

A REVIEW OF SHARK RESEARCH IN TURKISH WATERS

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ABSTRACT

Until the last quarter of the 20th century, most of our knowledge on the sharks of the Turkish waters was based on elasmobranch-specific chapters in general ichthyological inventory studies and on a limited number of anecdotal studies. Since the mid-1990s, however, there has been a remarkable rise in the number and quality of shark-specific studies and publications, resulting in a gradual filling of the gaps in our understanding of the sharks of the Turkish waters. Based on the publication dates, there were only 2 shark-specific articles published before 1990, 8 scientific articles about the sharks of the Turkish waters between 1990 and 2000, and as many as 88 papers dealing with several aspects of the sharks of Turkey since, for a total of 96 articles on the sharks of the Turkish waters published between 1968 and 2018. Hopefully, future studies by new generations of researchers will provide new data on several aspects of the sharks of the Turkish waters, which can deepen our understanding of them and complete their life stories.

Key words: shark research, publications, Turkish waters, eastern Mediterranean

REVISIONE DELLA RICERCA SUGLI SQUALI IN ACQUE DELLA TURCHIA

SINTESI

Fino all'ultimo quarto del XX secolo, la maggior parte delle nostre conoscenze sugli squali delle acque della Turchia si basava su capitoli specifici dedicati agli elasmobranchi pubblicati in studi generali di inventario ittologico e su un numero limitato di studi aneddotici. Dalla metà degli anni 90, tuttavia, c'è stato un notevole aumento del numero e della qualità degli studi e delle pubblicazioni specifici sugli squali, con un risultante riempimento graduale delle lacune nella comprensione degli squali delle acque turche. Sulla base delle date di pubblicazione, l'autore riscontra che solo due articoli specifici sugli squali sono stati pubblicati prima del 1990, 8 articoli scientifici sugli squali delle acque turche tra il 1990 e il 2000, e ben 88 articoli riguardanti diversi aspetti degli squali della Turchia da allora, per un totale di 96 articoli sugli squali delle acque turche pubblicati tra il 1968 e il 2018. L'autore spera che studi futuri di nuove generazioni di ricercatori possano fornire nuovi dati su diversi aspetti riguardanti gli squali delle acque turche, al fine di approfondirne la comprensione e completare le loro storie di vita.

Parole chiave: ricerca sugli squali, pubblicazioni, acque turche, Mediterraneo orientale

INTRODUCTION

Despite an anecdotal note on a great white shark, *Carcharodon carcharias* (Linnaeus, 1758), off the coast of İzmir (western Turkey) from the 16th century (Bellonii, 1553), the story of shark research in the seas of Turkey started in the early 1920s. Regardless of their remarkable ecological value, sharks have always been a short chapter in the general ichthyological inventory studies of Turkish marine waters (e.g., Ninni, 1923; Deveciyan, 1926; Ayaşlı, 1937; Akşiray, 1987). The first accounts of sharks in the seas of Turkey were by Ninni (1923) and Deveciyan (1926). Besides being two of the most wanted items among collectors of antique books on Turkey's ichthyofauna, these pioneering monumental studies also contain the first scientific inventories of the sharks of the Turkish waters. The chronology of shark research in the mentioned waters can be divided into two distinct eras, with the first reaching up to the last quarter of 20th century, and the second beginning in almost mid-1990s and still continuing. They each have peculiar characteristics that outline the general trends of shark research in the seas of Turkey. While the first era was dominated by a clear disregard of sharks in the general ichthyological studies and a lack of shark-specific research, the second has witnessed a boom in the study of the sharks of the seas of Turkey. In the present article, the author reviews the contemporary status of shark research in Turkish waters in the light of available data.

MATERIAL AND METHODS

The data of the present review were obtained from published journals and electronic sources. To extract data from electronic sources, a structured Boolean search was performed on search engines such as Google Scholar, ScienceDirect, etc., with the following keywords: "sharks", "elasmobranchii", "Turkey", "Levantine", "Black, Marmara, Aegean OR Mediterranean Seas", "distribution", "hexanchiformes", "lamniformes", "squaliformes", "carcharhiniformes". To extract data published in journals before 2000 and not accessible via internet, a manual search was performed. The collected data were arbitrarily grouped under the following headings: 'distribution, occurrence and first record; feeding biology; population dynamics, including studies on age, growth and length-weight relationship; reproduction, including studies on neonates, gravid females and nurseries; morphometry; underwater observations and behaviour; miscellaneous, including studies on conservation, fishery economy, anthropogenic injuries and newspaper portrayals; and general chondrichthyan studies including sharks'; and their contents were reviewed under the respective shark species. Since some of the articles dealt with more than one topic, each of these multi-topic articles was considered as a single article to prevent the overestimation of the total

number of publications. The taxonomic nomenclature of the shark species follows Serena (2005). The distribution of sharks in Turkish waters was based on Akşiray (1987), Bilecenoğlu *et al.* (2014), Kabasakal (2011b) or Kabasakal *et al.* (2017). The tabulated results of the data search are available upon request to the author, for further investigation.

RESULTS AND DISCUSSION

Overview of the studies

The data search for the present review revealed a remarkable difference between the numbers of shark-specific articles published in each of the two eras of research on the sharks of the Turkish waters (Fig. 1). In the first era, the historical data about sharks in Turkish waters were comprised in general ichthyological inventories (Ninni, 1923; Deveciyan, 1926; Ayaşlı, 1937) and rare anecdotal notes (e.g., Erazi, 1942; Geldiay & Mater, 1968), which, however, provided occurrence data of some rare (e.g., *Oxynotus centrina*, *Echinorhinus brucus*) or questionable (e.g., *Lamna nasus*) or threatened sharks (e.g., *Hexanchus griseus*, *Squatina squatina*) in the mentioned marine region. These references also represent some of the earliest occurrence records of sharks in the Levantine Basin, and therefore, provide an understanding of the historical distribution of sharks in the eastern Mediterranean.

Based on publication dates, there were only 2 shark-specific articles published before 1990, 8 scientific

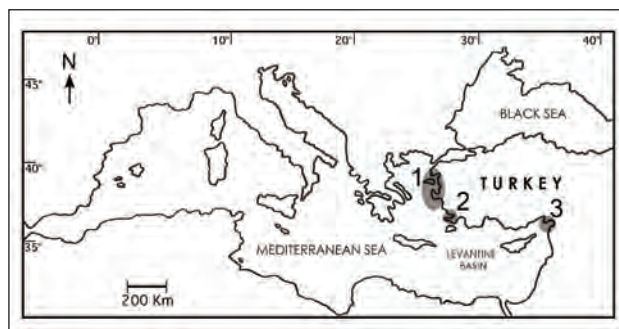


Fig. 1: Geographical location of Turkish waters in the Mediterranean ecosystem. The shaded areas indicate the approximate locations of the three possible sharks breeding grounds: (1) in the northern Aegean Sea, from Gökçeada to Foça, (2) Boncuk Bay in the southern Aegean Sea, and (3) in the Bay of İskenderun in the eastern Levant.

Sl. 1.: Geografska lega turških voda v Sredozemskem morju. Osenčeni območji označujejo približne lokalitete treh možnih območij razmnoževanja morskih psov: (1) severno Egejsko morje, v predelu Gökçeada - Foça, (2) zaliv Boncuk v južnem Egejskem morju, in (3) zaliv İskenderun v vzhodnem Levantu.

ic articles about the sharks of the Turkish waters between 1990 and 2000, and as many as 88 papers dealing with several aspects of the sharks of Turkey since, for a total of 96 articles on the sharks of the Turkish waters published between 1968 and 2018.

With regard to the topics of the publications, the largest number of articles ($n = 60$) dealt with the occurrence, distribution and first records of sharks in Turkish waters, followed by articles about stomach contents and feeding bioecology of sharks ($n = 13$), reproduction and nurseries ($n = 13$), morphometrics ($n = 13$), population dynamics ($n = 11$), underwater observations and behaviour studies ($n = 5$), and miscellaneous topics ($n = 5$) (Fig. 2). The sharks of the Turkish waters were also discussed in general chondrichthyan studies, including those about the batoids of the mentioned marine region ($n = 9$) (Fig. 2).

Species accounts

HEXANCHIFORMES

HEXANCHIDAE

Heptranchias perlo (Bonnaterre, 1788)

Distribution in Turkish waters: Aegean and Mediterranean Seas (Bilecenoğlu *et al.*, 2014).

Hexanchus griseus (Bonnaterre, 1788)

Distribution in Turkish waters: Black, Marmara, Aegean and Mediterranean Seas (Bilecenoğlu *et al.*, 2014).

Review of studies on *H. perlo* and *H. griseus* in Turkish waters

The earliest records of the hexanchid sharks, *H. griseus* and *Heptranchias perlo*, in Turkish waters were reported in general ichthyological inventories by Ninni (1923), Deveciyan (1926) and Akşiray (1987); their contemporary occurrences in the mentioned marine region were confirmed by Kabasakal (1998a, 2004a, 2005, 2009b, 2013a), Kabasakal and İnce (2008), and Başusta (2015). Among these, studies by Kabasakal (2005) and Başusta (2015) are particularly worth mentioning. On 19 November 2004, one male specimen of *H. griseus* of 300 cm TL and weighing 250 kg was captured by a commercial gill-netter nearly 3 miles off the coast of Amasra. This single capture extends the Mediterranean distribution of *H. griseus* to the Black Sea (Kabasakal, 2005). Occurrence of neonates of *H. perlo* in İskenderun Bay (north-eastern Mediterranean Sea) was recorded for the first time by Başusta (2015). In a recent review of large sharks caught by commercial fisheries in Turkish waters, *H. griseus* was the predominant species accounting for 169 specimens and 43.2% of total captures between 1990 and August 2015 (Kabasakal *et al.*, 2017).

Following the capture of newborns of sevengill sharks in İskenderun Bay, Başusta (2015) suggested the possibility of a breeding ground of *H. perlo* in the north-eastern Mediterranean Sea. In Turkish waters, bony fish constitute the main prey of *H. griseus* (Kabasakal,

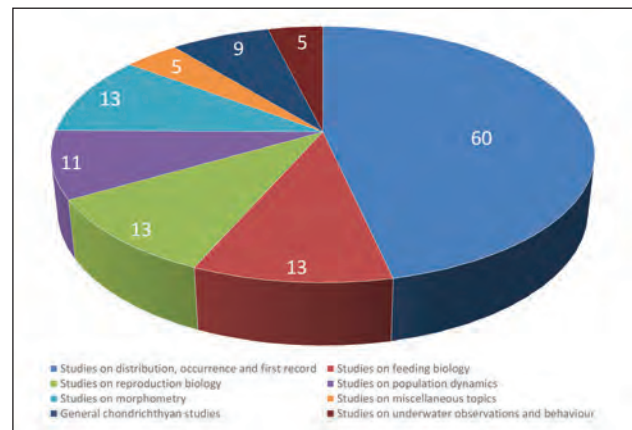


Fig. 2: Numerical distribution of the topics of articles on the sharks of the Turkish waters, published between 1968 and 2018.

Sl. 2: Številčna porazdelitev tematik prispevkov o morskih psih turških voda, objavljenih med leti 1968 in 2018.

2004a). Available information suggests that *H. griseus* gives birth between October and late February in the northern Aegean and Marmara Seas (Kabasakal, 2004a). Morphometric measurements of the *H. griseus* caught in the Sea of Marmara were reported by Kabasakal (1998a). Based on the specimens captured by commercial fishermen in Turkish waters, the length-weight relationship for the bluntnose sixgill shark, *H. griseus*, was calculated as $\log TW = 2.76 \times \log TL - 4.6$ ($r = 0.92$; $n = 34$; sexes combined; Kabasakal, 2006). Analysis of 81 articles related to *H. griseus* and published in major Turkish newspaper and internet media between 1974 and 2009 revealed that the tenor of the coverage was neutral in 49.3% of the articles, 45.6% were negative and only 4.9% were positive (Kabasakal, 2010c). The effect of anthropogenic and fishing-gear induced injuries on the survival and cryptic mortality of sharks were examined in two recent studies (Kabasakal 2010d, 2017a). Post-release behaviour of *H. griseus* in Saros Bay (north-eastern Aegean Sea) was also recorded via underwater videography (Kabasakal, 2010d).

SQUALIFORMES

ECHINORHINIDAE

Echinorhinus brucus (Bonnaterre, 1788)

Distribution in Turkish waters: Marmara, Aegean and Mediterranean Seas (Bilecenoğlu *et al.*, 2014).

Review of studies on *E. brucus* in Turkish waters

In October 2002, a bramble shark *E. brucus* was imaged by means of a ROV camera at a depth of 1,214 m in the northern Sea of Marmara (Kabasakal *et al.*, 2005). This single recording of the bramble shark shows that *E. brucus*, once thought extinct in Turkish seas, still occurs

in this area. Recent studies provide further records confirming the contemporary existence of *E. brucus* in Turkish waters (Kabasakal & Dalyan, 2011; Kabasakal & Bilecenoğlu, 2014; Kabasakal, 2017a).

SQUALIDAE

Squalus acanthias Linnaeus, 1758

Distribution in Turkish waters: Black, Marmara, Aegean and Mediterranean Seas (Bilecenoğlu *et al.*, 2014).

Squalus blainvillei (Risso, 1826)

Distribution in Turkish waters: Black, Marmara, Aegean and Mediterranean Seas (Bilecenoğlu *et al.*, 2014).

Review of studies on *S. acanthias* and *S. blainvillei* in Turkish waters

Subsequently to the pioneering study of Geldiay and Mater (1968), Kutaygil and Bilecik (1977) reported on the distribution and abundance of the spurdog, *S. acanthias*, which ranked the second and/or third among the demersal fish along the western and central Black Sea coasts of Turkey. Contemporary occurrence of the congeneric *S. blainvillei* in Turkish waters was confirmed by Kabasakal and Kabasakal (2004), and Başusta *et al.* (2016).

The main prey of *S. acanthias* and *S. blainvillei* is composed of decapod crustaceans and bony fish (Kabasakal 2002d; Demirhan *et al.*, 2007; Özütemiz *et al.*, 2009). Decapod crustaceans *Liocarcinus* sp. and the commercially important deep-water prawn, *P. longirostris*, constituted the main prey items recorded in the stomach contents of *S. blainvillei* (Kabasakal, 2002d). According to Demirhan *et al.* (2007), the availability of prey is the main criterion for the feeding strategy of *S. acanthias*; thus in winter, the main prey item of the spiny dogfish is anchovy (*Engraulis encrasicolus*). In the eastern Mediterranean population of *S. acanthias*, the length at 50% maturity was 87.57 cm for males and 102.97 cm for females (Demirhan & Seyhan, 2007). On the other hand, Yiğın and İşmen (2013) estimated the mean length at 50% maturity for females and males of *S. acanthias* at 56.4 cm and 52.8 cm, respectively. The structural problems of using spines for determining the age of the spiny dogfish (*S. acanthias*) were examined by Demirhan *et al.* (2006), and the authors concluded that the percentage of age reading failure was 70% and 37% on the first and second spines, respectively. One of the previous studies investigated the population structure of *S. acanthias* along the south-eastern Black Sea coast of Turkey (Düzgüneş *et al.*, 2006). In this study, a total of 267 specimens (85 male and 182 female) were collected and the mean (\pm se) length and weight were 88.25 \pm 2.157 cm and 3319 \pm 204 g for males, and 92.55 \pm 1.73 cm and 4387 \pm 217.6 g for females. The length-weight relationship for the stock was derived as $W=0.009*L3.3423$ ($r^2=0.9607$) (Düzgüneş *et al.*, 2006). In a previous study carried out in the south-eastern region of the Black Sea, Avşar (1996) reported that male specimens of *S. acanthi-*

as dominated the population, the age of this species in the region ranged between 1 and 14 years, and the mean annual growth rate was 7.2 cm. The growth parameters of *S. blainvillei* were examined based on the specimens captured in Sığacık Bay (Aegean Sea), and the mean size for the examined specimens of *S. blainvillei* was 21.46 \pm 2.21 cm, respectively (Özütemiz *et al.*, 2009).

CENTROPHORIDAE

Centrophorus granulosus (Bloch & Schneider, 1801)

Distribution in Turkish waters: Marmara, Aegean and Mediterranean Seas (Bilecenoğlu *et al.*, 2014).

Centrophorus uyato (Rafinesque, 1810)

Distribution in Turkish waters: Marmara Sea (Bilecenoğlu *et al.*, 2014).

Review of studies on *C. granulosus* and *C. uyato* in Turkish waters

In the early 1990s, the first record of the gulper shark, *Centrophorus granulosus*, in the Sea of Marmara was reported by Benli *et al.* (1993), based on specimens caught at a depth of 400 m. Although the congeneric *C. uyato* was also recorded in the Sea of Marmara in the mid-1990s (Meriç, 1995), White *et al.* (2013) suggested that *C. uyato* was not a valid species and that further research was necessary to clarify the taxonomic status of this species in Turkish waters (Kabasakal & Karhan, 2015).

ETMOPTERIDAE

Etmopterus spinax (Linnaeus, 1758)

Distribution in Turkish waters: Aegean and Mediterranean Seas (Bilecenoğlu *et al.*, 2014).

Review of studies on *E. spinax* in Turkish waters

Kabasakal and Ünsal (1999) reported rare occurrences of *E. spinax* caught in deep-water bottom-trawl fishery in the northern Aegean Sea, together with the morphometric measurements of the examined specimens. In a previous study, 116 velvet belly lantern sharks, *E. spinax*, were caught at depths between 200 and 600 m, in Sığacık Bay (Aegean Sea), and the population was composed of more females than males, at 53.4% and 46.6%, respectively; the maximum total lengths for females and males were 20.5 cm and 18.9 cm, respectively (Bilge *et al.*, 2010).

OXYNOTIDAE

Oxynotus centrina (Linnaeus, 1758)

Distribution in Turkish waters: Marmara, Aegean and Mediterranean Seas (Bilecenoğlu *et al.*, 2014).

Review of studies on *O. centrina* in Turkish waters

Based on the chronological order, the first shark-specific article on the distribution and occurrence of sharks in Turkish waters was published in late 1960s. It provided anecdotal data on an angular rough shark (*O. centrina*) caught in the Bay of İzmir (Geldiay & Mater,

1968). Studies on *O. centrina*, which is now considered a rare and threatened shark in the entire Mediterranean Sea, continued in the following decades and provided further understanding about the life story, occurrence and status of the angular rough shark in Turkish waters (Kabasakal, 2009a, 2010a, 2015a; Başusta *et al.*, 2015; Yiğın *et al.*, 2016). A recent review on the occurrence and status of *O. centrina* in the eastern Mediterranean (Kabasakal, 2015a) revealed that between the late 1800s and 2012, the highest number of *O. centrina* specimens (72%) was recorded in the Aegean Sea, followed by the Sea of Marmara (21.5%). Contemporary occurrence of *O. centrina* in Turkish waters was also confirmed by two recent studies (Başusta *et al.*, 2015; Yiğın *et al.*, 2016). Locomotory and feeding behaviour of the rare angular rough shark, *O. centrina*, were recorded by means of diver-operated camera in the northern Sea of Marmara (Kabasakal, 2009a). Measurements of *O. centrina* were reported by Yiğın *et al.* (2016), based on a specimen caught in Saros Bay (north-eastern Aegean Sea). Based on the occurrence of a gravid female in İskenderun Bay, Başusta *et al.* (2015) suggested a possible breeding ground of *O. centrina* in the region.

DALATIIDAE

Dalatias licha (Bonnaterre, 1788)

Distribution in Turkish waters: Marmara, Aegean and Mediterranean Seas (Bilecenoğlu *et al.*, 2014).

Review of studies on *D. licha* in Turkish waters

Kabasakal and Kabasakal (2002) reported rare occurrences of *D. licha* caught in deep-water bottom-trawl fishery in the northern Aegean Sea. Although the main prey of *D. licha* is comprised of decapod crustaceans (*Lio-carcinus* sp. and *P. longirostris*), remains of the sympatric blackmouth dogfish (*G. melastomus*) were also found in the stomach contents of the kitefin shark (Kabasakal & Kabasakal, 2002). Based on the occurrence of newborn specimens of *D. licha*, Kabasakal and Kabasakal (2002) suggested a possible breeding area of the kitefin shark over the bathyal grounds of the north-eastern Aegean Sea. Morphometric measurements of 5 newborn *D. licha* from the north-eastern Aegean Sea were reported by Kabasakal and Kabasakal (2002). Recently, an adult female of *D. licha*, 118 cm TL, got entangled in a trammel net set at a depth of 40 m in İskenderun Bay (NE Mediterranean sea) (Ergüden *et al.*, 2017)

SQUATINIFORMES

SQUATINIDAE

Squatina aculeata Dumeril, in Cuvier, 1817

Distribution in Turkish waters: Aegean and Mediterranean Seas (Bilecenoğlu *et al.*, 2014).

Squatina oculata Bonaparte, 1840

Distribution in Turkish waters: Marmara, Aegean and Mediterranean Seas (Bilecenoğlu *et al.*, 2014).

Squatina squatina (Linnaeus, 1758)

Distribution in Turkish waters: Black, Marmara, Aegean and Mediterranean Seas (Bilecenoğlu *et al.*, 2014).

Review of studies on *S. aculeata*, *S. oculata* and *S. squatina* in Turkish waters

In Turkish waters, the angel shark family Squatinidae is represented by 3 species: *Squatina aculeata*, *S. oculata* and *S. squatina*, and their contemporary occurrences have been confirmed by a number of studies (Başusta, 2002; Başusta *et al.*, 1998; Kabasakal & Kabasakal, 2004, 2014; Yağlıoğlu *et al.*, 2015). *S. squatina* is considered one of the largest sharks in Turkish waters, and, historically, it was one of the commercially important shark species in Turkish demersal fishery. However, the remarkable decrease that has been recorded in angel shark populations is alarming, as the survival of the species may be threatened. As recent surveys show, *S. squatina* accounts for less than 2 percent of the total shark biomass incidentally caught by Turkish fishermen (Yağlıoğlu *et al.*, 2015; Kabasakal *et al.*, 2017).

LAMNIFORMES

ODONTASPIDIDAE

Carcharias taurus Rafinesque, 1810

Distribution in Turkish waters: Aegean and Mediterranean Seas (Bilecenoğlu *et al.*, 2014).

Odontaspis ferox (Risso, 1810)

Distribution in Turkish waters: Aegean and Mediterranean Seas (Bilecenoğlu *et al.*, 2014).

Review of studies on *C. taurus* and *O. ferox* in Turkish waters

There is no specific study available on odontaspidid sharks in Turkish waters.

ALOPIIDAE

Alopias superciliosus (Lowe, 1839)

Distribution in Turkish waters: Marmara, Aegean and Mediterranean Seas (Bilecenoğlu *et al.*, 2014).

Alopias vulpinus (Bonnaterre, 1788)

Distribution in Turkish waters: Black, Marmara, Aegean and Mediterranean Seas (Bilecenoğlu *et al.*, 2014).

Review of studies on *A. superciliosus* and *A. vulpinus* in Turkish waters

Kabasakal (1998b) reported on the incidental capture of a female thresher shark, *A. vulpinus*, 453 cm TL, by a commercial purse-seiner off Şile coast (south-western Black Sea), on 8 November 1996, and this anecdotal note was followed by further records. Contrary to the species' open water habits, Kabasakal (2007) reported on the coastal occurrences of 19 common thresher sharks (*A. vulpinus*) that were incidentally captured by coastal stationary netters. Recently, Ergüden *et al.* (2015) reported on a single male thresher shark, 392 cm TL and weighing ca. 180 kg, captured incidentally in purse-

-seine fishery in İskenderun Bay; this was the first record of *A. vulpinus* from the north-eastern Mediterranean coast of Turkey. The first record of the congeneric bigeye thresher shark, *A. superciliosus*, in Turkish waters dates back to the early 2000s (Mater, 2005; Bay of Gökova, south-eastern Aegean Sea); a few years later it was recorded in the Sea of Marmara (Kabasakal & Karhan, 2008). The female bigeye thresher shark, 450 cm TL, caught on 28 February 2011 off Fethiye coast, is one of the largest specimens of *A. superciliosus* ever recorded in the Mediterranean Sea and worldwide (Kabasakal *et al.*, 2011). Based on the total number ($n = 392$) of large sharks caught by commercial fishermen between 1990 and August 2015 in Turkish waters, *A. superciliosus* and *A. vulpinus* accounted for 2.5% and 9.9% of the total catch, respectively (Kabasakal *et al.*, 2017).

CETORHINIDAE

Cetorhinus maximus (Gunnerus, 1765)

Distribution in Turkish waters: Aegean and Mediterranean Seas (Bilecenoğlu *et al.*, 2014).

Review of studies on *C. maximus* in Turkish waters

Early writings on the occurrence of basking sharks in Turkish waters date back to the 1990s, when an anecdotal record of basking shark, *Cetorhinus maximus*, was reported from north-eastern Levantine waters (Kideys, 1997). It was followed by further records off the Turkish coasts, particularly in the Bay of Antalya (Kabasakal, 2002a, 2004b, 2013b). In January of 2009, an adult male basking shark was accidentally caught in a stationary net in the waters some 2 nautical miles off Küçükuyu (north Aegean Sea); its total length measured ca. 1,000 cm (Kabasakal, 2009c). According to Kabasakal (2009c), this specimen is the largest well-documented basking shark recorded in the Mediterranean to date. In a recent review of the status of basking sharks in the eastern Mediterranean, Kabasakal (2013c), based on the extremely low number of records off Turkish coast since the 1950s, emphasized the rarity of *C. maximus* in Turkish waters and the need for a specific monitoring program accompanied by zooplankton surveys that would determine the seasonal movements of basking sharks in the mentioned region and answer the questions whether the occurrence of this species in Turkish waters exhibits seasonality and site fidelity or not.

LAMNIDAE

Carcharodon carcharias (Linnaeus, 1758)

Distribution in Turkish waters: Marmara, Aegean and Mediterranean Seas (Bilecenoğlu *et al.*, 2014).

Review of studies on *C. carcharias* in Turkish waters

In a 16th century record, Bellonii (1553) reported on the occurrence of *C. carcharias* off İzmir coast. Following this historical note, this top predator was listed in the general ichthyological inventories of Turkish waters

(Ninni, 1923; Deveciyan, 1926; Ayaşlı, 1937; Akşiray, 1987) When talking about the sharks of the Mediterranean Sea, the great white shark, *C. carcharias*, has always been the “top star” of research efforts and incidental captures of this predator have always found room in newspaper reports as well. Therefore, a detailed search in newspaper archives covering the period between the early 1900s and the late 1960s yielded several articles about specimens of *C. carcharias* incidentally captured by tuna hand-liners in the Bosphorus Strait during that time (Kabasakal, 2003a, b). Further research revealed the presence of *C. carcharias* in Marmara and Turkish Aegean waters between the 1960s and the 1990s (Kabasakal 2008, 2011a; Kabasakal & Kabasakal, 2004). Following the capture of two newborns of the great white in Edremit Bay (northern Aegean Sea) in the summer of 2008, contemporary occurrence of *C. carcharias* in Turkish waters was confirmed (Kabasakal & Gedikoğlu, 2008) and this incidence was followed by the captures of additional specimens (4 newborns and 3 juveniles) in the north-eastern Aegean Sea, in the coastal zone extending from Foça (central Aegean Sea) to Gökçeada (north-eastern Aegean Sea) (Kabasakal, 2014; Kabasakal & Kabasakal, 2015; Kabasakal *et al.*, 2009). Among the captured newborns, a north Aegean Sea specimen (85 cm TL) caught by a coastal trammel netter in Edremit Bay on 6 July 2011, is possibly the smallest neonate great white shark reported from Mediterranean waters to date (Kabasakal, 2014). The capture of neonate, young-of-the-year and juvenile white sharks suggested the presence of a breeding ground of *C. carcharias* in the central and northern coasts of the Turkish Aegean Sea (Kabasakal, 2014; Kabasakal & Kabasakal, 2015; Kabasakal *et al.*, 2009). In light of the available data, *C. carcharias* is an extant lamnid shark in the Aegean waters off the Turkish coast, but presently not occurring in the Sea of Marmara (Kabasakal, 2016a, Kabasakal *et al.*, 2018), contrary to the assertions in Bilecenoğlu *et al.* (2014), which are based on historical occurrence data of the species.

Isurus oxyrinchus Rafinesque, 1810

Distribution in Turkish waters: Aegean and Mediterranean Seas (Bilecenoğlu *et al.*, 2014).

Review of studies on *I. oxyrinchus* in Turkish waters

A huge female shortfin mako shark, *Isurus oxyrinchus*, was caught in the late 1950s off Marmaris (south-eastern Aegean Sea; Kabasakal & De Maddalena, 2011). Photographic documentation was used by the authors to estimate the total length of this specimen at 585 cm, which greatly exceeded the previous maximum size recorded for the species (445 cm). Although recent studies have confirmed the contemporary occurrence of *I. oxyrinchus* in Turkish Aegean and Mediterranean waters (Ergüden *et al.*, 2013; Kabasakal 2015b, 2017b; Kabasakal & Kabasakal, 2013; Tunçer & Kabasakal,

2016), this is a rare lamnoid shark in Turkish waters. Therefore, the seasonal occurrence of both young and adult shortfin mako sharks off Turkey's Aegean and Mediterranean coasts should be monitored to clarify whether the shortfin mako shark is a resident or a vagrant species along the aforementioned coastline. According to Kabasakal *et al.* (2017), *I. oxyrinchus* accounted for 5.3% of the total number of large sharks captured by commercial fishermen in the 1990–2015 period in Turkish waters. Occurrences of *I. oxyrinchus* newborns and young-of-the-year off Foça and in İskenderun Bay suggest the possibility of a mating region in the northern Aegean and north-eastern Mediterranean Seas (Ergüden *et al.*, 2013; Kabasakal, 2015b).

Lamna nasus (Bonnaterre, 1788)

Distribution in Turkish waters: Marmara, Aegean and Mediterranean Seas (Bilecenoğlu *et al.*, 2014).

Review of studies on *L. nasus* in Turkish waters

Occurrence of the porbeagle shark, *Lamna nasus*, in Turkish waters was reported by Deveciyan (1926), Akşiray (1987) and Kabasakal (2002b). Kabasakal and Kabasakal (2004) reported on a porbeagle shark, 250 cm TL, caught off Bozcaada (northern Aegean Sea), on 11 April 2004. *L. nasus* is a rare shark in Turkish waters and its questionable presence in Marmaric waters requires confirmation (Kabasakal & Karhan, 2015).

CARCHARHINIFORMES

SCYLIORHINIDAE

Galeus melastomus Rafinesque, 1810

Distribution in Turkish waters: Marmara, Aegean and Mediterranean Seas (Bilecenoğlu *et al.*, 2014).

Scyliorhinus canicula (Linnaeus, 1758)

Distribution in Turkish waters: Black, Marmara, Aegean and Mediterranean Seas (Bilecenoğlu *et al.*, 2014).

Scyliorhinus stellaris (Linnaeus, 1758)

Distribution in Turkish waters: Marmara, Aegean and Mediterranean Seas (Bilecenoğlu *et al.*, 2014).

Review of studies on *G. melastomus*, *S. canicula* and *S. stellaris* in Turkish waters

Contemporary occurrences of cat sharks (family Scyliorhinidae), *Galeus melastomus*, *Scyliorhinus canicula* and *S. stellaris*, in Turkish waters were confirmed by Başusta *et al.* (2016), Kabasakal (2002b), Kabasakal and Kabasakal (2004), Kabasakal and Karhan (2015), Keskin and Karakulak (2006), İşmen *et al.* (2013), and Yağlıoğlu *et al.* (2015). *S. canicula* is the most abundant cartilaginous fish species caught in demersal fishery in Turkish waters (Cihangir *et al.*, 1997; Kabasakal, 2002b; Keskin & Karakulak, 2006; İşmen *et al.*, 2013; Yağlıoğlu *et al.*, 2015).

Investigations carried out since 1997 have revealed that, in Turkish waters, the main prey items of *S. canicula* are decapod crustaceans (*Parapenaeus longirostris*, *Lio-*

carcinus sp., *Goneplax rhomboides*, *Xantho* sp. and *Munida* sp.) and teleostean fish, while secondary food items comprise polychaetes (e.g., Sipunculida) and cephalopods (Cihangir *et al.*, 1997; Kabasakal, 2001, 2002c; Filiz & Taşkavak, 2006; Türker Çakır 2006). A previous study on the stomach contents and feeding ecologies of the *S. canicula* and thornback ray, *Raja clavata*, caught in the northern Aegean Sea, revealed a clear niche overlap between *S. canicula* (all sizes) and *R. clavata* (>50 cm TL), and competition for similar prey items (Kabasakal, 2001). In a broader perspective, in Turkish waters, *G. melastomus* preys mainly on crustaceans, teleosteans and cephalopods (Kabasakal, 2002c; Özütemiz *et al.*, 2009), while in the deep zones (>1000 m depth) of the Sea of Marmara, the blackmouth catshark feeds mainly on crustaceans, *Calocaris macandreae* and *Sergestes robustus* (Oral, 2010).

In a previous study on the distribution and determine biological aspects of the lesser spotted dogfish in the north-eastern Aegean Sea, Cihangir *et al.* (1997) reported that the reproduction of *S. canicula* occurs year-round, with a relatively low rate of oogenesis in winter and early spring. Demersal trawl surveys carried out in the northern Aegean Sea showed that seasonal biomass of *S. canicula* in shallow waters (≤ 100 m depth) varied from 576 to 2,958 tonnes (Cihangir *et al.*, 1997). Filiz and Mater (2002) examined the length-weight relationships of seven elasmobranch species sampled from the north Aegean Sea, and calculated the length-weight equations for *S. canicula*, *M. mustelus* and *S. acanthias* as follows: $WT = 0.0016TL \times 3.1804$ ($r^2 = 0.9795$), $WT = 0.0008TL \times 3.3259$ ($r^2 = 0.9745$) and $WT = 0.0031TL \times 3.1056$ ($r^2 = 0.9814$), respectively. According to Türker-Çakır *et al.* (2006), the weight increased allometrically in the both sexes of the *S. canicula* sampled in the northern Aegean Sea ($b = 2.93$). Sexual dimorphism, dentition and morphometry of the *S. canicula* caught in Turkish waters were studied by Erdoğan *et al.* (2004) and Filiz and Taşkavak (2006).

Growth parameters of *G. melastomus* were examined based on specimens captured in Sığacık Bay (Aegean Sea), and the mean size for the examined specimens was 14.01 ± 1.96 cm (Özütemiz *et al.*, 2009). The length-weight relationship parameters of 16 out of the 30 cartilaginous fish species (11 sharks, 18 batoids and 1 chimaera) caught in the central Aegean Sea were examined; the values of the slope b in the length-weight relationship parameters ranged from 2.79 (*Torpedo marmorata*) to 3.78 (*Scyliorhinus stellaris*), a values from 0.0002 (*Scyliorhinus stellaris*) to 0.9713 (*Dasyatis pastinaca*) (Eronat and Özaydın, 2014).

TRIAKIDAE

Galeorhinus galeus (Linnaeus, 1758)

Distribution in Turkish waters: Marmara, Aegean and Mediterranean Seas (Bilecenoğlu *et al.*, 2014).

Mustelus asterias Cloquet, 1821

Distribution in Turkish waters: Black, Marmara, Aegean and Mediterranean Seas (Bilecenoğlu *et al.*, 2014).
Mustelus mustelus (Linnaeus, 1758)

Distribution in Turkish waters: Marmara, Aegean and Mediterranean Seas (Bilecenoğlu *et al.*, 2014).
Mustelus punctulatus Risso, 1826

Distribution in Turkish waters: Aegean and Mediterranean Seas (Bilecenoğlu *et al.*, 2014).

Review of studies on *G. galeus*, *M. asterias*, *M. mustelus* and *M. punctulatus* in Turkish waters

Contemporary occurrences of triakid sharks (family Triakidae), *Galeorhinus galeus*, *Mustelus asterias*, *M. mustelus* and *M. punctulatus*, in Turkish waters have been confirmed by a number of studies (Filiz and Mäter, 2002; Kabasakal, 2002b; Kabasakal & Kabasakal, 2004; Başusta *et al.*, 1998, 2016; Yağlıoğlu *et al.*, 2015). Two specimens of the starry smoothhound, *M. asterias*, were captured three miles off the coast of Şile (south-western Black Sea) on 19 November 2000 at a depth of ca. 90 m, and this previous record extended the Mediterranean distribution of *M. asterias* to the Black Sea (Eryılmaz *et al.*, 2011). The tope shark, *G. galeus*, is one of the largest shark species occurring in Turkish waters, and the recent remarkable decrease in its populations is alarming. Between 1990 and 2015, *G. galeus* accounted for less than 2 percent of the total shark biomass recorded in the Turkish commercial fisheries (Kabasakal *et al.*, 2017). The diet of *M. mustelus* is heterogeneous and generalized, and the main prey item found in the stomach contents is decapod crustaceans, with teleosteans and cephalopods featuring as secondary important food items (Kabasakal, 2002c; Filiz, 2009; Özcan & Başusta, 2016).

CARCHARHINIDAE

Carcharhinus altimus (Springer, 1950)

Distribution in Turkish waters: Mediterranean Sea (Bilecenoğlu *et al.*, 2014).

Carcharhinus brevipinna (Müller & Henle, 1839)

Distribution in Turkish waters: Aegean and Mediterranean Seas (Bilecenoğlu *et al.*, 2014).

Carcharhinus limbatus (Müller & Henle, 1839)

Distribution in Turkish waters: Mediterranean Sea (Bilecenoğlu *et al.*, 2014).

Carcharhinus melanopterus (Quoy & Gaimard, 1824)

Distribution in Turkish waters: Mediterranean Sea (Akşiray, 1987; Kabasakal, 2011b).

Carcharhinus obscurus (Lesueur, 1818)

Distribution in Turkish waters: Mediterranean Sea (Akşiray, 1987; Kabasakal, 2011b).

Carcharhinus plumbeus (Nardo, 1827)

Distribution in Turkish waters: Aegean and Mediterranean Seas (Bilecenoğlu *et al.*, 2014).

Prionace glauca (Linnaeus, 1758)

Distribution in Turkish waters: Marmara, Aegean and Mediterranean Seas (Bilecenoğlu *et al.*, 2014).

Review of studies on *Carcharhinus* species and *P. glauca* in Turkish waters

Despite historical and contemporary occurrences of carcharhinid sharks (family Carcharhinidae) in Turkish waters have been noted in general ichthyological or chondrichthyan inventories of the mentioned region (e.g., Ninni, 1923; Akşiray, 1987; Başusta *et al.*, 1998; Kabasakal, 2002b, 2003b; Kabasakal & Kabasakal, 2004; Kabasakal *et al.*, 2017; Yağlıoğlu *et al.*, 2015), the paucity of species specific studies is obvious. In a previous report on the status of the blue shark, *Prionace glauca*, in the northern Aegean Sea, Kabasakal (2010b) emphasized that coastal trammel- and gill-netting is a serious threat to the survival of the young populations of the species in Edremit Bay. In an extensive survey on the chondrichthyan fish of İskenderun Bay (north-eastern Mediterranean Sea), Başusta *et al.* (1998) recorded the bignose shark, *Carcharhinus altimus*, for the first time in Turkish waters and confirmed the contemporary presence of the sandbar shark, *C. plumbeus*, as well. Underwater observations carried out in Boncuk Bay (south-eastern Aegean Sea) and the knowledge gathered from these surveys played a critical role in declaring *C. plumbeus* a protected species in Turkish seas (Akça, 2010; Öztürk, 2006). Recent surveys have confirmed the occurrence of the dusky shark, *C. obscurus*, in the Bay of İskenderun (Kabasakal *et al.*, 2017). The spinner shark, *C. brevipinna*, is considered a rare shark and has only been listed in the general ichthyological and chondrichthyan inventories of Turkish waters (Akşiray, 1987; Kabasakal, 2002b); recently, Filiz and Kabasakal (2015) reported on a specimen of this species photographed in the Bay of Gökova. The recently discovered photographic evidence suggests that *Carcharhinus* spp. were present in the Sea of Marmara in the 1950s (Kabasakal, 2015c), and this evidence also extends the known historical distributional range of *Carcharhinus* spp. into Marmaric waters, a northern extension of the Mediterranean Basin.

In a pioneering study in which the length-weight relationship (LWR) of the sandbar shark, *C. plumbeus*, from the northeastern Mediterranean Sea population was examined for the first time, the LWR estimated for combined sexes, females and males, were $W = 0.01 \cdot TL$ ($r = 0.915$, $SE = 0.174$), $W = 0.0034 \cdot TL$ ($r = 0.912$, $SE = 0.278$) and $W = 0.0039 \cdot TL$ ($r = 0.915$, $SE = 0.231$), respectively (Başusta, 2016). According to Başusta (2016), the type of allometric growth in the examined population of *C. plumbeus* was negative ($b < 3$) for all sexes and for males, and positive ($b > 3$) for females. Seeing that Boncuk Bay (south-eastern Aegean Sea) is of critical importance for the reproduction of *C. plumbeus*, Öztürk (2006) suggested that the bay should be declared a protected area and all fishery should be banned in its waters. Underwater observations to record the bioecological characteristics of the sandbar shark, *C. plumbeus*, were also carried out in Boncuk Bay (south-eastern Aegean Sea) during a 39-day expedition

in 2009 (Akça, 2010). A study has also been carried out which confirmed the year-round aggregations of sandbar sharks in the area and provided new and solid evidence for banning all fishing activities in this marine protected area (Filiz, 2018).

SPHYRNIDAE

Sphyrna (Sphyrna) zygaena (Linnaeus, 1758)

Distribution in Turkish waters: Aegean and Mediterranean Seas (Bilecenoğlu *et al.*, 2014).

Review of studies on *S. zygaena* in Turkish waters

Our knowledge on hammerhead sharks (family Sphyrnidae) in Turkish waters consists of rudimentary data. Ulutürk (1987) and Kabasakal and Kabasakal (2004) reported rare occurrences of the smooth hammerhead shark, *Sphyrna zygaena*, off Gökçeada coasts (northern Aegean Sea), and the species was observed off the Kaş Peninsula (western Levantine Basin) in August 2015 (Kabasakal *et al.*, 2017). Although its occurrence was confirmed, *S. zygaena* is a rare shark in Turkish waters (Kabasakal *et al.*, 2017).

Review of general studies on chondrichthyan fish in Turkish waters

In an extensive survey of the chondrichthyan fish of İskenderun Bay, the bignose shark, *C. altimus*, was recorded for the first time in Turkish waters and the presence of *C. plumbeus*, *O. centrina* and *S. oculata* in the bay waters were confirmed as well (Başusta *et al.*, 1998). Based on the results of field surveys and a review of available data, Kabasakal (2002b) reported on the presence of 39 shark species in Turkish waters, defining the occurrence of 8 of them questionable and requiring confirmation. The results of an extensive trawl survey carried out in the northern Aegean Sea determined *S. canicula* as the most abundant cartilaginous fish species, with a total mass estimated at 2,850.6 kg/nm² (Keskin & Karakulak, 2006). Between March 2005 and June 2008, in Saros Bay, Turkey, ten shark species were sampled from depths ranging from 5 to 500 m for length-weight relationship using a commercial trawl vessel. The values of the exponent *b* of the length-weight relationships ranged from 2.6816 to 3.6060 (İşmen *et al.*, 2009). In rare occasions, selected measurements of lamniform sharks (*C. maximus*, *A. superciliosus*, *A. vulpinus*, *C. carcharias* and *I. oxyrinchus*) were also reported by Kabasakal (2002a, 2017b), Kabasakal and Gedikoğlu (2008), Kabasakal and Karhan (2008), Kabasakal and Kabasakal (2013), Ergüden *et al.* (2013, 2015) and Tunçer and Kabasakal (2016).

Between October 2011 and February 2013, the composition of by-catch in the beam trawls used in the pink shrimp (*Parapenaeus longirostris*) fishery was surveyed seasonally and *S. canicula*, *S. stellaris*, *S. acanthias* and *O. centrina* were recorded (İşmen *et al.*, 2013). Between 2009 and 2010, the total biomass, species composition, depth distribution, seasonal distribution and abundance

of elasmobranchs caught by commercial bottom-trawlers in İskenderun Bay (north-eastern Levantine Sea) were also examined (Yağlıoğlu *et al.*, 2015). In this study, *M. mustelus*, *S. canicula*, *S. stellaris*, *G. melastomus* and *S. squatina* represented between 0.45% and 1.7% of the total biomass of the examined cartilaginous fish. Single or sporadic captures were also recorded for *I. oxyrinchus*, *C. altimus*, *C. plumbeus* and *O. centrina* (Yağlıoğlu *et al.*, 2015). In a recent review on cartilaginous fish and fisheries along the Mediterranean coast of Turkey, Başusta *et al.* (2016) recorded 32 species from 16 families, and concluded that the landings of elasmobranchs were reduced from 3,980 tonnes in 2000 to 246.2 tonnes in 2015. The production and economic values of sharks and their relatives in Turkey have been analysed for the last 34 years, and according to Doğan (2006), the maximum catch level was recorded in 1979 (11,125 t), followed by a significant decrease after 1989 and reaching the minimum level of 400 t in 2003. The current status of sharks and shark fisheries in the waters of the Sea of Marmara has been of late extensively reviewed (Kabasakal, 2016b; Yiğın *et al.*, 2016). Last but not least, in a recent survey of shark attacks against humans and boats, 13 shark attacks were recorded in Turkey's waters between 1931 and 1983, 2 of which fatal (Kabasakal & Gedikoğlu, 2015).

CONCLUSIONS

Until the last quarter of the 20th century, most of our knowledge on the sharks of the Turkish waters was based on elasmobranch-specific chapters in general ichthyological inventory studies and on a limited number of anecdotal studies. Since the mid-1990s, however, there has been a remarkable rise in the number and quality of shark-specific studies and publications, resulting in a gradual filling of the gaps in our understanding of the sharks of the Turkish waters. The reference list of the present article also serves as a bibliographical archive of the shark- and elasmobranch-specific studies related to Turkish waters that were published between 1968 and 2018. The next step in shark- and elasmobranch-specific studies should involve designing a master plan for the management of sharks and their relatives in Turkish waters, and implementing the conservatory acts that would be based on the available data.

Currently, 36 species of sharks with confirmed occurrence are present in Turkish waters (Akşiray, 1987; Kabasakal, 2011b; Bilecenoğlu *et al.*, 2014; Kabasakal *et al.*, 2017): *Hexanchus griseus*, *Heptranchias perlo*, *Echinorhinus brucus*, *Squalus acanthias*, *S. blainvillei*, *Centrophorus granulosus*, *C. uyato*, *Etmopterus spinax*, *Oxynotus centrina*, *Dalatias licha*, *Squatina aculeata*, *S. oculata*, *S. squatina*, *Carcharias taurus*, *Odontaspis ferox*, *Alopias superciliosus*, *A. vulpinus*, *Cetorhinus maximus*, *Carcharodon carcharias*, *Isurus oxyrinchus*, *Lamna nasus*, *Galeus melastomus*, *Scyliorhinus canicula*, *S. stellaris*, *Galeorhinus galeus*, *Mustelus asterias*,

M. mustelus, *M. punctulatus*, *Carcharhinus altimus*, *C. brevipinna*, *C. limbatus*, *C. melanopterus*, *C. obscurus*, *C. plumbeus*, *Prionace glauca*, and *Sphyrna zygaena*. There are also species of questionable occurrence, which are included in one of the noteworthy ichthyological inventories of Turkish waters (Akşiray, 1987), but require confirmation, namely: *C. longimanus*, *S. lewini*, *S. tudes* and *Somniosus rostratus*.

The continuous rise in the number of articles and chapters on the sharks of the Turkish waters published annually is promising. The seasonal occurrence of neonate and young-of-the-year specimens of several shark species in Turkish waters, as well as the presence of documented breeding and nursery grounds in the region form a solid basis for the implementation of seasonal restrictions of commercial fisheries in these grounds. Based on the by-catch records of neonates and juvenile specimens of some rare sharks, such as *D. licha* and *O. centrina*, or some large sharks, for example, *H. griseus*, *C. carcharias*, *I. oxyrinchus* and *C. plumbeus*, it is possible to speculate that sharks, at least the mentioned species, could reproduce in Turkish waters throughout the vast coastal zone spreading from the north Aegean Sea to the eastern Levant. In light of available and confirmed data, there are three possible breeding grounds; (1) in the northern Aegean Sea, between Gökçeada and Foça, (2) in Boncuk Bay in the southern Aegean Sea, and (3) in the Bay of İskenderun, eastern Levant (Fig. 1). To allow the survival of shark species, these areas should be declared seasonally protected or at least restricted zones for commercial fisheries. Currently, Boncuk Bay is the only protected area.

Different geographical populations of the same shark species can exhibit different growth parameters, which

should be taken into account in their management. For instance, available data on the parameters of the Aegean Sea and Black Sea populations of *S. acanthias* present a clear difference in length at 50% maturity (Demirhan & Seyhan, 2007; Yiğın & İşmen, 2013) – a critical detail that should not be overlooked in the regional management of *S. acanthias* in Turkish waters.

Populations of many large shark species in Turkish waters have drastically declined; a recent review of the distribution of large sharks captured mostly by commercial fishermen in the 1990–2015 period in Turkish waters showed that large sharks accounted for less than 2 percent of the total captured biomass (Kabasakal *et al.*, 2017). According to Kabasakal *et al.* (2017), large sharks in Turkish waters are threatened by multi-parameter fishing pressure of demersal and pelagic fisheries of artisanal to industrial scale that operate in coastal to open waters and in shallow to deep fishing grounds almost year-round. Last but not least, fishing-gear induced injuries and harsh handling are overlooked contributors to the cryptic mortality of sharks in Turkish waters. Hopefully, future studies by new generations of researchers will provide new data on several aspects of the sharks of the Turkish waters, which can deepen our understanding of them and fill in the blanks in their life stories.

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PREGLED RAZISKAV O MORSKIH PSIH V TURŠKIH VODAH

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POVZETEK

Do zadnje četrtine 20. stoletja je bilo poznavanje o morskih psih v turških vodah omejeno na poglavja v specifičnih monografijah o morskih psih v splošnih ihtioloških pregledih in manjšem številu anekdotičnih raziskav. Od srede devetdesetih let pa je prišlo do občutnega povečanja v številu in kvaliteti specifičnih raziskav in publikacij o morskih psih, ki je počasi mašilo vrzel o poznavanju morskih psov v turških vodah. Pred letom 1990 sta bila objavljena le dva specifična prispevka o morskih psih, 8 prispevkov med leti 1990 in 2000 ter 88 prispevkov po letu 2000. Skupno je bilo objavljeno 96 prispevkov o morskih psih v turških vodah med leti 1968 in 2018. Smiselno je upati, da bodo nove generacije raziskovalcev odkrile nove podatke o morskih psih iz turških morij iz vseh vidikov, kar bo poglobilo in izpopolnilo znanje o njih in njihovem življenju.

Ključne besede: raziskave morskih psov, objave, turške vode, vzhodno Sredozemlje

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