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DISTRIBUTION AND STATUS OF THE GREAT WHITE SHARK, *CARCHARODON CARCHARIAS*, IN TURKISH WATERS: A REVIEW AND NEW RECORDS

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ABSTRACT

The occurrence of Carcharodon carcharias in Turkish waters has been reported since the end of the 19th century. A total of 77 records of great white shark have been compiled from 1881 to 2020. The available data suggest that the species occurs in Turkish waters throughout the year. The occurrences of adult specimens have shown a remarkable decrease during this period, nevertheless, the species has not been extirpated from the region. The present study demonstrates that the distribution of C. carcharias in Turkish waters has seen a significant regional shift over time, with the current distribution of young-of-the-year and juveniles extending from the central to northern Aegean Sea and concentrating in the Bay of Edremit. C. carcharias has been recently declared as a species under protection in Turkish waters, but the next steps towards providing better protection for the species in the region are urgently required.

Key words: nursery, management, conservation, eastern Mediterranean, Lamnidae, coastal fishery

DISTRIBUZIONE E STATUS DEL GRANDE SQUALO BIANCO, *CARCHARODON CARCHARIAS*, NELLE ACQUE TURCHE: RASSEGNA E NUOVE SEGNALAZIONI

SINTESI

La presenza di Carcharodon carcharias nelle acque turche è stata segnalata dalla fine del XIX secolo. Dal 1881 al 2020 sono state raccolte 77 registrazioni di squali bianchi. I dati disponibili suggeriscono che la specie è presente nelle acque turche durante tutto l'anno. La presenza di esemplari adulti ha mostrato una notevole diminuzione durante questo periodo, tuttavia la specie non è stata estirpata dalla regione. Il presente studio dimostra che la distribuzione di C. carcharias nelle acque turche ha subito un significativo spostamento regionale nel corso del tempo, con l'attuale distribuzione dei giovani dell'anno e del novellame che si estende dall'Egeo centrale a quello settentrionale e si concentra nella Baia di Edremit. Lo squalo bianco è stato recentemente dichiarato specie sotto protezione nelle acque turche, ma i prossimi passi per fornire una migliore protezione alla specie nella regione sono urgenti.

Parole chiave: nursery, gestione, conservazione, Mediterraneo orientale, Lamnidae, pesca costiera

INTRODUCTION

The great white shark, *Carcharodon carcharias* (Linnaeus, 1758) (Lamniformes: Lamnidae), has been the focus of both naturalists and scientists since the Middle Ages (De Maddalena & Heim, 2012). For example, in the book entitled *De aquatilibus*, the 16th century French naturalist Petrus Bellonius gave brief information about the great white shark (referred to as *Canis carcharias*), which is considered one of the earliest descriptions of *C. carcharias* (Bellonius, 1553). Another 16th century French naturalist, Guillaume Rondelet, narrated of the discovery of an armoured knight following the evisceration of an enormous great white shark caught off the coast of Marseilles and noted one of the earliest observations on the predatory behaviour of *C. carcharias* (Steel, 1985). Due to significant popular and scientific interest that it arouses, *C. carcharias* is today considered a “flagship species” in all aspects of shark research and conservation efforts, and in public perception it has changed from a sea monster into a charismatic member of marine megafauna (Mazzoldi *et al.*, 2019).

According to Compagno (2002), *C. carcharias* is a huge and formidable shark, inhabiting both coastal and offshore waters over continental and insular shelves in temperate seas. It is circumglobal, commonly occurring in most temperate seas, including the Mediterranean Sea, and less common in tropical regions (Ebert & Stehmann, 2013). *C. carcharias* is a very active, nomadic and social lamnid shark, whose regional occurrence is remarkably effected by migration (e.g., bluefin tuna, *Thunnus thynnus*) or coastal communities (e.g. pinnipeds) of its prey species. Although the seasonal occurrence of the great white shark in coastal or insular waters in certain localities worldwide is clearly associated with the presence of coastal populations of pinnipeds (e.g., South African [Cape] fur seal, *Arctocephalus pusillus pusillus*, or California sea lion, *Zalophus californianus*; Kelly & Klimley, 2003; Martin *et al.*, 2005; Johnson *et al.*, 2009), its occurrence in the Mediterranean Sea is closely associated with the migrations of *T. thynnus* (De Maddalena, 2000; Kabasakal, 2016; Barrull & Mate, 2001; Soldo & Jardas, 2002; Galaz & De Maddalena, 2004; De Maddalena & Heim, 2012; Morey *et al.*, 2003).

Publications on several aspects of the life history of the great white shark in the Mediterranean Sea, where currently 779 confirmed cases have been recorded (Moro *et al.*, 2020; Jambura *et al.*, 2021), include regional occurrence records of single or few individuals (e.g. Celona, 2002; Galaz & De Maddalena, 2004; Soldo & Dulčić, 2005; Celona *et al.*, 2001; Maliet *et al.*, 2013; Tiralongo *et al.*, 2020; Jambura *et al.*, 2021), reviews of regional abun-

dance and distribution (e.g., De Maddalena, 2000; Barrull & Mate, 2001; Soldo & Jardas, 2002; Morey *et al.*, 2003; Maliet *et al.*, 2013), and assessments of Mediterranean population as a whole (e.g, Fergusson, 1996; Gubili *et al.*, 2010; De Maddalena & Heim, 2012; Boldrocchi *et al.*, 2017; Moro *et al.*, 2020).

Although the first records of *C. carcharias* in Turkish waters were reported from the Bosphorus Strait, the far northern extension of the Mediterranean ecosystem, as early as the end of the 19th century (Fergusson, 1996), the occurrence of the great white shark in the region has been mentioned in only a few 20th century ichthyological inventories (Deveciyan, 1926; Ayaşlı, 1937; Akyüz, 1957; Akşiray, 1987). Apart from occasional reports on the capture of this megashark in the urban waters of Istanbul city, which is also known as Bosphorus, accompanied with catchy photographs, appearing in newspapers up to the early 1970s (Kabasakal, 2003), an inexplicable paucity of *C. carcharias* specific studies characterised the entire 20th century. However, with the beginning of the 2000s this situation changed and the number of studies and publications specifically devoted to great white sharks occurring in Turkish waters has steadily increased (Kabasakal 2003, 2008, 2011, 2014, 2016, 2020a,b,c,d; Kabasakal & Gedikoğlu, 2008; Kabasakal & Bayrı, 2020, 2021; Kabasakal *et al.*, 2009, 2018). The present article provides a review of the existing literature and new records on the occurrence, distribution, and status of the great white shark in Turkish waters. More specifically, this article reviews (1) spatial and seasonal distribution of *C. carcharias* in Turkish waters, (2) seasonal and spatial distribution of length groups, (3) potential nursery areas, and (4) fishery and human interaction in the study region.

MATERIAL AND METHODS

Study area

Turkey is a peninsular country, surrounded by the Black, Aegean and Levantine Seas and the Turkish Straits system, which stretches along the Dardanelles Strait, the Sea of Marmara and the Bosphorus Strait (Fig. 1). Generally speaking, the most prominent oceanographical peculiarities of the seas around Turkey are as follows: the high hydrogen sulphide concentration prevailing below 150 to 200 m in the Black Sea is an important factor preventing the dispersal of fishes in the deep zones. The TSS plays a significant if not decisive ecological role in the dispersal of living organisms between the Mediterranean and Black Seas, since it constitutes a barrier, a corridor, or an acclimatisation zone for marine species. The Aegean Sea is topographically

divided by (approximately) the 38° parallel into two basins, i.e., the North and South Aegean, where the North Aegean Sea is an area characterised by cold-water fauna, and the South Aegean Sea by warm-water fauna, including Lessepsian migrants. Finally, with the opening of the Suez Canal in 1869 and the general warming of the world oceans, the Mediterranean Sea has been impacted by the phenomenon known as “tropicalisation”, which causes the retreating of temperate species towards colder areas of the basin. Recent studies have revealed the occurrence of 38 shark species in Turkish waters (Kabasakal, 2021; Turan *et al.*, 2021).

Data sources and collection

Data on the great white sharks were collected from the following sources: (a) articles published in peer-reviewed journals, (b) specimens recorded in old historical inventories (Deveciyan, 1926; Ayaşlı, 1937; Akyüz, 1957; Akşiray, 1987), (c) news reports on the capture of great white sharks in Turkish waters published in old newspapers between the late 19th and the late 20th centuries, (d) social media posts reporting on the capture of great white sharks shared on Facebook, Instagram, and YouTube, collated as digital sources, and (e) unpublished records, which mostly consist of observations by citizen scientists. For each of the records, the following data were collected, if available: date, locality of capture, total length (TL), total weight (TW), sex, type of data source (scientific reference, old ichthyological record, old newspaper record, online source or citizen science observation data), and remarks (e.g. stomach contents, presence of human remains, type of fishing gear, presence of birth mark, and the outcome after landing the shark). Unless otherwise stated, all sizes are TL, in the measurement of which the shark is held belly down with its dorsal caudal-fin lobe depressed into line with its body axis and the TL is measured as a point to point distance (not over the curve of the body) from the snout tip to the tip of the dorsal caudal-fin lobe (Compagno, 2002). Collated data are presented in the Turkish Great White Shark Data Archive (TGWSDA, Appendix 1). To allow the identification and mapping of the approximate locality of a possible nursery ground of *Carcharodon carcharias* in Turkish waters, data on the pregnant females, newborns and juveniles were treated as high priority. A newborn shark is defined as a specimen with an open or healing birth mark (or umbilical scar) between the pectoral fins on the belly (De Maddalena & Heim, 2012). To provide a visual guideline for a quick crosscheck, historical and contemporary photographs of the respective great white shark were shown side by side, as proposed by Kabasakal & Bayrı (2021).

The age classification of great white sharks was based on the following four length categories (Boldrocchi *et al.*, 2017): young-of-the-year (YOY) (≤ 175 cm TL), juveniles (>175 –300 cm TL), subadults (>300 –360 cm TL, males; >300 –450 cm TL, females), and adults (>360 cm TL, males; >450 cm TL, females). When sex was not recorded, a threshold of maturity was set at >450 cm TL, which would include adult males and most maturing females (Boldrocchi *et al.*, 2017).

Data analysis

The great white shark records listed in the TGWSDA (Appendix 1) were analysed for spatial and temporal distribution in Turkish waters and by shark size to identify possible spatial patterns in the subregions of Turkish seas. The subregional and temporal distribution of *C. carcharias* in Turkish waters by shark size was investigated using the Wilcoxon test ($\alpha=0.05$). An ANOVA test was used to investigate the seasonal occurrence of great white sharks across subregions and the influence of type of fishing gear on the TL of captured fish ($p=0.05$). The chi-square test was used to investigate the differences between subregions ($p=0.05$). Statistical analyses were performed using the Analysis ToolPak Excel software.

RESULTS

Spatial distribution of the great white shark in Turkish waters

Between 1881 and 2020, 77 records of *Carcharodon carcharias* were collected. Most of them originated from the Aegean Sea ($n=32$, 41.5%), followed by the Sea of Marmara ($n=23$, 29.8%) and the Bosphorus Strait ($n=20$, 25.9%). The Dardanelles Strait and the Bay of İskenderun are each represented by 1 record (1.3%). All records of *C. carcharias* from the Bosphorus Strait and the Sea of Marmara consisted of historical or old captures of the great white shark, while the majority of the Aegean Sea records were recent captures dating from the early 2000s ($n=28$, 36.3% of all records). Related data and remarks concerning these records are listed in the TGWSDA (Appendix 1).

Records of *C. carcharias* from both the Bosphorus Strait and the Bay of Edremit are of special importance due to their proximity to urban areas (Fig. 1). The Bosphorus Strait records in particular contain reports of very large great white sharks which were in some cases caught just a few hundred meters off the coast of a metropolitan centre (Istanbul). A similar metropolitan affinity can be observed in records of *C. carcharias* in the Sea of Marmara, where most of

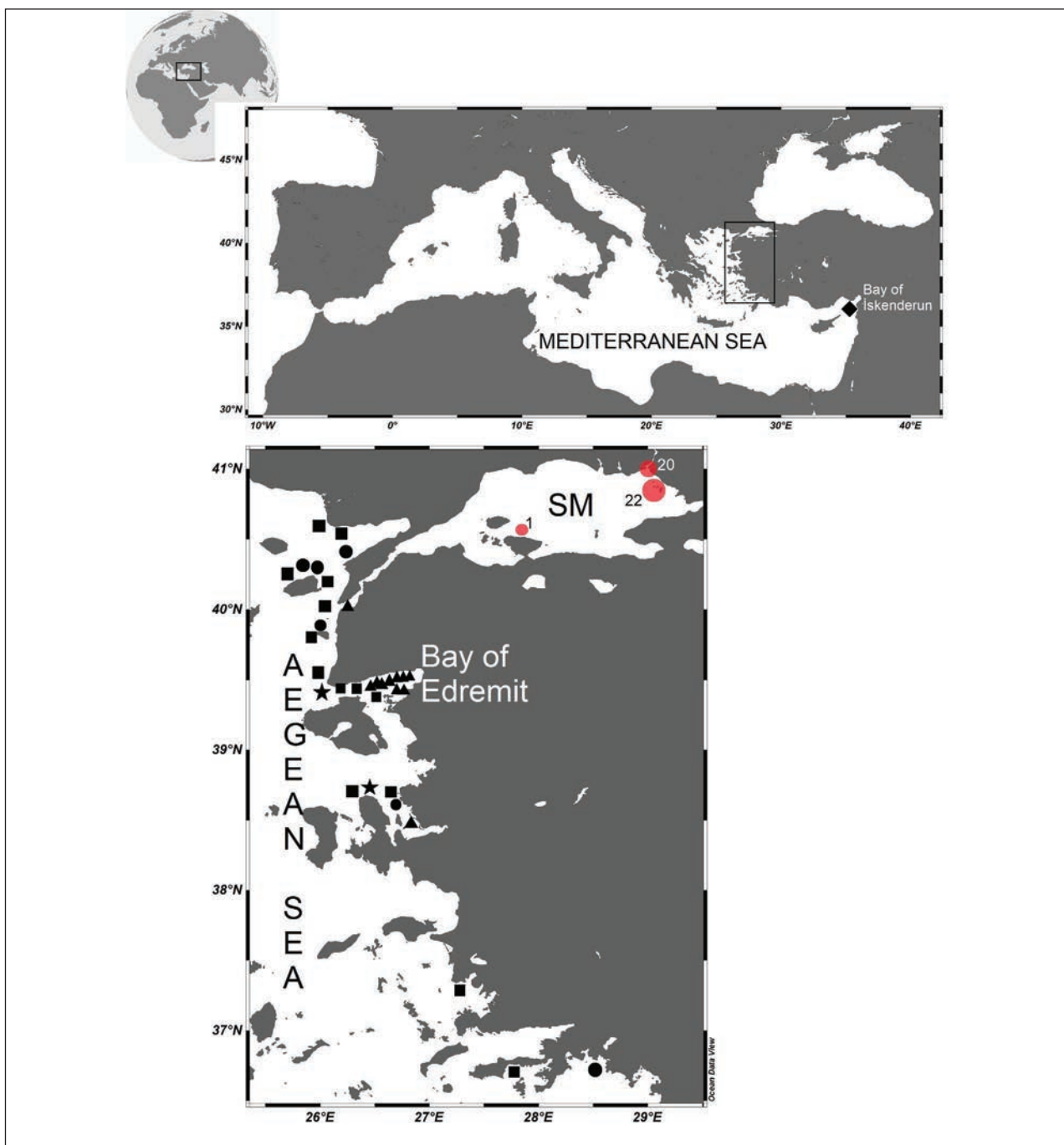


Fig. 1: Spatial distribution of great white sharks ($n=77$) in Turkish waters. On the map of the Mediterranean Sea, the sign (◆) indicates the specimen reported by Akyüz (1957; sp. no. 21 in Appendix 1); on the map below, the solid red circles indicate localities of historical records of *C. carcharias* in the waters of the Bosphorus Strait (total $n=20$) and the Prince Islands (total $n=22$), and the single specimen sighted off Kapıdağ Peninsula in 1985 (sp. no. 44 in Appendix 1); the (▲), (■) and (●) symbols indicate YOY, juvenile, and adult specimens of *Carcharodon carcharias* recorded in Turkish Aegean waters, respectively.

Sl. 1: Razširjenost belega morskega volka ($n=77$) v turških vodah. Na zemljevidu Sredozemskega morja diamant (◆) označuje primerek, o katerem poroča Akyüz (1957; primerek št. 21 v Prilogi 1); polni rdeči krogi na spodnji mapi Bosporske ožine in Prinčevih otokov označujejo lokalitete, kjer so v preteklosti poročali o belih morskih volkovih (skupno število = 22) in o primerku, opaženem ob polotoku Kapıdağ leta 1985 (primerek št. 44 v Prilogi 1). Ostali znaki: enoletni (▲), mladostni (■) in odrasli primerki (●) belega morskega volka v turških egejskih vodah.

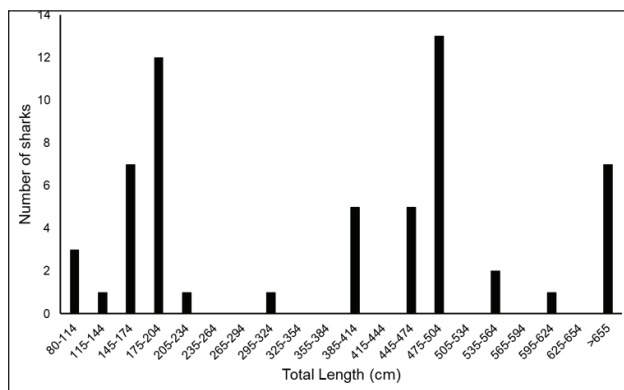


Fig. 2: Length-frequency distribution of the great white shark in Turkish waters for both sexes combined (n=58).

Sl. 2: Velikostna porazdelitev dolžin belega morskega volka v turških vodah za oba spola (n=58).

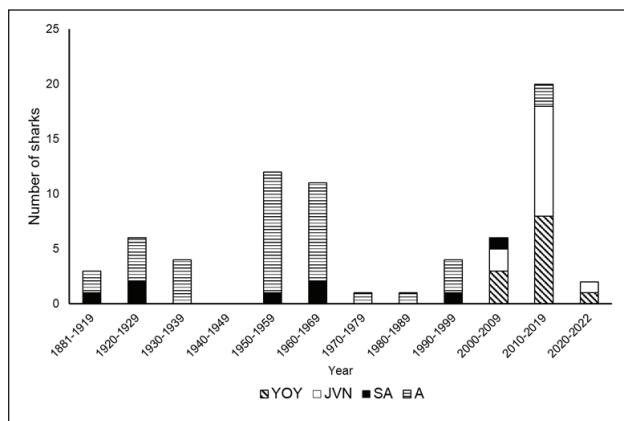


Fig. 3: Distribution of age classes of the great white shark in Turkish waters from 1881 to 2022 (n=70). YOY: young-of-the-year; JVN: juvenile; SA: subadult; A: Adult.

Sl. 3: Porazdelitev starostnih skupin belega morskega volka v turških vodah v obdobju 1881-2022 (n=70). YOY: enoletni; JVN: mladostni; SA: pododrasli; A: odrasli primerki.

the captures occurred in the Prince Islands region, characterised by dense human population. Records of *C. carcharias* from the Bay of Edremit (northeastern Aegean Sea), a popular tourist destination in summer with resultant hundred thousands of seasonal visitors, consist of YOY and juveniles (n=12, 15.5% of all Turkish records and 37.5% of all Aegean records).

Length distribution

A total of 58 records included information on the shark length. The sizes of the recorded great white

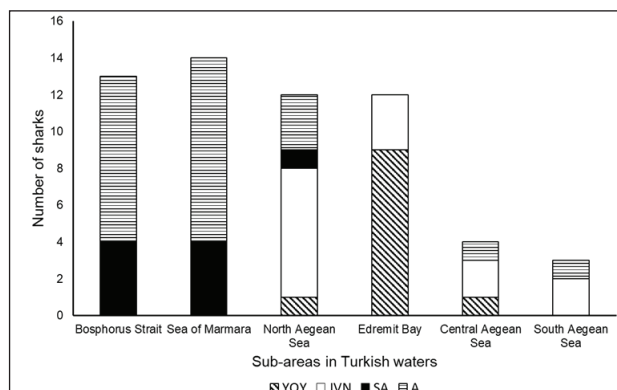


Fig. 4: Subregional distribution of the great white shark in Turkish waters by age class (n=58). YOY: young-of-the-year; JVN: juvenile; SA: subadult; A: Adult. Sl. 4: Subregionalna porazdelitev belega morskega volka v turških vodah glede na starostne razrede (n=58). YOY: enoletni; JVN: mladostni; SA: pododrasli; A: odrasli primerki.

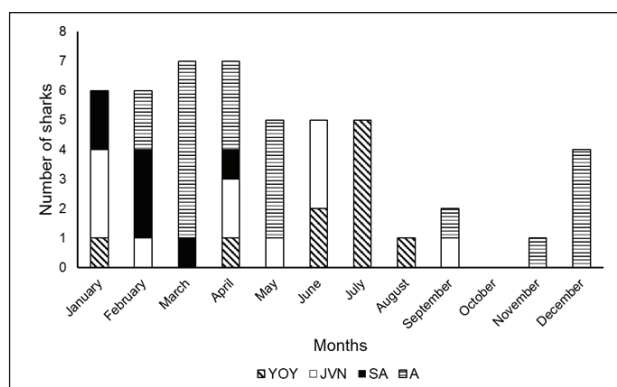


Fig. 5: Monthly distribution of the great white shark in Turkish waters by age class (n=39). YOY: young-of-the-year; JVN: juvenile; SA: subadult; A: Adult.

Sl. 5: Mesečna porazdelitev belega morskega volka v turških vodah glede na starostne razrede (n=39). YOY: enoletni; JVN: mladostni; SA: pododrasli; A: odrasli primerki.

sharks (TL) ranged from 80 cm (YOY) to an estimated 800 cm (mean 377.08 ± 202.63 cm, Fig. 2), including all size classes, from YOY to very large adults. The TL ranges of males (n=5) and females (n=16) examined in the present study were 125.5-500 cm (mean 234.1 ± 152.28 cm) and 85-700 cm (419.31 ± 201.4 cm), respectively.

The study identified a significant correlation between year of capture and TL ($W=0$, $p=0.05$). The majority of the very large great white sharks (≥ 500 cm TL) were specimens captured between the 1880s and the 1970s. After that, the occurrence of very large sharks remarka-

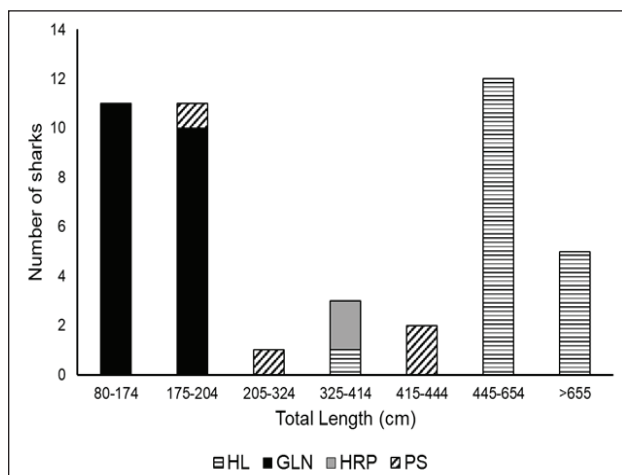


Fig. 6: Distribution of the fishing gear used in capturing the great white sharks in Turkish waters and age classes of the captured specimens ($n=45$). HL: hand-line; GLN: gill-net; HRP: harpoon; PS: purse-seine.

Sl. 6: Porazdelitev uporabljenega ribolovnega orodja za ulov belega morskega volka v turških vodah in starostni razredi ujetih primerkov ($n=45$). HL: trnek; GLN: zabodna mreža; HRP: harpuna; PS: zaporna plavarica.

bly decreased, while the numbers of YOY and juveniles increased (Fig. 3). With regard to regional distribution of length groups, adult great white sharks mostly occurred in the Sea of Marmara and the Bosphorus Strait. Aegean Sea records of *C. carcharias* were dominated by YOY and juveniles, with very few records of adult specimens collected from this region (Fig. 4). Although a difference was identified in the regional distribution of length groups, it was not statistically significant ($W=3$, $p=0.05$; ANOVA, $F=3.58$, $p=0.904$).

Seasonality of occurrences

The study revealed a significant influence of seasonality on the distribution of length groups ($W=9$, $p=0.05$). In Turkish waters, subadults and adults of *Carcharodon carcharias* were mostly observed between early autumn and early summer, the YOY mostly during summer. The occurrence of juveniles was more prominent in early autumn, and from early winter to early summer. All size groups were present from January to June, except for the YOY, which were only recorded from July to early August (Fig. 5).

Fisheries interactions and size groups

Data on the type of fishing gear and shark length were available for 45 individuals (Fig. 6).

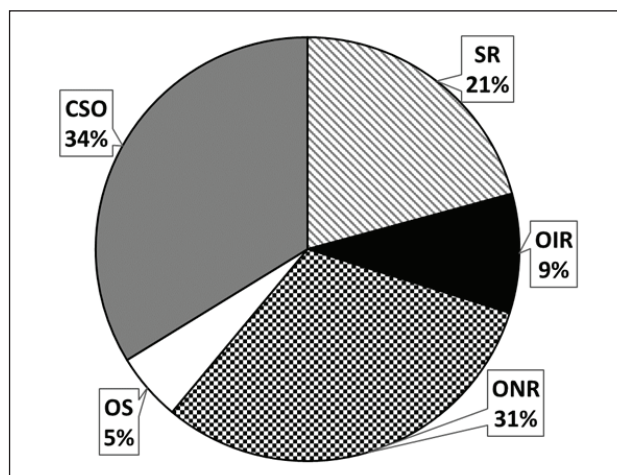


Fig. 7: Distribution of data sources: (SR) scientific reference, (OIR) old ichthyological reports or inventories, (CSO) citizen scientist observations, (OS) online or digital sources, and (ONR) old newspaper reports ($n=77$). **Sl. 7:** Porazdelitev podatkovnih virov: strokovna literatura (SR), stara ihtiološka poročila ali inventarizacije (OIR), podatki dobljeni s pomočjo ljubiteljske znanosti (CSO), spletni in digitalni viri (OS) in starejši podatki, objavljeni v časopisih (ONR) ($n=77$).

The analysis showed a significant difference between the type of fishing gear and length of the great white shark (ANOVA, $F=4.121$, $p<0.05$). Almost half of the great white shark bycatch occurred during artisanal coastal gill-net fishery (46.67%), followed by handlining for bluefin tuna (40%), purse seining (8.89%) and harpooning for sword fish (4.44%). The majority of the YOY and juveniles were recorded as bycatch in artisanal gill-net fishery ($n=21$, 91.3%); however, adults of *Carcharodon carcharias* were mostly captured by bluefin tuna handliners ($n=17$, 77.27%).

Reproduction and a potential nursery ground in the Bay of Edremit

With regard to length groups, 32.47% ($n=25$) of *Carcharodon carcharias* records were related to YOY and juveniles (Fig. 2), of which 11 specimens were YOY (44%) and 14 were juveniles (56%). The distribution of records of YOY and juveniles in Turkish waters extends from central to northern Aegean Sea and is concentrated in the Bay of Edremit (Fig. 1). A Bay of Edremit specific chi-square test showed a significant difference between the distribution of the YOY and other length groups (χ^2 , $p<0.05$, $p=0.0001$). No pregnant females were recorded in Turkish waters.

Stomach contents and human interactions

The stomach contents of 8 great white sharks are presented in Appendix 1. The prey of adult great white sharks ($n=3$, TL range 400–800 cm) included remains or whole specimens of large bony fishes, such as *T. thynnus*, *Sarda sarda* and *Xiphias gladius*; teleosteans *Lophius* sp., *Belone belone* and *Merluccius merluccius* were found in the stomach contents of one juvenile (TL 180 cm). Human clothing - 3 pairs of boots and a fez, traditional Ottoman men's headwear - was found in the stomach contents of an adult great white shark with a reported length of 500 cm, caught on 2 February 1926 (sp. no. 9 in Appendix 1), but no human remains. *C. carcharias* was the prime suspect in 80 % of shark attacks on boats and swimmers occurring between 1931 and 1983 (Kabasakal & Gedikoğlu, 2015). There was another fatal shark attack, occurring on 7 June 1967 in the northeastern Sea of Marmara (Kabasakal & Gedikoğlu, 2015), in which the suspected species was also *C. carcharias*, but the incident is not included in the TGWSDA due to the lack of reliable evidence.

Overview of data sources

Citizen scientist observations were the major source of data (CSO, 34% of total records) forming the TGWSDA, followed by old newspaper reports (ONR, 31%), scientific references (SR, 21%), old ichthyological inventories (OIR, 9%), and online references (OR, 5%) (Fig. 7). The analysis indicated a significant difference in the temporal distribution of types of data sources (X^2 , $p<0.05$, $p=0.003$).

New records

Eleven out of the 77 great white sharks in the TGWSDA included unpublished records of *Carcharodon carcharias* (Appendix 1). One in these 11 unpublished records reported on a historical catch of *C. carcharias* in the Sea of Marmara in 1936 (sp. no. 13 in Appendix 1; Fig. 8), and the remaining 10 records (90.9% sp. nos. 51, 52, 58, 62, 63, 66, 67, 69, 70, and 74 in Appendix 1) referred to incidental captures of the great whites in the Aegean Sea since 2009 (Appendix 1).

DISCUSSION

The first assessment of the distribution and status of *Carcharodon carcharias* in Turkish waters included 46 great white sharks recorded between 1881 and 2011 (Kabasakal, 2014). In this second assessment almost ten years afterwards, the number of individuals available nearly doubled, despite relying heavily on opportunistic data collection. Due to the nature

of the data collection method not all of the basic information (e.g. TL, TW, type of fishing gear, locality of capture, biological remarks) are always available for each specimen. Therefore, the interpretation of results based on opportunistic research findings presents more limitations when compared to the results of research programs employing systematic, long-term and conventional scientific methods. Also, opportunistic research may often include limited information and inaccurate measurements (McPherson & Myers, 2009). For example, the size of very large great white sharks, reported at 800 cm in historical records, especially in old newspaper reports, is mostly regarded with suspicion by great white shark experts. However, in the absence of quantifiable scientific data, opportunistic data have the potential to provide valuable insights into several aspects of the life history of *C. carcharias* (De Maddalena & Heim, 2012; Boldrocchi et al., 2017; Moro et al., 2020).

Our study demonstrates that the distribution of *C. carcharias* in Turkish waters underwent a significant regional shift over time. While the presence of *C. carcharias* in Turkish waters had been doubted or even denied in the past, the historical presence of the species in the region has been demonstrated by ever-growing evidence (Fergusson, 1996; Kabasakal, 2003, 2011, 2020; Kabasakal & Bayrı, 2021) and its contemporary occurrence in Turkish Aegean waters supported by new evidence (Kabasakal & Kabasakal, 2004, 2015; Kabasakal & Gedikoğlu, 2008; Kabasakal et al., 2009, 2018). It is therefore time to end the skepticism and even stubborn denial of the existence of *C. carcharias* in Turkish waters in the face of all evidence, and instead take the necessary steps to ensure the survival, occurrence, and reproduction of this valuable population in the Aegean Sea.

The maximum length and weight of *C. carcharias* have always been subject of debates among great white shark experts (Randall, 1973; Mollet et al., 1996; De Maddalena et al., 2001). Randall (1973) stated that TL size of the great white shark can reach up to 750 or even 800 cm; Mollett et al. (1996), on the other hand, emphasised that the reported TL for specimens exceeding 600 cm can be rough estimations at best or mere speculation. Nevertheless, based on a detailed morphometric analysis of two very large great white sharks caught in Maltese and Australian waters, Mollet et al. (1996) also stated that a *C. carcharias* can attain 700 cm in TL. The major problem with very old photographs, newspapers or ichthyological records depicting *C. carcharias* specimens is that they contain no appropriate visual reference that could be used for obtaining accurate data on the length of the specimens through visual analysis (De Maddalena & Heim, 2012; De Maddalena et al., 2001). Based on a visual analysis of several old photographs of *C. carcharias* specimens

caught in the Mediterranean Sea, De Maddalena *et al.* (2001) stated that the maximum TL of the great white shark can exceed 660 cm. In a recent analysis of Mediterranean great white sharks, Boldrocchi *et al.* (2017) reported the maximum TL for *C. carcharias* to be 675 cm. Information on the length of very large great white sharks (≥ 600 cm) listed in the TGWSDA were collected from the relevant references or historical data sources (Appendix 1). Among these, the historical record of the great white shark (ca. 800 cm TL, sp. no. 8, Appendix 1) reported by Ayaşlı (1937) can be considered an exception because it is based on scientific reference, which however, includes no information on the measurement method of the TL of the specimen. The results of the present study show that the TL of *C. carcharias* occurring in Turkish waters ranges between 80 cm (YOY) and ≥ 600 cm (large adults). However, for the sake of measurement accuracy and the currently accepted definition of measuring TL (Compagno, 2002), the size of the largest great white shark to be recorded in Turkish waters and measured accurately is 550 cm (Kabasakal & Kabasakal, 2004; sp. No. 46, Appendix 1). This size coincides with the maximum TL reported for Mediterranean great white sharks (De Maddalena & Heim, 2012; De Maddalena *et al.*, 2001; Boldrocchi *et al.*, 2017).

The majority of adult specimens (>450 cm TL) of *C. carcharias* were caught off the Prince Islands (northeastern Sea of Marmara) and in the Bosphorus Strait between September and May (Fig. 5). The captures of adult great white sharks in the mentioned regions took place from 1881 to 1985, with the number of captured specimens reaching its peak in the 1950–1970 period (Figs. 3, 4, and 5). The main reason for that was the bluefin tuna (*T. thynnus*) fishery, conducted intensively in these regions during the same time intervals (Karakulak & Oray, 2009). There is strong evidence that pinniped colonies (Le Boeuf, 2004; Martin *et al.*, 2005) or migrations of teleosteans (Domeier & Nasby-Lucas, 2008; Weng *et al.*, 2007), such as scombrid tuna and swordfish, are associated with recorded concentrations of great white sharks in certain regions around the world and at certain times of the year. The absence or paucity of pinnipeds in the stomach contents of great whites occurring in the Mediterranean is well-documented (Fergusson, 1996; De Maddalena & Heim, 2012). On the other hand, in the Mediterranean Sea, the bluefin tuna is the major prey of this apex predator, and therefore, seasonal migration and occurrence of *C. carcharias* in the mentioned region are closely associated with the dynamics of *T. thynnus* (De Maddalena, 2000; Kabasakal, 2016; Barrull & Mate, 2001; Soldo & Jardas, 2002; De Maddalena & Heim, 2012; Morey *et al.*, 2003). The majority of the Mediterranean records of *C. carcharias* have

been reported in bluefin tuna fisheries (e.g., North Adriatic Sea, De Maddalena, 2000; Sea of Marmara, Kabasakal, 2016; Catalan Sea, Barrull & Mate, 2001; eastern Adriatic Sea, Soldo & Jardas, 2002; Balearic Islands, Morey *et al.*, 2003). Therefore, as a result of decline or collapse of bluefin tuna fishery in several subregions of the Mediterranean Sea, incidental captures of great white sharks in the same subregions also decreased (De Maddalena & Heim, 2012). This situation, indicating a predator/prey species relationship throughout the Mediterranean, is also valid for Turkish waters.

The distribution of adult (TL >450 cm) great white sharks in Turkish waters is also significantly diversified in relation to fishing gear, with the occurrence of adult specimens significantly associated with handlining (Fig. 6). Almost all of the mentioned great white sharks were incidentally captured by bluefin tuna handliners. Until the last quarter of the 20th century, those Hemingway-like bluefin tuna handliners who used very strong handlines with large hooks baited with bonito, *S. sarda*, in the Sea of Marmara (around the Prince Islands) and in the Bosphorus Strait, were familiar images of the fishing season, lasting from early September to early May. Following the drastic decline of bluefin tuna populations in the Sea of Marmara, the artisanal handlining in the region disappeared in the early 1980s (Karakulak & Oray, 1991). The year 1985, marking the last sighting of adult great whites in the Sea of Marmara, coincides with the period when the bluefin tuna fishery in the same region collapsed. Since then, adult great white sharks in Turkish waters have only been caught in small numbers in the Aegean Sea by commercial purse seiners (Figs. 4 and 6).

Incidental captures of YOY and juvenile great white sharks in coastal artisanal gill-net fishery represent another dimension of the relation between the type of fishing gear and the occurrence of *C. carcharias* in Turkish waters (Fig. 6). Coastal artisanal gill-net fishery is reported as the major threat to the survival of the YOY and juveniles (Santana-Morales *et al.*, 2012; Lyons *et al.*, 2013; White *et al.*, 2019). According to Santana-Morales *et al.* (2012) and Lyons *et al.* (2013), 75 to 85 % of bycatch of YOY and juveniles are recorded in demersal gill-net fisheries. In Turkish waters, particularly in the Bay of Edremit, there is a significant relationship between the bycatch of YOY and juvenile great whites and demersal gill-net fisheries (Fig. 6). Since the Bay of Edremit is currently recognised as a potential nursery ground for *C. carcharias* (Kabasakal, 2020b; Boldrocchi *et al.*, 2017; Kabasakal, 2020b), gill-net fishing, which in this region is conducted year round and without any limitations, can also be considered a threat to the overall survival of *C. carcharias* in the

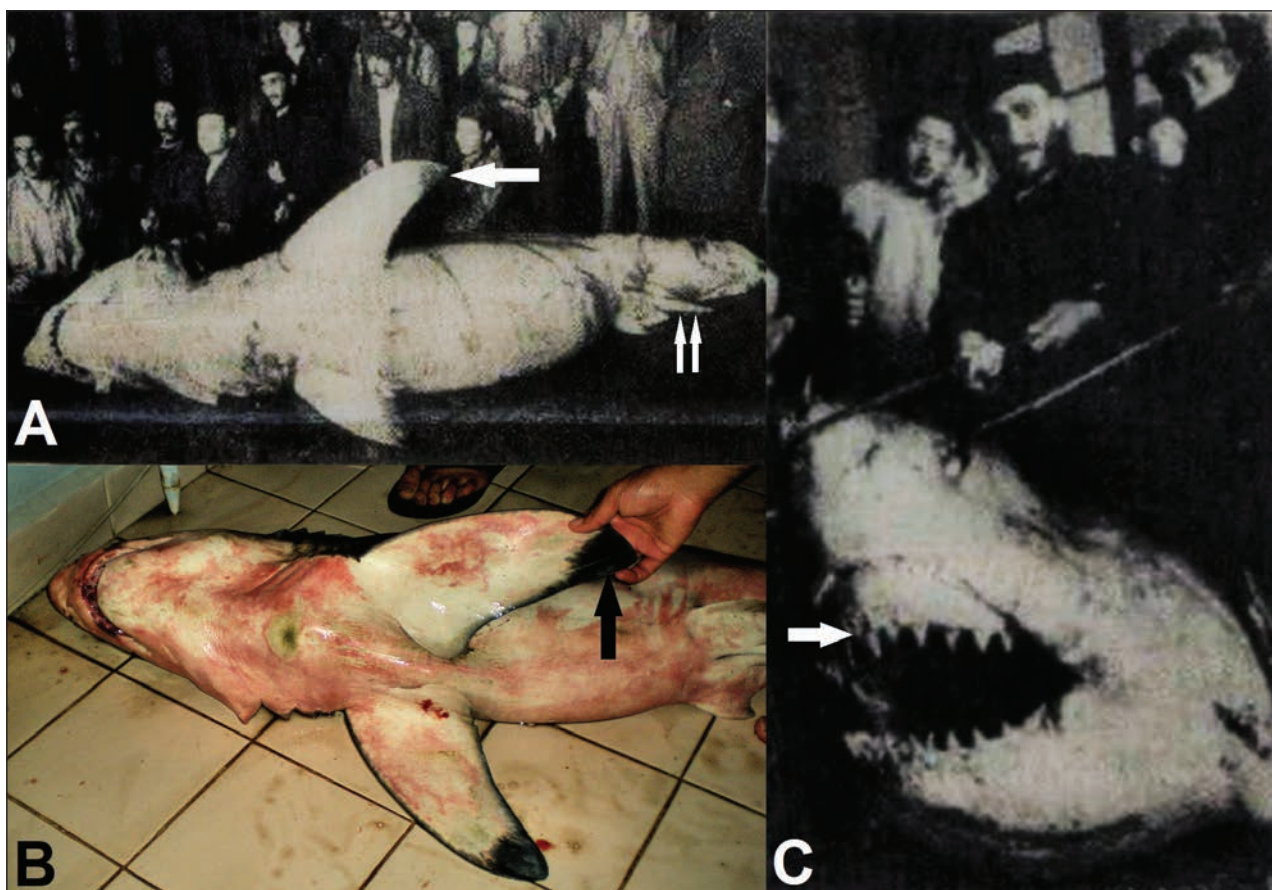


Fig. 8: Adult male great white shark (a and c) caught on 17 May 1936 off Büyükada Island (north-eastern Sea of Marmara; sp. no. 13 in Appendix 1); comparison specimen (b) published in Kabasakal & Gedikoğlu (2008). In photographs (a) and (b), (←) and (↑), respectively, indicate the characteristic black blotch on the ventral surface of the pectoral fin of *C. carcharias* and (↑↑) indicates the claspers of the male, which are extending well behind the pelvic fins; in photograph (c), (→) indicates the triangular teeth of the specimen.

Sl. 8: Odrasli samec belega morskega volka (a in c), ujet 17. maja 1936 blizu otoka Büyükada (severovzhodni del Marmarskega morja; primerek št. 13 v Prilogi 1); primerek (b), objavljen v viru Kabasakal & Gedikoğlu (2008). Na fotografijah (a) in (b), z znakoma (←) in (↑) je označena značilna črna zajeda na trebušni strani prsne plavuti belega morskega volka in z znakom (↑↑) samčev klasper, ki sega veliko čez trebušno plavut. Na fotografiji c je z znakom (→) označen trikotni zob primerka.

entire Mediterranean Sea.

Very few localities in the Mediterranean Sea are regarded as potential breeding and nursery grounds for *C. carcharias* (Fergusson, 1996; De Maddalena & Heim, 2012; Bradaï *et al.*, 2012; Boldrocchi *et al.*, 2017). Until the early 20th century, a habitat that enhanced the growth and survival of juvenile *C. carcharias* was Croatian waters (northeastern Adriatic Sea) (De Maddalena & Heim, 2012). Based on the spatial and temporal distribution of juvenile great whites (<185 cm TL), Fergusson (1996) indicated the marine area between the island of Sicily and the Tunisian coast as a possible breeding and nursery ground for *C. carcharias* in the central Mediterranean Sea. The suggested location off the Tunisian coast was

further supported by evidence provided by Bradaï *et al.* (2012), and the capture of a pregnant great white shark (587 cm TL) in the Gulf of Gabès in 2004, which was carrying 4 developing embryos (mean TL 133.6 ± 1.2 cm), also supports the hypothesis of a breeding and nursery ground in Tunisian waters (Saïdi *et al.* 2005; Bradaï *et al.*, 2012). Boldrocchi *et al.* (2017) reported the average TL of pregnant females in the Mediterranean Sea to be 504 ± 81.1 cm. In the Mediterranean Sea, most YOY *C. carcharias* (n=29) were recorded in Italian waters (n=11, 37.9%; Boldrocchi *et al.*, 2017). Current evidence suggests that the nursery ground in the northeastern Adriatic is no longer used and that the area between Sicily and Tunisia may be the only remaining nursery

ground for this species in the central Mediterranean. Therefore, the Bay of Edremit, where the YOY are regularly observed in summer, is of great importance for ensuring the reproduction of the Mediterranean population of *C. carcharias*.

The first documented YOY of *C. carcharias* in Turkish waters were recorded in the Bay of Edremit in 2008 ($n=2$; Kabasakal & Gedikoğlu, 2008), and according to the results of a systematic survey of published and unpublished data, 23 more YOY and juveniles were recorded in Turkish Aegean waters in the following 12 years (Kabasakal, 2020a; Appendix 1). Repetitive occurrences of YOY and juveniles in the region justifies the necessity of declaring the same as seasonal or year-round marine protected area.

YOY and juvenile great white sharks have also been recorded in the central and northern parts of the Turkish Aegean region (Kabasakal, 2020b). In the northern Aegean Sea, juveniles of *C. carcharias* had been previously reported off the Thasos Island and Coast of Kavala (Greece waters of the Aegean Sea), in the 1940s or earlier (Fergusson, 1996). The TL of Thasos and Kavala specimens were 180 and 230 cm, respectively (Fergusson, 1996). One of two YOY recorded just outside the Bay of Edremit was captured off the coast of Izmir (unpublished data; central Aegean Sea; sp. no. 63, Appendix 1) and the other one in the Dardanelles Strait (Kabasakal & Bayrı, 2020; northern Aegean Sea; sp. no. 76, Appendix 1). Therefore, it can be assumed that the nursery ground for *C. carcharias* may extend over a wider area exceeding the limits of the Bay of Edremit. As it is clearly seen from the map (Fig. 1), the coastal topography of Turkey's Aegean seaboard, which is characterised by the presence of numerous bays and nearshore islands, provides a habitat for the YOY and juveniles to gain experience of movement between offshore and nearshore islands before departing for long-distance migrations. According to Hoyos-Padilla *et al.* (2016), tagged juvenile sharks stay at least 1 year in areas that allow them to travel short distances between the coast and an island (in that case, the Guadalupe island), before moving to more remote areas. Moreover, according to Weng *et al.* (2007), YOY great whites can travel 700 km in just 2 months. In another study investigating the movements of juvenile great whites, Bruce *et al.* (2019) reported that a juvenile tagged with a satellite tracking device travelled 1800 km in 190 days. The largest juvenile recorded in this study (TL 300 cm; sp. no 54; Appendix 1) was caught at the western border of the nursery ground in the Bay of Edremit (Fig. 1). On the other hand, the coastal line between the locality of capture of the juvenile recorded in Hisarönü Bay (TL 200 cm; sp. no. 70; Appendix 1; Fig. 1) and the Bay of Edremit is roughly 500 km long. Cailliet *et al.* (1985) reported

of juvenile great whites measuring 200 and 300 cm in TL, respectively, which he concluded to be aged 2 and 6 years. In the light of these findings, specifically the Bay of Edremit and, on a larger scale, the insular waters of the eastern Aegean Sea can be considered as an area of development and gaining experience, where the great white shark usually spends its first 6 years of life. Considering the seasonality of the YOY and juveniles (Fig. 5), it can be deduced that birth occurs between June and August, and juveniles could be sighted in the study area from January to September. The two YOY caught in January and April may have been individuals born in the previous summer that had not yet left the nursery area. It is rare, though not unusual, to encounter YOY in winter; for example, Curtis *et al.* (2014) reported that in winter, the incidence of YOY great whites in northwestern Atlantic waters is 2% and the rate of juveniles 75%. To sum up, in the eastern Aegean Sea, although the YOY prefer inhabiting a restricted area in their first year, the distance of juveniles' home ranges increases with growth, which is consistent with the literature (Fergusson, 1996; Boldrocchi *et al.*, 2017; Weng *et al.*, 2007; Bruce *et al.*, 2019).

To summarize the status of *C. carcharias* in the study region based on records between 1881 and 2020: the great white shark occurs in Turkish waters throughout the year. Although the occurrences of adult specimens have shown a remarkable decrease during this period, the species has not been extirpated from the region. The main reason for this decrease is assumed to be the drastic decline of bluefin tuna populations in Turkish waters, particularly in the Sea of Marmara and the Bosphorus Strait. Following the decline of bluefin tuna populations, handlining fishery, which is selectively targeting very large fish, disappeared from the Bosphorus Strait and Sea of Marmara (Kabasakal, 2016). On the other hand, since the 1990s, the number of adult great white sharks to be incidentally captured in commercial purse seinig in Turkish Aegean waters has declined. In the central Mediterranean, over 70 % of great white shark bycatch was reported by purse seiners (Serena, 2021), in Turkish waters, nearly 9%. All contemporary records of adult great white sharks are related to either captures or sightings around the periphery of the nursery ground in the Bay of Edremit.

The status and distribution of *C. carcharias* in Turkish waters has been investigated in a species-specific effort since the early 2000s (Kabasakal, 2003, 2020). Although we are still at the beginning level compared to regions with abundant great white shark research (Pacific and Atlantic coasts of North America, South Africa, Australia-New Zealand, western and central Mediterranean; Huveneers *et*

al., 2018), the past 20 years of research in Turkey (Kabasakal, 2020) provide a reliable background for future research of the biology, ecology, socioeconomics, management, and conservation of *C. carcharias* in Turkish waters. Besides generally accepted systematic scientific research methods, opportunistic study techniques, such as systematic review of old newspaper reports and citizen science observation data, have significantly contributed to an ever increasing collection of *C. carcharias* records over the last 20 years. Although the first scientifically validated evidence on the occurrence of YOY and juvenile great whites in the Bay of Edremit was obtained in 2008 (Kabasakal & Gedikoğlu, 2008), testimonials of some local fishermen now aged 80 to 90 years revealed that the young generations of *C. carcharias* may have regularly occurred in the region for at least the last 50 years (H. Kabasakal pers. data). In the most recent assessment of the distribution and abundance of great white sharks in the Mediterranean, Moro *et al.* (2020) reported 773 records between 1860 and 2016, but six new records from Libyan waters dating between 2017 and 2020 have been added to the existing inventory through the effort of citizen scientists (Jambura *et al.*, 2021). In the matter of great white shark, fantasy and reality are often confused, and especially nowadays a remarkable number of imprecise or incorrect sighting records are available online (Bargnesi *et al.*, 2020). If data collected by citizen scientists were properly standardised (Giovos *et al.*, 2021; Bargnesi *et al.*, 2022), they would provide cost-effective and useful information on the status and conservation of great white sharks and other shark species in Turkish waters; in fact, such standardised data stream would be a significant contribution to conservation efforts across the Mediterranean.

Compared to eastern Mediterranean records of *C.*

carcharias (total $n=12$; Ben-Tuvia, 1971; Fergusson, 1996; Damalas & Megalofonou, 2012), records of species from the Turkish waters ($n=77$) provide a significant regional contribution to the knowledge of the entire Mediterranean population. For the moment, the total number of eastern Mediterranean records of *C. carcharias* is 89, which represents 11.4 % of all Mediterranean records ($n=779$; Moro *et al.*, 2020; Jambura *et al.*, 2021). Today, one of the main subjects of discussions on shark conservation is the eternal Noah's Ark problem - which species should be given priority (Cachera & Le Loc'h, 2017). *C. carcharias* is a K-selected apex predator, currently classified as "vulnerable" on the IUCN Red List (Rigby *et al.*, 2019) and "critically endangered" in the Mediterranean Sea (Serena *et al.*, 2020). Due to site fidelity and natal philopatry of *C. carcharias* (De Maddalene & Heim, 2012; Jorgensen *et al.*, 2010), seasonal migrations of pregnant females to nursery grounds (in case of the Mediterranean, either the Sicily-Tunisia region or the Bay of Edremit) to give birth can be predicted. As a first step to ensuring the survival of *C. carcharias*, the great white shark has been recently declared as a species under protection in Turkish waters (Official Gazette, 10 September 2022), but the next steps towards providing better protection for the species in the region are urgently required: measures for the management of artisanal coastal gill-net fishery in the Bay of Edremit and the designation of the latter as a marine protected area.

ACKNOWLEDGMENTS

The authors thank to fishermen and divers who shared observations, stories and old photographs of great white sharks captured or sighted in Turkish waters.

Appendix 1: Inventory of specimens in the Turkish Great White Shark Data Archive. Abbreviations in the “type of record” column indicate the type of original source on which the respective record of the great white shark is based. SR: Scientific reference; OIR: Old ichthyological record; ONR: Old newspaper report; OS: Online source; CSO: Citizen science observation data.

Priloga 1: Popis primerkov belega morskega volka iz arhiva podatkov turških belih morskih volkov. Okrajšave v stolpcu “vrsta zapisa” označujejo tip izvirnega podatka, na katerem temelji zapis o belem morskem volku. Podatek iz strokovne literature - SR; stari ihtiološki zapis - OIR; stari časopisni prispevek - ONR; spletni vir – OS in podatki, pridobljeni na podlagi ljubiteljske znanosti - CSO.

No	Date	Location	TL (cm)	W (kg)	Sex	Remarks	Type of record	Reference
1	Feb. 1881	Bosphorus Strait	391	?	?	Stranded near Beylerbeyi coast.	SR	Fergusson (1996)
2	17 Nov. 1881	Bosphorus Strait	470	1500	♀	Type of fishing gear unknown.	SR	Fergusson (1996)
3	1916	Sea of Marmara	ca. 700	?	?	Entrapped in Salistra fish trap; shot by fishermen with 3 bullets in its head.	OIR	Deveciyan (1945)
4	1920	Sea of Marmara	~500	?	?	Caught off Prince Islands and displayed to public in Taksim Square, İstanbul city.	OS	Kabasakal (2014)
5	May 1920	Sea of Marmara	465	ca. 1200	?	Caught off Sedef island; a bluefin tuna, weighing ca. 200 kg, remains of a swordfish, a few bonitos, and a small stone found in its stomach.	OIR	Deveciyan (1945)
6	1923	Sea of Marmara	?	?	?	N/A	ONR	Kabasakal (2020a)
7	before 1926	Sea of Marmara	ca. 400	?	?	Displayed in İstanbul Fish Market; eight large bonitos found in its stomach.	OIR	Deveciyan (1926)
8	before 1926	Bosphorus Strait	ca. 800	ca. 4500	?	Two large tunas per weighing 200 kg, and one large dolphin found in the stomach.	OIR	Ayaşlı (1937)
9	2 Feb. 1926	Sea of Marmara	500	2000	?	Incidentally caught by tuna hand-liners off Prince Islands. Three pairs of boots, and a fez – traditional Ottoman men’s headwear – having been found in the stomach of the shark	ONR	Kabasakal & Bayrı (2021)
10	20 Feb. 1926	Sea of Marmara	450	over 1500	?	Caught off Büyükdada island.	ONR	Kabasakal (2003)
11	1930	Sea of Marmara	?	?	?	Attacked to a fishing boat off San Stefano (Yeşilköy).	ONR	Kabasakal (2014)
12	1936	Sea of Marmara	500	3000	?	Incidentally caught by tuna hand-liners off Büyükdada	ONR	Kabasakal & Bayrı (2021)
13	17 May 1936	Sea of Marmara	ca. 500	?	♂	Incidentally caught off Büyükdada.	ONR	Unpublished data
14	21 Mar. 1937	Sea of Marmara	?	1700	?	Harpooned by fishermen set sail for catching swordfish off Büyükdada. Landed at the fishmarket for public display.	ONR	Kabasakal (2016)
15	1939	Sea of Marmara	?	ca. 3000	?	Caught by the tuna handliner Karnıyas and delivered to the fishmarket.	ONR	Kabasakal (2016)
16	1950s	Sea of Marmara	ca. 400	?	?	Caught by a tuna handliner off Burgazada coast.	OS	Kabasakal (2020c)
17	30 Mar. 1954	Sea of Marmara	450	1500	?	Caught off Tuzla island.	ONR	Kabasakal (2003)
18	1 Feb. 1955	Sea of Marmara	?	1500	?	Caught by the fisherman Mr. Hayri Kuloğlu, after struggling nearly 4 and half hours. Almost 50 kg of bonito, <i>Sarda sarda</i> found in the stomach contents.	ONR	Kabasakal (2016)
19	15 Apr. 1956	Sea of Marmara	?	2500	?	Caught by the handliner Mr. Necdet Şarcı off Ahırkapı. According to newspaper report, fisherman struggled the shark nearly 8 hours before harpooned it.	ONR	Kabasakal (2016)
20	15 Apr. 1956	Sea of Marmara	618	ca. 3000	♀	Caught off Prince Islands; its mass surely incorrectly estimated.	ONR	Kabasakal (2003)
21	1957	Mediterranean Sea	?	?	?	Caught in İskenderun Bay.	SR	Akyüz (1957)
22	1958	Bosphorus Strait	ca. 700	?	?	Caught off Ahırkapı, but escaped from the hook and attacked to a fishing boat.	ONR	Kabasakal (2014)
23	5 Mar. 1958	Sea of Marmara	500	2500	♀	Caught off Prince Islands. Delivered to fishmarket for public display and auction.	ONR	Kabasakal (2016)
24	25 Dec. 1958	Sea of Marmara	ca. 700	ca. 2000	♀	Caught off Prince Islands by fishermen Niyazi Dalgın, Cemil Unalır and Şadan Şalvarlı, then landed at Ahırkapı coast.	ONR	Kabasakal (2020a)
25	28 Dec. 1958	Bosphorus Strait	ca. 800	?	?	Caught off Ahırkapı coast by fishermen Yunus Potur and Ali Durmaz. Great white shark attacked the boat and caused damage.	ONR	Kabasakal (2020a)
26-33	Between 1958-1960	Bosphorus Strait	500 to 700	ca. 1500 to 4000	?	Seven great white sharks captured in bosphoric and prebosphoric area by the same fisherman, “Samatyalı” İrfan Yürür. Voice record of an interview with Mr. Yürür is available on the following link (in Turkish): https://youtu.be/OZYzJaCpZn0	CSO	Kabasakal (2014)
34	Feb. 1962	Bosphorus Strait	500+	3750	♀	Mass surely incorrectly estimated.	SR	Fergusson (1996)
35	19 Mar. 1962	Bosphorus Strait	?	3000	♀	Caught by the fishermen Mr. Hayri Kuloğlu and Mr. Ziya Zeki Zayni off Ortaköy.	ONR	Kabasakal (2016)
36	28 Dec. 1965	Bosphorus Strait	500	ca. 4000	♀	Caught off Dolmabahçe coast; mass surely incorrectly estimated.	ONR	Kabasakal (2003)
37	28 Dec. 1965	Bosphorus Strait	700	ca. 3000	♀	Caught near Maiden’s Tower.	ONR	Kabasakal (2003)
38	13 Jan. 1966	Sea of Marmara	?	?	?	Incidentally caught by tuna handliners and harpooned off Kumkapı. Auctioned at the fishmarket for its liver oil.	ONR	Kabasakal (2016)
39	13 Jan. 1966	Bosphorus Strait	ca. 400	ca. 2000	?	Harpooned off Kabataş coast.	ONR	Kabasakal (2003)
40	13 Jan. 1966	Bosphorus Strait	ca. 400	ca. 2000	?	Harpooned off Kabataş coast; belly of the second specimen shown overturned on the left of the photograph presented in Kabasakal (2003)	ONR	Kabasakal (2003)

41	1967	Sea of Marmara	?	?	?	Caught off Büyükada coast by a tuna hand-liner.	OIR	Kabasakal (2008)
42	Mar. 1968	Bosphorus Strait	551	?	♀	Caught by a tuna hand-liner.	ONR	Kabasakal (2011)
43	before 1974	Sea of Marmara	?	ca. 2000	?	Caught off Prince Islands.	OIR	Güney (1974)
44	May 1985	Sea of Marmara	ca. 500	?	?	Sighted off Kapıdağ peninsula.	CSO	Kabasakal (2003)
45	18 Mar. 1991	Aegean Sea	ca. 500	3500	♀	Caught off Foça coast by a commercial purse-seiner; transported to İstanbul Fish Market and displayed to public.	ONR	Kabasakal (2008)
46	Mar. 1996	Aegean Sea	550	?	♀	Caught off Bozcaada island by a commercial purse-seiner.	OIR	Kabasakal & Kabasakal (2004)
47	Apr. 1998	Aegean Sea	ca. 450	?	?	Sighted by a gill-netter.	CSO	Kabasakal & Kabasakal (2004)
48	May 1999	Aegean Sea	ca. 500	?	?	Sighted by a diver off Büyükkemikli cape.	CSO	Kabasakal & Kabasakal (2004)
49	1 Jul. 2008	Aegean Sea	125.5	30	♂	Caught in Bay of Edremit, off Altınoluk coast by a commercial gill-netter; unhealed birth mark was visible on the belly.	SR	Kabasakal & Gedikoğlu (2008)
50	4 Jul. 2008	Aegean Sea	145	?	♂	Caught in Bay of Edremit, off Altınoluk coast by a commercial gill-netter; unhealed birth mark was visible on the belly.	SR	Kabasakal & Gedikoğlu (2008)
51	2009	Aegean Sea	160	?	?	Captured by commercial artisanal fisherman off Babakale.	OS	Unpublished data
52	2009	Aegean Sea	ca. 200	?	?	Captured in Bay of Edremit.	OS	Unpublished data
53	21 Feb. 2009	Aegean Sea	180	47.5	♀	Caught off Gökçeada island; two angler fish (<i>Lophius</i> sp.), one gar fish (<i>Belone belone</i>) and one hake (<i>Merluccius merluccius</i>) were found in the stomach.	SR	Kabasakal <i>et al.</i> (2009)
54	15 Apr. 2009	Aegean Sea	300	102	♀	Caught off Çanakkale coast by a commercial purse-seiner; transported to İstanbul and displayed to public.	SR	Kabasakal <i>et al.</i> (2009)
55	2010; late Jun., early Jul.	Aegean Sea	80	?	?	Captured by coastal gill-netters in Bay of Edremit, off Altınoluk.	SR	Kabasakal (2014)
56	2010; late Jun., early Jul.	Aegean Sea	100	?	?	Captured by coastal gill-netters in Bay of Edremit, off Altınoluk.	SR	Kabasakal (2014)
57	2010; late Jun., early Jul.	Aegean Sea	?	?	?	Captured by coastal gill-netters in Bay of Edremit, off Altınoluk.	SR	Kabasakal (2014)
58	21 Jun. 2010	Aegean Sea	230	60	?	Captured off Bozcaada island.	CSO	Unpublished data
59	14 Jul. 2010	Aegean Sea	150	30		The great white shark, which was entangled in unspecified nets deployed by local fisherman in Bay of Edremit	CSO	Kabasakal & Bayrı (2021)
60	6 Jul. 2011	Aegean Sea	85	12	♀	Caught in Bay of Edremit, off Altınoluk by a trammel-netter in inshore waters. After landing, the specimen transferred to seawater tank but upon observing stress signs, it was released after a couple of hours of captivity. A video of this specimen is available on the following link: http://vimeo.com/46296179	CSO	Kabasakal (2014)
61	28 Sep. 2011	Aegean Sea	~500	?	?	Sighted by a diver at a depth of 15 m, while he was spearfishing off Marmaris coast. According to interview with the diver, great white shark approached to him, but no attack occurred.	CSO	Kabasakal (2014)
62	7 May 2013	Aegean Sea	ca. 200	50	?	Captured off Çanakkale.	CSO	Unpublished data
63	21 Aug. 2014	Aegean Sea	ca. 150	40	?	Captured off İzmir.	CSO	Unpublished data
64	19 Sep. 2014	Aegean Sea	200	40	♂	It was incidentally caught by a stationary net off Yeni Foça, which was deployed for lobster fishing.	CSO	Kabasakal & Kabasakal (2015)
65	2 Jan. 2016	Aegean Sea	175	?	♀	Entangled in a coastal stationary net in the Bay of Edremit. The dried head, jaws and caudal fin of the specimen are preserved by local fishermen in Altınoluk province.	CSO	Kabasakal <i>et al.</i> (2018)
66	2017	Aegean Sea	ca. 180	35	?	Captured off Altınoluk.	CSO	Unpublished data
67	2017	Aegean Sea	ca. 180	40	?	Captured in Saroz Bay by means of gill-net. Released alive	CSO	Unpublished data
68	Jan. 2017	Aegean Sea	180	?	?	Entangled in coastal stationary net off Gökçeada coast.	CSO	Kabasakal (2020a)
69	4 Jan. 2017	Aegean Sea	160	?	?	Juvenile specimen incidentally captured in unspecified artisanal fishery off Burhaniye coast.	CSO	Unpublished data
70	27 Feb. 2017	Aegean Sea	ca. 200	?	♀	Incidentally captured in unspecified artisanal net in Bay of Hisarönü, Muğla. A video of the specimen is available in the archive of first author.	CSO	Unpublished data
71	Apr. 2017	Aegean Sea	160	?	?	Entangled in coastal stationary net in the Bay of Edremit.	SR	Kabasakal (2020a)
72	4 Jun. 2017	Aegean Sea	200	60	♂	Captured by a commercial purse-seiner off the Didim coast.	SR	Kabasakal <i>et al.</i> (2018)
73	14 Apr. 2018	Aegean Sea	180	?	♀	Captured by a coastal stationary-netter, off the İzmir coast.	SR	Kabasakal <i>et al.</i> (2018)
74	28 Jul. 2018	Aegean Sea	?	?	?	Captured off İzmir coast.	CSO	Unpublished data
75	Spring 2019	Aegean Sea	ca. 500	?	?	Sighted by a commercial fisherman off northern coast of Gökçeada.	SR	Kesici <i>et al.</i> (2021)
76	8 Jun. 2020	Dardanelles Strait	155	?	?	Captured by means of a stationary-netter, off Kumkale coast (southern entrance of Dardanelles Strait).	SR	Kabasakal & Bayrı (2020)
77	14 Jun. 2020	Aegean Sea	ca. 200	?	?	Sighted by the amateur fishermen in waters of Saroz Bay, off Enez coast. First documented case of leucism in <i>C. carcharias</i> .	CSO	Kabasakal (2020d)

STATUS IN RAZŠIRJENOST BELEGA MORSKEGA VOLKA (*CARCHARODON CARCHARIAS*) V TURŠKIH VODAH: PREGLED IN NOVI ZAPISI O POJAVLJANJU

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POVZETEK

O pojavljanju vrste *Carcharodon carcharias* v turških vodah poročajo že od konca 19. stoletja. Od leta 1881 do 2020 je bilo zbranih skupno 77 zapisov o pojavljanju belega morskega volka. Razpoložljivi podatki kažejo, da se ta vrsta v turških vodah pojavlja skozi vse leto. Število odraslih osebkov se je v tem obdobju znatno zmanjšalo, kljub temu pa vrste v regiji niso iztrebili. Ta študija dokazuje, da se je razširjenost vrste *C. carcharias* v turških vodah sčasoma znatno regionalno spremenila, pri čemer trenutna razširjenost mladičev in nedoraslih osebkov sega od osrednjega do severnega Egejskega morja in je skoncentrirana v zalivu Edremit. *C. carcharias* je bil nedavno razglašen za zaščiteno vrsto v turških vodah, vendar so naslednji koraki k zagotavljanju boljšega varovanja te vrste v regiji nujno potrebni.

Ključne besede: status, upravljanje, ohranjanje, vzhodno Sredozemlje, Lamnidae, obalni ribolov

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