-393.

Basusta, N. and Erdem, U. 2000. A study on the pelagic and demersal fishes of Iskenderum Bay. Turkish Journal of Zoology, 24: 1-19.

Ben Souissi, J., Golani, D., Mejri, H., Zaouli, J., Capapé, C. 2006. On the occurrence of *Scomberomorus commerson*, Lacepède 1800 (Osteichthyes: Scombridae) off northern Tunisia (Central Mediterranean). Cahiers de Biologie Marine, 47(2): 215-2018.

Ben-Tuvia, A. 1971. Revised list of the Mediterranean fishes of Israel. Israel Journal of Zoology, 20: 1-39.

Ben-Tuvia, A., 1985. The impact of the Lessepsian (Suez Canal) fish migration in the Eastern Med. In: *Mediterranean Marine Ecosystem*, *NATO Conference Series*, *I Ecology*, 8:367-375 (A. Moraitou-Apostolopoulou, V. Kiortsis, Eds.) Spinger, Boston, MA. doi: 10.1007/978-1-4899-2248-917.

Bilecenoğlu, M., Taskavak, E., Mater, S., Kaya, M. 2002. Checklist of the marine fishes of Turkey. Zootaxa, (113): 1-194.

Bilecenoğlu, M., Kaya, M., Cihangir, B., Çiçek, K. 2014. An updated checklist of the marine fishes of Turkey. Turkish Journal of Zoology, 38: 901-929.

Bradaï, M. N., Quignard, J. P., Bouaïn, A., Jarboui, O., Ouannes-Ghorbel, A., Ben Abdallah, L., Zaouali, J., Ben Salem, S. 2004. Ichtyofaune autochtone et exotique des côtes tunisiennes: recensement et biogéographie. Cybium, 28: 315-328.

Buhan, E., Yilmaz, H., Morjan, Y., Büke, E., Yüksek, A. 1997. A new potential catch for Güllük Bay and Gökoya Bay: *Scomberomorus commerson* (Lacepède, 1800) (Pisces: Teleostei). Akdeniz Balıkçılık Kongresi, Bildiri Kitabı, 9-11 Nisan, İzmir, pp. 937-944 (in Turkish).

Collette, B. B. 1986. Scombridae (including *Thunni* fishes of the north-eastern Atlantic and the Mediterranean, volume 2: 981-997 (Whitehead, P. J. P., Bauchot, M. L., Hureau, J. C., Nielsen, J., Tortonese, E. (eds.))). Unescon, Paris.

Collette, B. B. and Nauen, C. E. 1983. FAO species catalogue. Vol. 2. Scombrids of the world. An annotated and illustrated catalogue of tunas, mackerels, bonitos and related species known to date. FAO Fish. Synop. 125(2): 137 pp.

Collette, B. B. and Russo, J. L. 1979. An introduction to the Spanish mackerels Genus *Scomberomorus*. Proceedings: Colloquium on the Spanish and king mackerel resources of the Gulf of Mexico. Gulf States Marine Commission, 4: 3-16.

Collette, B. B. 2001. Scombridae. In: Carpenter, K. E. and Niem, V. (eds.), *The living marine resources of the Western Central Pacific*. FAO, Rome, 3721-3756 pp.

Collette, B., Chang, S. K., Di Natale, A., Fox, W., Juan Jorda, M., Miyabe, N., Nelson, R. 2011. *Scomberomorus commerson*. The IUCN Red List of Threatened Species 2011: e.T170316A6745396. http://dx.doi.org/10.2305/IUCN.UK.2011-2.RLTS.T17036A6745396.en.

Corsini-Foka, M. and Kalogirou, S. 2008. On the findings of the Indo-Pacific fish *Scomberomorus commerson* in Rhodes (Greece). Mediterranean Marine Science, 9(1): 167-171.

Çinar, M. E., Bilecenoğlu, M., Őztűrk B., Katagan, T., Aysel, V. 2005. Alien species of the coast of Turkey. Mediterranean Marine Science, 6(2): 119-146.

Çinar, M. E., Bilecenoğlu, M., Őztűrk B., Katagan, T., Yokes, M., Aysel, V., Dagli, E., Acik, S., Ozcan, T., Erdogan, H. 2011. An updated review of alien species on the coasts of Turkey. Mediterranean Marine Science, 12(2): 257-315. https://doi.org/10.12681/mms.34.

Di Natale, A., Srour, A., Hattour, A., Keskin, Ç., Idrissi, M., Orsi Relini, L. 2009. Regional study on small tunas in the Mediterranean including the Black Sea. GFCM-FAO, Studies and Reviews, 85: 1-150.

Di Natale, A., El-Haweet, A. E.A., Abouelmagd, N., Lahoud, I., Bariche, M. 2020. Fisheries of the narrow-barred Spanish mackerel (*Scomberomorus commerson*, Lacépède, 1800) in the southern and eastern Mediterranean Sea and relevance of this species to ICCAT. Collective Volumes of Scientific Papers, ICCAT, 77(9): 85-99.

Edwards, R. R. C., Bakhader, A., Shaher, S. 1985. Growth, mortality, age composition and fishery yields of fish from the Gulf of Aden. Journal of Fish Biology, 27(1): 13-21.

Elbaraasi, H. 2014. Length-weight relationships for five Lessepsian fish species from the coast of Benghazi, Libya (Southern Mediterranean). Agriculture, Forestry and Fisheries, 3(3): 178-180.

El Haweet, A., 2001. Catch composition and management of daytime purse seine fishery on the Southern Mediterranean Sea Coast, Abu Qir Bay, Egypt. Mediterranean Marine Science, 2(2): 119-126.

El Sayed, R. S., 1994. Check-list of Egyptian Mediterranean fishes. Bulletin of National. Institute of Oceanography & Fisheries, 1-77.

Froese, R. and Pauly, D. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2022).

Gilaad, R-L., Galil, B. S., Diamant, A., Goren, M. 2017. The diet of native and invasive fish species along the eastern Mediterranean coast (Osteichthyes). Zoology in the Middle East, 63(4): 325-335. https://doi.org/10.1080/09397140.2017.1375196.

Golani, D., Orsi-Relini, L., Massuti, E., Quignard, J. P. 2002. CIESM Atlas of exotic species in the Mediterranean, vol 1. *Fishes*. F. Briand, ed. CIESM publishers, Monaco. 256 pp. ISBN 92-990003-1X.

Golani, D., Öztürk, B., Başusta, N. 2006. The fishes of the Eastern Mediterranean. Turkish Marine Research Foundation, Publication No. 24. Istanbul, 259 pp.

Goren, M., Galil, B. S., Diamant, A., Stern, N., Levitt-Barmats, Y. 2016. Invading up the food web? Invasive fish in the southeastern Mediterranean Sea. Marine Biology, 163(180): 1-11.

Gruvel, A. 1936. Contribution á l'étude de la bionomie générale et de l'explotation de la faune du Canal de Suez. Mémoires présentés à l'Institut d'Égypte, 29: 1-229.

Gücü, A. C., Bingel, F., Avsar, D., Uysal, N. 1994. Distribution and occurrence of Red Sea fish at the Turkish Mediterranean coast – northern Cilician basin. Acta Adriatica, 34(1/2): 103-113.

Halim, Y. and Rizkalla, S. 2011. Aliens in Egyptian Mediterranean waters. A check-list of Erythrean fish with new records. Mediterranean Marine Science, 12(2): 479-490. https://doi.org/10.12681/mms.46.

Hayden, B., Holopainen, T., Amundsen, P-A., Eloranta, A. P., Knudsen, R., Praebel, K., Kahilainen K. K. 2013. Interactions between invading benthivorous fish and native whitefish in subarctic lakes. Freshwater Biology, 58: 1234-1250.

Hoolihan, J. P., Anandh, P., van Herwerden, L. 2006. Mitochondrial DNA analyses of narrow-barred Spanish mackerel (*Scomberomorus commerson*) suggest a single genetic stock in the ROPME sea area (Arabian Gulf, Gulf of Oman, and Arabian Sea). ICES Journal of Marine Science, 63: 1066-1074.

Hornell, J. 1935. Report on the Fisheries of Palestine. Government of Palestine. Crown Agent for the Colonies, London, 106 pp.

Katsanevakis, S., Tsiamis, K., Ioannou, G., Michailidis, N., Zenetos, A. 2009. Inventory of alien marine species of Cyprus. Mediterranean Marine Science, 10(2): 109-133.

Keller, C. 1882. Die fauna in Suez Canal und die diffusion der Mediterranean und Erythraischen Tierwelt. Neue Denkschriften der allgemeinen. Schweizerischen Gesellschaft für die gesamten naturwissenschaften, 28(3): 1-28.

Kuiter, R. H. and Tonozuka, T. 2001. Pictorial guide to Indonesian reef fishes. Part 3. Jawfishes – Sunfishes, Opistognathidae – Molidae. Zoonetics, Australia, 623-893.

Lee, B. 2013. The biology of and fishery for king mackerel *Scomberomorus commerson* (Scombridae), along the southern Mozambique and KwaZulu-Natal coast. Oceanographic Research Institute, University of KwaZulu-Natal, Durban. Master thesis. 158 pp.

Mackie, M. C., Gaughan, D. J., Buckworth, R. C. 2003. Stock assessment of narrow-barred Spanish mackerel (*Scomberomorus commerson*) in Western Australia. Final Report FRDC Project No. 1999/151, 242 pp.

Mcpherson, G. R. 1993. Reproductive biology of the narrow barred Spanish mackerel (*Scomberomorus commerson* Lacepède, 1800) in Queensland waters. Asian Fisheries Science, 6(2): 169-182.

McIlwain, J. L., Claereboudt, M. R., Al-Oufi, H. S., Zaki, S., Goddard, J. S. 2005. Spatial variation in age and growth of the kingfish (*Scomberomorus commerson*) in the coastal waters of the Sultanate of Oman. Fisheries Research, 73(3): 283-298. doi:10.1016/j.fishres.2044.10.020.

Mohsen, S. H., EL-Aiatt, A. A. O. Ahmed, M. Z., Ahmed, A. A. 2020. Biological studies on the narrow-barred Spanish mackerel, *Scomberomorus commerson* of eastern Merditerranean (north Sinai coast) Egypt during 2017. Aqua, 13(1): 43-64.

Myers, R. F. 1991. Micronesian reef fishes. Second Ed. Coral Graphics, Barrigada, Guam. 298 pp.

Niamaimandi, N., Kaymaram, F., Hoolihan, J. P., Mohammadi, G. H., Fatemi, S. M. R. 2015. Population dynamics parameters of narrow-barred Spanish mackerel, *Scomberomorus commerson* (Lacepède, 1800), from commercial catch in the northern Persian Gulf. Global Ecology and Conservation, 4: 666-672.

Öğretmen, F., Yilmaz, F., Torcu Koç, H. 2005. An investigation on fishes of Gökova Bay (Southern Aegean Sea). *Balıkesir Üniversitesi Fen Bilimleri Enstitüsü Dergisi*, 7(2): 19-36.

Ovenden, J. R., Street., R. 2007. Genetic population structure of Spanish mackerel. In: Buckworth, R. C., Newman, S. J., Ovenden, J. R., Lester, R. J. G., McPherson, G. R., (eds). The stock structure of Northern and Western Australian Spanish mackerel. Fishery report 88 (FDRC98/159). Norther Territory Government, Australia. 93-143 pp.

Öz, M. I., Okus, E., Yuksek, A. 2007. Notes on the Erythrean alien fishes of Datca-Bozburum Peninsula – a specially protected area in the south eastern Aegean Sea (Turkey). Rapp. Comm. Int. Mer. Medit., 38: 563.

Papacostantinou, C. 2014. Fauna Graecie. An updated checklist of the fishes in the Hellenic seas. Monograph on Marine Science, 7.

Pauly, D., Cabandan, A., Torres Jr., F. S. B. 1996. Fishery biology of 40 trawl-caught teleosts of western Indonesia. 135-216 pp. In: Pauly, D. and Martosubroto, P. (eds.) *Baseline studies of biodiversity: the fish resource of western Indonesia*. ICLARM Studies and Reviews, 23.

Por, F. D. 1978. Lessepsian migration. Springer Verlag, Berlin, Heidelberg, New York: 1-228.

Radhakrishnan, D. P., Nedumpally, V., Kathirvelpandian, A., Saidmuhammed, B. V., Gopalakrishnan, A. 2018. Population structure of Spanish mackerel *Scomberomorus commerson* (Lacepède, 1800) in the Northern Indian Ocean determined using microsatellite markers. Aquatic Living Resources, 31(22): 1-10. https://doi.org/10.1051/alr/2018011.

Randall, J. E. 1995. Coastal fishes of Oman. University of Hawaii Press, Honolulu, Hawaii. 430 pp.

Riede, K. 2004. Global register of migratory species – from global to regional scales. Final report of the R&D Project 808 05 081. Federal Agency for Nature Conservation, Bonn, Germany. 329 pp.

Saad, A. 2005. Check-list of bony fish collected from the coast of Syria. Turkish Journal of Fisheries and Aquatic Sciences, 5: 99-106.

SCRS, 2022. Report on the standing committee on research and statistics (SCRS). ICCAT, 2022. Report for Biennial Period, 2020-21, Part II, Vol. 2, 287 pp.

Shakman, E. A. and Kinzelbach, R. 2007. Distribution and characterization of lessepsian fishes along the coast of Libya. Acta Ichthyology et Piscatoria, 37(1): 7-15.

Siddeek, M. S. M. 1995. Review of fisheries biology *Scomberomorus* and *Acanthocybium* species in the Western Indian Ocean (FAO Area 51). Working Group on Pelagics, Gulfs Committee for Fisheries Management and Development. Working Paper WGP 95/2, 32 pp.

Torcu Koç, H. and Mater, S. 2000. Lessepsian Fishes Spreading Along the Coasts of the Mediterranean and Southern Aegean Sea of Turkey. Turkish Journal of Zoology, 24: 139-148.

Tortonese, E. 1975. Fauna d'Italia. Osteichthyes – Pesci Ossei. Ed. Calderini, Bologna, vol. IX: 350-356, 365-368, 369-370.

Tortonese, E. 1987. I Pesci del Mediterraneo. Recenti studi intorno alla sistematica e distribuzione. Quaderni dell' Istituto di Idriobiologia e Acquacoltura 'G Brunelli' Sabaudia, 1-111.

Weng, J-S., Yu, S-F., Lo, Y-S., Shiao, J-C., Lee, M-A., Liu, K-M., Huang, H-H., Wang, Y-C., Wu, L-J. 2020. Reproductive biology of the narrow-barred Spanish mackerel (*Scomberomorus commerson*) in the central Taiwan Strait, western Pacific. Deep Sea Research Part II: Topical Studies in Oceanography, 175, 104755. https://doi.org/10.1016/j.dsr2.2020.104755.

Zenetos, A., Gofas, S., Verlaque, M., Cinar, M. E., Bianchi, C., N. 2010. Alien species in the Mediterranean Sea by 2010. A contribution to the application of European Union's Marine Strategy Framework Directive. Part I. Spatial Distribution. Mediterranean Marine Science, 11(2): 381-493. doi:10.12681/mms.87.