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TWO JUVENILE GREAT WHITE SHARKS, *CARCHARODON CARCHARIAS* (LINNAEUS, 1758) (CHONDRICHTHYES; LAMNIDAE), CAUGHT IN THE NORTHEASTERN AEGEAN SEA

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ABSTRACT

Two juvenile female white sharks, Carcharodon carcharias (Linnaeus, 1758), were captured in coastal waters of the northeastern Aegean Sea. Both sharks were captured by means of commercial fishing gear. Total lengths of the specimen Nos. 1 and 2 were 180 and 300 cm. Two angler fish (Lophius spp.), one gar fish (Belone belone) and one hake (Merluccius merluccius) were found in the stomach contents of specimen No 1. Due to coastal occurrence of C. carcharias, regular monitoring and seasonal banning of coastal gill-netting and long-lining in the areas of the northeastern Aegean Sea, where white sharks are sighted, is necessary in order to minimize the impact of fishing on the species. Authors also discuss the current status of C. carcharias in Turkish waters, with respect to available data.

Key words: White shark, *Carcharodon carcharias*, coastal occurrence, Aegean Sea

DUE GIOVANI DI GRANDE SQUALO BIANCO, *CARCHARODON CARCHARIAS* (LINNAEUS, 1758) (CHONDRICHTHYES; LAMNIDAE), CATTURATI NELL'EGEO NORD-ORIENTALE

SINTESI

Due giovani femmine di squalo bianco, Carcharodon carcharias (Linnaeus, 1758), sono state catturate in acque costiere dell'Egeo nord-orientale. Entrambi gli esemplari sono stati pescati con attrezzature per pesca commerciale. Le lunghezze totali degli esemplari 1 e 2 erano rispettivamente di 180 e 300 cm. Due rane pescatrici (Lophius spp.), un'aguglia (Belone belone) ed un nasello (Merluccius merluccius) sono stati trovati nei contenuti stomacali dell'individuo No 1. Vista la presenza in acque costiere di C. carcharias, gli autori sottolineano la necessità di un monitoraggio regolare e divieti stagionali di pesca costiera, con reti a strascico e tramagli, nelle aree dell'Egeo nord-orientale dove gli squali bianchi vengono avvistati, al fine di minimizzare l'impatto della pesca su tale specie. Gli autori discutono anche lo stato attuale di C. carcharias in acque turche, tenendo conto dei dati disponibili.

Parole chiave: squalo bianco, *Carcharodon carcharias*, presenza costiera, mare Egeo

INTRODUCTION

Although early writings on the occurrence of the white shark, *Carcharodon carcharias* (Linnaeus, 1758), in Bosphoric and Marmaric waters date back into the last quarter of the 19th century (Fergusson, 1996; Kabasakal, 2003), and the first two decades of the 20th century (Ninni, 1923; Deveciyan, 1926; Ayaşlı, 1937), its presence in Bosphoric and Marmaric waters, as well as in Turkish seas has always been a point of controversy. Despite the historical records on *C. carcharias* from the Turkish Straits Systems – Dardanelles and Bosphorus straits, and the Sea of Marmara (Kabasakal, 2003), and its contemporary records from the Turkish Aegean Sea (Kabasakal & Kabasakal, 2004; Kabasakal, 2008; Kabasakal & Gedikoğlu, 2008), it's still questioned from time to time, whether the great white shark occurs in Turkish seas.

Following the recent captures of two newborn white sharks in the Edremit Bay (Kabasakal & Gedikoğlu, 2008), Ichthyological Research Society (I.R.S.) has intensified the field surveys among fishermen along the coast of the northeastern Aegean Sea in order to record any specimen of *C. carcharias* from the area. Similar efforts have been made in İstanbul city, where fishmongers purchased this so called "fearsome beast" for public display.

The present article deals with two juvenile great white sharks caught in the northeastern Aegean Sea. Authors also discuss the current status of *C. carcharias* in Turkish waters, with respect to available data.

MATERIAL AND METHODS

The present study is a part of an extensive area of research (KANIT Project – Türk Sularında Yaşayan Köpekbalıklarının Tesbiti Projesi (Identifying the Sharks of Turkish Waters); KANIT means "proof" in Turkish), which was initiated in 2000 by the IRS. Data on great white sharks has been collected from the following sources: (a) scientific literature; (b) daily newspapers, fishing magazines and other popular media, and as far as popular sources are concerned, the validity of the recordings has been confirmed by means of direct contact with the fishermen reported in the source; (c) visiting the fishing ports.

Both white sharks were captured in Turkish territorial waters (Fig. 1) by commercial fishing gear. The total lengths (TL) of the specimens were measured to the nearest cm. TL is the distance from the tip of the snout to the tip of the upper caudal lobe, where the caudal fin is placed in its natural position. Both specimens were photographed. Specimen No. 1 is now kept at Balıkesir University, Faculty of Arts and Sciences.

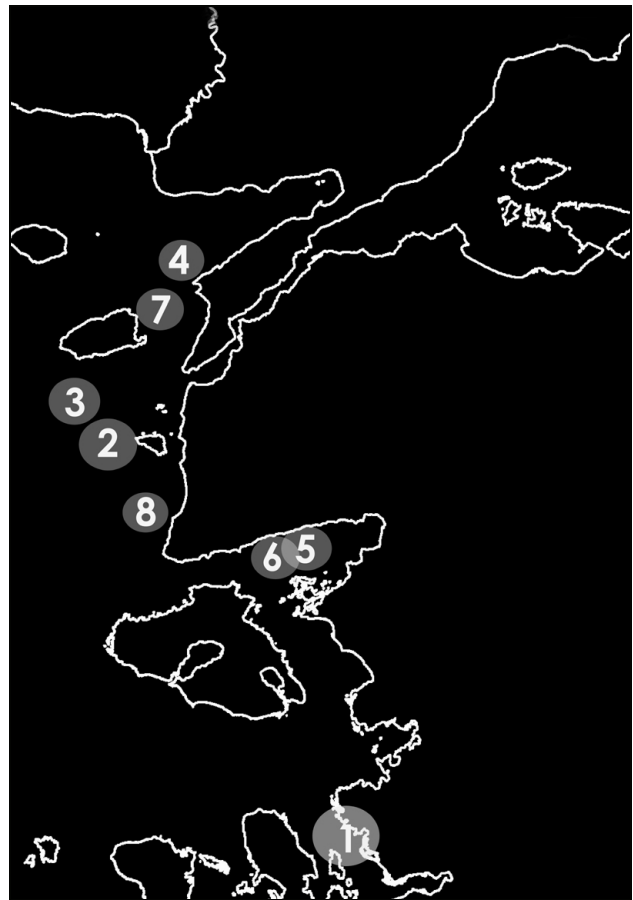


Fig. 1: Fishing localities of specimen Nos. 1 and 2 of the present study, and previous great white shark records from the northeastern Aegean Sea. Legend: 1 – specimen caught off Foça on 18th March 1991; 2 – specimen caught off Bozcaada in March 1996; 3 – specimen sighted south of Gökçeada in April 1998; 4 – specimen sighted in Saros Bay in May 1999; 5 and 6 – newborns caught in Edremit Bay, on 1st and 4th of July 2008, respectively; 7 – present specimen No. 1; 8 – present specimen No. 2.

Sl. 1: Lokaliteti, kjer sta bila ujeta obravnavana primerka št. 1 in 2, in predhodne zabeležbe pojavljanja velikega belega morskega volka v severovzhodnem Egejskem morju. Legenda: 1 – primerek, ujet v bližini kraja Foça 18. marca 1991; 2 – primerek, ujet pri otoku Bozcaada marca 1996; 3 – primerek, viden južno od otoka Gökçeada aprila 1998; 4 – primerek, viden v zalivu Saros maja 1999; 5 in 6 – novorojena primerka, ujeta v Edremitiskem zalivu 1. in 4. julija 2008; 7 – obravnavani primerek št. 1; 8 – obravnavani primerek št. 2.

Detailed observation of specimen No. 1 was carried out by the second author, Aylin Yarmaz (A.Y.); however, as specimen No. 1 is part of the on-going master thesis of A.Y., only fishing data (locality, fishing gear, etc.) of specimen No. 1 is given in the present paper, to prevent violating the originality of the dissertation. The third author, Sait Özgür Gedikoğlu (S.Ö.G.), an İstanbul based underwater videographer, could only measure the TL of specimen No. 2 and determine its sex. Unfortunately, the fishmonger did not allow S.Ö.G. to eviscerate the shark or take any samples from the teeth or tissues. Photographs of both specimens, and teeth from upper and lower jaws of specimen No. 1, are kept in the archives of I.R.S.

RESULTS

Specimen No. 1

On 21st February 2009, a female great white shark (Figs. 2, 3) was caught off Gökçeada (Fig. 1) by a bottom-trawler. After docking at Çanakkale harbour the captain of the trawler donated the specimen to Balıkesir University. Here the shark was measured and dissected. The total length of the shark was 180 cm and its total weight 47.5 kg. 26 teeth were counted in the upper jaw and 24 were in the lower jaw. Two angler fish (*Lophius* spp.), one gar fish (*Belone belone*) and one hake (*Merluccius merluccius*) were found in the stomach.

Specimen No. 2

On 15th April 2009, the second great white shark, a female of 300 cm TL and weighing 102 kg (Figs. 4, 5), was caught off Çanakkale coast (Fig. 1) by a commercial purse-seiner. As in many previous instances, after dock-

ing at Çanakkale harbour, specimen No. 2 was transported to İstanbul for public display at a fishmonger's. On 17th April, S.Ö.G. saw specimen No. 2 from the sidewalk and examined the shark. Unfortunately, the fishmonger did not allow to collect teeth or tissue samples. A few days later, specimen No. 2 was purchased by a collector for its jaws. All efforts of I.R.S. to access the jaws of specimen No. 2 failed.

DISCUSSION AND CONCLUSIONS

Female *C. carcharias* reach maturity at a total length between 450 and 500 cm (Casey & Prat Jr., 1985; Lipej *et al.*, 2004; Compagno *et al.*, 2005). The total lengths of specimen Nos. 1 and 2 were 180 and 300 cm, respectively; thus both great white sharks were juvenile specimens.

The first record of *C. carcharias* from the seas of Turkey dates back to February 1881, when 391 cm TL great white shark stranded off Beylerbeyi coast in the Bosphorus Strait (Fergusson, 1996). Kabasakal (2003) reviewed the historical records of *C. carcharias* from Turkish waters and concluded that almost all of them were from the Sea of Marmara. The great white shark had been a by-catch of tuna hand-liners in Bosphoric and Marmaric waters until the end of the 1970's (Kabasakal, 2003). Despite the historical accounts of *C. carcharias* from the Bosphorus Strait and the Sea of Marmara (Ninni, 1923; Deveciyan, 1926; Ayaşlı, 1937; Fergusson, 1996; Kabasakal, 2003, 2008), great white sharks from the Turkish coast of the Aegean Sea were accounted in specific studies only very recently (Kabasakal & Kabasakal, 2004; Kabasakal, 2008; Kabasakal & Gedikoğlu, 2008). Although Akşiray (1987), Mater & Meriç (1996) and Bilcennoğlu *et al.* (2002) reported *C. carcharias* from the Turkish coast of the Aegean Sea, there is no specific in-



Fig. 2: Specimen No. 1 (180 cm TL) caught off Gökçeada on 21st February 2009. (Photo: I.R.S. Archive)

Sl. 2: Primerek št. 1 (180 cm celotne dolžine), ujet pri otoku Gökçeada 21. 2. 2009. (Foto: Arhiv IRS)



Fig. 3: Teeth of specimen No. 1: scale = 1 cm. (Photo: I.R.S. Archive)

Sl. 3: Zobovje primerka št. 1; merilo = 1 cm. (Foto: Arhiv IRS)

formation available in these general ichthyological studies of where the examined specimens were caught or available for inspection.

The historical and contemporary occurrences of *C. carcharias* in the Mediterranean basin have been subjected to several investigations (Postel, 1958; Barrull, 1993–94; Fergusson, 1996, 2002; De Maddalena, 2000, 2002; Storai *et al.*, 2000, 2005; Barrull & Mate, 2001; Celona, 2002; Soldo & Jardas, 2002; Morey *et al.*, 2003; Megalofonou *et al.*, 2005; Saïdi *et al.*, 2005; Soldo & Dulčić, 2005; Cristo *et al.*, 2006). To date, 478 cases of great white sharks from the Mediterranean have been recorded (De Maddalena, 2006). According to Fergusson (1996), the Mediterranean distribution of *C. carcharias* is concentrated mainly in the western and central parts of the basin. Only 35 great white sharks, including the present specimens, have been recorded from the eastern Mediterranean, and the adjacent Aegean and Marmara Seas (Ben-Tuvia, 1971; Fergusson, 1996; Kabasakal, 2003; Kabasakal & Kabasakal, 2004; Kabasakal, 2008; Kabasakal & Gedikoğlu, 2008). The total number of great white sharks reported from the eastern Mediterranean and adjacent seas (35), constitutes 7.3 percent of the total number recorded by De Maddalena (2006).

The role played by sea surface temperatures (SSTs) in

affecting the distribution of great white sharks is demonstrated in the literature (Casey & Pratt, Jr., 1985; Nakaya, 1994; Fergusson, 1996; Barrull & Mate, 2001; Kabasakal, 2003; Morey *et al.*, 2003). Casey & Pratt, Jr. (1985) concluded that the 15°C isotherm is a rough indication of the seasonal great white shark distribution in the northern latitudes. *C. carcharias*, in the Mediterranean Sea tolerated SSTs ranging from 7.5°C to 25°C, but few cases were reported in waters with a temperature above 23°C (Fergusson, 1996). Three great white sharks, reported in Kabasakal & Kabasakal (2004) from the northeastern Aegean Sea, were captured or sighted between March and May, when SSTs ranged from 13°C to 18°C (Kocataş & Bilecik, 1992).

Specimen No. 2, reported in Kabasakal (2008) from the central Aegean Sea, was captured on 18th March 1991, when SST in the central Aegean Sea varied between 13°C and 14°C (Kocataş & Bilecik, 1992). Two newborn great white sharks, reported from Edremit Bay, were captured in late June and early July (SSTs 20–21.5°C). Specimen No. 1 of the present study was caught in February (SSTs 10–13°C) and specimen No. 2 was caught in April (SSTs 13–15°C). Although young great white sharks have a lower thermal tolerance for sea water temperature changes, an important factor limiting the



Fig. 4: Specimen No. 2 (300 cm TL) caught off Çanakkale coast on 15th April 2009, and displayed at a fishmonger's in İstanbul. (Photo: I.R.S. Archive)

Sl. 4: Primerka št. 2 (300 cm celotne dolžine), ujet pri obali Çanakkale 15. 4. 2009 in razstavljen v ribarnici v Istanbulu. (Foto: Arhiv IRS)



Fig. 5: A close-up view of the head and dentition of specimen No. 2. (Photo: I.R.S. Archive)

Sl. 5: Bližnji posnetek glave in zobovja primerka št. 2. (Foto: Arhiv IRS)

movement of juveniles (Casey & Pratt, Jr., 1985), eurythermal nature of the great white sharks suggests that the species can remain along the Turkish coast of the central and north Aegean Sea all year round. Weng *et al.* (2007) noted that, in the eastern Pacific, vertical excursions were deeper and cooler for 3-year-old great white sharks than young-of-the-year specimens.

According to Klimley (1985), pups remain inshore and as they grow larger, they live both inshore and near offshore islands. Fishing data of 8 great white sharks from the Turkish coast of the north Aegean Sea revealed that all specimens were caught or seen in coastal and insular waters (Kabasakal & Kabasakal, 2004; Kabasakal, 2008; Kabasakal & Gedikoğlu, 2008). The proximity of offshore islands to Edremit Bay, which is clearly seen on the map in figure 1, creates an advantageous locality for newborn and growing great white sharks for moving between coastal and offshore waters.

The central Mediterranean Sea has long been considered as a nursery site for great white sharks because of the previous and recent captures of pregnant females with developing and near-term embryos, as well as free-swimming juveniles, particularly in the Gulf of Gabés (Fergusson, 1996; Saïdi *et al.*, 2005). On the other hand, the possibility of a breeding ground for *C. carcharias* in the eastern Mediterranean basin has always been debatable. In addition to the recent captures of two newborn great white sharks off the Altınoluk coast (Kabasakal & Gedikoğlu, 2008), capture of the present juvenile great white sharks off Gökçeada and Çanakale coasts provides extra evidence supporting the presumption of a breeding ground in the northeastern Aegean Sea, extending from Edremit Bay to the north of Gökçeada (Fig. 1).

The stomach examination of 54 young great white sharks caught in the northwest Atlantic showed a diet comprised primarily of demersal fish (Casey & Pratt, Jr., 1985). According to Weng *et al.* (2007), benthic foraging is important for the juvenile great white sharks. Benthic prey, mainly fish, was also observed in the stomach contents of small great white sharks (< 300 cm TL) from California waters (Tricas & McCosker, 1984). Benthic prey (*Lophius* spp. and *M. merluccius*) was found in the stomach contents of specimen No. 1 of the present study. A sparid fish (*Sparidae* spp.) was found in the stomach contents of the newborn great white shark (142 cm TL) from Edremit Bay (Kabasakal & Gedikoğlu, 2008). Piscivorous foraging habits of young great white sharks are an important factor increasing the possibility of incidental captures of juveniles in coastal fishing gear. The occurrence of *C. carcharias* in different regions of the Mediterranean basin is associated with the presence of tuna stocks (Boero & Carli, 1979; De Maddalena, 2000; Vacchi *et al.*, 2002; Morey *et al.*, 2003; Cristo *et al.*, 2006). The introduction of intensive tuna fishing and the following drastic decline of tuna (*Thunnus thynnus*)

stocks resulted in a clear decline, even a total disappearance of great white sharks in many parts of the Mediterranean and the adjacent seas, e.g., eastern Adriatic waters (Soldo & Jardas, 2002), Marmaric waters (Kabasakal, 2003), Balearic waters (Morey *et al.*, 2003; Fromentin & Powers, 2005). The intensive fishing of major prey of *C. carcharias* is a major anthropogenic impact on the decline of great white sharks in the Mediterranean.

Today more data is available on the great white sharks from Turkish waters; however, new data brings new questions. What is the rate of encounters with fishing nets and the associated mortality? What are the larger-scale movement patterns and what is the extent of their movements along the Turkish coast? Do the juvenile great white sharks exhibit diurnal onshore/offshore movements? When and where are the juveniles feeding? Is the great white shark a resident or a vagrant species in the northeastern Aegean Sea? In contrast to previous suggestions that the great white shark is a questionable or extinct species in Turkish waters, available data revealed that *C. carcharias* is still occurring off the Turkish coast. Regarding the entire coastal line of Turkey, the regularity of this occurrence remains unclear; however, regular occurrence of newborns and young great white sharks in Turkish coastal waters of the north Aegean Sea is well-documented in Kabasakal & Gedikoğlu (2008) and in the present study. Several popular diving spots are also located within the boundaries of this possible nursing ground. Thousands of swimmers, as well as skin and scuba divers visit the area between late spring and early autumn. Seasonal co-existence of man and the great white shark is another major concern jeopardizing the survival of *C. carcharias*. To the best of our (authors) knowledge, no shark attack by great white sharks or other large sharks in the northeastern Aegean Sea has been recorded to date. However, increasing occurrence of great white sharks in the area may cause an aggressive interaction between man and shark, not only in the form of a shark attack, but also creating public fear and an increase in the killing of great white sharks.

Fricke *et al.* (2007) considered the great white shark a highly endangered species in Turkey, as well as a very sensitive species to human activity. For IUCN in the Mediterranean the species is vulnerable (Serena, 2005), *C. carcharias* is listed on Appendix II of the Bern Convention, as well as CITES Appendix III, since 28th May 2003 (Compagno *et al.*, 2005; Serena, 2005; Fricke *et al.*, 2007). The great white sharks are now protected in some parts of the world (Compagno *et al.*, 1997); however, due to their migratory habits, a worldwide cooperation is necessary for the survival of the species. Currently, there is no measurement for the protection of *C. carcharias* set in the Fisheries Act of Turkey. The great white sharks and other large sharks caught mainly by commercial fishing boats operating in Turkish waters are

often sold to a small but lucrative market, primarily for their jaws. Although the great white shark can descend to a depth of 1300 m (Serena, 2005), it is primarily a coastal and offshore inhabitant of continental and insular shelves (Compagno, 1984). Due to the coastal occurrence of *C. carcharias*, regular monitoring and seasonal banning of coastal gill-netting and long-lining in the areas, where white sharks are sighted in the northeastern

Aegean Sea, is necessary in order to minimize the impacts of fishing on the species.

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DVA MLADOSTNA VELIKA BELA MORSKA VOLKA, *CARCHARODON CARCHARIAS* (LINNAEUS, 1758) (CHONDRICHTHYES; LAMNIDAE), UJETA V SEVERNOVZHODNEM EGEJSKEM MORJU

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POVZETEK

Dve mladostni samici velikega belega morskega volka, Carcharodon carcharias (Linnaeus, 1758), sta bili ujeti v obalnih vodah severnovzhodnega Egejskega morja, obe z opremo za gospodarski ribolov. Primerek št. 1 je v celotno dolžino meril 180 cm, primerek št. 2 pa 300 cm. V vsebini želodca primerka št. 1 so našli dve morski spaki (Lophius spp.), iglico (Belone belone) in osliča (Merluccius merluccius). Zaradi pojavljanja C. carcharias v obalnih vodah bi bil na območju severovzhodnega Egejskega morja, kjer so beli morski volki videni, nujno potreben reden monitoring in sezonska prepoved obalnega ribolova z zabodno mrežo in vlečnimi mrežami, da se zmanjša vpliv ribolovnih dejavnosti na to vrsto. Avtorji razpravljajo tudi o trenutnem statusu C. carcharias v turških vodah.

Ključne besede: beli morski volk, *Carcharodon carcharias*, pojavljanje v obalnih vodah, Egejsko morje

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