

A FIELD GUIDE TO THE SHARKS OF TURKISH WATERS

Hakan KABASAKAL



TURKISH
MARINE
RESEARCH
FOUNDATION



Publication Number: 55

A FIELD GUIDE TO THE SHARKS OF TURKISH WATERS

Hakan Kabasakal



A FIELD GUIDE TO THE SHARKS OF TURKISH WATERS

All rights are reserved. No part of the publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means without the prior permission from the Turkish Marine Research Foundation (TUDAV).

© Turkish Marine Research Foundation
ISBN: 978-975-8825-47-9

Citation: Kabasakal, H. 2020. A Field Guide to the Sharks of Turkish Waters. Turkish Marine Research Foundation (TUDAV) Publication No: 55, Istanbul, Turkey. 133 p.

Cover photo: Sait Özgür Gedikoğlu, *Carcharhinus plumbeus*, Boncuk Bay (Marmaris, Turkey).

Turkish Marine Research Foundation (TUDAV)
P.O. Box: 10, Beykoz, Istanbul
Tel: 0 (216) 424 07 72
Fax: 0 (216) 424 07 71
E-mail: tudav@tudav.org
www.tudav.org



/tudav



/TudavTudav



/TÜDAV



/turkdenizarastirmalarivakfi

CONTENTS

PREFACE	vi
ACKNOWLEDGMENTS	vii
INTRODUCTION	1
<i>Study area</i>	2
<i>What is a shark?</i>	4
<i>How do sharks reproduce?</i>	8
<i>What do sharks eat?</i>	12
<i>Where do sharks live?</i>	14
<i>Status of sharks of Turkish waters</i>	14
<i>Questionable sharks of Turkish waters</i>	17
<i>Shark attacks in Turkish waters and adjacent regions</i>	17
<i>Conservation issues of sharks</i>	20
<i>Identification key for the sharks of Turkish waters</i>	23
<i>Species accounts</i>	36
HEXANCHIFORMES	37
HEXANCHIDAE	37
<i>Hexanchus griseus</i> (Bonnaterre, 1788).....	37
<i>Heptanchias perlo</i> (Bonnaterre, 1788).....	39
SQUALIFORMES	40
ECHINORHINIDAE	40
<i>Echinorhinus brucus</i> (Bonnaterre, 1788).....	40
SQUALIDAE	42
<i>Squalus acanthias</i> Linnaeus, 1758.....	42
<i>Squalus blainvillei</i> (Risso, 1826).....	44
CENTROPHORIDAE	46
<i>Centrophorus granulosus</i> (Bloch & Schneider, 1801).....	46
<i>Centrophorus uyato</i> (Rafinesque, 1810).....	48
ETMOPTERIDAE	50
<i>Etmopterus spinax</i> (Linnaeus, 1758).....	50
OXYNOTIDAE	51
<i>Oxynotus centrina</i> (Linnaeus, 1758).....	51
DALATIIDAE	53
<i>Dalatias licha</i> (Bonnaterre, 1788).....	53
SQUATINIFORMES	55
SQUATINIDAE	55
<i>Squatina aculeata</i> Dumeril, in Cuvier, 1817.....	55
<i>Squatina oculata</i> Bonaparte, 1840.....	57
<i>Squatina squatina</i> (Linnaeus, 1758).....	58
LAMNIFORMES	60
ODONTASPIDIDAE	60
<i>Carcharias taurus</i> Rafinesque, 1810.....	60
<i>Odontaspis ferox</i> (Risso, 1810).....	62

ALOPIIDAE	64
<i>Alopias superciliosus</i> (Lowe, 1839).....	64
<i>Alopias vulpinus</i> (Bonnaterre, 1788).....	65
CETORHINIDAE	67
<i>Cetorhinus maximus</i> (Gunnerus, 1765).....	67
LAMNIDAE	69
<i>Carcharodon carcharias</i> (Linnaeus, 1758).....	69
<i>Isurus oxyrinchus</i> Rafinesque, 1810.....	71
<i>Lamna nasus</i> (Bonnaterre, 1788).....	73
CARCHARHINIFORMES	75
SCYLIORHINIDAE	75
<i>Galeus melastomus</i> Rafinesque, 1810.....	75
<i>Scyliorhinus canicula</i> (Linnaeus, 1758).....	77
<i>Scyliorhinus stellaris</i> (Linnaeus, 1758).....	79
TRIAKIDAE	80
<i>Galeorhinus galeus</i> (Linnaeus, 1758).....	80
<i>Mustelus asterias</i> Cloquet, 1821.....	82
<i>Mustelus mustelus</i> (Linnaeus, 1758)	83
<i>Mustelus punctulatus</i> Risso, 1826.....	84
CARCHARHINIDAE	85
<i>Carcharhinus altimus</i> (Springer, 1950).....	85
<i>Carcharhinus brevipinna</i> (Müller & Henle, 1839)	87
<i>Carcharhinus limbatus</i> (Valenciennes, in Müller & Henle, 1839).....	89
<i>Carcharhinus melanopterus</i> (Quoy & Gaimard, 1824).....	91
<i>Carcharhinus obscurus</i> (Lesueur, 1818).....	93
<i>Carcharhinus plumbeus</i> (Nardo, 1827).....	95
<i>Prionace glauca</i> (Linnaeus, 1758).....	97
SPHYRNIDAE	99
<i>Sphyrna zygaena</i> (Linnaeus, 1758).....	99
PLATE I	101
<i>Hexanchus griseus</i>	101
<i>Heptarhynchus perlo</i>	101
<i>Echinorhinus brucus</i>	101
PLATE II	102
<i>Squalus acanthias</i>	102
<i>Squalus blainvillei</i>	102
<i>Centrophorus granulosus</i>	102
PLATE III	103
<i>Etmopterus spinax</i>	103
<i>Oxynotus centrina</i>	103
<i>Dalatias licha</i>	103
PLATE IV	104
<i>Squatina aculeata</i>	104
<i>Squatina oculata</i>	104
<i>Squatina squatina</i>	104

PLATE V	105
<i>Carcharias taurus</i>	105
<i>Odontaspis ferox</i>	105
PLATE VI	106
<i>Alopias superciliosus</i>	106
<i>Alopias vulpinus</i>	106
<i>Cetorhinus maximus</i>	107
PLATE VII	108
<i>Carcharodon carcharias</i>	108
<i>Isurus oxyrinchus</i>	108
<i>Lamna nasus</i>	108
PLATE VIII	109
<i>Galeus melastomus</i>	109
<i>Scyliorhinus canicula</i>	109
<i>Scyliorhinus stellaris</i>	109
PLATE IX	110
<i>Galeorhinus galeus</i>	110
<i>Mustelus asterias</i>	110
<i>Mustelus mustelus</i>	110
PLATE X	111
<i>Mustelus punctulatus</i>	111
<i>Carcharhinus altimus</i>	111
<i>Carcharhinus brevipinna</i>	111
PLATE XI	112
<i>Carcharhinus obscurus</i>	112
<i>Carcharhinus plumbeus</i>	112
<i>Prionace glauca</i>	112
<i>Sphyrna zygaena</i>	113
REFERENCES	114

PREFACE

It's a great honour for me to write a preface for the book of "A Field Guide to the Sharks of Turkish Waters" written by Mr. Hakan Kabasakal. His passion, curiosity and enthusiasm never cease about sharks of the world, Mediterranean and in Turkish waters since he started to study at Faculty of Fisheries, Istanbul University. I truly congratulate him for such an excellent study.

It is a matter of fact that sharks are under threats of bycatch, pollution, overfishing and so on all over the world, including Turkish waters. That is why Turkish Marine Research Foundation (TUDAV) organized two important workshops in 2005 and 2018 in Istanbul to establish a national action plan for the conservation of cartilaginous fish species. After these successful workshops, a road map for the national action plan was adopted. Later, due to our continuous pressure to Turkish authorities, 12 cartilaginous fish species, including Giant Manta, have become protected species and this was an obvious success for the conservation of sharks and rays in Turkey by TUDAV.

We know that sawfish, *Pristis pristis*, has already disappeared from the Black and Mediterranean Seas. In that context, this book has a special mission for protecting sharks in Turkish waters, which cover large areas, mainly in the Black Sea, Marmara Sea, Aegean and Mediterranean Sea.

This field guide of sharks in Turkey will certainly help protect these marvellous, mysterious and ancient animals in our seas. Most of the pictures, excellent quality and very informative, were taken by Mr. Kabasakal. Surely, this book will fill an important gap in both the Black Sea and Mediterranean Basin in terms of shark research and conservation. Besides, for nature lovers, researchers and decision makers, it is an informative and practical field guide.

Mr. Kabasakal is not only ambitious and a hard worker but also so polite and modest. He has written that I was his mentor in the field of marine biology during his undergraduate years. This is also an honour for me after so many years passed. He has been dedicating his life to sharks, which not so many people do in Turkey or around us...

As a president of Turkish Marine Research Foundation, I would like to emphasize that our support will continue for Mr. Kabasakal who we believe is a guardian and an ambassador for the sharks in the Black Sea and Mediterranean Basin.

Tokyo Japan, May 2020

Prof. Dr. Bayram Öztürk
Founder and President
Turkish Marine Research Foundation

ACKNOWLEDGMENTS

My quest in the wake of sharks started almost thirty years ago. Since the very first day of this great journey, I've been collaborating with wonderful people. Dr. Alessandro De Maddalena of Milan, curator of the Mediterranean Great White Shark Data Bank, has always supported my research and publications on sharks, with his masterpiece illustrations and precious comments, especially on the life story of Mediterranean great whites. Dr. Lovrenc Lipej, Dr. Martina Orlando and Dr. Patricija Mozetic, of Marine Biology Station, Piran, have always been supported my publication efforts with friendly comments. Dr. Nuri Bařusta, Dr. Murat Kaya, Dr. Murat Bilecenoglu, Dr. Halit Filiz, Dr. Sezginer Tuncer, Dr. S. Ünsal Karhan, Dr. Cem Dalyan, Dr. Ata Bilgili, Dr. Deniz Ergüden, Dr. Deniz Ayas, Dr. Alen Soldo, Ms. Avivit Fischler, Mr. Ateř Evirgen, Mr. S. Özgür Gedikoęlu, Mr. Timuçin Dinçer, Mr. Berg G. İpek, Mr. Erdi Bayrı, Mr. Halil Ataç and Mr. Emir Şerefoęlu, generously shared their experiences or photographs of sharks with me. Their contributions to my long journey will always be remembered with friendly feelings and gratitude. Once my mentor in the field of marine biology, Dr. Bayram Öztürk, founding president of Turkish Marine Research Foundation, TUDAV, has given any possible support for the publication of this book, and I will always remember his support with gratitude, as well. Dr. Arda Tonay, a long lasting friend and a colleague, has handled almost all of the bothering paperwork during the publication process with a great patience. Last but not least, very special thanks go to my wife, Özgür, and my son, Derin, for their endless love, support and patience to my incorrigible passion of science and adventure. I love you both with all my heart.

Hakan Kabasakal
Ichthyological Research Society

INTRODUCTION

The story of sharks in the world's oceans started nearly 400 million years ago. Since their first appearance, sharks have occupied a wide range of habitats as a result of their diverse morphological or behavioural adaptations to their environment. Sharks are one of the success stories of evolution, because of their life-history characteristics as k-selected species (large maximum body size, slow growth, late maturity and long lifespan (Camhi *et al.* 1998).

When speaking of the sharks of the Mediterranean Sea, where sharks display their diversity with 51 species (De Maddalena and Della Rovere 2005), Turkish waters is known as a remarkable habitat for these predatory fishes and considered a unique confirmed or proposed breeding ground for several shark species, *e.g.* the great white shark, *Carcharodon carcharias*, the shortfin mako shark, *Isurus oxyrinchus*, the sandbar shark, *Carcharhinus plumbeus* and the angular roughshark, *Oxynotus centrina* (Kabasakal 2011, 2014, 2015a, 2015b, 2019). Despite the fact that, the group of sharks is considered poorly known as far as the fish fauna of the Turkish waters is concerned. Sharks have not been commercially important in the Turkish sea fishery for a number of years, which is the reason why most of the ichthyological research has been focused on commercially important fish species (Kabasakal, 1998a, 2002a, 2019).

The chronology of elasmobranch research in Turkish waters can be divided into two distinct eras: the first, which lasted until the late 1990s, was characterised by a paucity of shark-specific studies. Since sharks were at the time considered as “pests” with no commercial value, the clear scientific neglect of shark-specific studies of Turkish waters resulted in a remarkable gap of knowledge about them (Kabasakal 2019).

Following the foundation of the Ichthyological Research Society in early 2000, a non-governmental and non-profit organization dedicated to shark research, exploration efforts in the mentioned field increased considerably. The publication of nearly 100 shark-specific scientific articles by the author of this guide and his colleagues between 1990's and 2020, significantly improved our knowledge about sharks occurred in Turkish waters and in the broader area of eastern Mediterranean. Furthermore, an increased number of shark-related studies and publications by several Turkish researchers, carried out in the mentioned region, can be considered as the hallmark of the second era: the rise of shark research in Turkey (Kabasakal 2019).

To sum up above, remarkable amount of information regarding the sharks of Turkish waters were gathered to date, and the book entitled “*Türk Sularında Köpekbalıkları (Sharks of Turkish Waters)*” was the fruit of joint efforts of Turkish shark researchers (Kabasakal 2011). Since the book was published in Turkish language, the text doesn't make a sense for foreign readers, except

providing an illustrated guide to sharks of the mentioned region. Therefore, publication of a field guide of sharks of Turkish waters in English language has been an unmet necessity for long years, and the author of the present study aims to provide a clear and updated field guide, including the sharks of Turkish waters, as well as eastern Mediterranean, in a broad sense.

Study area

Turkey is a peninsular country, which is surrounded by Black, Aegean and Mediterranean seas, and the Turkish Straits System (TSS), which stretches along Çanakkale Strait, Sea of Marmara and İstanbul Strait (Figure 1). Generally speaking on the oceanographical peculiarities of seas around Turkey, the following points become prominent: 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 of Pontic waters (Prodanov *et al.* 1997). According to Öztürk and Öztürk (1996), TSS plays a significant and decisive ecological role in the dispersal of living organisms between the Mediterranean and Black Seas, since it constitutes a barrier, a corridor, or an acclimatization zone for marine species. The Sea of Marmara is a 280 km long and 80 km wide intracontinental sea on the waterway between the Mediterranean and Black Seas (Figure 1). Its maximum depth is 1370 m, and the sea consists of three deep basins with depths exceeding 1100 m (Çağatay *et al.* 2016). The northern part of the Sea of Marmara is characterized by a narrow shelf area, the southern sublittoral, on the other hand, is covered by a remarkably wider continental shelf. The Aegean Sea is topographically divided into two basins by (approximately) the 38° parallel, *i.e.* into the north and south Aegean (Papaconstantinou 1992). Based on the spreading of Lessepsian immigrants, Papaconstantinou (1987) characterised the North Aegean Sea as an area of cold-water fauna and the South Aegean Sea as the sea of warm-water fauna. Finally, with the opening of the Suez Channel in 1869, as well as due to the general heating of the world oceans, Mediterranean Sea has been impacting by the phenomenon known as the “tropicalisation”, which causes retreating of temperate species towards colder areas of the basin (Bianchi and Morri 2003).

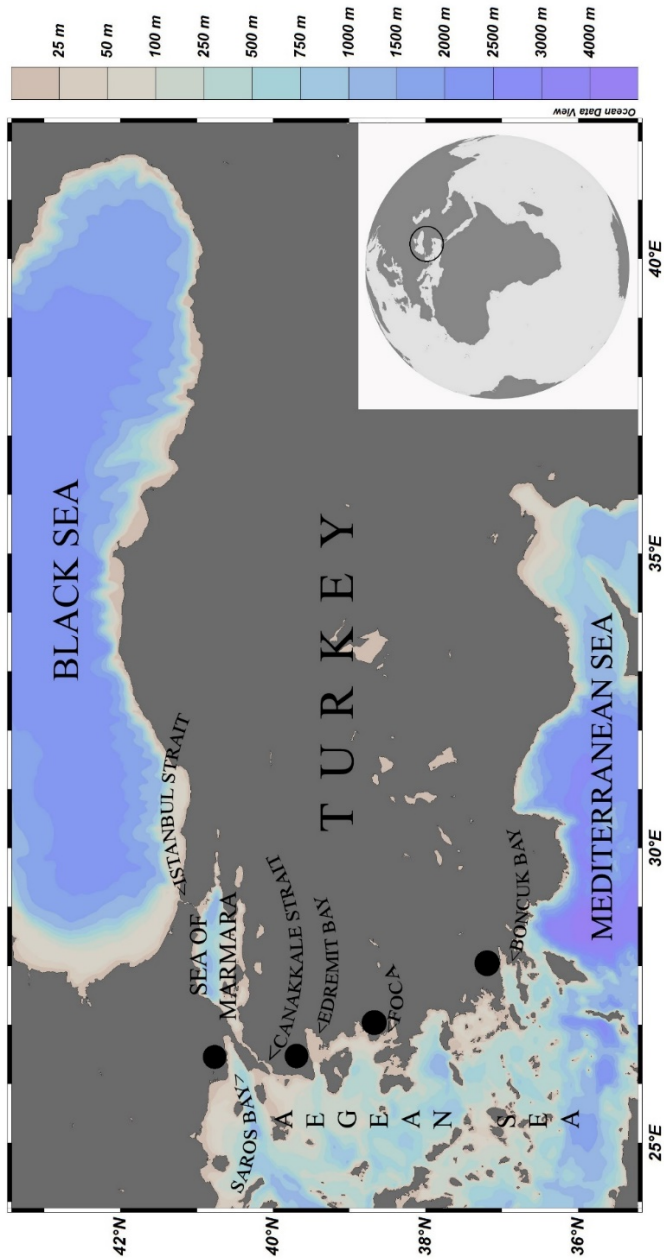


Figure 1. Global locality of Turkish seas, the area of investigation, which is circled on the map of globe. Black circles depict the approximate localities of documented shark nurseries along Turkish Aegean coast.

What is a shark?

Shark is a superfish, which seems to be designed and evolved for a single purpose: to rule the oceans via its predatory power. With no doubt, a vast number of people almost simultaneously associate the word “shark” with the imagination of a huge marine creature with strong jaws armed with sharp teeth, awaiting to seize and apart its prey. When speaking about sharks, strong jaws and sharp teeth are perhaps the best known and first features come to mind. Public imagination of a predatory shark is not wrong, but it can’t tell you the entire story of these magnificent and misunderstood top predators.

The familiar edible bony fishes of our household menu, like bonito, mackerel or anchovies; marine mammals, such as whales or dolphins; or even the skates and rays, the close relatives of sharks, may be confused with them. With regards to some key morphological features, which are summarised in Table 1, sharks differ from bony fishes, marine mammals, and skates and rays.

Since the principal supporting structure of their bodies is composed of cartilage, -basically a semi-transparent, elastic material-, sharks and their relatives (skates, rays and ratfishes or chimaeras) are all known as cartilaginous fishes. Sharks also exhibit a remarkable interspecific diversity in many aspects. Regarding the body size, the smallest shark, *Squaliolus laticaudus*, is less than 15 cm in length when fully mature; while maximum length of the whale shark, *Rhincodon typus*, is recorded as 13.7 m (Compagno 1984a), which also makes it as the largest fish occurring in world oceans. Speaking of the size of sharks, the smallest shark occurring in Turkish waters is the blackmouth catshark, *Galeus melastomus*, of which the recorded total length (TL) range usually varies between 20 to 40 cm, and the basking shark, *Cetorhinus maximus*, is the largest shark occurring in the mentioned region, reaching about 10 m TL in fully grown females (Serena 2005; Kabasakal 2009a).

Based on body form and fin shapes of sharks proposed by Wilga and Lauder (2004), body form of sharks of Turkish waters ranges from the anguilliform or eel-like, slow-swimming, demersal catsharks, *Scyliorhinus* sp. and *Galeus melastomus*, to the flattened ray-like angel sharks, *Squatina* sp. The fast-swimming, predatory species, like thresher, *Alopias* sp., shortfin mako, *Isurus oxyrinchus*, great white, *Carcharodon carcharias*, or blue sharks, *Prionace glauca*, are all characterised with a torpedo-like streamlining body form. Some sluggish, demersal, deep-sea sharks, like the angular rough shark, *Oxynotus centrina*, and the bramble shark, *Echinorhinus brucus*, have stout and robust bodies, with spines in front of the sail-like dorsal fins in the former species, or prickles covering the entire body surface in the latter one. Regarding such immense variation, it is clearly difficult to talk about an “ideal” shark definition, which can be fitted on different species. However, a number of

features are common to all sharks and now, let's glance over them (Table 1; Figure 2).

- 1) A cartilaginous skeleton, with only jaws and the backbone are heavily calcified; despite the calcified parts of the skeleton, there is no true bone in the body.
- 2) Five to seven gill slits, located on the side surfaces of the head. There is no operculum is present.
- 3) Since sharks do not have a swim bladder internally, buoyancy control is relied upon the continuous swimming and oily liver.
- 4) Except the tail of the angel sharks, *Squatina* sp., caudal (tail) fin is asymmetric, the upper lobe being longer than the lower lobe. However, the degree of the asymmetry varies considerably, being almost symmetrical in the almost lunate tail fin of lamnid sharks (e.g. great white shark, *Carcharodon carcharias*), or prominently asymmetrical in thresher sharks, *Alopias* sp., of which the upper lobe is nearly the half of the total length of the shark.
- 5) The surface of the skin is extremely rough, being covered with tiny placoid scales or dermal denticles. In bramble sharks, *Echinorhinus brucus*, prickles with enlarged basal plates are seen scattered over the body surface.
- 6) One or two dorsal fins, with or without spines in front of their anterior margins. An anal fin is present or not.

Table 1. Summary of the key similarities and differences between sharks and members of other marine animals, which they might be confused (adopted from Vas 1991).

Sharks	Skates and Rays	Bony fishes	Dolphins and Whales
5-7 gill slits on sides of the head	5 gill slits on the ventral surface of the head	no gill slits	no gills, a blowhole on top of the head
no operculum	no operculum	gills covered by an operculum	no operculum
skin very rough, like sandpaper, covered with dermal denticles, the placoid scales	skin very rough, like sandpaper, covered with dermal denticles, the placoid scales	skin covered with cycloid scales	skin very smooth, no scales,
skeleton of cartilage, no true bone	skeleton of cartilage, no true bone	skeleton of fully calcified true bone	skeleton of fully calcified true bone

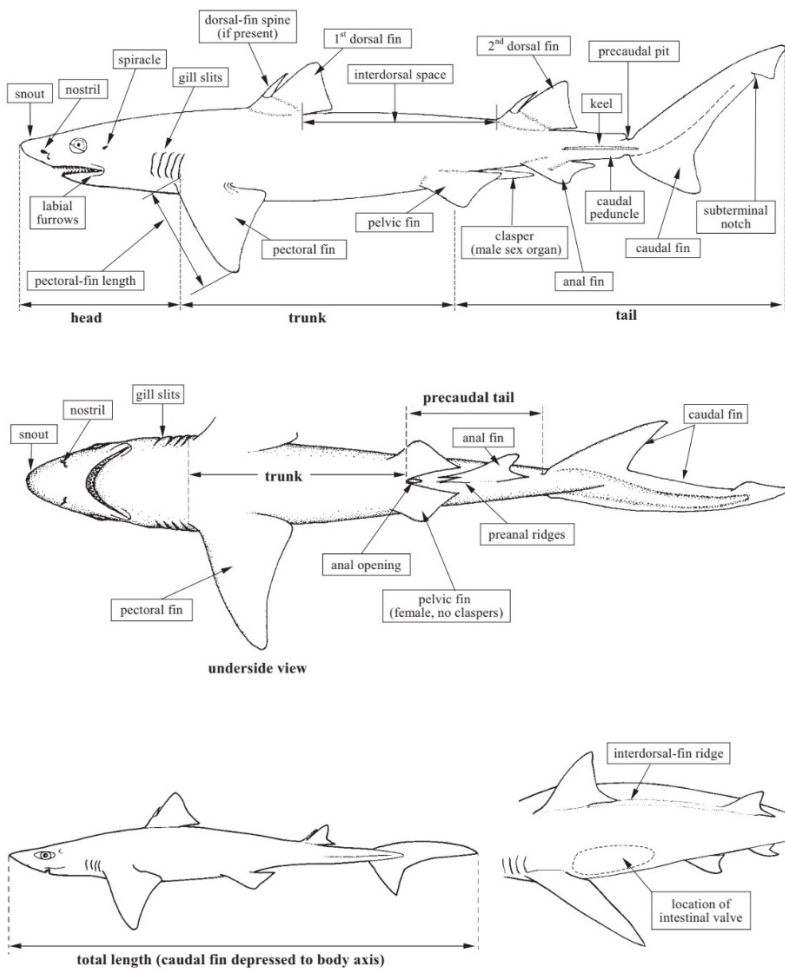


Figure 2. Technical terms and measurements of sharks (adopted from Serena 2005); note that, illustrations are depicting a generalised shark, thus, not every characteristics may present on different species.

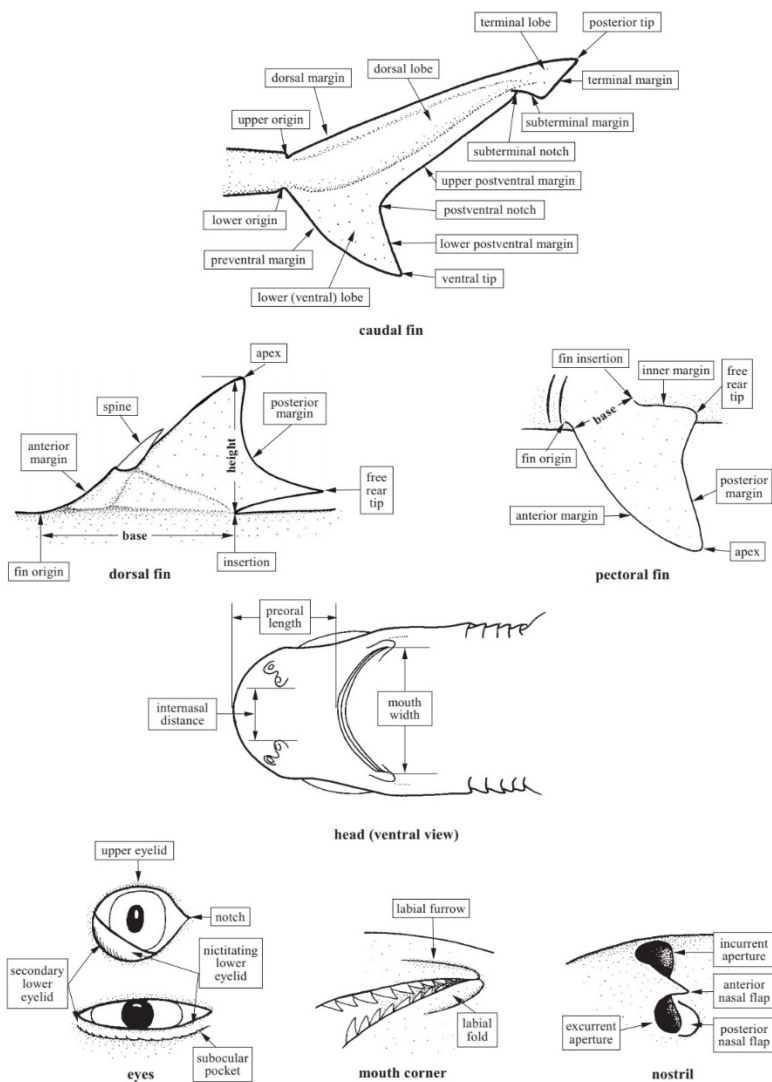


Figure 2 (continued). Technical terms and measurements of sharks (adopted from Serena 2005).

How do sharks reproduce?

Before addressing the embryonic development of sharks, let's take a glance on the reproductive systems of male and female sharks. Reproductive organs of sharks are remarkably different than bony fishes, and demonstrate peculiar characteristics. Regardless the species of shark, one can easily differentiate the males from females, only based on the presence or absence of the claspers, the copulation organs of the male shark (Figure 3). Each male has two claspers, which are located along the inner side of the shark's pelvic fins, as a deep-grooved cartilaginous extension. When it mates, the male deposits his sperm into the female's cloaca (entrance of the female's uterus) via these claspers. In young adolescent males, claspers are soft and shorter than the pelvic fins; however, as the male shark grown up, length of the claspers increases and getting harder because of the calcification of the supporting cartilage. Claspers of the adult males are remarkably longer than pelvic fins.



Figure 3. Claspers of a male bluntnose six-gill shark, *Hexanchus griseus*.
(Photo: H. Kabasakal).

Embryonic development of sharks occurs in three different ways (Kabasakal 2011). Some species of sharks, such as cat sharks of the family Scyliorhinidae, lay eggs and the developing embryo covered by a tough protective case, or the egg-case (Figure 4). This way of embryonic development is known as oviparous reproduction. In oviparous sharks, nutrition of the developing

embryo is provided by the nutritious yolk supply, which is also protected in the egg-case with the embryo. After the embryonic development has completed, the egg hatches and young shark emerges from the egg-case.



Figure 4. Egg case of lesser spotted cat shark, *Scyliorhinus canicula*, entangled on the branches of gold coral, *Gerardia savaglia*, sampled in waters of southwestern Sea of Marmara. Since the coral beds are considered as breeding grounds for oviparous sharks, protection of coral ecosystems is a critical step in the conservation of shark populations (Photo: B. Öztürk).

Most species of sharks are ovoviviparous or live-bearers. Females of ovoviviparous species retain their eggs inside the body until the young hatch in uterus and then born “alive” (Figure 5). Ovoviviparity provides the young shark with the advantageous of protection from predators during their earliest developmental stages. Dogfish sharks of the family Squalidae, and angelsharks of the family Squatinidae are well-known examples of the ovoviviparous shark species. After the hatch of the embryos inside the mother, they stay in the mother for some additional time, while providing nourishment by consuming nutrient-rich unfertilized eggs, which ovulated for them. The unique sand tiger shark, *Carcharias taurus*, exhibits one of the extremes of embryonic nutrition or intrauterine cannibalism, in which the earliest embryo hatched in each uterus preys on its siblings.



Figure 5. In utero developing siblings of the starry smoothhound, *Mustelus asterias*. (Photo: H. Kabasakal).

Hammerheads (family Sphyrnidae) and requiem sharks (family Carcharhinidae) exhibit the most advanced form of embryonic development or viviparity, which is quite similar to the developmental process of mammals. In viviparous sharks, placental connection is created between the embryo and the mother, which the embryo obtains nutrients via the placenta during its intrauterine development, and then born alive. The only exception of the viviparous requiem sharks is the tiger shark, *Galeocerdo cuvieri*, in which the embryonic development occurs through ovoviviparity, explained above.

Recent field surveys have shown that the great white shark (*Carcharodon carcharias*) and the sandbar shark (*Carcharhinus plumbeus*) are using several bays along the Turkish Aegean coast as nursery grounds (see the map on Figure 1), and seasonal close encounters between sharks and visitors are becoming a growing concern.

Boncuk Bay in south-western Turkey is known to the local fishermen as 'sharks lair'. Sandbar sharks are present here from late April to mid June, and as a result of decades of dedicated scientific research, Boncuk Bay is now listed as a protected area. Just several hundred kilometers north of Boncuk Bay, is Edremit Bay (see the map on Figure 1). Following the capture of two neonates in 2008, and the recent capture of a subadult specimen, this area has been noted as a potential nursery ground for the top predator of the shark world, the great white (Figure 6). Although the data is new, interviews with the local fishermen

suggest a regular summer occurrence of adult females and offspring in the bay. In addition to neonate great white sharks, the yearly blue shark offspring (*Prionace glauca*) have also become entangled in coastal nets. These incidental captures suggest that *P. glauca*, which normally inhabit offshore waters, may also use the bay area for rearing young. Moreover, capture of neonates and young-of-the-year specimens of the shortfin mako shark (*Isurus oxyrinchus*) in gill-net fishery in waters of Saros Bay and off Foça coast (see the map on Figure 1), as well as the capture of a young specimen of the great white shark (*C. carcharias*) in the latter region, suggests that the limits of this probable shark nursery can be expanded across a broader area both in north and south of Edremit Bay.



Figure 6. A new-born great white shark, *Carcharodon carcharias*, incidentally captured in Edremit Bay in early summer 2008. Arrow denotes the healing umbilical scar, characteristic mark of a new-born shark. (Photo: H. Kabasakal).

Bathyal trawling off northern Gökçeada has provided evidence of possible nursery grounds used by deep water shark species in the north Aegean Sea. From early summer to late autumn, the decks of fishing trawlers are covered by several hundred newborns and juveniles of deep water species such as blackmouth cat sharks (*Galeus melastomus*) and velvet bellies (*Etmopterus spinax*), and even the rare kitefin shark (*Dalatias licha*) and huge sixgill shark (*Hexanchus griseus*). This possible breeding ground of deep sea sharks overlaps with one of the most highly exploited bottom-trawler fishing grounds off north of Gökçeada, where the bathyal sharks are struggling to survive.

Shark nurseries along the Turkish Aegean coast, whether bathyal or coastal, are subjected to considerable effects of human activities. With a popular tourist industry where fear of sharks amongst visitors is common, very few people

understand the threats to these animals which are given such a small chance to survive. Several popular diving spots are also located in the vicinity of those possible coastal breeding grounds. During the apex of the holiday season, thousands of swimmers and divers visit the mentioned area. Thus, seasonal coexistence of people and the apex predators, such as the shortfin mako (*Isurus oxyrinchus*) and great white sharks (*Carcharodon carcharias*), could be a major threat jeopardizing the survival of sharks utilizing the area for breeding. To best of authors knowledge, no shark attack by large predatory sharks in northeastern Aegean Sea has been recorded to date. Nevertheless, increasing occurrence of large predatory sharks in the area may cause an aggressive interaction between people and shark, not limited with a shark attack, but also triggering public fear and resulting the killing of sharks.

What do sharks eat?

Sharks can provide food in different ways; however, the exact answer depends on the species of shark in question (Springer and Gold, 1989; Steel 1985). Most species are opportunistic predators and can prey on various sources of food; however, some species are specialized feeders and in pursuit of specific organisms. In general, diet of carnivorous sharks usually includes fishes, molluscs and crustaceans. Top predators, such as the great white shark, *Carcharodon carcharias*, the mako sharks, *Isurus oxyrinchus* and *I. paucus*, and the sixgill shark, *Hexanchus griseus*, can also feed on large bony fishes, like swordfish and the blue-fin tuna, sea turtles, and marine mammals, like seals and dolphins (Compagno 1984a).

Feeding habits of the gentle giants of the sea, the whale shark, *Rhincodon typus*, and the basking shark, *Cetorhinus maximus*, strikingly contrasting with the predatory idea of large sharks. When fully-grown, size of these sharks can exceed 10 meters, and unlike meat-eating large carnivorous shark idea, these gentle giants are filter-feeders, which prey on nutritious plankton soup (Compagno 1984a).

‘He was a very big mako shark built to swim as fast as the fastest fish in the sea and everything about him was beautiful except his jaws... They were not the ordinary pyramid-shaped teeth of most sharks. They were shaped like a man’s fingers when they are crisped like claws. They were nearly as long as the fingers of the old man and they had razor-sharp cutting edges on both sides.’ In his monumentary novel, *The Old Man and the Sea*, Ernest Hemingway glorifies the predatory power of the mako shark and describes it’s dentition with these words. Sharks as a group have a long history as highly successful predatory fishes (Motta and Wilga 2001), and the mako shark, *I. oxyrinchus*, is one of the prominent species idealising the predatory abilities of all sharks roving in the blue world, primarily because of it’s razor-sharp teeth creating a merciless cutting edge on both jaws (Figure 7).



Figure 7. Non-serrated blade-like teeth of the shortfin mako shark, *Isurus oxyrinchus*, which is on display in a restaurant at Kuşadası fish market. (Photo: H. Kabasakal).

Depending on the type of the prey to be consumed, dental morphology of sharks exhibits remarkable variations, and the relationship between tooth shape and function in sharks has shown by several studies (e.g. Huber *et al.* 2009; Lucifora *et al.* 2001). Speaking honestly, blade-like, razor-sharp tooth is the unforgettable focal point of predatory shark idea. Shape and/or size of teeth play various roles during catching and handling of prey by sharks. Although tooth-food interactions are highly complex, as emphasized by Huber *et al.* (2009), these interactions can be generalized as piscivorous sharks, such as the blue shark (*P. glauca*; Figure 8a), have narrow and long teeth while sharks that prey on marine mammals (e.g. great white shark, *C. carcharias*; Figure 8b), have large and serrated teeth. Sharks, that feed on crabs, molluscs and other hard-shelled organisms, such as hound sharks of the genera *Mustelus*, have pavement-like dentitions (Figure 8c). With its hook-like upper teeth and serrated saw-like lower teeth, the kitefin shark (*D. licha*; Figure 8d), is a very good example of combination dentition of a shark, which can be feed on both shelled and/or fleshy organisms.

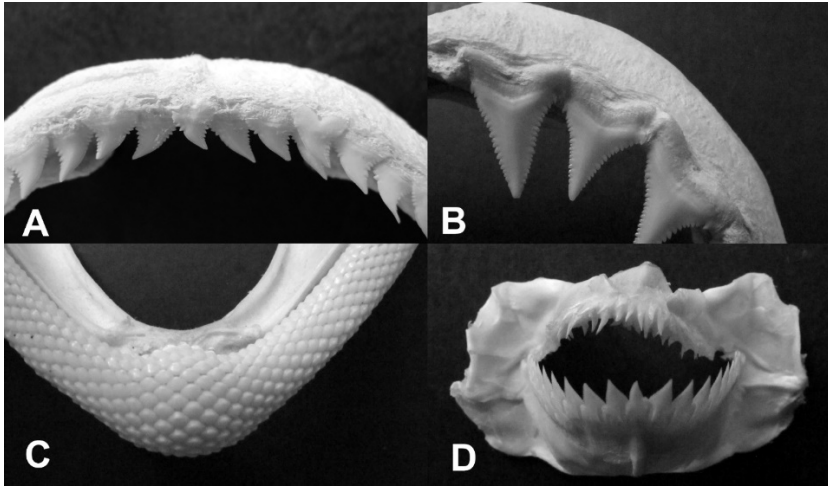


Figure 8. Dentition of different species of sharks: (a) blue shark, *Prionace glauca*; (b) great white shark, *Carcharodon carcharias*; (c) starry smoothhound shark, *Mustelus asterias*; and (d) kitefin shark, *Dalatias licha*. (Photo: H. Kabasakal).

Where do sharks live?

Besides the occurrence of very few species of sharks in brackish seas or freshwater lakes and rivers, a great majority of sharks are marine animals. Tropical, temperate or cold regions of oceans are home to varying numbers of sharks. The only possible exception of this worldwide occurrence range is the ice-cold waters of Antarctic. Sharks can live in shallow coastal areas and the open ocean; they may be confined to near-surface waters or to the bathyal depths, where the sunlight never penetrate. Despite the occurrence of hundreds of species of sharks in tropical waters, only 7 species of sharks –*Scyliorhinus canicula*, *Squalus acanthias*, *Squalus blainvillei*, *Mustelus asterias*, *Squatina squatina*, *Hexanchus griseus* and *Alopias vulpinus*– inhabit the brackish Black Sea, of which the occurrence of *Squatina squatina* requires confirmation, and of *Hexanchus griseus* and *Alopias vulpinus* appeared to be occasional vagrants in the area (Kabasakal 2019). To date, no species of sharks of Turkish waters recorded in freshwater rivers or brackish water of estuaries.

Status of sharks of Turkish waters

Sharks of Turkish waters are known including both small or large, demersal or pelagic, and shallow-water, slope or deep-sea sharks. Thirty six species of sharks representing 13 families (Table 2; Akşiray 1987; Bilecenoglu *et al.*

2014; Kabasakal, 2011, 2019; Kabasakal *et al.* 2017), which are known to occur in Turkish waters, are included in this field guide.

The sharks included in this field guide can be grouped in 3 categories on the basis of their relative occurrence in Turkish waters:

- 1) Residents (R): Specimens of these species can be found in Turkish waters all the year round.
- 2) Seasonals (S): These species occur in the Turkish waters for part of the year only as a result of seasonal migrations.
- 3) Vagrants (V): These species occur rarely or infrequently in Turkish waters, usually as solitary specimens.

Based on the above definitions, which adopted from Vas (1991), this field guide includes 14 residents, 15 seasonals and 7 vagrants (Table 2).

Table 2. Classification, systematic arrangement and distribution of sharks of Turkish waters (Serena 2005). R: Resident; V: Vagrant; S: Seasonal; BS: Black Sea; SM: Sea of Marmara; AS: Aegean Sea; MS: Mediterranean Sea. Occurrence status (R, V, S) of sharks are adopted from the definitions proposed by Vas (1991).

Order HEXANCHIFORMES			
Family Hexanchidae			
<i>Heptranchias perlo</i> (Bonnaterre, 1788)	sharpnose seven-gill shark	V	AS, MS
<i>Hexanchus griseus</i> (Bonnaterre, 1788)	bluntnose six-gill shark	R	BS, SM, AE, MS
Order SQUALIFORMES			
Family Echinorhinidae			
<i>Echinorhinus brucus</i> (Bonnaterre, 1788)	bramble shark	V	SM, AE, MS
Family Squalidae			
<i>Squalus acanthias</i> Linnaeus, 1758	spotted spiny dogfish	R	BS, SM, AE, MS
<i>Squalus blainvillei</i> (Risso, 1826)	longnose spurdog	R	BS, SM, AE, MS
Family Centrophoridae			
<i>Centrophorus granulosus</i> (Bloch and Schneider, 1801)	gulper shark	V	SM, AE, MS
<i>Centrophorus uyato</i> (Rafinesque, 1810)	little gulper shark	V	SM, AE, MS
Family Etmopteridae			
<i>Etmopterus spinax</i> (Linnaeus, 1758)	velvet belly	R	AE, MS
Family Oxynotidae			
<i>Oxynotus centrina</i> (Linnaeus, 1758)	angular rough shark	R	SM, AE, MS
Family Dalatiidae			
<i>Dalatias licha</i> (Bonnaterre, 1788)	kitefin shark	V	SM, AE, MS
Order SQUATINIFORMES			
Family Squatinaidae			
<i>Squatina aculeata</i> Dumeril, in Cuvier, 1817	sawback angelshark	R	AE, MS
<i>Squatina oculata</i> Bonaparte, 1840	smoothback angelshark	R	SM, AE, MS
<i>Squatina squatina</i> (Linnaeus, 1758)	angelshark	R	BS, SM, AE, MS

Table 2. Continued

Order LAMNIFORMES			
Family Odontaspidae			
<i>Carcharias taurus</i> Rafinesque, 1810	sandtiger shark	V	AE, MS
<i>Odontaspis ferox</i> (Risso, 1810)	smalltooth sand tiger	V	AE, MS
Family Alopiidae			
<i>Alopias superciliosus</i> (Lowe, 1839)	bigeye thresher	S	SM, AE, MS
<i>Alopias vulpinus</i> (Bonnaterre, 1788)	thresher shark	R	BS, SM, AE, MS
Family Cetorhinidae			
<i>Cetorhinus maximus</i> (Gunnerus, 1765)	basking shark	S	AE, MS
Family Lamnidae			
<i>Carcharodon carcharias</i> (Linnaeus, 1758)	great white shark	S	AE, MS
<i>Isurus oxyrinchus</i> Rafinesque, 1810	shortfin mako	S	AE, MS
<i>Lamna nasus</i> (Bonnaterre, 1788)	porbeagle	V	SM, AE, MS
Order CARCHARHINIFORMES			
Family Scyliorhinidae			
<i>Galeus melastomus</i> Rafinesque, 1810	blackmouth catshark	R	SM, AE, MS
<i>Scyliorhinus canicula</i> (Linnaeus, 1758)	smallspotted catshark	R	BS, SM, AE, MS
<i>Scyliorhinus stellaris</i> (Linnaeus, 1758)	nursehound	R	SM, AE, MS
Family Triakidae			
<i>Galeorhinus galeus</i> (Linnaeus, 1758)	tope shark	V	AE, MS
<i>Mustelus asterias</i> Cloquet, 1821	starry smoothhound	R	BS, SM, AE, MS
<i>Mustelus mustelus</i> (Linnaeus, 1758)	smoothhound	R	BS, SM, AE, MS
<i>Mustelus punctulatus</i> Risso, 1826	blackspotted smoothhound	R	AE, MS
Family Carcharhinidae			
<i>Carcharhinus altimus</i> (Springer, 1950)	bignose shark	V	MS
<i>Carcharhinus brevipinna</i> (Müller and Henle, 1839)	spinner shark	V	AE, MS
<i>Carcharhinus limbatus</i> (Müller and Henle, 1839)	blacktip shark	V	MS
<i>Carcharhinus melanopterus</i> (Quoy and Gaimard, 1824)	blacktip reef shark	V	MS
<i>Carcharhinus obscurus</i> (Lesueur, 1818)	dusky shark	V	MS
<i>Carcharhinus plumbeus</i> (Nardo, 1827)	sandbar shark	S	AE, MS
<i>Prionace glauca</i> (Linnaeus, 1758)	blue shark	S	AE, MS
Family Sphyrnidae			
<i>Sphyrna (Sphyrna) zygaena</i> (Linnaeus, 1758)	smooth hammerhead	V	AE, MS

Questionable sharks of Turkish waters

In his monumetary work on marine fishes of Turkey, Akşiray (1987) mentions the occurrence of several shark species. These species are as follows: little sleeper shark, *Somniosus rostratus* (Risso, 1810); oceanic white tip shark, *Carcharhinus longimanus* (Poey, 1861); scalloped hammerhead shark, *Sphyrna lewini* (Griffith and Smith, 1834); and small eye hammerhead shark, *Sphyrna tudes* (Valenciennes, 1822). Since the author has not given any information, where the specimens of each species captured or being preserved for further examination, occurrence of these sharks in Turkish waters have always been a subject of debate, and considered as questionable by contemporary ichthyologists and not included in the up-to-date ichthyological inventories of the seas of Turkey (e.g. Bilecenoğlu *et al.* 2014; Kabasakal, 2002a, 2011, 2019).

Contemporary Mediterranean occurrences of these species can be summarised as follows: Serena (2005) considers *S. rostratus* as a very rare shark, which occurs in western Mediterranean, and rare in Levantine Basin. Although considered as a probable shark species in the Mediterranean by Whitehead *et al.* (1984), *C. longimanus* is another doubtful shark of the region and therefore, not included in the field identification guide of the Mediterranean sharks and rays (Serena 2005). According to Serena (2005) *S. tudes* is an occasional species in western Mediterranean; and although, same author confines the distribution of *S. lewini* to western Mediterranean, Bariche (2012) included the scalloped hammerhead shark in his recent field guide of marine resources of eastern and southern Mediterranean, but considers *S. lewini* very rare to absent in the region.

As a consequence, further investigations are required in order to clarify the current status of these questionable sharks, whether they contemporarily occur in Turkish waters or not. Collaboration of citizen scientists, providing photographs of captured sharks for species identification by shark experts, would certainly be a precious contribution for clarifying these puzzling sharks.

Shark attacks in Turkish waters and adjacent regions

Of more than 6500 cases recorded in the Global Shark Attack File (GSAF), 160 have occurred in the Mediterranean Sea. According to the GSAF, only 2 attacks occurred in Turkish waters in the 1930's. Nowadays, one of the major questions to be answered is, whether the knowledge on shark attacks allegedly occurring in Turkish waters, reflects the real situation or not? In order to provide a reasonable explanation to this question, detailed investigation of the following data sources by the researchers of Ichthyological Research Society, was carried out: (1) news that has appeared in printed and internet media; (2)

GSAF data base which is accessible via the following link: www.sharkattackfile.net; and (3) interviews with fishermen, especially old tuna handliners, who actively fished in Bosphoric waters.

Analysis of the mentioned data sources revealed 13 shark attacks occurred in Turkish waters between 1931 and 1983 (Kabasakal and Gedikoğlu, 2015). Ten out of the 13 attacks (76.9%) occurred in the Sea of Marmara, and were followed by 2 attacks (15.3%) recorded in the Mediterranean and 1 attack (7.7%) in the Aegean sea. Four attacks (30.7%) occurred during late spring (May), summer (July and August) and early autumn (September) months, when sea surface temperatures were $>20^{\circ}\text{C}$, while 3 attacks (23.1%) occurred during winter (December and February) and early spring (March) months, when sea surface temperatures were $<20^{\circ}\text{C}$ (Table 1). In 7 attacks (53.8%) targets were the fishing boats, of which 6 of them were boats of tuna handliners, while 6 attacks (46.2%) were directed against humans. In 3 incidents (23.1%) skin or scuba divers, who were harpooning fish, were attacked. Additional 3 attacks were against swimmers. Two attacks (15.3%) were fatal.

Regarding the fatal shark attacks, on 17 September 1948, a non-provoked fatal shark attack occurred off Yumurtalık (NE Mediterranean Sea). According to the newspaper report, a migrant worker was attacked by a shark while swimming off Yumurtalık. In the first strike the shark severed one of his legs, and then as the victim struggled to leave the water, the shark made a second attack, which resulted in severing his other leg. The victim died a very short time later due to severe bleeding. The Yumurtalık incident is considered the first confirmed fatal shark attack to have occurred in Turkish waters, which was proved by the newspaper report (Figure 9). The species of the shark remains unknown.

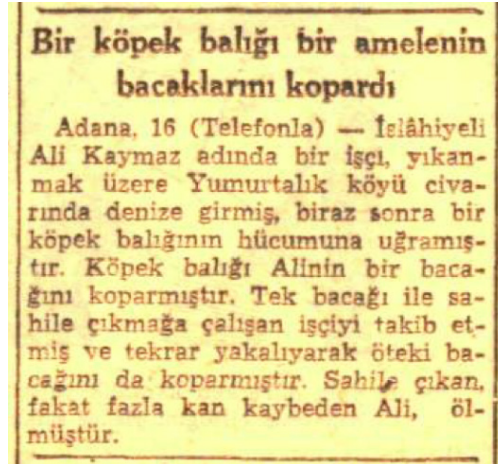


Figure 9. Newspaper clip reporting the fatal shark attack occurred off Yumurtalık coast on 17 September 1948 (case no 5 in Table 1).

On 7 July 1967, an Istanbul based Scuba diver Mr. Güngör Güven dived off Tuzla coast (Sea of Marmara). According to the newspaper report of the same date, Mr. Güven was spearfishing only 200 m off the coast at a depth of 10 m. Suddenly the water turned red and Mr. Güven never ascended to the surface. Just a few minutes later a large dorsal fin appeared at the surface, where Mr. Güven had been spearfishing. Search and rescue divers could only find the right hand, a finger bearing teeth marks, the scuba tank and the torn diving suit of the victim. Although not confirmed by the officials, Tuzla incident is suggested to be the second fatal shark attack, which was possibly provoked by spearfishing, in Turkish seas.

Chronological analyses of the shark attacks that have occurred in Turkish waters show that the incidents cover almost the entire 20th century, all of which are summarised in Table 3. The majority (84.6%) of these attacks occurred during fishery operations (handlining or spearfishing). The causal factor of one of these shark attacks, as emphasised by Kabasakal and Gedikoğlu (2015), was the dumping of waste, therefore, it should be kept in mind that anthropogenic waste dumping from slaughterhouses or similar facilities can create sensorial stimulus for sharks to come closer to coastal areas. From this point of view, aquaculture cages set too close to shore lines or offshore transport cages of pelagic fish like bluefin tuna can also create a stimulus for the attraction of predatory sharks (Galaz and De Maddalena 2004; Papastamatiou *et al.* 2010; Kabasakal 2014). Juvenile and adult specimens of the great white shark, *Carcharodon carcharias*, short fin mako shark, *Isurus oxyrinchus*, blue shark, *Prionace glauca*, as well as several requiem sharks, *Carcharhinus* sp., all of which armed with amazing top-predatory capabilities, are known to occur in coastal waters of Turkey's Aegean and Mediterranean seas (Kabasakal 2011, 2019). When speaking on the foraging capacity of these top-predators, we should always bear in mind that sharks can learn in an associative or non-associative means by which they can counteract the behavioural plasticity of their prey, fine tuning foraging tactics and capture (Guttridge *et al.* 2009). Since aquaculture cages offer easy-meal opportunities to sharks, the possibility of future encounters with large predatory sharks around coastal-set net-cages, is well beyond any speculation. Although, for the moment, threats to public safety of these aggregating top-predators is unknown, aquaculture farm planners should bear in mind that such marine cages can create sensorial stimulus of easy source of prey for sharks, a predator capable of learning.

Table 3. Chronological list of shark attacks occurred in Turkish waters. AE: Aegean Sea, MS: Mediterranean Sea, SM: Sea of Marmara.

No	Date	Region	Locality	Activity	Fatality	Reference
1	1930	SM	Yeşilköy	Hand lining	No	De Maddalena and Heim 2012
2	17 Mar 1931	SM	Bakırköy	Hand lining	No	Kabasakal and Gedikoğlu 2015
3	8 Feb 1934	SM	Haydarpaşa	Hand lining	No	Kabasakal and Gedikoğlu 2015
4	16 Aug 1937	SM	İstanbul	Swimming	No	GSAF 2020
5	17 Sept 1948	MS	Yumurtalık	Swimming	Yes	Kabasakal and Gedikoğlu 2015
6	1958	SM	Ahırkapı	Hand lining	No	Kabasakal and Gedikoğlu 2015
7	1958	SM	Ahırkapı	Hand lining	No	Kabasakal and Gedikoğlu 2015
8	25 Dec 1958	SM	Ahırkapı	Hand lining	No	Kabasakal and Gedikoğlu 2015
9	1966	SM	Sivriada	Scuba diving and spearfishing	No	Kabasakal and Gedikoğlu 2015
10	7 Jul 1967	SM	Tuzla	Scuba diving and spearfishing	Yes	Kabasakal and Gedikoğlu 2015
11	1970	MS	Antalya	Swimming	No	Kabasakal and Gedikoğlu 2015
12	1970	AE	İzmir	Hand lining	No	Kabasakal and Gedikoğlu 2015
13	1983	SM	Dilovası	Spearfishing	No	Kabasakal and Gedikoğlu 2015

Conservation issues of sharks

As it is already mentioned in Introduction section, sharks have not been commercially important in the Turkish sea fishery for a number of years, and considered as competing opportunistic predators, which are in pursuit of fishing gears and/or boats for ‘easy’ food. Following the release of blockbusting *Jaws* movie in 1970’s, the bloodthirsty monster image of sharks could have never-forgotten for many years, and considered as a reasonable ground for the slaughter of sharks in world oceans. Unfortunately, most sharks are characterised by k-selected life history traits, including slow growth, late sexual maturity, low fecundity and long life (Camhi *et al.* 1998). Such life histories plus targeted or untargeted fisheries of sharks, make these species highly vulnerable to overexploitation, and slow or even irremediable to recover once their populations have been depleted.

Currently, by-catch in marine fisheries, particularly those using pelagic and demersal long-lines, is a major driver of declines in abundance of sharks around the world (Favaro and Cote 2015). There is a well-documented history of shark stocks that have undergone a brief period of fisheries exploitation, which is characterised a “boom” period, and followed by a sudden collapse in yield, that is the “burst” of fisheries (Camhi *et al.* 1998). Previously, General Fisheries Commission for the Mediterranean (GFCM) published a significant report, evaluating the status, ecology and biology of elasmobranchs of the Mediterranean and Black Sea (Bradai *et al.* 2012). Based on a bibliographic analysis, Bradai *et al.* (2012) estimated that 31 species of Mediterranean elasmobranchs (40 percent of all) are by far the most endangered group of marine fish in the Mediterranean Sea. Following this remarkable assessment on the conservation status of Mediterranean elasmobranchs, Dulvy *et al.* (2016) emphasized that 54 percent of Mediterranean shark species are faced an elevated risk of extinction. Risk of decline or local extinction risk of Mediterranean elasmobranchs elevated nearly 15 percent only in four years, which can translate as alarming news for the survival of sharks of Mediterranean!

According to Dulvy *et al.* (2016), the principal driver of decline and local extinction is overfishing, and most species are taken as retained valuable bycatch in small-scale and large-scale trawl and net multispecies fisheries. A clear example of retained as valuable bycatch is the status of oceanic pelagic sharks, which are taken and retained as secondary bycatch in longline fisheries targeting swordfishes and tunas (Figure 10). Bycatch of large elasmobranchs in commercial pelagic fisheries, as well as coastal fisheries, operated in the entire Mediterranean Sea, is an escalating threat on the survival of these k-selected species, which is outlined by the recent MEDLEM report (Mancusi *et al.* 2020). In a recent review on chondrichthyan species as bycatch in Turkish waters, Bengil and Başusta (2018) stated that, chondrichthyan species are a big part of the bycatch in Turkish seas, as in other seas of the world. According to Bengil and Başusta (2018), sharks had the highest bycatch percentage among total chondrichthyans, and almost half of the bycatch recorded in Turkish waters, was comprised of small spotted catshark, *Scyliorhinus canicula*, and followed by blackmouth catshark, *Galeus melastomus*. Based on the estimations that 41 to 49 percent of eastern Mediterranean chondrichthyans are threatened species (Dulvy *et al.* 2016), Bengil and Başusta (2018) underlined that half of Turkish chondrichthyan fish fauna being threatened, which is a worrying result for the future of sharks in the eastern Mediterranean.

So, what should we do to protect sharks from extinction? Before the implementation of evidence-based measures for the conservation, and even a ban on the fishing of large and/or rare shark species, promoting fishermen to release live specimens, appears to be an urgent, feasible first step in the protection of sharks of Turkish waters. However, regarding the safety of both

fishermen and captured sharks, training of fishermen on, which species of sharks are endangered and under protection, and how these species should be kept alive on deck and handle before the release, is a critical demand. Even if incidentally captured specimens of large sharks were returned to the sea intact, these sharks are unlikely to survive the trauma of their capture from deepwater. Therefore, the development of bycatch mitigation measures such as the use of trawl exclusion devices should be undertaken in relevant fisheries, as proposed by Graham *et al.* (2016).

Degradation of important nursery grounds and other critical coastal habitats, due to marine pollution, overfishing, coastal urbanization and unplanned human occupation, leads another serious threat on the survival of sharks. In the recently published national action plan for the conservation of cartilaginous fishes of Turkish waters (Öztürk 2018), bycatch in trawl, trammel nets and purse seines, unreported and unregulated fishing, marine pollution and habitat loss are listed as four main threats for the cartilaginous species, occurring in Turkish waters (Öztürk 2018). A recent research on the extinction risk and conservation of globally distributed lineage of 1,041 chondrichthyan species – sharks, rays and chimaeras- emphasised that, extinction risk of chondrichthyans is substantially higher than most other vertebrates, and only one-third of chondrichthyan species are considered safe by the authors (Dulvy *et al.* 2014). Following the revisions, proposed in the national action plan, and positively implemented them in the fisheries act of Turkey (Official Gazette 2016, article 16(1), page 16; Official Gazette 2018, article 3, page 15; Öztürk 2018), currently the following shark species are considered under protection: *Carcharhinus plumbeus*, *Cetorhinus maximus*, *Galeorhinus galeus*, *Lamna nasus*, *Alopias vulpinus*, *Isurus oxyrinchus*, *Squalus acanthias*, *Squalus blainvillei*, *Oxynotus centrina*, *Squatina aculeata*, *Squatina oculata* and *Squatina squatina*. The fisheries act prohibits any person under Turkey's jurisdiction from killing and/or landing the sharks mentioned in the list of protected species, and any violations of the law are imposed a fine.

In the published text of the abovely mentioned national action plan, Öztürk (2018) also speculates on the general lack of information for the biology and ecology of most cartilaginous species, occurring in eastern Mediterranean Sea, and this speculation can be generalized for almost all elasmobranch species of Turkish waters. Therefore, it is crucial to promote and improve scientific studies on these species in the area, to obtain baseline data, which are necessary for the management and conservation of cartilaginous fishes.

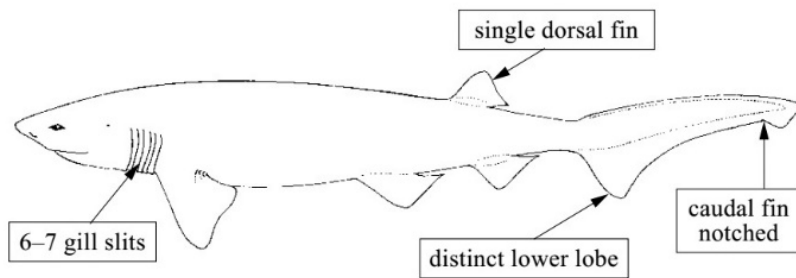


Figure 10. A big eye thresher shark, *Alopias superciliosus*, incidentally captured by a commercial purse-seiner, targeting bluefin tuna, off Keldağ coast (Turkey, northeastern Mediterranean Sea). (Photo: archive of H. Kabasakal).

Identification key for the sharks of Turkish waters

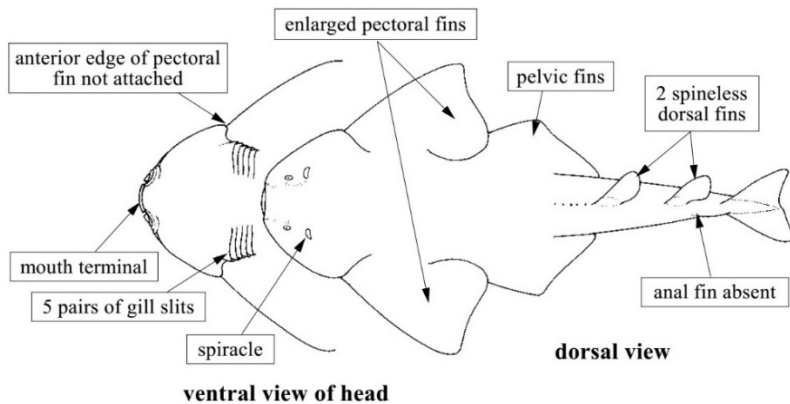
Before species accounts of sharks of Turkish waters, a dichotomous key, consisting of a series of paired and contrasting statements which describe one or more characteristics of a shark, is presented. At the end of each statement, either the species is named or directions are given to a later pair of features or couplets. In order to identify a specimen of a shark from Turkish waters, begin with the first couplet, select the statement which best describes the specimen under examination, then follow the directions given. Repeat this comparison until the species is identified and named. Finally, check the information given under the respective chapter of the named species in Species Accounts section. Illustrations are provided throughout the key to assist the identification process. Following key is based on the systematic criteria proposed by Compagno (1984a,b; 2002), Whitehead *et al.* (1984) and Serena (2005).

- 1a 6 or 7 gill slits; single dorsal fin... 2
 1b 5 gill slits; 2 dorsal fins... 3



(adapted from Serena 2005)

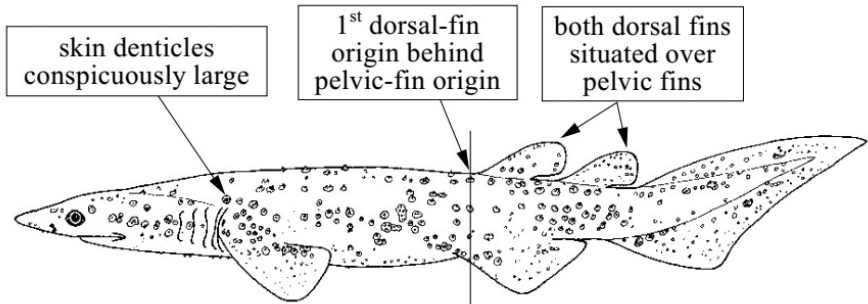
- 2a 6 gill slits... *Hexanchus griseus*
 2b 7 gill slits... *Heptranchias perlo*
- 3a No anal fin; 2 dorsal fins with or without spines; 1st dorsal fin origin over or behind pelvic fin... 4
 3b Anal fin present; 2 dorsal fins without spines; 1st dorsal fin origin is closer to pectorals than pelvics... 14
- 4a Body dorso-ventrally flattened, ray-like; eyes dorsal... 5
 4b Body fusiform, not ray-like; eyes lateral... 7



(adapted from Serena 2005)

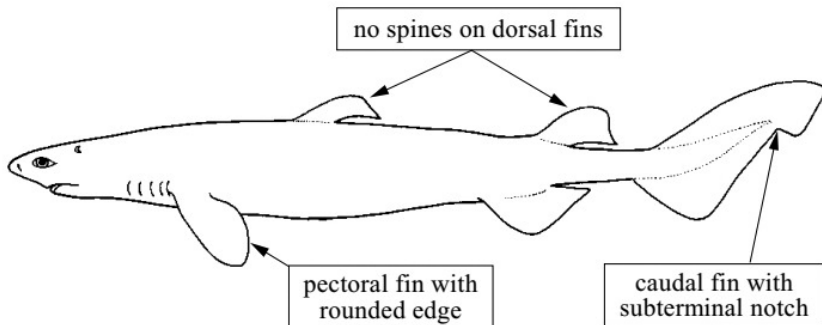
- 5a A single line of dermal denticles on midline of back; origin of 1st dorsal fin before pelvic fin rear extremity... *Squatina aculeata*
 5b No dermal denticles on midline of back... 6

- 6a Origin of 1st dorsal fin behind pelvic fin rear extremity; some large rounded dark spots on fins and body... *Squatina oculata*
- 6b Origin of 1st dorsal fin in line with pelvic fin rear extremity... *Squatina squatina*
- 7a Both dorsal fins situated over pelvic fins; origin of 1st dorsal fin behind pelvic fin origin; conspicuously large dermal denticles spreaded over body surface and fins... *Echinorhinus brucus*



(adapted from Serena 2005)

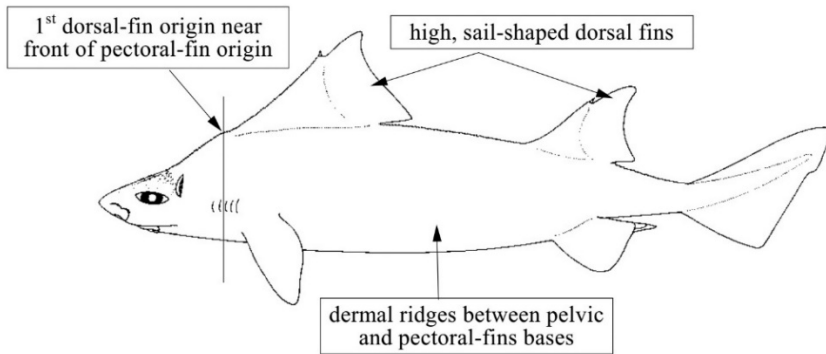
- 7b Dorsal fins with or without spines; origin of 1st dorsal fin closer to pectorals than pelvics... 8
- 8a No spines on dorsal fins; pectoral fin with rounded edge; caudal fin with subterminal notch... *Dalatias licha*



(adapted from Serena 2005)

- 8b 1st and 2nd dorsal fins with spines... 9

- 9a Origin of 1st dorsal fin near front of pectoral fin origin; dorsal fins high and sail-shaped; first dorsal spine inclined forwards; only tips of dorsal spines visible; body very high and compressed; dermal ridges between pelvic and pectoral fins bases... *Oxynotus centrina*



(adapted from Serena 2005)

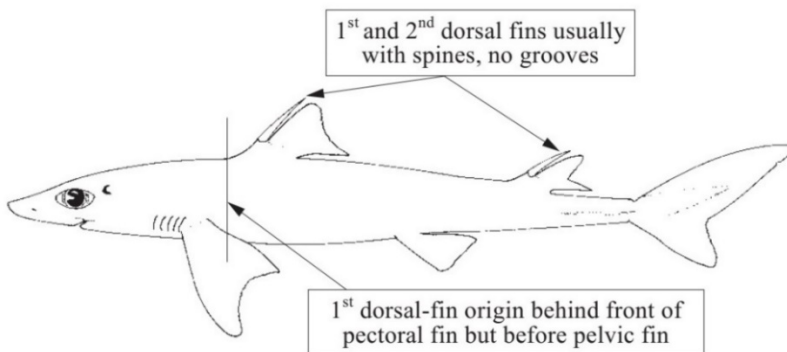
- 9b Origin of 1st dorsal fin behind front of pectoral fin but before pelvic fin; dorsal spines trail in parallel with anterior margins of 1st and 2nd dorsals... 10

10a Dorsal spines without grooves... 11

10b Dorsal spines with grooves... 12

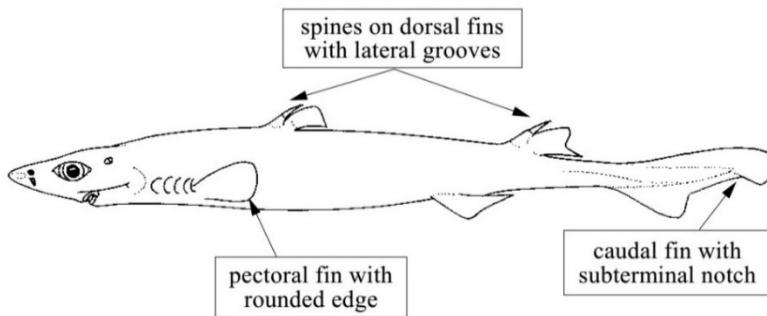
11a 1st dorsal spine shorter than fin base; origin of 1st dorsal spine behind inner pectoral fin in the adult; white spots on body surface... *Squalus acanthias*

11b 1st dorsal spine as long as fin base; no white spots... *Squalus blainvillei*



(adapted from Serena 2005)

- 12a Pectoral fin with rounded edge; 2nd dorsal fin larger than 1st; body ventrally black; flank photomarks present... *Etmopterus spinax*

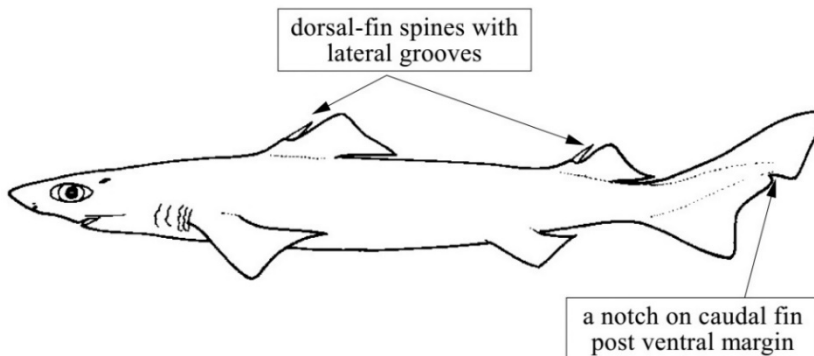


(adapted from Serena 2005)

- 12b Free rear tip of pectoral fin pointed and extended... 13

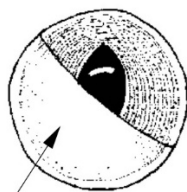
- 13a Teeth on upper jaw with perpendicular cusps; free rear tip of pectoral fin in line with apex of 1st dorsal fin... *Centrophorus granulosus*

- 13b Teeth on upper jaw with somewhat oblique cusps; free rear tip of pectoral fin not in line with apex of 1st dorsal fin... *Centrophorus uyato*



(adapted from Serena 2005)

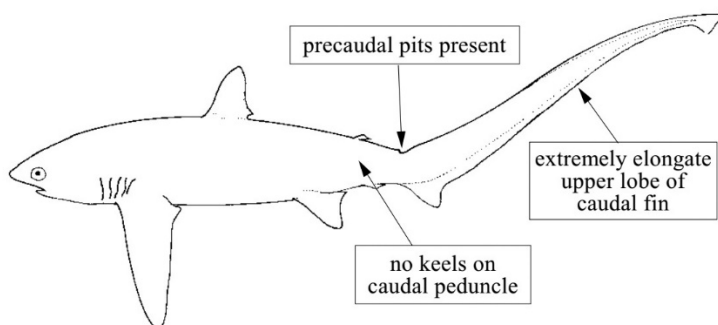
- 14a No movable nictitating eyelid... 15
 14b Movable nictitating eyelid... 22



nictitating eyelid

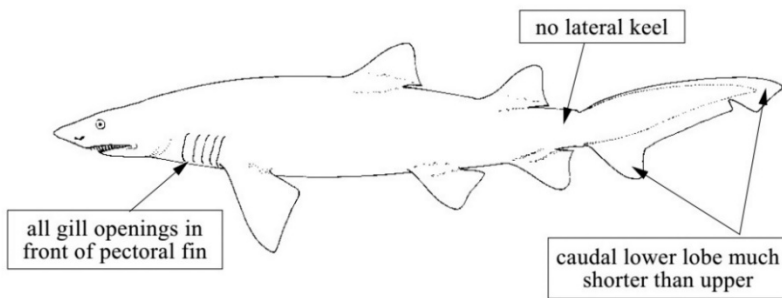
(adapted from Serena 2005)

- 15a Long curving assymmetrical caudal fin, with the upper caudal lobe is nearly as half of the total length... 16



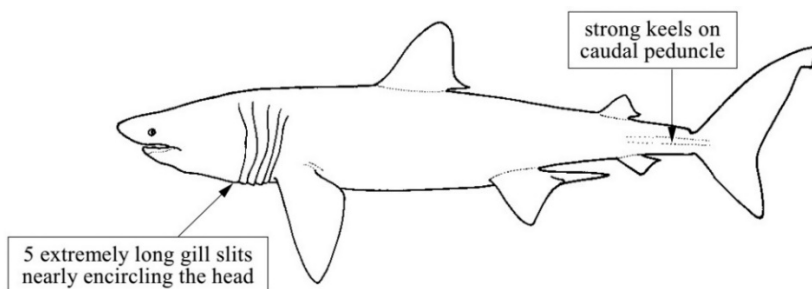
(adapted from Serena 2005)

- 15b Upper caudal lobe not extremely elongated... 17
- 16a Deep grooves on nape; eyes large, reaching the dorsal surface of head; 1st dorsal fin closer to pelvics than pectorals... *Alopias superciliosus*
- 16b No grooves on nape; small eyes on side of head; 1st dorsal fin closer to pectorals than pelvics... *Alopias vulpinus*
- 17a No lateral keel on caudal peduncle; 1st and 2nd dorsal fins are almost equal in size, or 1st dorsal fin is somewhat larger than the 2nd dorsal; caudal lower lobe much shorter than upper lobe... 18



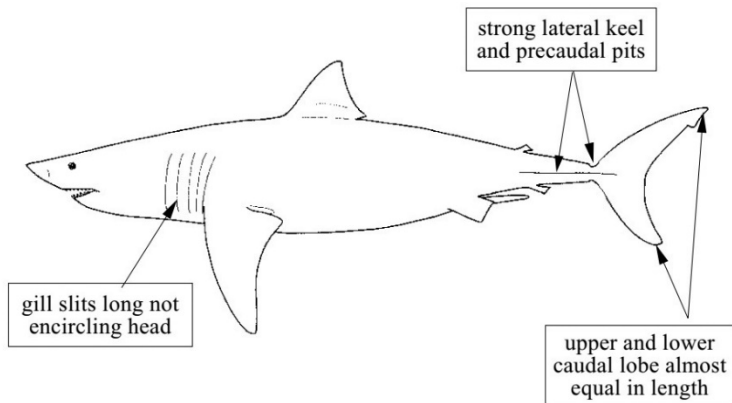
(adapted from Serena 2005)

- 17b Strong keels on caudal peduncle; 1st dorsal fin much larger than 2nd dorsal fin; gill slits long... 19
- 18a Snout short and flattened; three rows of large upper anterior teeth on each side of symphysis; upper anterior teeth separated from lateral teeth by a small intermediate tooth; 1st dorsal fin about as large or slightly larger than 2nd dorsal fin and anal fin; 1st dorsal fin closer to pelvic fin bases than pectoral fin bases... *Carcharias taurus*
- 18b Snout long and conical; two rows of large upper anterior teeth on each side of symphysis; upper anterior teeth separated from lateral teeth by 2 to 5 rows of small intermediate teeth; 1st dorsal fin noticeably larger than 2nd dorsal fin and anal fin; 1st dorsal fin closer to pectoral fin bases than pelvic fin bases... *Odontaspis ferox*
- 19a 5 gill slits extremely long, nearly encircling the head; upper and lower teeth minute... *Cetorhinus maximus*



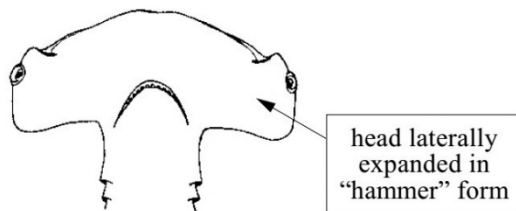
(adapted from Serena 2005)

- 19b Gill slits long not encircling the head; caudal fin lunate; large triangular or blade-like teeth... 20



(adapted from Serena 2005)

- 20a Triangular teeth with regularly serrated edges... *Carcharodon carcharias*
- 20b Blade-like teeth with smooth edges... 21
- 21a Blade-like teeth without cusplets, tips of anterior teeth hooked outwards... *Isurus oxyrinchus*
- 21b Teeth with 1 cusplets on sides of tooth base; secondary keel on lower caudal lobe... *Lamna nasus*
- 22a Head laterally expanded in “hammer” form... *Sphyrna zygaena*

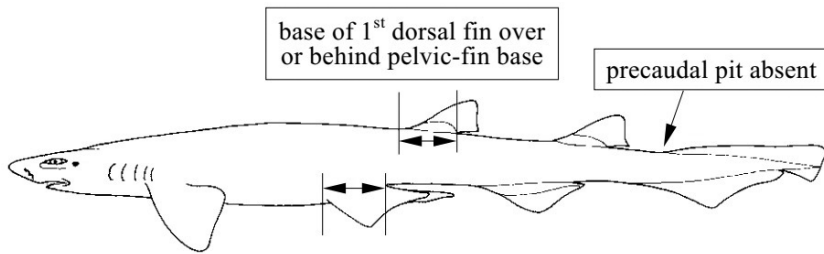


underside of head

(adapted from Serena 2005)

- 22b Head not laterally expanded... 23

- 23a Base of 1st dorsal fin over or behind pelvic fin base... 24



(adapted from Serena 2005)

- 23b Base of 1st dorsal fin well ahead of pelvic fin base... 26

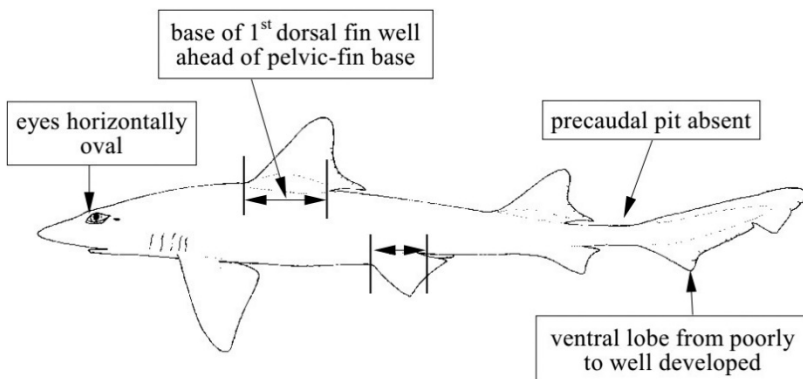
- 24a A distinct crest of enlarged and modified denticles at the origin of the upper lobe of caudal fin; inside of mouth black... *Galeus melastomus*

- 24b No caudal crest of modified denticles; inside of mouth whitish... 25

- 25a Nasal flaps almost joined together in midline; very numerous small dark brown spots about the size of the pupil on the back and sides; origin of 2nd dorsal fin level with the hind end of anal fin base... *Scyliorhinus canicula*

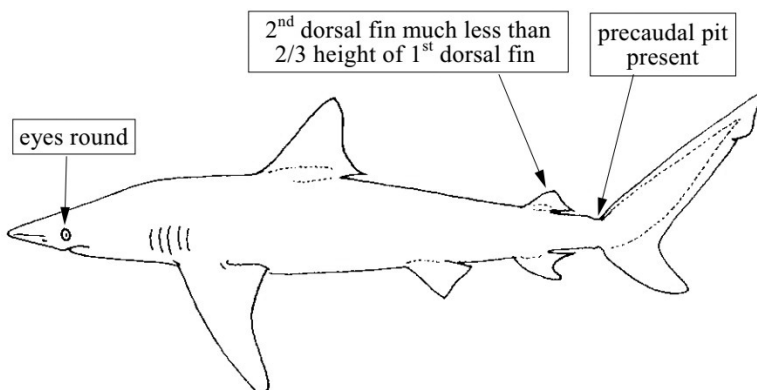
- 25b Nasal flaps widely separated; dark brown spots larger than the pupil sparsely distributed on the back and sides; origin of the 2nd dorsal fin before posterior end of anal fin base... *Scyliorhinus stellaris*

- 26a Precaudal pit absent; eyes horizontally oval... 27



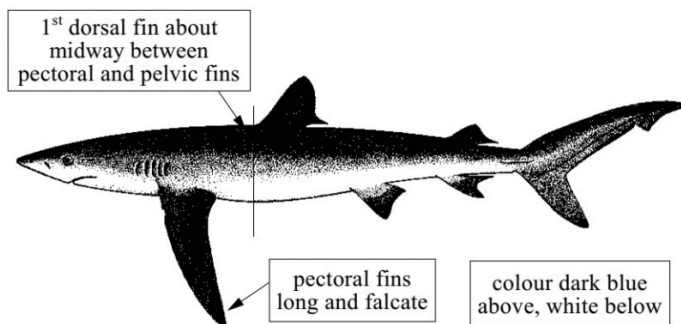
(adapted from Serena 2005)

- 26b Precaudal pit present; eyes round... 30



(adapted from Serena 2005)

- 27a 2nd dorsal fin notably smaller than 1st dorsal fin; upper and lower teeth with high cusps... *Galeorhinus galeus*
- 27b Dorsal fins almost in equal size; low-crowned molar-like teeth on upper and lower jaws... 28
- 28a Body surface covered with spots... 29
- 28b No spots on body surface... *Mustelus mustelus*
- 29a Body surface covered with white spots... *Mustelus asterias*
- 29b Body surface covered with black spots... *Mustelus punctulatus*
- 30a 1st dorsal fin base much closer to pelvic bases than pectorals; colour brilliant dark blue above in life... *Prionace glauca*



(adapted from Serena 2005)

- 30b 1st dorsal fin base equidistant between pectoral and pelvic bases or (usually) closer to pectorals; colour light to dark grey, greyish brown, brown or grey-black above... 31

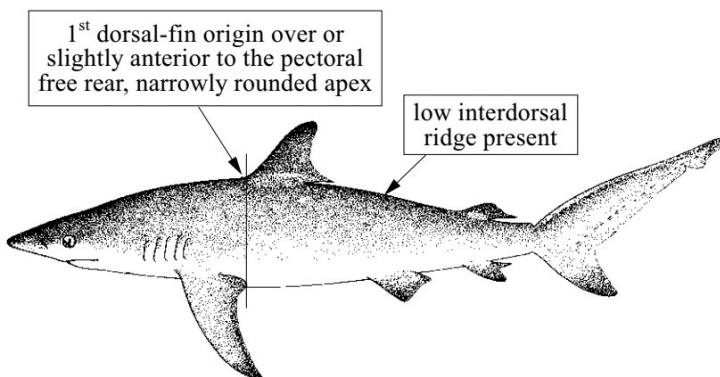
31a Interdorsal ridge present... 32



(Arrow denotes interdorsal ridge. Photo: H. Kabasakal)

31b Interdorsal ridge absent... 34

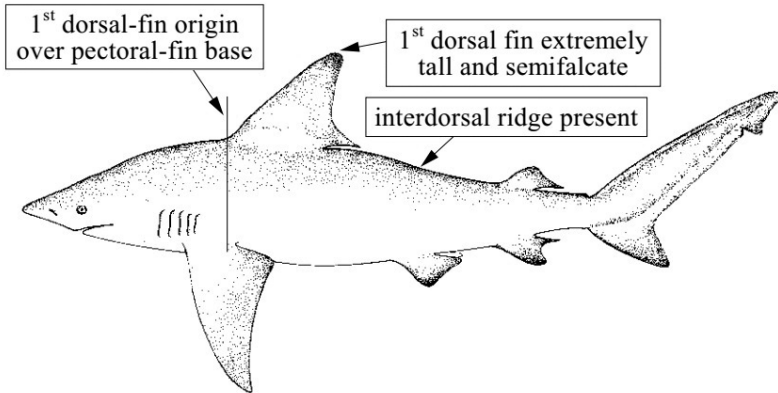
32a 1st dorsal origin opposite or somewhat in front of pectoral rear tips but closer to than pectoral insertions; 1st dorsal fin lower with a rounded anterior margin; pectoral fins more falcate... *Carcharhinus obscurus*



(adapted from Serena 2005)

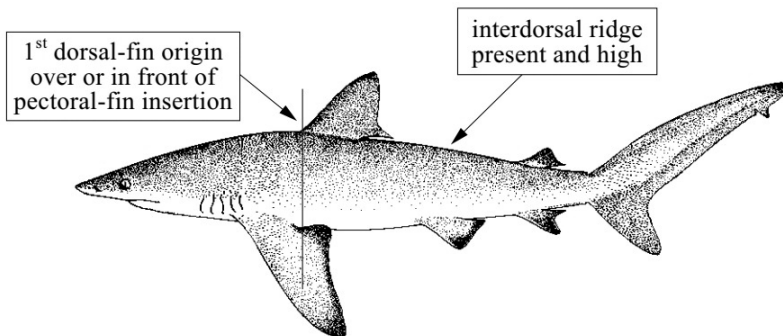
32b 1st dorsal origin in front or over pectoral insertions or at least nearer to it than pectoral free rear tips... 33

- 33a Distance from nostrils to mouth more than 2.4 times in mouth width; upper anterolateral teeth moderately high; 1st dorsal fin very high, with height about half predorsal space; interdorsal ridge low...
Carcharhinus plumbeus



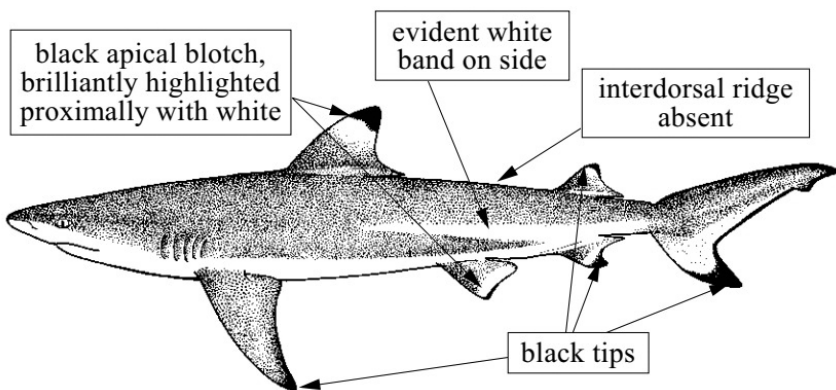
(adapted from Serena 2005)

- 33b Distance from nostrils to mouth less than 2.4 times in mouth width; upper anterolateral teeth very high; 1st dorsal fin lower, with height much less than half predorsal space; interdorsal ridge high...
Carcharhinus altimus



(adapted from Serena 2005)

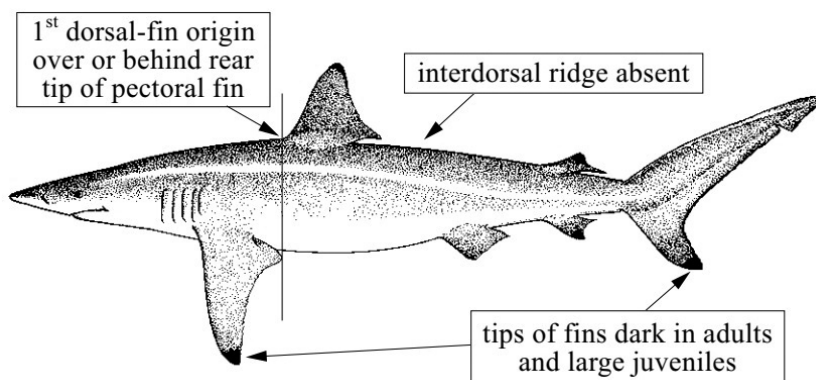
- 34a Entire posterior margin of caudal fin with a narrow but obvious black edge; pectoral, 2nd dorsal and caudal fins with obvious black tips; 1st dorsal fin with a broad black blotch at its apex, highlighted below with white... *Carcharhinus melanopterus*



(adapted from Serena 2005)

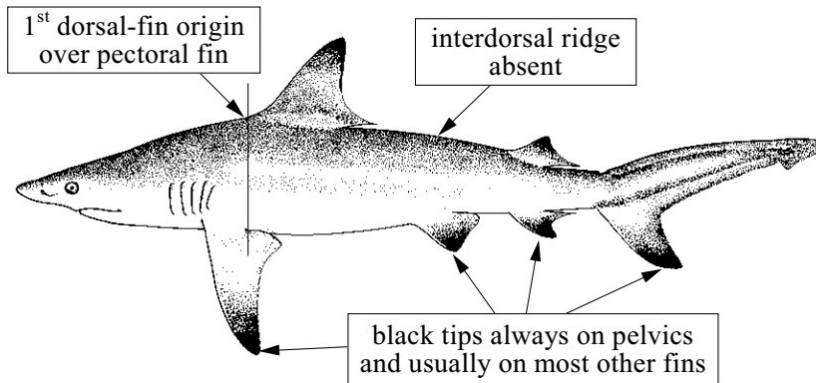
34b Posterior margin of caudal fin not black or partly dusky or black; fins black-tipped or not... 35

35a 1st dorsal fin origin over or behind rear tip of pectoral fin...
Carcharhinus brevipinna



(adapted from Serena 2005)

35b 1st dorsal fin origin over pectoral fin... *Carcharhinus limbatus*



(adapted from Serena 2005)

Species accounts

To supplement the identification key, further details on the size, coloration, feeding habits, reproductive behaviour, distribution and conservation status of each species are provided in this section. Feeding habits of each species are limited by major prey groups only. Since the reader may request more detailed information on a respective species, a list of key references for each species are also provided for further reading. Taxonomic order for the presentation of each species and its conservation status follow Serena (2005). Conservation status of each species is based on following criteria (Serena 2005):

A. Not exploited species: species that are not currently targeted by fisheries and are not normally found as bycatch of any fisheries.

B. Exploited species: species that are directly exploited by fisheries or caught as bycatch.

- **Category 1:** exploited species that cannot be placed in any of the subsequent categories because of lack of data.
- **Category 2:** species pursued in directed fisheries and/or regularly found in bycatch, whose catches have not decreased historically, probably due to their high reproductive potential.
- **Category 3:** species that are exploited by directed fisheries or bycatch and, due to a limited reproductive potential and/or their life history characteristics, are especially vulnerable to overfishing and/or are being fished in their nursery areas.
- **Category 4:** species that show substantial historical declines in catches and/or have become locally extinct

Order
HEXANCHIFORMES

Family
HEXANCHIDAE

Hexanchus griseus (Bonnaterre, 1788)
(Figure 11; Plate I.1)

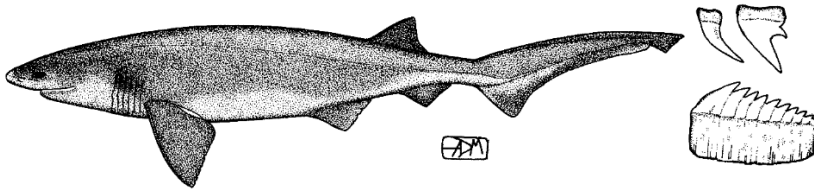


Figure 11. Side view, upper and lower teeth of *Hexanchus griseus*.
(Illustration: A. De Maddalena).

Common name:	Bluntnose six-gill shark
Key features:	A heavy-bodied, broad-headed sixgill shark. Comb-shaped, blade-like teeth on each side of lower jaw. One dorsal fin situated closer to anal fin origin. Caudal peduncle is short and stout. Pectoral fins broadly triangular.
Colour:	Grey or tan to blackish with a conspicuous lighter lateral line and sometimes with darker spots on the sides.
Size:	Maximum total length probably to about 550 cm.
Distribution:	Worldwide with somewhat patchily distributed in boreal, temperate and tropical seas. In Turkish waters, it was recorded off Black, Marmara, Aegean and Mediterranean coasts. Marmara, Aegean and Mediterranean occurrences of bluntnose six-gill shark are regular, while Black Sea occurrences are sporadic.
Habitat and biology:	It is a mostly deepwater demersal and pelagic shark of the continental and insular shelves and slopes. Depth range extends down to at least 2500 m on the upper continental slope. The bluntnose

	sixgill shark is a voracious feeder consuming a wide range of marine organisms, but principally cephalopods and marine vertebrates, with cartilaginous fishes, bony fishes, marine mammals and cephalopods being the major prey categories. Ovoviviparous, litters of about 20 to 50, possibly up to 100 embryos. Rarely caught as bycatch by bottom trawls and longlines.
Importance to fisheries:	
Conservation status:	FAO, B3; IUCN, Near Threatened; Mediterranean, vulnerable species.
Further readings:	Ebert and Stehmann (2013), Serena (2005), Kabasakal (2013a, 2019), Kabasakal <i>et al.</i> (2017).

Heptranchias perlo (Bonnaterre, 1788)
(Figure 12; Plate I.2)

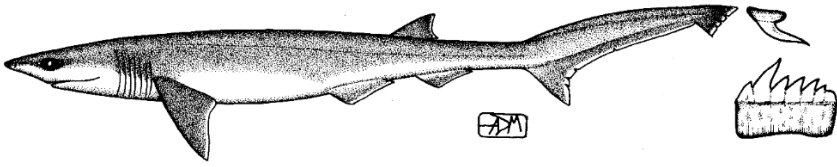


Figure 12. Side view, upper and lower teeth of *Heptranchias perlo*.
(Illustration: A. De Maddalena).

Common name:	Sharpnose seven-gill shark
Key features:	A narrow-headed, big-eyed, seven-gilled shark with one dorsal fin. Five rows of lower comb-shaped anterolateral teeth on each side. Caudal peduncle elongated.
Colour:	Uniform pale grey to olive above, lighter to white below; dorsal fin and upper caudal fin lobe with black tips, faded or absent in adults but distinct in young specimens.
Size:	Maximum total length reportedly to about 2 meter.
Distribution:	Probably worldwide in tropical and subtropical waters but nowhere common. Present in entire Mediterranean and Aegean Sea.
Habitat and biology:	Usually benthic at depths from 50 to 400 m, occasionally to 1000 m. Yolk-sac viviparous, with 6 to 20 young per litter. In the Mediterranean Sea it seems to be reproductive throughout the year. It's diet includes crustaceans, cephalopods and a wide variety of small to moderately large demersal and pelagic bony fishes, and even small sharks and rays.
Importance to fisheries:	Seldom caught as bycatch by bottom trawls and longlines.
Conservation status:	FAO, B1; IUCN, Near Threatened; Mediterranean, threatened.
Further readings:	Ebert and Stehmann (2013), Başusta (2015), Kabasakal and İnce (2008), Serena (2005).

Order

SQUALIFORMES

Family

ECHINORHINIDAE

Echinorhinus brucus (Bonnaterre, 1788)
(Figure 13; Plate I.3)

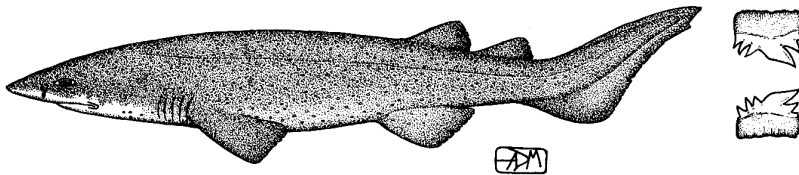


Figure 13. Side view, upper and lower teeth of *Echinorhinus brucus*.
(Illustration: A. De Maddalena).

Common name:	Bramble shark
Key features:	A large, short-nosed and flat headed, cylindrical shark. No anal fin, two spineless dorsal fins, the origin of the 1 st dorsal fin set behind the pelvic-fin origins. Denticles enlarged, tack-like, distinct and scattered over body and fins.
Colour:	Light to medium grey, grey-brown, brownish or blackish on the dorsal surface, often lighter below; fin edges blackish.
Size:	Maximum reported total length to 310 cm.
Distribution:	Wide ranging with a patchy distribution in entire Atlantic, western Indian and western Pacific oceans, and in the Mediterranean Sea. In Turkish waters, contemporary occurrence of the bramble shark covers Aegean and Marmara seas.
Habitat and biology:	A bottom-dwelling shark on upper slope waters from 200 to 1214 m. It is a yolk-sac viviparous shark, with the number of young per litter ranging from 15 to 26. Benthic and littoral bony fishes, small

Importance to fisheries:	sharks and crustaceans found in its stomach contents.
Conservation status:	Bycatch in bottom-trawl and set-net fisheries.
Further readings:	FAO, B4; IUCN, Data Deficient, Mediterranean, occasional, rare shark. Ebert and Stehmann (2013), Serena (2005), Kabasakal <i>et al.</i> (2005), Kabasakal and Dalyan (2011), Kabasakal and Bilecenoğlu (2014), Kabasakal (2017a).

Family
SQUALIDAE

Squalus acanthias Linnaeus, 1758
(Figure 14; Plate II.1)

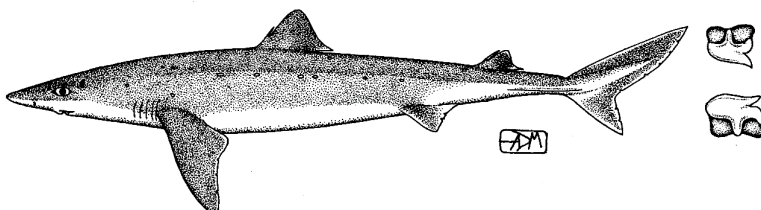


Figure 14. Side view, upper and lower teeth of *Squalus acanthias*.
(Illustration: A. De Maddalena).

Common name:

Spotted spiny dogfish

Key features:

A moderate-sized to very large dogfish, with a moderately long, narrow, angular or subangular snout. Somewhat slender body, with two unequal-sized dorsal fins with ungrooved, strong spines. 1st dorsal fin fairly long and low, with fin origin usually behind pectoral-fin rear tips and fin spine origin always behind them. 1st dorsal-fin spine slender and very short. No anal fin. Upper precaudal pit and lateral keels on caudal peduncle.

Colour:

Grey or bluish grey above and lighter to white below. Sides of body usually with a conspicuous line of white spots. Dorsal fins with dusky fin edges in adults, but black in young.

Size:

Maximum total length probably to 130 cm.

Distribution:

Widespread and common on both sides of the North Atlantic. Throughout the Mediterranean and Black Sea.

Habitat and biology:

Benthic on soft bottoms from the surface down to the bottom, possibly to 1446 m on the deep slopes, but mostly on the shelf and upper slope above 600 m. Yolk-sac viviparous, with litters of 1 to 32 young. Gestation period is generally reported

Importance to fisheries:	as 18 to 24 months. A powerful, voracious predator feeds primarily on bony fishes, as well as cephalopods and crustaceans. Caught by trawls, longlines and gillnets. Before the depletion of the stocks, it was one of the primary targets of Turkish bottom-fishery in the Black Sea.
Conservation status:	FAO, B4; IUCN, Near Threatened; vulnerable in the Mediterranean; Turkey, included in the current inventory of marine protected species, listed in Turkish Fisheries Act.
Further readings:	Ebert and Stehmann (2013), Serena (2005), Düzgüneş <i>et al.</i> (2006), Demirhan <i>et al.</i> (2006, 2007), Demirhan and Seyhan (2007), Yığın and İşmen (2013), Kabasakal (2019).

Squalus blainvillei (Risso, 1826)
(Figure 15; Plate II.2)

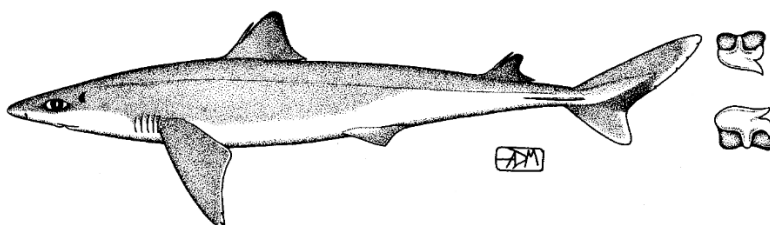


Figure 15. Side view, upper and lower teeth of *Squalus blainvillei*.
(Illustration: A. De Maddalena).

Common name:	Longnose spurdog
Key features:	A large dogfish species with a wide head, and stocky to moderately slender body. Pectoral fins are broad, semifalcate with a slightly concave posterior margins. Two unequal-sized dorsal fins with ungrooved high spines. 1 st dorsal fin more anteriorly situated, with fin origin about over pectoral insertions or just behind them. 1 st dorsal fin spine high; length of anterior margin of exposed spine nearly or as long as fin base and spine tip falling a short distance below apex of fin. No anal fin.
Colour:	Greyish brown above and lighter below; no white spots on sides of body. Pectoral fins dusky above with light posterior margins. Dorsal fins with white edges.
Size:	Maximum total length up to 100 cm.
Distribution:	Eastern Atlantic to Mediterranean and Black Sea.
Habitat and biology:	Benthic on continental shelves and upper slopes, at the depths of 16 to 720 m. A yolk-sac viviparous shark, with litters of 1 to 9 young. Its diet includes bony fishes, crustaceans and cephalopods.
Importance to fisheries:	Bycatch in bottom trawls and longlines.
Conservation status:	FAO, B1; Mediterranean, vulnerable; Turkey, included in the current inventory of marine protected species, listed in Turkish Fisheries Act.

Further readings:

Ebert and Stehmann (2013), Serena (2005), Başusta *et al.* (2016), Özütemiz *et al.* (2009), Kabasakal (2002b, 2019).

Family
CENTROPHORIDAE

Centrophorus granulosus (Bloch & Schneider, 1801)

(Figure 16; Plate II.3)

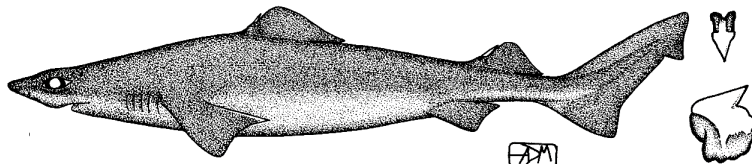


Figure 16. Side view, upper and lower teeth of *Centrophorus granulosus*.
(Illustration: A. De Maddalena).

Common name:	Gulper shark
Key features:	Snout moderately long and thick. Bladelike monocuspidate teeth in upper and lower jaws, with lowers much larger than uppers; teeth on upper jaw with perpendicular cusps. Rear tips of pectoral fins narrowly angular and greatly elongated; free rear tip of pectoral fin in line with apex of 1 st dorsal fin. Two dorsal fins with large grooved spines, 1 st dorsal fin higher than 2 nd dorsal fin; 1 st dorsal fin short and high, 2 nd dorsal fin with spine base over pelvic-fin inner margins. No anal fin.
Colour:	Body dark grey or grey-brown above, slightly lighter below; fins with dark grey or blackish webs but without prominent black tips and margins.
Size:	Maximum total length to 120 cm.
Distribution:	Possibly widespread in the Atlantic, Indian and western Pacific oceans. Mediterranean, including Sea of Marmara. Absent in the Black Sea.
Habitat and biology:	Benthic on outer continental shelves and upper slopes, at the depths of 150 to 1400 m. Yolk-sak viviparous shark, with 1 to 6 youngs per litter. Its diet includes bony fishes, cephalopods and crustaceans.
Importance to fisheries:	Bycatch in bottom fishing gears.
Conservation status:	FAO, B1; IUCN, Vulnerable (A1abd+2d); Mediterranean, vulnerable.

Further readings:

Ebert and Stehmann (2013), Serena (2005), Benli (1993), Meriç (1995), Kabasakal (2019).

Centrophorus uyato (Rafinesque, 1810)
(Figure 17)

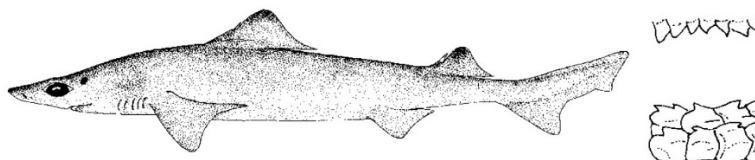


Figure 17. Side view, upper and lower teeth of *Centrophorus uyato*.
(Illustration: Serena 2005).

Common name:	Little gulper shark
Key features:	Teeth on upper jaw with somewhat oblique cusps; free rear tip of pectoral fin not in line with apex of 1 st dorsal fin; 1 st dorsal fin is shorter and more triangular than the 1 st dorsal fin of <i>C. granulosus</i> , which is longer and lower. No anal fin. The lateral trunk denticles of <i>C. uyato</i> are also different than those of <i>C. granulosus</i> in having flat, block-like denticles with only a short cusp which gives the skin a smooth feel rather than the granular texture associated with <i>C. granulosus</i> .
Colour:	Body dark grey or grey–brown above, slightly lighter below.
Size:	Maximum total length to 100 cm
Distribution:	Patchy distribution in Eastern Atlantic and Indian Ocean. Rare in the western Mediterranean. Historically recorded in the Sea of Marmara in 1990's, now it is considered as questionable.
Habitat and biology:	Benthic on outer shelf and upper slope at depths from 50 to 1400 m. Ovoviviparous with only one young per litter. Its diet includes small bony fishes and cephalopods, squids in particular.
Importance to fisheries:	Occasionally caught as bycatch by bottom fishing gears.
Conservation status:	FAO, B1; IUCN, Data Deficient; Mediterranean, rare species.
Further readings:	Serena (2005), Meriç (1995), White <i>et al.</i> (2013), Kabasakal and Karhan (2015), Kabasakal (2019).

Remarks:

According to White *et al.* (2013), the genus *Centrophorus* is one of the most taxonomically complex and confusing elasmobranch groups. Although the nomenclature of *C. granulosus* and *C. uyato* has been previously confused, they are morphologically distinct from one another (White *et al.* 2013). White *et al.* (2013) also suggested that *C. uyato* is not a valid species due to its questionable taxonomic status. For this reason, further research is required to clarify the taxonomic status of Marmaric specimens of *C. uyato*; and therefore, in a recent review of sharks of Sea of Marmara, Kabasakal and Karhan (2015) included it in the list of species as *Centrophorus* sp.

Family
ETMOPTERIDAE

Etmopterus spinax (Linnaeus, 1758)
(Figure 18; Plate III.1)

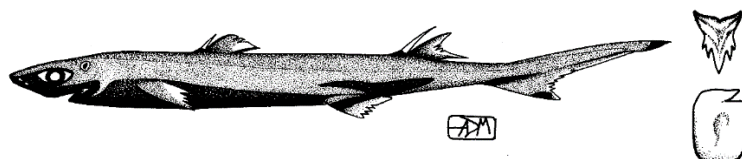


Figure 18. Side view, upper and lower teeth of *Etmopterus spinax*.
(Illustration: A. De Maddalena).

Common name:	Velvet belly
Key features:	Head relatively long, broad and flattened. Eyes narrow and elongated. Denticles not in lines and with long slender cusps. Two spined dorsal fins; 2 nd dorsal fin is larger than 1 st dorsal fin; 1 st dorsal fin origin about or just behind pectoral fin free rear tips; 1 st dorsal fin spine stout, short and usually lower than 1 st dorsal fin apex. No anal fin.
Colour:	Brown on dorsal surface, underside of snout and abdomen abruptly black, dorsal surface light, ventral surface conspicuously dark; photomarks present on flanks.
Size:	Maximum total length to about 45 cm.
Distribution:	Eastern Atlantic to Mediterranean and Aegean Sea; absent in the Sea of Marmara and the Black Sea.
Habitat and biology:	Benthic on shelves and upper slopes, at depths between 70 to 2000 m, mostly between 200 to 500 m. Yolk-sac viviparous, with litter sizes from 1 to 21. Feeds on fishes, cephalopods and other invertebrates.
Importance to fisheries:	Bycatch in bottom trawl and longline fisheries.
Conservation status:	FAO, B1; Mediterranean, stable biomass.
Further readings:	Ebert and Stehmann (2013), Serena (2005), Kabasakal and Ünsal (1999), Bilge <i>et al.</i> (2010), Başusta (2015).

Family
OXYNOTIDAE

Oxynotus centrina (Linnaeus, 1758)

(Figure 19; Plate III.2)

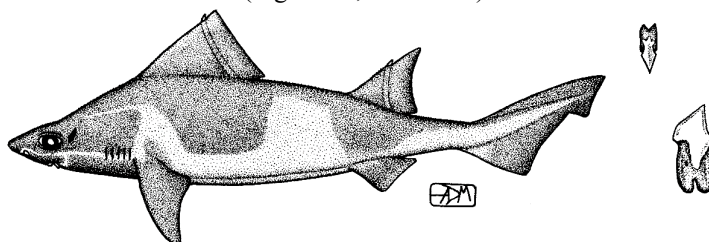


Figure 19. Side view, upper and lower teeth of *Oxynotus centrina*.

(Illustration: A. De Maddalena).

Common name:

Angular rough shark

Key features:

High, thick, triangular body with dermal ridges between pelvic and pectoral fins bases. Short, blunt snout, high, sail-like dorsal fins with spines; apices of dorsal fins broadly triangular, posterior margins shallowly concave. 1st dorsal fin spine inclined forwards. 1st dorsal fin anterior margin from spine to apex 0.8 to 1.0 in 1st dorsal fin spine height, 2nd dorsal fin anterior margin from spine to apex 0.6 to 0.8 in 2nd dorsal fin spine height. 2nd dorsal fin base 1.5 to 1.8 in interdorsal space, 2nd dorsal fin origin well anterior to pelvic fin origins. Pectoral fins leaf-shaped, not strongly falcate. No anal fin.

Colour:

Grey or grey-brown above and below, with darker blotches on head and sides; a light horizontal line separates dark areas on head and another crosses cheeks below eyes.

Size:

Maximum total length to about 150 cm, usually to 70 cm.

Distribution:

Eastern Atlantic, western Indian Ocean. Entire Mediterranean, including Sea of Marmara. Absent in the Black Sea. A rare to uncommon shark throughout its range.

Habitat and biology:

A bottom shark of the continental shelves and upper slope at depths of 50 to 770 m.

	Yolk-sac viviparous with a litter size of 7 to 23. Feeds primarily on polychaetes; crustaceans and bony fishes making up smaller portion of its diet; it also feeds on the egg cases <i>Scyliorhinus canicula</i> .
Importance to fisheries:	Bycatch in deepsea fishing gear, mainly in trawling.
Conservation status:	FAO, B1; IUCN, to be urgently investigated; Mediterranean, threatened species; Turkey, included in the current inventory of marine protected species, listed in Turkish Fisheries Act.
Further readings:	Ebert and Stehmann (2013), Serena (2005), Kabasakal (2009b, 2015a), Başusta <i>et al.</i> (2015), Yığın <i>et al.</i> (2016).

Family
DALATIIDAE

Dalatias licha (Bonnaterre, 1788)
(Figure 20; Plate III.3)

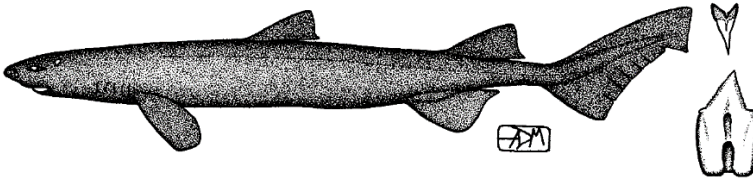


Figure 20. Side view, upper and lower teeth of *Dalatias licha*.
(Illustration: A. De Maddalena).

Common name:

Kitefin shark

Key features:

A moderate-sized, short- and blunt-snouted shark. Both dorsal fins without spines; 1st dorsal fin origin somewhat behind free rear tips of pectoral fins, 1st dorsal fin insertion well anterior to pelvic fin origins, closer to pectoral fin bases than pelvic fins; 2nd dorsal fin origin about over middle of pelvic fin bases; 2nd dorsal fin only slightly larger than 1st, its base less than 1.5 times 1st dorsal fin base; pectoral fins with short, broadly rounded free rear tips, not broadly lobate or acute and elongated; no anal fin.

Colour:

Greyish to black or blackish brown, sometimes violet with black spots.

Size:

Maximum total length to 180 cm.

Distribution:

Atlantic, Indian, central and western Pacific oceans. Mediterranean, including Sea of Marmara, where the contemporary occurrence of the species requires confirmation.

Habitat and biology:

Benthic to mesopelagic from 90 to 1 000 m. Mainly on slopes at depths of 300 to 600 m. Yolk-sac viviparous, with litters of 3 to 16 young; a possible breeding area of the kitefin shark over the bathyal grounds of the north-eastern Aegean Sea. A powerful and versatile deep-sea predator feeds primarily on deepwater

Importance to fisheries:

Conservation status:

Further readings:

bony fishes, as well as small elasmobranchs, cephalopods and crustaceans.

Bycatch in bottom trawl fishery.

FAO, B3; IUCN, Data Deficient;

Mediterranean, vulnerable species.

Ebert and Stehmann (2013), Serena

(2005), Kabasakal and Kabasakal (2002),

Ergüden *et al.* (2017).

Order
SQUATINIFORMES

Family
SQUATINIDAE

Squatina aculeata Dumeril, in Cuvier, 1817
(Figure 21; Plate IV.1)

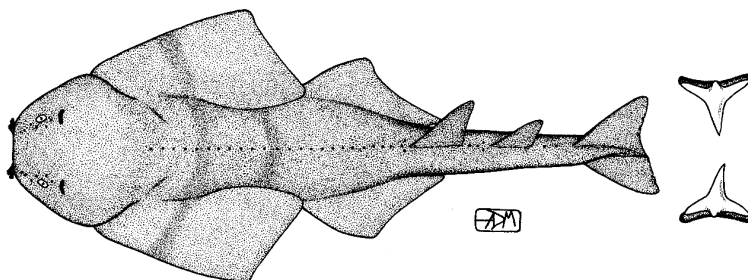


Figure 21. Side view, upper and lower teeth of *Squatina aculeata*.
(Illustration: A. De Maddalena).

Common name:

Sawback angelshark

Key features:

Trunk relatively slender. Anterior nasal barbels strongly fringed; posterior margin of anterior nasal flaps between nasal barbels and tips strongly fringed. Origin of 1st dorsal fin before pelvic fin rear extremity. Large spines present on midline of back and tail from head to dorsal fins and between the fin bases, also on snout and above eyes.

Colour:

Dull grey to a light brown on back that has scarcely scattered with small irregular white and regular small dark brownish spots. No ocelli on body.

Size:

Maximum total length to 180 cm, usually to 150 cm.

Distribution:

Eastern Atlantic to Mediterranean; recently recorded in southern Aegean Sea.

Habitat and biology:

Benthic on muddy bottoms at depths from 50 to 500 m. Ovoviviparous. Feeds on small demersal bonyfishes and small elasmobranchs.

Importance to fisheries:

Bycatch in bottom-trawl and set-net fisheries.

Conservation status:

FAO, B1; IUCN, to be urgently investigated; Mediterranean, threatened species; Turkey, included in the current inventory of marine protected species, listed in Turkish Fisheries Act.

Further readings:

Serena (2005), Başusta (2002, 2015), Filiz *et al.* (2005).

Squatina oculata Bonaparte, 1840

(Figure 22; Plate IV.2)

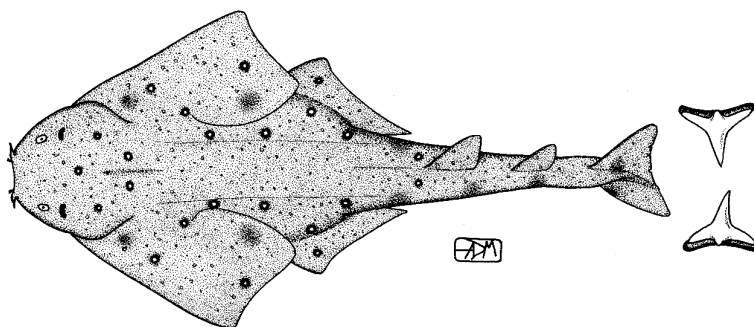


Figure 22. Side view, upper and lower teeth of *Squatina oculata*.
(Illustration: A. De Maddalena).

Common name:	Smoothback angelshark
Key features:	Trunk rather slender. Anterior nasal barbels weakly bifurcated; posterior margin of anterior nasal flaps between nasal barbels and tips weakly fringed. Origin of 1 st dorsal fin usually well behind free rear tips of pectoral fins. Large spines present on snout and above eyes but usually absent from midback.
Colour:	Dorsal surface grey-brown with small, round black and white spots and a distinctive white neck spot.
Size:	Maximum total length to 150 cm.
Distribution:	Eastern Atlantic to Mediterranean. Sporadic records from Sea of Marmara.
Habitat and biology:	Benthic on muddy and sandy bottoms from 20 to 560 m, more common between 50 and 100 m. Ovoviviparous. Feeds on small demersal fish.
Importance to fisheries:	Bycatch in bottom-trawl and set-net fisheries.
Conservation status:	FAO, B1; IUCN, Endangered (A1abd+A2d); Mediterranean, threatened species; Turkey, included in the current inventory of marine protected species, listed in Turkish Fisheries Act.
Further readings:	Serena (2005), Kabasakal and Karhan (2015), Yığın <i>et al.</i> (2019).

Squatina squatina (Linnaeus, 1758)

(Figure 23; Plate IV.3)

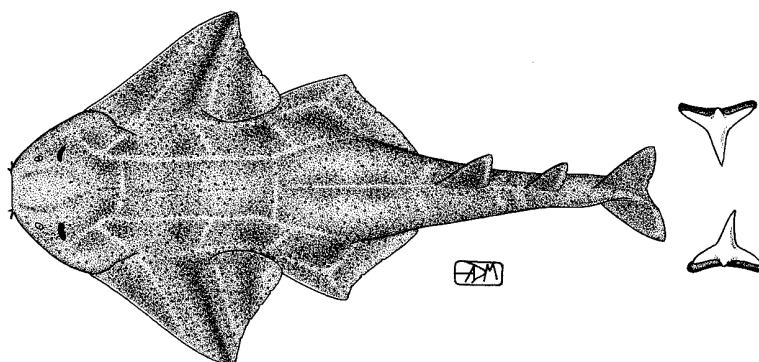


Figure 23. Side view, upper and lower teeth of *Squatina squatina*.
(Illustration: A. De Maddalena).

Common name:

Angelshark

Key features:

Trunk very broad. Anterior nasal barbels simple and with a spatulate tip; posterior margin of anterior nasal flaps between nasal barbels and tips weakly fringed. Origin of 1st dorsal fin in line with pelvic fin rear extremity. Small spines present or absent on midline of back and tail from head to dorsal fins and between the fin bases, and patches of small spines on snout and above eyes.

Colour:

Grey to reddish or greenish brown above, with many small black and white spots, and white below; no ocelli on body.

Size:

Maximum total length to 250 cm.

Distribution:

Eastern North Atlantic to Mediterranean. Rarely occurs in the Sea of Marmara and its Black Sea occurrence requires confirmation.

Habitat and biology:

A bottom dwelling shark on sandy or muddy bottoms at depths between 5 and 100 m. Ovoviviparous, with litters of 9 to 20 young. Feeds primarily on bony fishes, especially flatfishes but also other demersal fishes and skates, crustaceans and molluscs.

Importance to fisheries:	Target species of bottom fisheries in several parts of Mediterranean. A drastic depletion in stocks of angelshark observed since early 2000's in Turkish waters, resulted decrease of annual landings from 34 tons in 2008, to nearly 1 ton in 2017.
Conservation status:	FAO, B1; IUCN, Vulnerable (A1abcd+A2d); Appendix 3 of the Bern Convention; Mediterranean, vulnerable species; Turkey, included in the current inventory of marine protected species, listed in Turkish Fisheries Act.
Further readings:	Ebert and Stehmann (2013), Serena (2005), Kabasakal and Kabasakal (2004, 2014), Kabasakal (2019), Kabasakal <i>et al.</i> (2017), Yağlıoğlu <i>et al.</i> (2015), Yiğın <i>et al.</i> (2019).

Order
LAMNIFORMES

Family
ODONTASPIDIDAE

Carcharias taurus Rafinesque, 1810
(Figure 24; Plate V.1)

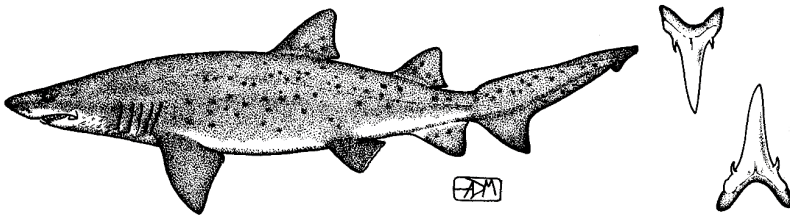


Figure 24. Side view, upper and lower teeth of *Carcharias taurus*.
(Illustration: A. De Maddalena).

Common name:

Sandtiger shark

Key features:

A large, bulky shark with a flattened-conical snout, eyes without nictitating eyelids, mouth long and extending behind eyes, teeth large with prominent narrow cusps and lateral cusplets, upper anterior teeth separated from lateral teeth by small intermediate teeth, anal fin and both dorsal fins equally large and broad-based, 1st dorsal fin on back closer to pelvic fins than to pectoral fins, upper precaudal pit present but lateral keels absent from caudal peduncle, caudal fin asymmetrical but with a strong ventral lobe.

Colour:

Light brown, often with darker reddish or brownish spots scattered on body, eyes with light green irises.

Size:

Maximum total length to 320 cm.

Distribution:

Wide-ranging in warm-temperate and tropical coastal waters of the Atlantic Ocean, Mediterranean Sea, and Indo-West Pacific Ocean. Occurrence in Turkish waters based on sporadic records.

Habitat and biology:	Coastal species from surface to a depth of 200 m, mostly less than 70 m. Ovoviviparous usually with litters of 2 young; intrauterine cannibalism reported. Feeds primarily on a wide variety of bony fishes, while elasmobranchs are considered as secondary preys; crustaceans and cephalopods are also preyed on.
Importance to fisheries:	An occasional bycatch in commercial and recreational fisheries.
Conservation status:	FAO, B4; IUCN, Vulnerable (A1ab+A2d); Mediterranean, occasional/rare species.
Further readings:	Compagno (2002), Serena (2005), Cengiz <i>et al.</i> (2011), Bargnesi <i>et al.</i> (2020).

Odontaspis ferox (Risso, 1810)
(Figure 25; Plate V.2)

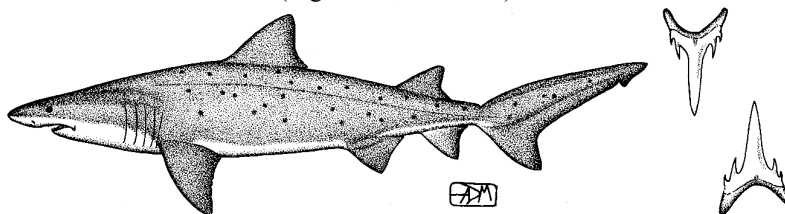


Figure 25. Side view, upper and lower teeth of *Odontaspis ferox*.
(Illustration: A. De Maddalena).

Common name:

Sandtiger shark

Key features:

A large, bulky shark with a long bulbously conical snout, eyes moderately large without nictitating eyelids, mouth long and extending behind eyes, teeth moderately large with prominent narrow cusps and two or more pairs of lateral cusplets, upper anterior teeth separated from lateral teeth by 2 to 5 rows of small intermediate teeth, anal fin and 2nd dorsal fin smaller than 1st dorsal fin but broad-based, 1st dorsal fin on back and closer to pectoral fins than pelvic fins, upper precaudal pit present but lateral keels absent from caudal peduncle, caudal fin asymmetrical but with a strong ventral lobe.

Colour:

Medium grey or grey-brown above, usually lighter below, sometimes with darker spots scattered on body.

Size:

Maximum total length to 410 cm.

Distribution:

Possibly circumglobal in warm-temperate and tropical waters but spottily distributed; western to eastern North Atlantic, and Mediterranean; central to eastern Pacific.

Habitat and biology:

A little-known deep-dwelling shark at depths from 15 to 420 m. Probably ovoviviparous with litter size unknown. Feeds on small bony fishes, squid and shrimp.

Importance to fisheries:

An occasional bycatch of bottom-trawl and set-net fisheries.

Conservation status:

FAO, A; IUCN, Data Deficient;
Mediterranean, occasional/rare species.

Further readings:

Compagno (2002), Serena (2005),
Fergusson *et al.* (2008), Kabasakal and
Bayrı (2019).

Family
ALOPHIIDAE

Alopias superciliosus (Lowe, 1839)
(Figure 26; Plate VI.1)

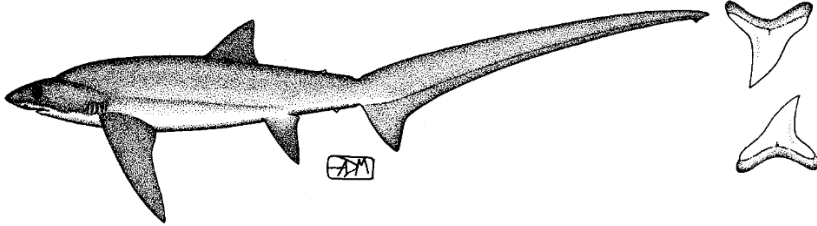


Figure 26. Side view, upper and lower teeth of *Alopias superciliosus*.
(Illustration: A. De Maddalena).

Common name:	Bigeye thresher
Key features:	Head nearly flat between eyes, with a deep horizontal groove on nape on each side above gills; eyes very large, with orbits expanded onto dorsal surface of head. 1 st dorsal midbase closer to pelvic-fin bases than to pectoral-fin bases.
Colour:	Body purplish grey or grey-brown on upper surface and sides with underside grey to white, light colour of abdomen not extending over pectoral-fin bases; no white dot on upper pectoral-fin tips.
Size:	Maximum total length to 460 cm.
Distribution:	Temperate and tropical areas of all oceans. Mediterranean, including Sea of Marmara.
Habitat and biology:	Epipelagic, oceanic and coastal in warm-temperate and tropical waters, in depth to 1 000 m. Ovoviviparous, with uterine cannibalism as in other species of <i>Alopias</i> , and litter size of 2 to 4 youngs. Primarily feeds on small fishes and squid.
Importance to fisheries:	Occasional bycatch of pelagic fisheries.
Conservation status:	FAO, B3; IUCN, Data Deficient; Mediterranean, occasional/rare species.
Further readings:	Compagno (2002), Serena (2005), Ayas <i>et al.</i> (2020a), Kabasakal (2017b), Kabasakal and Karhan (2008), Kabasakal <i>et al.</i> (2011, 2017).

Alopias vulpinus (Bonnaterre, 1788)

(Figure 27; Plate VI.2)

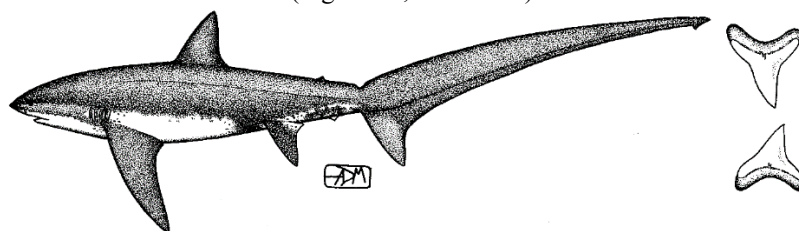


Figure 27. Side view, upper and lower teeth of *Alopias vulpinus*.

(Illustration: A. De Maddalena).

Common name:

Thresher shark

Key features:

Head broad in dorsal and ventral view, with a strongly convex dorsolateral profile. Snout relatively short, conical and pointed. Eyes moderately large at all sizes, not expanded onto dorsal surface of head. 1st dorsal-fin midbase closer to pectoral-fin bases than to pelvic fin bases.

Colour:

Body blue-grey to dark grey or blackish above with sides silvery or coppery and underside white, white colour of abdomen extending dorsally and anteriorly over pectoral-fin bases as a conspicuous patch; white dot often present on upper pectoral-fin tips.

Size:

Maximum total length possibly to 610 cm.

Distribution:

Temperate zones of all oceans.

Throughout the Mediterranean to the Sea of Marmara and Black Sea.

Habitat and biology:

Migratory species inhabiting epipelagic, oceanic and coastal in cold-temperate to tropical waters from the surface to 360 m. Apparently an intrauterine cannibal ovoviviparous shark with litters of 2 to 7 embryos. Feeds mostly on small schooling fishes but also bottom fishes.

Importance to fisheries:

Bycatch of pelagic fisheries.

Conservation status:

FAO, B4; IUCN, Data Deficient;

Mediterranean, vulnerable species;

Turkey, included in the current inventory of marine protected species, listed in Turkish Fisheries Act.

Further readings:

Compagno (2002), Serena (2005), Kabasakal (1998b, 2007), Kabasakal and Kabasakal (2004), Kabasakal *et al.* (2017), Ergüden *et al.* (2015).

Family
CETORHINIDAE

Cetorhinus maximus (Gunnerus, 1765)

(Figure 28; Plate VI.3)

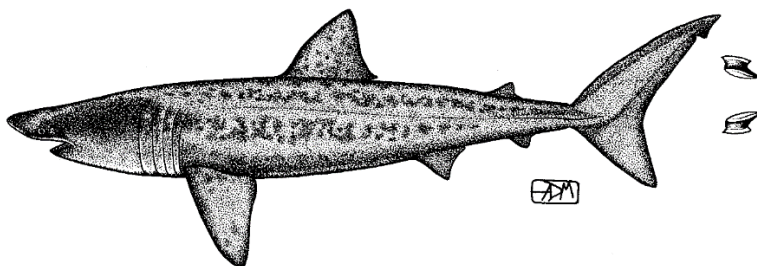


Figure 28. Side view, upper and lower teeth of *Cetorhinus maximus*.
(Illustration: A. De Maddalena).

Common name:

Basking shark

Key features:

Head moderately long but much shorter than trunk. Snout moderately long, pointed and conical, not depressed, flattened or blade-like. Eyes small. Gill openings extremely large, extending onto dorsal and ventral surfaces of head; all gill openings anterior to pectoral-fin bases; gill rakers present on internal gill slits. Teeth very small, hook-like, not blade-shaped. 1st dorsal fin large, high, erect and angular; 2nd dorsal and anal fins moderately large but less than half size of 1st dorsal. Caudal fin lunate, dorsal lobe moderately long but less than one-third length of rest of shark.

Colour:

Blackish to grey-brown, grey or blue-grey above and below on body and fins, undersurface sometimes lighter, often with irregular white blotches on the underside of the head and abdomen; flanks sometimes with lighter linear striping and spots.

Size:

Maximum total length to 1500 cm, but usually to 1000 cm.

Distribution:	Circumglobal with a wide but possibly disjunct distribution in all oceans. Entire Mediterranean, rare in Levanten Sea.
Habitat and biology:	Migratory species in epipelagic, oceanic waters, towards the coast mainly in spring and summer. Viviparous. A filter-feeding shark feeds on minute zooplankton.
Importance to fisheries:	Occasional bycatch of pelagic and coastal set-net fisheries.
Conservation status:	FAO, B3; IUCN, Vulnerable (A1ad+A2d); Mediterranean, Vulnerable species. Appendix 2 of Berne Convention; Appendix 2 of Barcelona Convention. Also listed in CITES Appendix II; Turkey, included in the current inventory of marine protected species, listed in Turkish Fisheries Act.
Further readings:	Compagno (2002), Serena (2005), Kabasakal (2009a, 2013b), Kabasakal <i>et al.</i> (2017).

Family
LAMNIDAE

Carcharodon carcharias (Linnaeus, 1758)

(Figure 29; Plate VII.1)

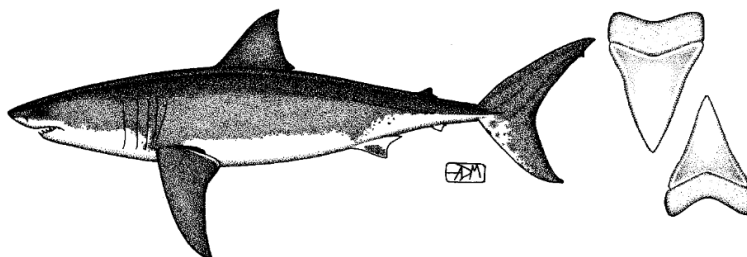


Figure 29. Side view, upper and lower teeth of *Carcharodon carcharias*.
(Illustration: A. De Maddalena).

Common name:

Great white shark

Key features:

A fusiform, stout spindle-shaped body, with a conical snout. Teeth large, triangular, and serrated. 1st dorsal fin large, erect and triangular; it's origin usually over the pectoral fin inner margins. 2nd second dorsal and anal fins minute. A large crescent-shaped caudal fin, with a strong keel on caudal peduncle; no secondary caudal keel.

Colour:

Dorsal surface grey, grey-brown to bluish-grey, ventral surface white; colour transition from dorsal and ventral surface sharply demarcated; tips of pectoral fins with black blotches ventrally.

Size:

Maximum total length to 650 cm.

Distribution:

Wide ranging in temperate oceans, rarely found in tropical waters. Mediterranean, historically occurred in the Sea of Marmara until mid 1980's; absent from Black Sea.

Habitat and biology:

Epipelagic, coastal and offshore, frequently occur in insular waters from surfaces to 1 300 m. Viviparous, with litters of 9 or 10 young; in Turkish waters, total length of new-borns, with

	umbilical scars varied from 80 to 145 cm. Great white sharks feed on a broad spectrum of prey items including bony fishes, other chondrichthyans, pinnipeds and small cetaceans, and large whales as carrion. It is a fearsome predator and is considered one of the most dangerous shark species.
Importance to fisheries:	A seldom bycatch in pelagic fisheries and tuna-traps. Historically captured by tuna hand-liners in the Bosphorus Strait during mostly the first half of 20th century.
Conservation status:	FAO, B3; IUCN, Vulnerable (A1cd+A2cd); Mediterranean, Vulnerable species. Appendix 2 of Berne Convention; Appendix 2 of Barcelona Convention. Proposed for CITES listing on Appendix I and II.
Remarks:	The provenance of <i>C. carcharias</i> in the Mediterranean is both a conundrum and an important conservation issue. Based on mitochondrial DNA analysis of four specimens, two of which incidentally captured in Turkish waters, Gubili <i>et al.</i> (2010), hypothesised that, DNA sequences of Mediterranean great whites, unexpectedly, showing little genetic differentiation from Indo-Pacific lineages, but strong separation from geographically closer Atlantic/western Indian Ocean haplotypes.
Further readings:	Compagno (2002), Serena (2005), Gubili <i>et al.</i> (2010), Kabasakal (2008, 2014, 2016), Kabasakal and Gedikoğlu (2008), Kabasakal and Kabasakal (2015), Kabasakal <i>et al.</i> (2009, 2017, 2018).

Isurus oxyrinchus Rafinesque, 1810
(Figure 30; Plate VII.2)

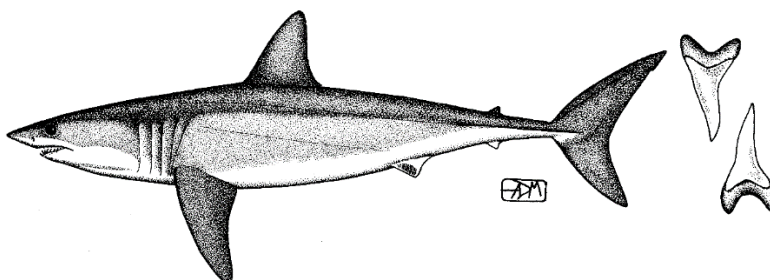


Figure 30. Side view, upper and lower teeth of *Isurus oxyrinchus*.
(Illustration: A. De Maddalena).

Common name:	Shortfin mako
Key features:	A spindle-shaped body, with long, acutely conical snout. Large blade-like teeth without cusplets or serrations; cusps of upper and lower anterior teeth flexed, tips reversed. Pectoral fins rather narrow-tipped and with anterior margins less than head length; 1 st dorsal fin large, 2 nd dorsal and anal fins minute and pivoting; strong keels on caudal peduncle, no secondary keels on caudal base.
Colour:	Dorsal surface a brilliant bright blue, becoming lighter blue laterally and white on ventral surface; ventral surface of snout usually white.
Size:	Maximum total length to 445 cm; size of a historical south Aegean Record reportedly to be 585 cm TL.
Distribution:	Cosmopolitan in temperate and tropical waters of Atlantic, Pacific and Indian Ocean. Entire Mediterranean to northern Aegean Sea (Saros Bay), absent in the Black Sea.
Habitat and biology:	Pelagic, coastal and oceanic, occurring at or near the surface or deeper, down to 400 m. Ovoviviparous, with litter size of 1 to 6 (rarely 10) young; reported total length of the smallest new-born in Turkish waters is 65 cm. The shortfin mako primarily feeds

Importance to fisheries:	on other fishes, cephalopods and smaller elasmobranchs to a lesser extent. Occasional bycatch of pelagic fisheries; neonates and young specimens seldomly captured by coastal set-net fisheries.
Conservation status:	FAO, B4; IUCN, Near Threatened; Mediterranean, Vulnerable species. Appendix 3 of Berne Convention; Appendix 3 of Barcelona Convention. Proposed for CITES listing on Appendix I and II; Turkey, included in the current inventory of marine protected species, listed in Turkish Fisheries Act.
Further readings:	Compagno (2002), Serena (2005), Ergüden <i>et al.</i> (2013), Kabasakal (2015b, 2017b), Kabasakal and De Maddalena (2011), Kabasakal and Kabasakal (2013), Kabasakal <i>et al.</i> (2017), Tunçer and Kabasakal (2016).

Lamna nasus (Bonnaterre, 1788)
(Figure 31; Plate VII.3)

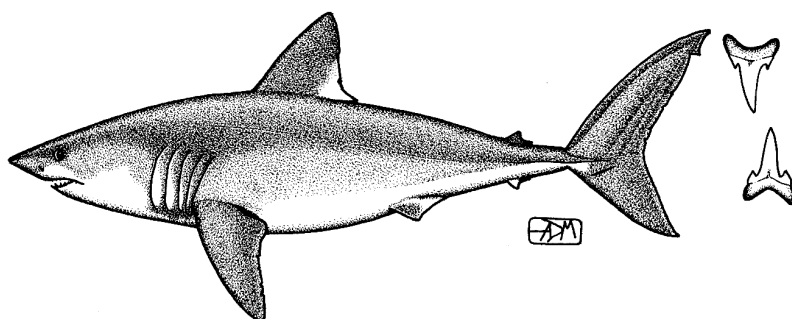


Figure 31. Side view, upper and lower teeth of *Lamna nasus*.
(Illustration: A. De Maddalena).

Common name:	Porbeagle
Key features:	Heavy spindle-shaped body, with moderately long conical snout. Moderately large blade-like teeth with lateral cusplets. 1 st dorsal fin large, 2 nd dorsal and anal fins minute and pivoting; strong keels on caudal peduncle, with short secondary keels on caudal base; crescentic caudal fin.
Colour:	Grey or bluish grey to blackish above, white below, with white abdominal colour terminating at rear end of pectoral bases; 1st dorsal fin with an abruptly white or greyish white free rear tip.
Size:	Maximum total length to 300+ cm.
Distribution:	Temperate waters of Northern and Southern Hemisphere. Entire Mediterranean, rare in the Aegean Sea, occurrence in the Sea of Marmara requires confirmation, absent in the Black Sea.
Habitat and biology:	Epipelagic, coastal and oceanic, occurring in deep midwaters at depths of 200 to 700 m, occasionally also on or close to the surface. Ovoviviparous, with litter size of 1 to 5 youngs. A voracious feeder on small to moderate-sized pelagic schooling fishes, as well as demersal fishes and small chondrichthyan preys.

Importance to fisheries:	A very rare bycatch in pelagic fisheries and deep drop-lines.
Conservation status:	FAO, B4; IUCN, Near Threatened; Mediterranean, Vulnerable species. Appendix 3 of Berne Convention; Appendix 3 of Barcelona Convention; Turkey, included in the current inventory of marine protected species, listed in Turkish Fisheries Act.
Further readings:	Compagno (2002), Serena (2005), Kabasakal (2019), Kabasakal and Kabasakal (2004).

Order
CARCHARHINIFORMES

Family
SCYLIORHINIDAE

Galeus melastomus Rafinesque, 1810
(Figure 32; Plate VIII.1)

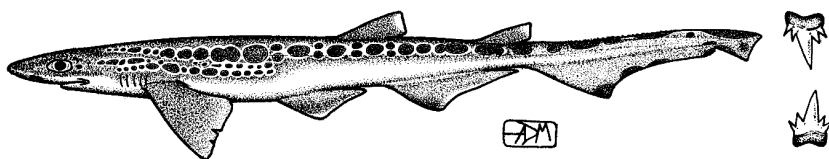


Figure 32. Side view, upper and lower teeth of *Galeus melastomus*.
(Illustration: A. De Maddalena).

Common name:

Blackmouth catshark

Key features:

Precaudal tail with base noticeably compressed. Snout moderately long and pointed. Eyes lateral on head, subocular ridges obsolete. Mouth fairly large and short; labial furrows moderately long, not confined to mouth corners. Pelvic fins small, low, and angular. Interspace between pelvic and anal bases much shorter; anal fin base long, 13 to 18% of total length, much greater than interdorsal space; caudal upper edge with greater denticles.

Colour:

Variegated dark saddle blotches and circular spots on body and caudal fin; saddles over 15 on back and tail; dorsal fins and caudal tip white; mouth lining dark.

Size:

Maximum reported total length to 90 cm, usually to about 50 cm.

Distribution:

Eastern North Atlantic and throughout the Mediterranean Sea, extending to Sea of Marmara.

Habitat and biology:

Benthic, from upper continental slope at depths of 200 to 1 200 m, mainly at 300 to 400 m. Preys on bottom-dwelling

Importance to fisheries:

Conservation status:

Further readings:

invertebrates and fishes, also scavenger.
Oviparous, spawning all year round with a peak in spring and summer.

Bycatch of deep-sea fishing gear.

FAO, B1; Mediterranean, very common, stable biomass.

Ebert and Stehmann (2013), Serena (2005), Kabasakal (2002c), Kabasakal and Kabasakal (2004), Meriç (1995), Özütemiz *et al.* (2009), Oral (2010).

Scyliorhinus canicula (Linnaeus, 1758)
(Figure 33; Plate VIII.2)

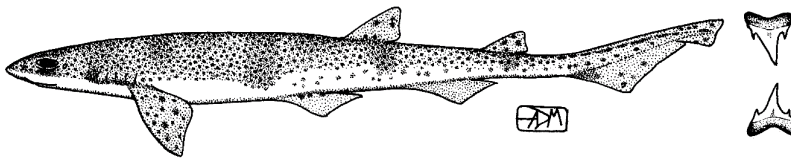


Figure 33. Side view, upper and lower teeth of *Scyliorhinus canicula*.
(Illustration: A. De Maddalena).

Common name:	Smallspotted catshark
Key features:	A slender, dark-spotted species with greatly expanded anterior nasal flaps, reaching mouth and covering shallow nasoral grooves, labial furrows on lower jaw only, 2 nd dorsal fin much smaller than 1 st ; 2 nd dorsal fin origin over anal fin insertion. Interdorsal space slightly greater than anal fin base.
Colour:	Pattern of numerous small dark spots, usually about size of eye pupil; 8 or 9 dusky saddle marks sometimes present but often obscure or obsolete; scattered white spots sometimes present.
Size:	Maximum reported total length to 90 cm, generally 20 to 50 cm.
Distribution:	Eastern North Atlantic, Mediterranean including the Black Sea.
Habitat and biology:	A common bottom-dwelling shark over gravelly, sandy or muddy bottom from shallow water up to 550 m, mainly from 50 to 250 m on the continental shelf. Oviparous with 90 to 115 egg-cases per year. Feeds mostly on bottom invertebrates, including crabs, gastropods, small cephalopods, and polychaete worms, as well as bottom-dwelling bony fishes.
Importance to fisheries:	A common bycatch of bottom-trawl fishery.
Conservation status:	FAO, B1; Mediterranean, this species is very common.

Further readings:

Ebert and Stehmann (2013), Serena (2005), Cihangir *et al.* (1997), Kabasakal (2001, 2002c), Erdoğan *et al.* (2004), Filiz and Taşkavak (2006), Türker Çakır *et al.* (2006).

Scyliorhinus stellaris (Linnaeus, 1758)
(Figure 34; Plate VIII.3)

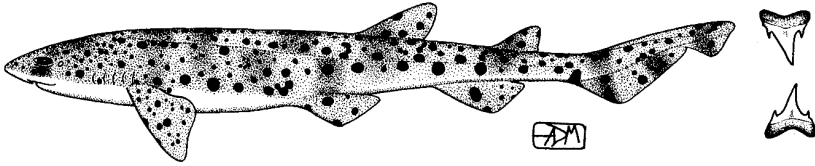


Figure 34. Side view, upper and lower teeth of *Scyliorhinus stellaris*.
(Illustration: A. De Maddalena).

Common name:	Nursehound
Key features:	A large, fairly stocky species with small anterior nasal flaps that don't reach mouth, no nasoral grooves, labial furrows on lower jaw only, 2 nd dorsal fin much smaller than 1 st ; 1 st dorsal fin origin opposite pelvic fin insertions; 2 nd dorsal fin origin well anterior to anal fin insertion.
Colour:	Pattern of numerous small and large black spots sometimes interspersed with white spots, the large spots often irregular, subangular, and sometimes expanded into large blotches that may totally cover the body in some individuals.
Size:	Maximum reported total length to 160 cm, usually to 110 cm.
Distribution:	Eastern North Atlantic to Mediterranean, including Sea of Marmara.
Habitat and biology:	Benthic over rough, rocky or coralline grounds from 20 m to about 100 m. Oviparous egg-laying (two egg-cases at time) all year round. Feeds mostly on cephalopods, crustaceans, and a variety of bony fish.
Importance to fisheries:	Bycatch in bottom trawl and artisanal fisheries.
Conservation status:	FAO, B1; Mediterranean, occasional rare and vulnerable species.
Further readings:	Ebert and Stehmann (2013), Serena (2005).

Family
TRIAKIDAE

Galeorhinus galeus (Linnaeus, 1758)
(Figure 35; Plate IX.1)

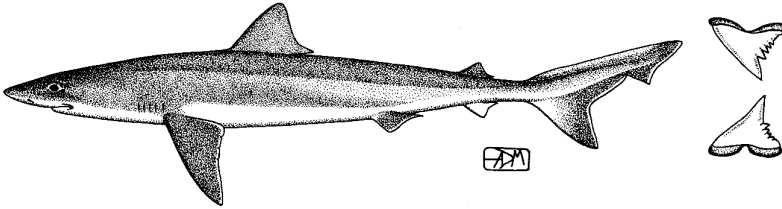


Figure 35. Side view, upper and lower teeth of *Galeorhinus galeus*.
(Illustration: A. De Maddalena).

Common name:

Tope shark

Key features:

A slender, long-nosed species; large horizontally oval eyes with internal nictitating lower eyelids; an arched mouth, moderately long upper labial furrows that fall short of lower symphysis, bladelike compressed teeth with oblique cusps and distal cusplets in both jaws. 2nd dorsal fin much smaller than 1st and about as large as anal fin, and an extremely long terminal caudal fin lobe about half the dorsal caudal fin margin.

Colour:

Uniform grey or bronze above, white below, without spots or dark bars.

Size:

Maximum reported total length to over 200 cm, usually from 80 to 120 cm.

Distribution:

All oceans temperate waters, throughout the Mediterranean, absent in the Black Sea.

Habitat and biology:

A coastal-pelagic shark of temperate continental and insular waters, from depths of 20 to 470 m. Ovoviviparous, with litter size up to 52 youngs. Preys mostly on a variety of bony fishes, as well as cephalopods, crustaceans and seldomly other small chondrichthyans.

Importance to fisheries:

Bycatch in demersal fisheries.

Conservation status:	FAO, B4; IUCN, Vulnerable (A1bd; A2d); Mediterranean, vulnerable; Turkey, included in the current inventory of marine protected species, listed in Turkish Fisheries Act.
Further readings:	Ebert and Stehmann (2013), Serena (2005), Kabasakal and Kabasakal (2004), Kabasakal <i>et al.</i> (2017).

Mustelus asterias Cloquet, 1821
(Figure 36; Plate IX.2)

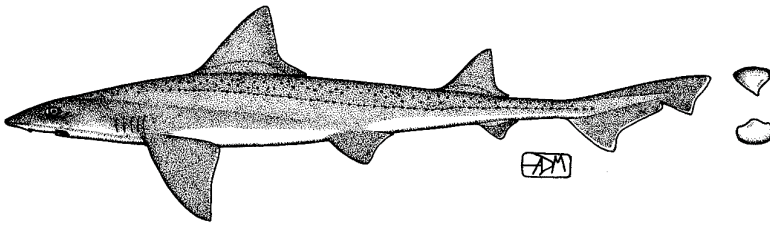


Figure 36. Side view, upper and lower teeth of *Mustelus asterias*.
(Illustration: A. De Maddalena).

Common name:	Starry smoothhound
Key features:	Body fairly slender, head short, snout moderately long and bluntly angular in lateral view, preoral snout 5.4 to 7.2% of total length, preorbital snout 5.7 to 7.2% of total length.
Colour:	Grey or grey-brown above, light below, usually with numerous small white spots on sides and back.
Size:	Maximum reported total length to 140 cm.
Distribution:	Eastern North Atlantic to Mediterranean and Sea of Marmara, rare in the Black Sea.
Habitat and biology:	Coastal, benthic on the continental shelf to 300 m, usually at 100 m. Ovoviviparous, with litter size from 7 to 15 young. Feeds primarily on crustaceans, as well as other bottom-dwelling invertebrates.
Importance to fisheries:	Bycatch in demersal fisheries.
Conservation status:	FAO, B1; IUCN, Least Concern; Mediterranean, vulnerable species.
Further readings:	Ebert and Stehmann (2013), Serena (2005), Eryılmaz <i>et al.</i> (2011), Kabasakal and Kabasakal (2004), Kabasakal and Karhan (2015).

Mustelus mustelus (Linnaeus, 1758)

(Figure 37; Plate IX.3)

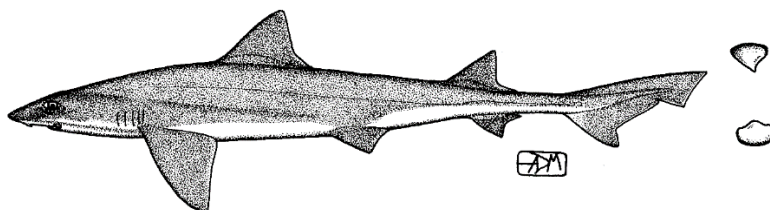


Figure 37. Side view, upper and lower teeth of *Mustelus mustelus*.
(Illustration: A. De Maddalena).

Common name:	Smoothhound
Key features:	Body fairly slender, head short, snout moderately long and bluntly angular in lateral view, preoral snout 5.3 to 7.4% of total length, preorbital snout 5.9 to 8.0% of total length.
Colour:	Uniform grey or grey-brown above, light below, no white spots or dark bars.
Size:	Maximum reported total length to 160 cm.
Distribution:	Eastern Atlantic to Mediterranean and Sea of Marmara, absent in the Black Sea.
Habitat and biology:	Coastal demersal species on the continental shelf and upper slope to 450 m, usually from 5 to 50 m. Viviparous, with litter size from 4 to 15 young. Feeds primarily on crustaceans, as well as cephalopods and bony fishes.
Importance to fisheries:	Bycatch in demersal fisheries.
Conservation status:	FAO, B1; Mediterranean, vulnerable species.
Further readings:	Ebert and Stehmann (2013), Serena (2005), Filiz (2009), Kabasakal (2002c), Özcan and Başusta (2016).

Mustelus punctulatus Risso, 1826
(Figure 38; Plate X.1)

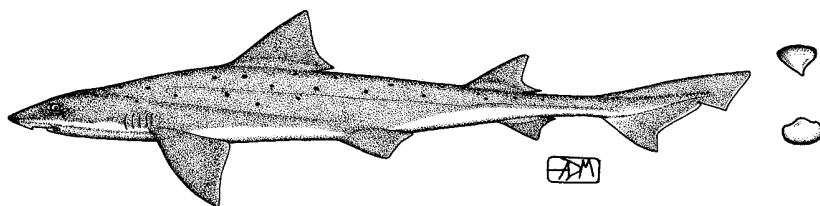


Figure 38. Side view, upper and lower teeth of *Mustelus punctulatus*.
(Illustration: A. De Maddalena).

Common name:	Blackspotted smoothhound
Key features:	Body fairly slender, head short, snout moderately long and bluntly angular in lateral view, preoral snout 5.6 to 7.5% of total length, preorbital snout 2.3 to 3.6% of total length.
Colour:	Uniform grey or grey-brown above, light below, with small black spots on dorsal surface of body and posterior margins of both dorsal fins bordered a narrow dark band.
Size:	Maximum reported total length to 190 cm, usually to 120 cm.
Distribution:	Eastern Atlantic to Mediterranean and Aegean Sea.
Habitat and biology:	Coastal benthic on the continental shelf to 200 m. Viviparous. Presumably a crustacean feeder.
Importance to fisheries:	Bycatch in demersal fisheries.
Conservation status:	FAO, B1; Mediterranean, vulnerable species.
Further readings:	Compagno (1984), Serena (2005), Kabasakal (2002a).

Family
CARCHARHINIDAE

Carcharhinus altimus (Springer, 1950)
(Figure 39; Plate X.2)

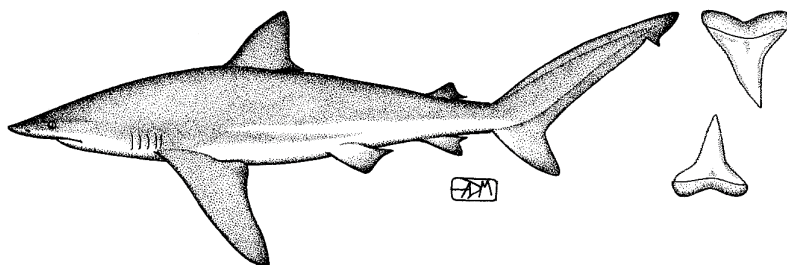


Figure 39. Side view, upper and lower teeth of *Carcharhinus altimus*.
(Illustration: A. De Maddalena).

Common name:

Bignose shark

Key features:

A large fairly slender shark with a long rounded or bluntly pointed snout, prominent anterior nasal flaps, high, triangular, serrated teeth without cusplets in upper jaw, erect narrow-cusped serrated teeth in lower jaw, usually 15/14 to 15 rows of anteroposterior teeth, a prominent interdorsal ridge, moderately high 1st dorsal fin, long, nearly straight pectoral fins.

Colour:

Light grey above, white below, with dusky fin tips, but no conspicuous markings; inconspicuous white marking on flanks.

Size:

Maximum reported total length to 300 cm.

Distribution:

Occurs in most warm temperate and tropical seas worldwide, with a patchy distribution; rare in the Mediterranean.

Habitat and biology:

Benthic, found off the continental shelves and upper slope, at depths from 100 to 450 m. Viviparous with litter size from 3 to 15 young. Preys on a variety of demersal bony fishes, and other small sharks and rays, as well as cephalopods.

Importance to fisheries:

Bycatch of deepsea long-line and set-net fishery.

Conservation status:

FAO, B1; IUCN, Least Concern;
Mediterranean, occasional/rare species.

Further readings:

Ebert and Stehmann (2013), Serena (2005), Başusta *et al.* (1998), Hemida *et al.* (2002), Yağlıoğlu *et al.* (2015), Kabasakal *et al.* (2017), Ayas *et al.* (2020b).

Carcharhinus brevipinna (Müller & Henle, 1839)
(Figure 40; Plate X.3)

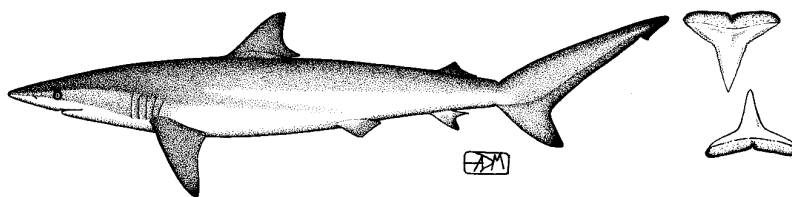


Figure 40. Side view, upper and lower teeth of *Carcharhinus brevipinna*.
(Illustration: A. De Maddalena).

Common name:	Spinner shark
Key features:	A large fairly slender shark with a long pointed snout, small eyes; narrow, mostly erect- and narrow-cusped serrated or partly serrated upper anterolateral teeth without cusplets, lower teeth with narrow, smooth-edged cusps, long gill slits, no interdorsal ridge, small pectoral fins, a small 1 st dorsal fin with a short rear tip and a moderately large 2 nd dorsal fin.
Colour:	Light grey dorsally and whitish ventrally; black tips usually present on pectoral, 1 st and 2 nd dorsal, anal fins, and ventral caudal fin lobe, and sometimes on pelvic fins; an inconspicuous white band on flanks.
Size:	Maximum reported total length to over 270 cm.
Distribution:	All temperate and tropical waters except in the eastern Pacific; entire Mediterranean, absent in the Black Sea.
Habitat and biology:	A common coastal-pelagic shark, occurring from close inshore to offshore; mostly at a depth of less than 30 m, but ranging down to at least 75 m deep. Viviparous, with litter size of 6 to 20 young. Feeds primarily on small bonyfish, as well as cephalopods.
Importance to fisheries:	Bycatch of demersal and pelagic long-line fisheries.
Conservation status:	FAO, B1; IUCN, Near Threatened (Vulnerable (A1bd+A2d); Mediterranean, occasional/rare species.

Further readings:

Ebert and Stehmann (2013), Serena (2005), Hemida *et al.* (2002), Ayas *et al.* (2019), Kabasakal (2002a), Filiz and Kabasakal (2015).

Carcharhinus limbatus (Valenciennes, in Müller & Henle, 1839)
(Figure 41)

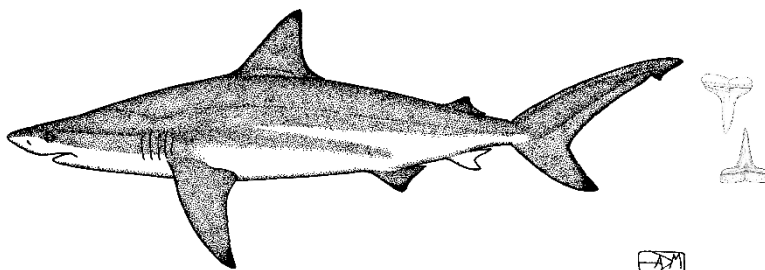


Figure 41. Side view, upper and lower teeth of *Carcharhinus limbatus*.
(Side view illustration: A. De Maddalena; teeth illustration: H. Kabasakal).

Common name:

Blacktip shark

Key features:

A large fairly stout shark with a long pointed snout, small eyes, narrow, mostly erect- and narrow-cusped serrated upper anterolateral teeth without cusplets, long gill slits, lower teeth with narrow, usually serrated cusps, no interdorsal ridge, moderately large pectoral fins, a large 1st dorsal fin with a short rear tip and a moderately large 2nd dorsal fin with a short rear tip.

Colour:

Grey or grey-brown above, white below; black tips usually present on pectoral fins, second dorsal fin, and ventral caudal-fin lobe, and sometimes on pelvic and anal fins, and black edges usually present on first dorsal-fin apex and dorsal caudal-fin lobe.

Size:

Maximum reported total length to 255 cm, usually to 150 cm.

Distribution:

Cosmopolitan species in temperate and tropical waters, entire Mediterranean, absent in the Black Sea.

Habitat and biology:

Pelagic, coastal and offshore but not a truly oceanic species, at the depths from the surface to 100 m depth. Viviparous, with a litter size from 10 to 14 young. Feeds primarily on bony fishes, as well as

	small sharks to a lesser extent, but their diet also includes some cephalopods and crustaceans.
Importance to fisheries:	A seldom bycatch of set-net and long-line fisheries.
Conservation status:	FAO, B3; IUCN, Near Threatened; Mediterranean, occasional/rare species.
Further readings:	Ebert and Stehmann (2013), Serena (2005), Kabasakal (2002a, 2019).

Carcharhinus melanopterus (Quoy & Gaimard, 1824)
(Figure 42)

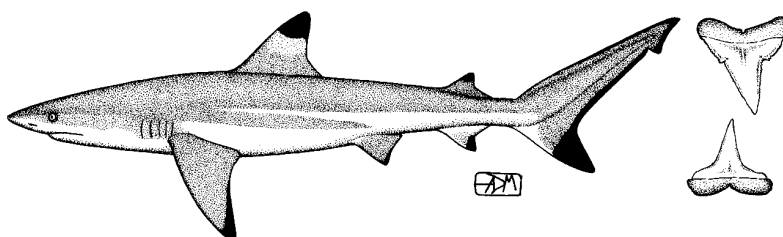


Figure 42. Side view, upper and lower teeth of *Carcharhinus melanopterus*.
(Illustration: A. De Maddalena).

Common name:	Blacktip reef shark
Key features:	A moderate-sized, with a short, bluntly rounded snout, horizontally oval eyes, no interdorsal ridge; a moderately large 2 nd dorsal fin with a short rear tip.
Colour:	Light brown above, white below; 1 st dorsal fin and ventral caudal lobe with a conspicuous black apical blotch, brilliantly highlighted proximally with white; less prominent black tips present on other fins.
Size:	Maximum reported total length to 200 cm, usually to 160 cm.
Distribution:	Temperate and tropical areas of the Indian and Pacific oceans, also in the Red Sea, and probably in the eastern Mediterranean.
Habitat and biology:	Inshore and sometimes offshore on continental and insular shelves, from surface to 100 m, prefers shallow water. Viviparous, with litter size from 4 to 14 young. Feeds primarily on small fish and invertebrates.
Importance to fisheries:	Bycatch of coastal gill-net and long-line fisheries.
Conservation status:	FAO, B1; IUCN, Near Threatened; Mediterranean, doubtful species.
Further readings:	Compagno (1984b), Serena (2005), Kabasakal (2002a, 2019).

Remarks:

According to Whitehead *et al.* (1984; p. 108). Mediterranean distribution of *C. melanopterus* is ranged from Israel to Tunisia, and northeastern Levanten Sea, as well. Moreover, Compagno (1984b; p. 488) states the presence of *C. melanopterus* in the eastern Mediterranean. The most recent record of *C. melanopterus* in Turkish waters dated back to summer 1996, in Bay of İskenderun, without photopraphic documentation (H. Kabasakal, *pers. obs.*) Even if Compagno (1984b) and Whitehead *et al.* (1984) state the presence of the species in the eastern Mediterranean, Golani *et al.* (2006) didn't include *C. melanopterus* in their ichthyological inventory of eastern Mediterranean. Therefore, the presence of the species in Turkish waters can be considered anecdotal. Serena (2005; p. 43), also considers *C. melanopterus* as a doubtful species in the Mediterranean Sea.

Carcharhinus obscurus (Lesueur, 1818)

(Figure 43; Plate XI.1)

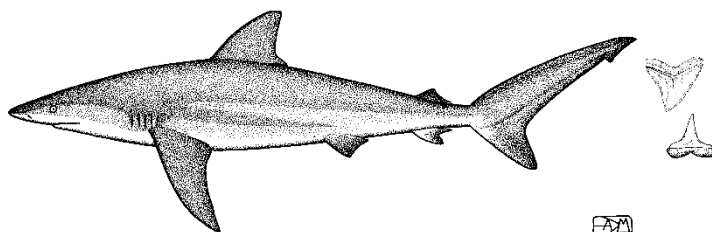


Figure 43. Side view, upper and lower teeth of *Carcharhinus obscurus*.
(Side view illustration: A. De Maddalena; teeth illustration: H. Kabasakal).

Common name:

Dusky shark

Key features:

A large shark with a fairly short broadly rounded snout; eyes fairly large; broad, triangular, rather low, erect and semioblique-cusped serrated anterolateral teeth without cusplets in upper jaw, lower teeth erect and narrow-cusped; a low interdorsal ridge, large, falcate pectoral fins, a moderate-sized 1st dorsal fin with a short rear tip and origin about opposite free rear tips of pectoral fins, a small, low 2nd dorsal fin.

Colour:

Grey above; tips of most fins dusky but not black or white; an inconspicuous white band on flank.

Size:

Maximum reported total length to 400 cm.

Distribution:

Cosmopolitan species in temperate and tropical areas of the Atlantic, Indian and Pacific oceans; rarely found in the Mediterranean.

Habitat and biology:

Epipelagic in coastal and open oceanic waters, demersal in coastal waters down to 400 m. Viviparous with litter size from 6 to 14 youngs. Feeds mainly on pelagic and demersal bony fishes; small elasmobranchs and crustaceans being the secondary prey items, an occasional carrion eater.

Importance to fisheries:

Bycatch of demersal and pelagic long-line fisheries.

Conservation status:

FAO, B4; IUCN, Near Threatened;
Mediterranean, threatened species.

Further readings:

Ebert and Stehmann (2013), Serena
(2005), Hemida *et al.* (2002), Zogaris and
De Maddalena (2014), Kabasakal (2002a,
2019), Kabasakal *et al.* (2017).

Carcharhinus plumbeus (Nardo, 1827)

(Figure 44; Plate XI.2)

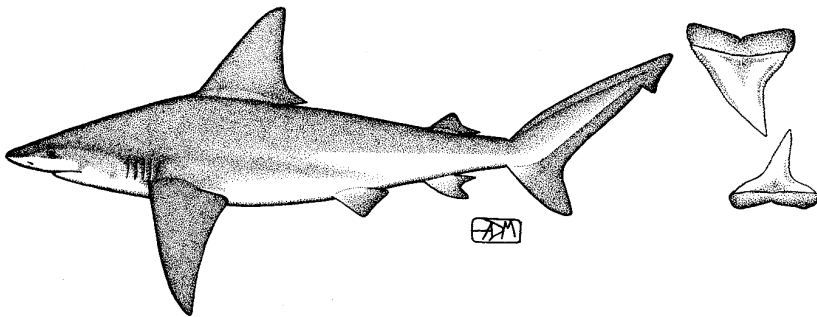


Figure 44. Side view, upper and lower teeth of *Carcharhinus plumbeus*.
(Illustration: A. De Maddalena).

Common name:	Sandbar shark
Key features:	A medium-sized shark with short rounded snout, an interdorsal ridge, an extremely tall triangular 1 st dorsal fin with its origin over or anterior to the pectoral fin insertions, and a moderately large 2 nd dorsal fin with a short rear tip broad; high-cusped, triangular serrated upper teeth without cusplets.
Colour:	Grey-brown above, white below; tips and posterior edges of fins often dusky, but no conspicuous markings; an inconspicuous white band on flank.
Size:	Maximum reported total length to 300 cm, usually to 240 cm.
Distribution:	Worldwide in most tropical seas; western and eastern north Atlantic; entire Mediterranean, with a documented nursery ground in southeastern Aegean Sea (Boncuk Bay, Turkey), absent in the Black Sea.
Habitat and biology:	Coastal-pelagic, on continental and insular shelves and in deep water adjacent to them up to 280 m. Viviparous, one litter every 2 to 3 years. Feeds primarily on small demersal bony fishes and invertebrates.
Importance to fisheries:	Bycatch of demersal fishing gear, and a seldom bycatch of pelagic longlines.

Conservation status:

FAO, B4; IUCN, Near Threatened;
Mediterranean, threatened species.

Further readings:

Ebert and Stehmann (2013), Serena
(2005), Hemida *et al.* (2002), Başusta
(2016), Öztürk (2006), Filiz (2018),
Kabasakal (2002a, 2019), Kabasakal *et al.*
(2017).

Prionace glauca (Linnaeus, 1758)

(Figure 45; Plate XI.3)

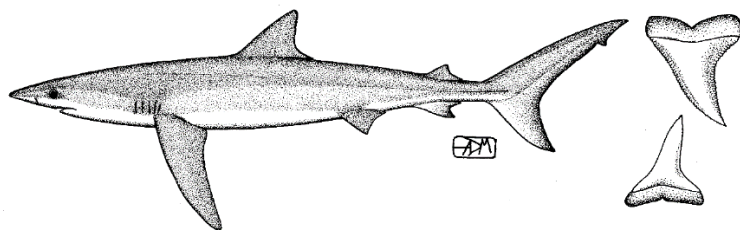


Figure 45. Side view, upper and lower teeth of *Prionace glauca*.
(Illustration: A. De Maddalena).

Common name:

Blue shark

Key features:

Body rather slender; head narrow, only moderately depressed; snout narrowly parabolic in dorsoventral view, very long; eyes large; upper and anteroposterior teeth with broad, triangular, curved erect to oblique, serrated cusps but with no blades or cusplets (except in very young specimens); lower teeth with slender cusps, no blades or cusplets, and variable serrations. 1st dorsal fin origin well behind pectoral fin rear tips, its midbase much closer to pelvic fins than to pectoral fin bases, and free rear tip slightly anterior to pelvic-fin origins; 2nd dorsal fin much smaller than first; pectoral fins very narrow and somewhat falcate.

Colour:

Intense deep blue above, white below, without any distinctive colour patterns

Size:

Maximum reported total length to 400 cm.

Distribution:

Cosmopolitan in tropical to cold-temperate waters; entire Mediterranean, absent in the Black Sea.

Habitat and biology:

Open oceanic waters, but occurring also in coastal waters, often swimming near the surface down to 150 m. Viviparous, litters up to 135 young. Feeds mostly on relatively small prey, especially bony fishes and squid, though other

	invertebrates, small sharks, and mammalian carrion being occasional food items.
Importance to fisheries:	Bycatch of pelagic long-line and drift-net fisheries; young specimens being incidentally captured in coastal gill-net fisheries.
Conservation status:	FAO, B3; IUCN, Near Threatened; Mediterranean, vulnerable species. Appendix 3 of the Berne Convention; Appendix 3 of the Barcelona Convention (ASPIM protocol, Asp. 3)
Further readings:	Ebert and Stehmann (2013), Serena (2005), Kabasakal (2002a, 2010, 2019), Kabasakal and Kabasakal (2004), Kabasakal <i>et al.</i> (2017).

Family
SPHYRNIDAE

Sphyrna zygaena (Linnaeus, 1758)

(Figure 46; Plate XI.4)

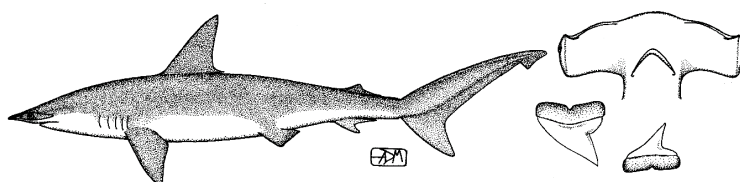


Figure 46. Side view, ventral view of head, upper and lower teeth of *Sphyrna zygaena*. (Illustration: A. De Maddalena).

Common name:	Smooth hammerhead
Key features:	Head broad and narrow-bladed, anterior margin of head broadly arched in adults and without a median indentation at any stage; teeth with very broad cusps and smooth to weakly serrated edge; 1 st dorsal fin moderately falcate, with free rear tip in front of pelvic fin origins, 2 nd dorsal fin low with weakly concave posterior margin and long inner margin about twice fin height; pelvic fins not falcate; posterior anal fin margin deeply-notched.
Colour:	Dark olive or dark grey-brown above, white below, undersides of pectoral fin tips dusky.
Size:	Maximum reported total length to 400 cm.
Distribution:	Temperate and tropical areas of all oceans, entire Mediterranean, a single Black Sea record to be confirmed.
Habitat and biology:	Coastal-pelagic, mainly on continental shelf from surface to 20 m. Viviparous, with litter size up to 37 youngs. Feeds on a variety of bony fishes, as well as small sharks and rays.
Importance to fisheries:	Bycatch of pelagic and demersal fisheries.
Conservation status:	FAO, B1; IUCN, Near Threatened; Mediterranean, vulnerable species.

Further readings:

Ebert and Stehmann (2013), Serena (2005), Ulutürk (1987), Kabasakal and Kabasakal (2004), Kabasakal *et al.* (2017).

PLATE I



1. *Hexanchus griseus*. (Photo: A. Bilgili).



2. *Heptranchias perlo*. (Photo: N. Başusta).



3. *Echinorhinus brucus*. (Photo: E. Şerefoğlu).

PLATE II



1. *Squalus acanthias*. (Photo: H. Kabasakal).



2. *Squalus blainvillei*. (Photo: H. Kabasakal).

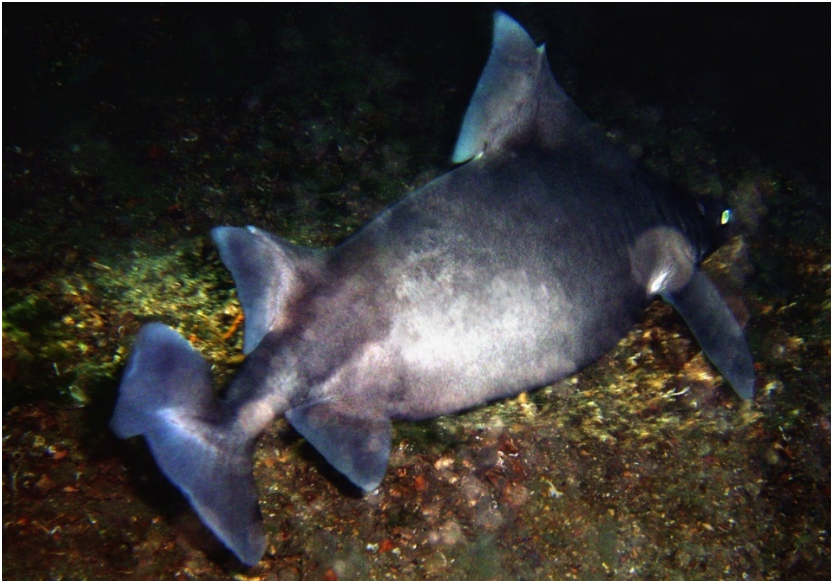


3. *Centrophorus granulosus*. (Photo: M. Kaya).

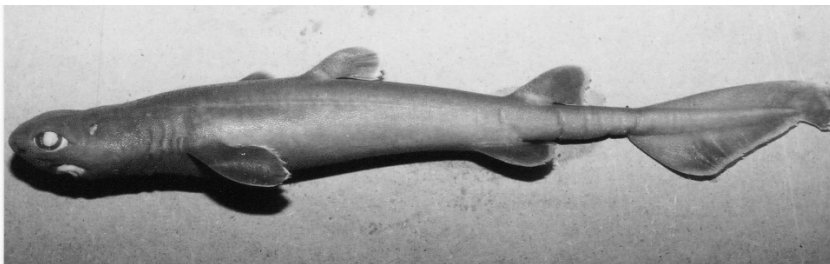
PLATE III



1. *Etmopterus spinax*. (Photo: H. Kabasakal).



2. *Oxynotus centrina*. (Photo: H. Kabasakal).



3. *Dalatias licha*. (Photo: H. Kabasakal).

PLATE IV



1. *Squatina aculeata*. (Photo: N. Başusta).



2. *Squatina oculata*. (Photo: H. Kabasakal).



3. *Squatina squatina*. (Photo: H. Kabasakal).

PLATE V



1. *Carcharias taurus*. (Photo: A. Evirgen).



2. Ventral view of head of *Odontaspis ferox*. (Photo: E. Bayrı).

PLATE VI



1. *Alopias superciliosus*. (Photo: B.G. İpek).



2. *Alopias vulpinus*. (Photo: H. Kabasakal).



3. *Cetorhinus maximus*. (Photo: S.Ö. Gedikoğlu).

PLATE VII



1. *Carcharodon carcharias*. (Photo: A. De Maddalena).



2. *Isurus oxyrinchus*. (Photo: H. Kabasakal).



3. *Lamna nasus*. (Photo: A. Soldo).

PLATE VIII



1. *Galeus melastomus*. (Photo: H. Kabasakal).



2. *Scyliorhinus canicula*. (Photo: H. Kabasakal).



3. *Scyliorhinus stellaris*. (Photo: H. Kabasakal).

PLATE IX



1. *Galeorhinus galeus*. (Photo: H. Kabasakal).



2. *Mustelus asterias*. (Photo: H. Kabasakal).



3. *Mustelus mustelus*. (Photo: H. Kabasakal).

PLATE X



1. *Mustelus punctulatus*. (Photo: T. Dinçer).



2. *Carcharhinus altimus*. (Photo: D. Ayas).



3. *Carcharhinus brevipinna*. (Photo: H. Filiz).

PLATE XI



1. *Carcharhinus obscurus*. (Photo: A. Fischler).



2. *Carcharhinus plumbeus*. (Photo: S.Ö. Gedikoğlu).



3. *Prionace glauca*. (Photo: H. Kabasakal).



4. *Sphyrna zygaena*. (Photo: H. Kabasakal).

REFERENCES

- Akşiray, F. (1987) Identification Guide for the Marine Fishes of Turkish Waters. 2nd edn. Publication No. 3490. Istanbul, Istanbul University, 811 pp. (in Turkish).
- Ayas, D., Çiftçi, N., Akbora, H.D. (2019) New record of *Carcharhinus brevipinna* (Müller & Henle, 1839) from Mersin Bay, the northeastern Mediterranean. *NEsciences* 4(3): 268-275.
- Ayas, D., Akbora, H.D., Çiçek, B.A. (2020a) Occurrence of the young thresher shark *Alopias superciliosus* Lowe, 1841 (Lamniformes: Alopiidae) in the Northeastern Mediterranean Sea. *Comm J Biol* 4(1). doi: 10.31594/commagene.713381.
- Ayas, D., Çiftçi, N., Yalçın, E., Akbora, H.D., Bakan, M., Ergüden, D. (2020b) First record of the bignose shark, *Carcharhinus altimus* (Springer, 1950) from Mersin Bay. *International Journal of Fisheries and Aquatic Studies* 8(2): 132-136.
- Bargnesi, F., Gridelli, S., Cerrano, C., Ferretti, F. (2020) Reconstructing the history of the sand tiger shark (*Carcharias taurus*) in the Mediterranean Sea. *Aquatic. Conserv: Mar Freshw Ecosyst* 1-13. doi: 10.1002/aqc.3301.
- Bariche, M. (2012) Field Identification Guide to the Living Marine Resources of the Eastern and Southern Mediterranean. FAO Species Identification Guide for Fishery Purposes. Rome, FAO, 610 pp.
- Başusta, N. (2002) Occurrence of a sawback angelshark (*Squatina aculeata* Cuvier, 1829) off the eastern Mediterranean coast of Turkey. *Turk J Vet Anim Sci* 26: 1177-1179.
- Başusta, N. (2015) New records of neonate and juvenile sharks (*Heptanchias perlo*, *Squatina aculeata*, *Etmopterus spinax*) from the north-eastern Mediterranean Sea. *Mar Biodiv* 46: 525-527 doi: 10.1007/s12526-015-0391-z.
- Başusta, N. (2016) Length-weight relationship of sandbar shark *Carcharhinus plumbeus* (Nardo, 1827) in Iskenderun Bay (north-eastern Mediterranean Sea). *Rapp Comm int Mer Médit* 41: 318.
- Başusta, N., Erdem, Ü., Çevik, C. (1998) An investigation on chondrichthyes in Iskenderun Bay. *Celal Bayar University Journal of Science* 1: 63-69.
- Başusta, N., Turan, C., Başusta, A. (2015) New records of gravid female and adult male of the angular rough shark, *Oxynotus centrina* (Oxynotidae) from the northeastern Mediterranean. *J Black Sea / Medit Environ* 21: 92-95.

Başusta, N., Başusta, A. Özbek, E.Ö. (2016) Cartilaginous fishes and fisheries in the Mediterranean coast of Turkey. In: The Turkish Part of the Mediterranean Sea; Marine Biodiversity, Fisheries, Conservation and Governance (eds., Turan, C., Salihoğlu, B., Özgür Özbek, E., Öztürk, B.) Turkish Marine Research Foundation (TUDAV), Publication No: 43, Istanbul, TURKEY. 248-274 pp.

Bengil, E.G.T., Başusta, N. (2018) Chondrichthyan species as bycatch: a review on species inhabiting Turkish waters. *J. Black Sea/Medit Environ* 24(3): 288-305.

Benli, H.A., Cihangir, B., Bizsel, K.C. (1993) A new record for the Sea of Marmara; (Family: Squalidae) *Centrophorus granulosus* (Bloch & Schneider, 1801). *Tr J of Zoology* 17: 133-135.

Bianchi, C.N., Morri, C. (2003) Global sea warming and ‘tropicalization’ of the Mediterranean Sea: biogeographic and ecological aspects. *Biogeographia*, 24: 319-327.

Bilecenoglu, M., Kaya, M., Cihangir, B., Çiçek, E. (2014) An updated checklist of the marine fishes of Turkey. *Turk J Zool* 38: 901-929.

Bilge, G., Filiz, H., Tarkan, A.N. (2010) Length-weight relationship of velvet belly lantern shark *Etmopterus spinax* (Linnaeus, 1758) in Sığacık Bay (Aegean Sea). *Istanbul University Journal of Fisheries and Aquatic Sciences* 25: 1-8.

Bradai, M.N., Saidi, B., Enajjar, S. (2012) Elasmobranchs of the Mediterranean and Black sea: status, ecology and biology. Bibliographic analysis. Studies and Reviews. General Fisheries Commission for the Mediterranean. No. 91. Rome, FAO. 103 pp.

Camhi, M., Fowler, S.L., Musick, J.A., Bräutigam, A., Fordham, S.V. (1998) Sharks and Their Relatives – Ecology and Conservation. IUCN/SSC Shark Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK. iv + 39 pp.

Cengiz, Ö., İşmen, A., Özekinci, U., Öztekin, A. (2011) An investigation on fish fauna of Saros Bay (Northern Aegean Sea). *AKU-J Sci* 11: 31-37.

Cihangir, B., Ünlüoğlu, A., Tıraşın, E.M. (1997) Distribution and some biological aspects of the lesser spotted dogfish (Chondrichthyes, *Scyliorhinus canicula*, Linnaeus, 1758) from the northern Aegean Sea. Mediterranean Fisheries Congress, 9-11 April 1997, İzmir, pp. 585-603.

Compagno, L.J.V. (1984a) FAO species catalogue. Sharks of the world: An annotated and illustrated catalogue of shark species known to date. Part 1.

Hexanchiformes to Lamniformes. Rome: FAO. (FAO Fisheries Synopsis, No. 125.).

Compagno L.J.V. (1984b) FAO species catalogue. Sharks of the world. An annotated and illustrated catalogue of shark species known to date. Part 2. Carcharhiniformes. Rome: FAO. (FAO Fisheries Synopsis, No. 125.).

Compagno, L.J.V. (2002) Sharks of the world. An annotated and illustrated catalogue of shark species known to date. Volume 2. Bullhead, mackerel and carpet sharks Heterodontiformes, Lamniformes and Orectolobiformes). FAO Species Catalogue for Fishery Purposes. No. 1, Vol. 2. Rome, FAO.

Çağatay, M.N., Uçarkuş, G., Alpar, B. (2016) Geology and morphotectonics of Sea of Marmara. In: The Sea of Marmara. Marine Biodiversity, Fisheries, Conservation and Governance (eds., Özsoy, E., Çağatay, M.N., Balkis, N., Balkis, N., Öztürk, B.). Turkish Marine Research Foundation (TUDAV), Publication No: 42, Istanbul: pp. 684-696.

De Maddalena, A., Della Rovere, G. (2005) First record of the pigeye shark, *Carcharhinus amboinensis* (Müller & Henle, 1839), in the Mediterranean Sea. *Annales Ser. Hist Nat* 15: 209-212.

De Maddalena, A., Heim, W. (2012) Mediterranean Great White Sharks. A Comprehensive Study Including All Recorded Sightings. McFarland, Jefferson, 254 p.

Demirhan, S.A., Seyhan, K. (2007) Maturity and fecundity of spiny dogfish (*Squalus acanthias* L., 1758) in the eastern Black Sea. *Turk J Zool* 31: 301-308.

Demirhan, S.A., Ögüt, H., Engin, S., Başusta, N., Genç, E. (2006) Difficulties in age readings from dorsal spines of spiny dogfish *Squalus acanthias* L., 1758. In: The Proceedings of the Workshop on Mediterranean Cartilaginous Fish with Emphasis on Southern and Eastern Mediterranean (eds., Başusta, N., Keskin, Ç., Serena, F., Seret, B.) Turkish Marine Research Foundation. Istanbul- TURKEY. Publication Number 23 pp. 28-34.

Demirhan, S.A., Seyhan, K., Başusta, N. (2007) Dietary overlap in spiny dogfish (*Squalus acanthias*) and thornback ray (*Raja clavata*) in the southeastern Black Sea. *Ekoloji* 16: 1-8.

Dulvy, N.K., Fowler, S.L., Musick, J.A., Cavanagh, R.D., Kyne, P.M., Harrison, L.R., Carlson, J.K., Davidson, L.N., Fordham, S.V., Francis, M.P., Pollock, C.M., Simpfendorfer, C.A., Burgess, G.H., Carpenter, K.E., Compagno, L.J., Ebert, D.A., Gibson, C., Heupel, M.R., Livingstone, S.R., Sanciangco, J.C., Stevens, J.D., Valenti, S., White, W.T. (2014) Extinction risk and conservation of the world's sharks and rays. *eLife*; 3:e00590. 34 p. doi: 10.7554/eLife.00590.

Dulvy, N.K., Allen, D.J., Ralph, G.M., Walls, R.H.L. (2016) The conservation status of sharks, rays and chimaeras in the Mediterranean Sea (Brochure). IUCN, Malaga, Spain.

Düzgüneş, E., Okumuş, I., Feyzioğlu, I., Sivri, N. (2006) Population parameters of spiny dogfish, *Squalus acanthias* from the Turkish Black Sea coast and its commercial exploitation in Turkey. In: The Proceedings of the Workshop on Mediterranean Cartilaginous Fish with Emphasis on Southern and Eastern Mediterranean (eds., Başusta, N., Keskin, Ç., Serena, F., Seret, B.) Turkish Marine Research Foundation. Istanbul- TURKEY. Publication Number 23 pp. 1-9.

Ebert, D.A., Stehmann, M.F.W. (2013) Sharks, batoids and chimaeras of the North Atlantic. FAO Species Catalogue for Fishery Purposes. No. 7. FAO, Rome, 523 pp.

Erdoğan, Z.Z., Torcu Koç, H., Türker Çakır, D., Nerlović, V., Dulčić, J. (2004) Sexual dimorphism in the small-spotted catshark, *Scyliorhinus canicula* (L., 1758), from the Edremit Bay (Turkey). *Annales Ser Hist Nat* 14: 165-170.

Ergüden, D., Gürlek, M., Turan, C. (2013) A young *Isurus oxyrinchus* Rafinesque, 1810 (Chondrichthyes: Lamnidae) individual captured from Iskenderun Bay, Turkey. *Medit Mar Sci* 14: 463-480.

Ergüden, D., Gürlek, M., Turan, C. (2015) Occurrence of the thresher *Alopias vulpinus* (Bonnaterre, 1788) from the northeastern Mediterranean coast of Turkey. *Biharean Biologist* 9: 76-77.

Ergüden, D., Çekiç, M., Alagöz Ergüden, S., Altun, A., Uygur, N. (2017) Occurrence of adult female kitefin shark *Dalatias licha* (Bonnaterre, 1788) in Iskenderun Bay (Eastern Mediterranean, Turkey). *Comm J Biol* 1: 60-62.

Eryılmaz, L., Yemişken, E., Dalyan, C. (2011) The first documented record of genus *Mustelus* (Chondrichthyes: Triakidae) in the Black Sea. *Turkish Journal of Fisheries and Aquatic Sciences* 11: 157-160.

Favaro, B., Cote, I.M. (2015) Do by-catch reduction devices in longline fisheries reduce capture of sharks and rays? A global meta-analysis. *Fish and Fisheries* 16: 300-309.

Fergusson, I.K., Graham, K.J., Compagno, L.J.V. (2008) Distribution, abundance and biology of the smalltooth sandtiger shark *Odontaspis ferox* (Risso, 1810) (Lamniformes: Odontaspidae). *Environ Biol Fish* 81: 207-228.

Filiz, H. (2009) Diet composition of smooth-hound, *Mustelus mustelus* (Linnaeus, 1758) in Aegean Sea, Turkey. *Belg J Zool* 139: 81-84.

Filiz, H. (2018) Year-round aggregation of sandbar shark, *Carcharhinus plumbeus* (Nardo, 1827), in Boncuk Cove in the southern Aegean Sea, Turkey (Carcharhiniformes: Carcharhinidae). *Zoology in the Middle East* 65(1): 35-39 doi: 10.1080/09397140.2018.1540148.

Filiz, H., Kabasakal, H. (2015) Photographic record of the spinner shark, *Carcharhinus brevipinna* (Müller & Henle, 1839), in Gökova Bay (south Aegean Sea, Turkey). *Annales Ser Hist Nat* 25: 123-128.

Filiz, H., Taşkavak, E. (2006) Sexual dimorphism in the head, mouth and body morphology of the lesser-spotted dogfish, *Scyliorhinus canicula*, from Turkey. In: The Proceedings of the Workshop on Mediterranean Cartilaginous Fish with Emphasis on Southern and Eastern Mediterranean (eds., Başusta, N., Keskin, Ç., Serena, F., Seret, B.) Turkish Marine Research Foundation. Istanbul, TURKEY. Publication Number 23 pp. 48-59.

Filiz, H., Irmak E., Mater, S. (2005) Occurrence of *Squatina aculeata* Cuvier, 1829 (Elasmobranchii, Squatinidae) from the Aegean Sea, Turkey. *EU Journal of Fisheries & Aquatic Sciences* 22(3-4): 451-452.

Galaz, T., De Maddalena, A. (2004) On a great white shark, *Carcharodon carcharias* (Linnaeus, 1758), trapped in a tuna cage off Libya, Mediterranean Sea. *Annales Ser Hist Nat* 14 (2): 159-164.

Golani, D., Öztürk, B., Başusta, N. (2006) Fishes of the Eastern Mediterranean. Turkish Marine Research Foundation. Publication No: 24, İstanbul, 259 pp.

Graham, K.J., Pollard, D.A., Gordon, I., Williams, S., Flaherty, A.A., Fergusson, I., Dicken, M. (2016) *Odontaspis ferox* (errata version published in 2016). *The IUCN Red List of Threatened Species* 2016: e.T41876A103433002. <http://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T41876A2957320.en>

GSAF (2020) Global Shark Attack File. Available at: <http://www.sharkattackfile.net/incidentlog.htm> (last accessed: 27 May 2020).

Gubili, C., Bilgin, R., Kalkan, E., Karhan, S.Ü., Jones, C.S., Sims, D.W., Kabasakal, H., Martin, A.P., Noble, L.R. (2010) Antipodean white sharks on a Mediterranean walkabout? Historical dispersal leads to genetic discontinuity and an endangered anomalous population. *Proc R Soc B* 278: 1679–1686. doi: 10.1098/rspb.2010.1856.

Guttridge, T.L., Myberg, A.A., Porcher, I.F., Sims, D.W., Krause, J. (2009) The role of learning in shark behaviour. *Fish and Fisheries* 10: 450–469. doi: 10.1111/j.1467-2979.2009.00339.x.

- Hemida, F., Seridji, R., Labidi, N., Bensaci, J., Capapé, C. (2002) Records of *Carcharhinus* spp. (Chondrichthyes: Carcharhinidae) from off the Algerian coast (southern Mediterranean). *Acta Adriat* 43(2): 83-92.
- Huber, D.R., Claes, J.M., Mallefet, J., Herrel, A. (2009) Is extreme bite performance associated with extreme morphologies in sharks? *Physiological and Biochemical Zoology* 82: 20-28.
- Kabasakal, H. (1998a) Shark and ray fisheries in Turkey. *Shark News* 11: 8.
- Kabasakal, H. (1998b) A note on the occurrence of the thresher shark, *Alopias vulpinus* from south-western Black Sea. *J Mar Biol Ass UK* 78: 685-686.
- Kabasakal, H. (2001) Preliminary data on the feeding ecology of some selachians from the north-eastern Aegean Sea. *Acta Adriat* 42: 15-24.
- Kabasakal, H. (2002a) Elasmobranch species of the seas of Turkey. *Annales Ser Hist Nat* 12: 15-22.
- Kabasakal, H. (2002b) Stomach contents of the longnose spurdog, *Squalus blainvillei* (Risso, 1826) from the north-eastern Aegean Sea. *Annales Ser Hist Nat* 12: 173-176.
- Kabasakal, H. (2002c) Cephalopods in the stomach contents of four elasmobranch species from the northern Aegean Sea. *Acta Adriat* 43: 17-24.
- Kabasakal, H. (2007) Incidental captures of thresher sharks (Lamniformes: Alopiidae) from Turkish coastal waters. *Annales Ser Hist Nat* 17: 23-28.
- Kabasakal, H. (2008) Two recent records of the great white sharks, *Carcharodon carcharias* (Linnaeus, 1758) (Chondrichthyes: Lamnidae), caught in Turkish waters. *Annales Ser Hist Nat* 18: 11-16.
- Kabasakal, H. (2009a) On the capture of a large basking shark *Cetorhinus maximus* (Chondrichthyes: Cetorhinidae) in the Bay of Edremit (northeastern Aegean Sea). *Annales Ser Hist Nat* 19: 11-16.
- Kabasakal, H. (2009b) Observations on a rare shark, *Oxynotus centrina* (Chondrichthyes: Oxynotidae), in the Sea of Marmara (north-western Turkey). *Pan-American Journal of Aquatic Sciences* 4: 609-612.
- Kabasakal, H. (2010) On the occurrence of the blue shark, *Prionace glauca* (Chondrichthyes: Carcharhinidae), off Turkish coast of northern Aegean Sea. *Marine Biodiversity Records* 3: e31 doi:10.1017/S1755267210000266.
- Kabasakal, H. (2011) Sharks of Turkish Waters. 4Deniz Yayınları, İstanbul.(in Turkish).

Kabasakal, H. (2013a) Bluntnose sixgill shark, *Hexanchus griseus* (Chondrichthyes: Hexanchidae), caught by commercial fishing vessels in the seas of Turkey between 1967 and 2013. *Annales Ser Hist Nat* 23: 33-48.

Kabasakal, H. (2013b) Rare but present: Status of basking shark, *Cetorhinus maximus* (Gunnerus, 1765) in eastern Mediterranean. *Annales Ser Hist Nat* 23: 127-132.

Kabasakal, H. (2014) The status of the great white shark (*Carcharodon carcharias*) in Turkey's waters. *Marine Biodiversity Records* 7: e109 doi:10.1017/S1755267214000980.

Kabasakal, H. (2015a) Occurrence of the angular rough shark, *Oxynotus centrina* (Chondrichthyes: Oxynotidae) in the eastern Mediterranean. *Annales Ser Hist Nat* 25: 1-10.

Kabasakal, H. (2015b) Occurrence of shortfin mako shark, *Isurus oxyrinchus* Rafinesque, 1810, off Turkey's coast. *Marine Biodiversity Records* 8: e134. doi:10.1017/S1755267215001104.

Kabasakal, H. (2016) Historical dispersal of the great white shark, *Carcharodon carcharias*, and bluefin tuna, *Thunnus thynnus*, in Turkish waters: Decline of a predator in response to the loss of its prey. *Annales Ser Hist Nat* 26: 213-220.

Kabasakal, H. (2017a) Remarks on incidental captures of deep-sea sharks in Marmaric shelf waters. *Annales Ser Hist Nat* 27: 37-144.

Kabasakal, H. (2017b) Notes on historical and contemporary catches of lamniform sharks in Turkish waters. *Annales Ser Hist Nat* 27: 51-58.

Kabasakal, H. (2019) A review of shark research in Turkish waters. *Annales Ser Hist Nat* 29: 1-16.

Kabasakal, H., Bayrı, E. (2019) Notes on the occurrence of smalltooth sandtiger shark, *Odontaspis ferox* (Lamniformes: Odontaspidae) from Antalya Bay, eastern Mediterranean, Turkey. *J. Black Sea/Medit Environ* 25(2): 166-171.

Kabasakal, H., Bilecenoglu, M. (2014) Not disappeared, just rare! Status of the bramble shark, *Echinorhinus brucus* (Elasmobranchii: Echinorhinidae) in the seas of Turkey. *Annales Ser Hist Nat* 24: 93-98.

Kabasakal, H., Dalyan, C. (2011) Recent records of the bramble shark, *Echinorhinus brucus* (Chondrichthyes: Echinorhinidae), from the Sea of Marmara. *Marine Biodiversity Records* 4: e12 doi:10.1017/S1755267211000108.

- Kabasakal, H., De Maddalena, A. (2011) A huge shortfin mako shark *Isurus oxyrinchus* Rafinesque, 1810 (Chondrichthyes: Lamnidae) from the waters of Marmaris, Turkey. *Annales Ser Hist Nat* 21: 21-24.
- Kabasakal, H., Gedikoğlu, S.Ö. (2008) Two new-born great white sharks, *Carcharodon carcharias* (Linnaeus, 1758) (Lamniformes; Lamnidae) from Turkish waters of the northern Aegean Sea. *Acta Adriat* 49: 125-135.
- Kabasakal, H., Gedikoğlu, S. Ö. (2015) Shark attacks against humans and boats in Turkey's waters in the twentieth century. *Annales Ser Hist Nat* 25: 115-122.
- Kabasakal, H., İnce, P. (2008) Note on a sharpnose sevengill shark, *Heptanchias perlo* (Bonnaterre, 1788) (Chondrichthyes: Hexanchidae), stranded in Saroz Bay (NE Aegean Sea, Turkey). *Annales Ser Hist Nat* 18: 173-176.
- Kabasakal, H., Kabasakal, E. (2002) Morphometrics of young kitefin sharks, *Dalatias licha* (Bonnaterre, 1788), from northeastern Aegean Sea, with notes on its biology. *Annales Ser Hist Nat* 12: 161-166.
- Kabasakal, H., Kabasakal, E. (2004) Sharks captured by commercial fishing vessels off the coast of Turkey in the northern Aegean Sea. *Annales Ser Hist Nat* 14: 171-180.
- Kabasakal, H., Kabasakal, Ö. (2013) First record of a shortfin mako shark, *Isurus oxyrinchus* Rafinesque, 1810 (Chondrichthyes: Lamnidae) from the Bay of Saroz (NE Aegean Sea). *Annales Ser Hist Nat* 23: 27-32.
- Kabasakal, H., Kabasakal, Ö. (2014) Status of angelshark, *Squatina squatina* (Elasmobranchii: Squatiniformes: Squatinidae) in the Sea of Marmara. *Annales Ser Hist Nat* 24: 41-46.
- Kabasakal, H., Kabasakal, Ö. (2015) Recent record of the great white shark, *Carcharodon carcharias* (Linnaeus, 1758), from central Aegean Sea off Turkey's coast. *Annales Ser Hist Nat* 25: 11-14.
- Kabasakal, H., Karhan, S.Ü. (2008) On the occurrence of the bigeye thresher shark, *Alopias superciliosus* (Chondrichthyes: Alopiidae), in Turkish waters. *Marine Biodiversity Records* 1: e69 doi: 10.1017/S1755267207007452.
- Kabasakal, H., Karhan, S.Ü. (2015) Shark biodiversity in the Sea of Marmara: departures and arrivals over a century. *Marine Biodiversity Records* 8: e59 doi: 10.1017/S1755267215000342.
- Kabasakal, H., Ünsal, N. (1999) Observations on *Etmopterus spinax* (Pisces: Squalidae), from the north-eastern Aegean Sea. *Bilješke – Notes* 81: 1-11.

Kabasakal, H., Öz, M. İ., Karhan, S.Ü. Çaylarbaşı, Z., Tural, U. (2005) Photographic evidence of the occurrence of bramble shark, *Echinorhinus brucus* (Bonnaterre, 1788) (Squaliformes: Echinorhinidae) from the Sea of Marmara. *Annales Ser Hist Nat* 15: 51-56.

Kabasakal, H., Yarmaz, A., Gedikoğlu, S.Ö. (2009) Two juvenile great white sharks, *Carcharodon carcharias* (Linnaeus, 1758) (Chondrichthyes; Lamnidae), caught in the Northeastern Aegean Sea. *Annales Ser Hist Nat* 19: 127-134.

Kabasakal, H., Dalyan, C., Yurtsever, A. (2011) Additional records of the bigeye thresher shark *Alopias superciliosus* (Lowe, 1839) (Chondrichthyes: Lamniformes: Alopiidae) from Turkish waters. *Annales Ser Hist Nat* 21: 143-148.

Kabasakal, H., Karhan, S.Ü., Sakınan, S. (2017) Review of the distribution of large sharks in the seas of Turkey (Eastern Mediterranean). *Cah Biol Mar* 58: 219-228.

Kabasakal, H., Bayrı, E., Ataç, E. (2018) Recent records of the great white shark, *Carcharodon carcharias* (Linnaeus, 1758) (Chondrichthyes: Lamnidae), in Turkish waters (Eastern Mediterranean). *Annales Ser Hist Nat* 28(2): 93-98.

Lucifora, L.O., Menni, R.C., Escalante, A.H. (2001) Analysis of dental insertion angles in the sand tiger shark, *Carcharias taurus* (Chondrichthyes: Lamniformes). *Cybiu* 25: 23-31.

Mancusi, C., Baino, R., Fortuna, C., De Sola, L.G., Morey, G., Bradai, M., Kallianotis, A., Soldo, A., Hemida, F., Saad, A., Dimech, M., Peristeraki, P., Bariche, M., Clò, S., De Sabata, E., Castellano, L., Garibaldi, F., Lanteri, L., Tinti, F., Pais, A., Sperone, E., Micarelli, P., Poisson, F., Sion, L., Carlucci, R., Cebrian-Mencherro, D., Séret, B., Ferretti, F., El-Far, A., Saygu, I., Shakman, E., Bartoli, A., Gualart, J., Damalas, D., Megalofonou, P., Vacchi, M., Bottaro, M., Notarbartolo Di Sciara, G., Follesa, M., Cannas, R., Kabasakal, H., Zava, B., Cavlan, G., Jung, A., Abudaya, M., Kolutari, J., Barash, A., Joksimovic, A., Marčeta, B., Gonzalez Vilas, L., Tiralongo, F., Giovos, I., Bargnesi, F., Lelli, S., Barone, M., Moro, S., Mazzoldi, C., Charis, C., Abella, A., Serena, F. (2020) MEDLEM database, a data collection on large elasmobranchs in the Mediterranean and Black seas. *Medit Mar Sci* 21(2): 276-288.

Meriç, N. (1995) A study on existence of some fishes on the continental slope of the Sea of Marmara. *Tr J of Zoology* 19: 191-198.

Motta, P.J., Wilga, C.D. (2001) Advances in the study of feeding behaviours, mechanisms, and mechanics of sharks. *Environmental Biology of Fishes* 60: 131-156.

- Oral, M. (2010) A preliminary study on feeding habits of black-mouth catshark *Galeus melastomus*, Rafinesque, 1810 sampled from the Sea of Marmara. *Marmara Denizi 2010 Sempozyumu*, 25-26 Eylül 2010, İstanbul, pp. 312-316.
- Özcan, E.İ., Başusta, N. (2016) Digestive system contents of the *Mustelus mustelus* (Linnaeus, 1758) inhabiting northeastern Mediterranean. *Firat Univ. Journal of Science* 28: 7-12.
- Öztürk, B. (2006) Save the sandbar sharks of Boncuk Bay, Turkey. In: The Proceedings of the Workshop on Mediterranean Cartilaginous Fish with Emphasis on Southern and Eastern Mediterranean (eds., Başusta, N., Keskin, Ç., Serena, F., Seret, B.) Turkish Marine Research Foundation. Istanbul, Turkey. Publication Number 23 pp. 42-47.
- Öztürk, B. (2018) National action plan for the conservation of cartilaginous fishes in the Turkish water of the eastern Mediterranean Sea. *Journal of the Black Sea/Medit Environ* 24: 91-96.
- Öztürk, B., Öztürk, A.A. (1996) On the biology of the Turkish straits system. *Bull Inst océanogr, Monaco*, no spécial 17: 205-221.
- Özütemiz, Ş., Kaya, M., Özaydın, O. (2009) Growth and feeding characteristics of two shark species [*Galeus melastomus* Rafinesque, 1810 and *Squalus blainvillei* (Risso, 1826)] from Sığacık Bay (Aegean Sea). *E.U. Journal of Fisheries & Aquatic Sciences* 26: 211-217.
- Papaconstantinou, C. (1987) Distribution of the Lessepsian fish migrants in the Aegean Sea. *Biologia Gallohellenica* 13: 15-20.
- Papaconstantinou, C. (1992) General remarks on the Greek seas fish fauna. *Doriana* 6: 1-8.
- Papastamatiou, Y.P., Itano, D.G., Dale, J.J., Meyer, C.G., Holland, K.N. (2010) Site fidelity and movements of sharks associated with ocean farming cages in Hawaii. *Mar Freshwater Res* 61: 1366-1375.
- Prodanov, K., Mikhailov, K., Daskalov, G., Maxim, C., Chaschin, A., Arkhipov, A., Shlyakhov, V., Özdamar, E. (1997) Environmental management of fish resources in the Black Sea and their exploitation. Studies and Reviews. General Fisheries Council for the Mediterranean. No. 68. Rome, FAO, 178 pp.
- Serena, F. (2005) Field identification guide to the sharks and rays of the Mediterranean and Black Sea. FAO Species Identification Guide for Fishery Purposes, FAO, Rome, 97 p.
- Springer, V.G., Gold, J.P. (1989) Sharks in Question: The Smithsonian Answer Book. Washington, D.C., Smithsonian Institution Press, 187 pp.

- Steel, R. (1985) *Sharks of the world*. Blandford Press, London, 192 pp.
- Tunçer, S., Kabasakal, H. (2016) Capture of a juvenile shortfin mako shark, *Isurus oxyrinchus* Rafinesque, 1810 (Chondrichthyes: Lamnidae) in the Bay of Edremit, northern Aegean Sea (Turkey). *Annales Ser Hist Nat* 26: 31-36.
- Türker Çakır, D., Torcu Koç, H., Erdoğan, Z. (2006) Some biological aspects of the lesser spotted dogfish *Scyliorhinus canicula* (Linnaeus, 1758) in Edremit Bay (the northern Aegean Sea) Turkey. In: The Proceedings of the Workshop on Mediterranean Cartilaginous Fish with Emphasis on Southern and Eastern Mediterranean (eds., Başusta, N., Keskin, Ç., Serena, F., Seret, B.). Turkish Marine Research Foundation. Istanbul, Turkey. Publication Number: 23 pp. 17-27.
- Ulutürk, T. (1987) Fish fauna, background radioactivity of the Gökçeada marine environment. *Journal of Aquatic Products University of Istanbul* 1: 95-119.
- Vas, P. (1991) A field guide to the sharks of British coastal waters. *Field Studies* 7: 651-686.
- White, W.T., Ebert, D.A., Naylor, G.J.P., Ho, H.C., Clerkin, P., Veríssimo, A., C.F., Cotton (2013) Revision of the genus *Centrophorus* (Squaliformes: Centrophoridae) Part 1 – Redescription of *Centrophorus granulosus* (Bloch & Schneider), a senior synonym of *C. acus* Garman and *C. niaukang* Teng. *Zootaxa* 3752: 035–072.
- Whitehead, P.J.P., Bauchot, M.-L., Hureau, J.C., Nielsen, J., Tortonese, E. (eds.) (1984) *Fishes of the north-eastern Atlantic and Mediterranean*. vol. 1. UNESCO, Paris.
- Wilga, C.A.D., Lauder, G.V. (2004) Biomechanics of locomotion in sharks, rays and chimeras. In: *Biology of Sharks and Their Relatives*. (eds., Carrier, J. C., Musick, J.A., Heithaus, M.R.). CRC Press, Boca Raton, London, New York, Washington DC, 596 p.
- Yağlıoğlu, D., Deniz, T., Gürlek, M., Ergüden, D., Turan, C. (2015) Elasmobranch bycatch in a bottom trawl fishery in the Iskenderun Bay, northeastern Mediterranean. *Cah Biol Mar* 56: 237-243.
- Yığın, C.Ç., İşmen, A. (2013) Reproductive biology of spiny dogfish *Squalus acanthias*, in the north Aegean Sea. *Turk J Fish Aquat Sci* 13: 169-177.

Yığın, C. Ç., İşmen, A., Önal, U. (2016) Occurrence of a rare shark, *Oxynotus centrina* (Chondrichthyes: Oxynotidae), from Saros Bay, North Aegean Sea, Turkey. *J Black Sea / Medit Environ* 22: 103-109.

Yığın, C.Ç., İşmen, A., Daban, B., Cabbar, K., Önal, U. (2019) Recent findings of rare sharks, *Squatina oculata* Bonaparte, 1840 and *Squatina squatina* (Linnaeus, 1758) from Gökçeada Island, Northern Aegean Sea, Turkey. *J Black Sea / Medit Environ* 25(3): 305-314.

Zogaris, S., De Maddalena, A. (2014) Sharks, blast fishing and shifting baselines: insights from Hass's 1942 Aegean expedition. *Cah Biol Mar* 55: 305-313.

