

RESEARCH ARTICLE

## Historical and Contemporary Occurrence of *Odontaspis ferox* (Risso, 1810) (Lamniformes: Odontaspidae) in Turkish Seas, with New Records from the Region

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### Introduction

The family Odontaspidae is represented by a single genus and two uncommon species in the world's oceans (small-tooth sand tiger *Odontaspis ferox* (Risso, 1810) and bigeye sand tiger *O. noronhai* (Maul, 1955)) (Ebert *et al.*, 2021; Froese & Pauly, 2023). They are characterized by stout, large heavy-bodies with bulbous conical snouts, long mouths extending behind eyes, eyes without nictitating eyelids, tearing type dentition, anal fin and second dorsal fin smaller than first dorsal fin, all three broad-based

(Compagno, 2001). The bigeye sand tiger is arguably the most rarely captured extant lamniform species in the world with sporadic records from the Indian, Pacific, and Atlantic oceans (Stone & Shimada, 2019), while the small-tooth sand tiger is found circumglobally in warm-temperate and tropical seas with a very irregular and disjunctive distribution, and is the only representative of the genus in the Mediterranean Sea (Bonfil, 1995; Compagno, 2001). *Odontaspis ferox* was first described from the Nice coast (Western Mediterranean) by Risso (1810), and it is

### Abstract

**Objective:** The aim of the present article is to review historical and recent records of the critically endangered *Odontaspis ferox* from Turkish seas, and to present previously unpublished sightings.

**Materials and Methods:** Data of the present article was collated from the following sources: (a) observations during the visits to main fishing ports and fish markets located along Aegean and Mediterranean coasts of Türkiye; (b) screening of digital and published media reporting on the capture of large sharks in Turkish seas; (c) screening of old and contemporary ichthyological books and shark-specific publications, dealing with the fishes of Aegean Sea and eastern Mediterranean; and (d) citizen scientists' observations.

**Results:** Four previously unpublished records of *O. ferox* from the Turkish Mediterranean coasts are reported, and with the addition of recent sightings, the total number of documented records of the species from Türkiye has increased to eight.

**Conclusion:** Despite previous suspicions of the existence of *O. ferox* in Turkish seas, the present study has verified the occurrence of the species in the region. The scarcity of evidence-based observations is compatible with research findings from other parts of the Mediterranean Sea and the Turkish population of the species is currently recognized as rare. Owing to the extinction risk of *O. ferox*, it should be rapidly included in the list of species banned for fishing through official fishery legislation published by the Ministry of Agriculture and Forestry.

**Keywords:** Aegean Sea, Mediterranean Sea, occurrence, smalltooth, status

mostly associated with deep and upper slope waters along continental and insular shelves and lives on or near the bottom (Compagno, 2001). The Mediterranean population distributes mainly at depths from 10 to 250 m (Fergusson *et al.*, 2008), but it is also known to inhabit depths as shallow as 1 m and as deep as 928 m elsewhere in the world (Fergusson *et al.*, 2008; Francis & Lyon, 2012; Barria *et al.*, 2018), and the recent findings of Higgs *et al.* (2022) support this depth range.

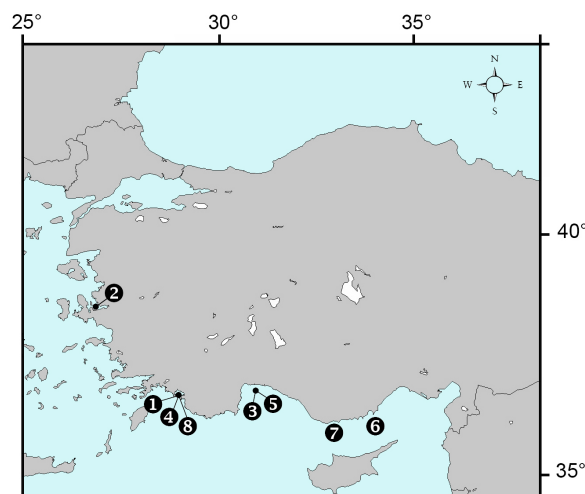
Despite the fact that *O. ferox* observations from the Mediterranean Sea date back to the 1800s (Hoffman & Jordan, 1892; Carus, 1893), it was mentioned to be a rare species a century ago (Desbrosses, 1930). There are relatively few reported captures globally, where Fergusson *et al.* (2008) compiled a list with nearly 160 records, 14 of which were from the Mediterranean Sea observed during the period between 1964 and 2008. The small-tooth sand tiger shark is thus regarded as a naturally rare species making *O. ferox* highly susceptible to exploitation because of its *k*-selected life strategies (slow growth, late maturation, low fecundity, long gestation periods), combined with the semi-enclosed nature of the Mediterranean Sea and existing anthropogenic stressors (Bonfil, 1995; Cavanagh & Gibson, 2007; Nuez *et al.*, 2021). Populations of *O. ferox* are declining and the species has been listed by the IUCN as vulnerable on a global scale (Graham *et al.*, 2016) and critically endangered at the Mediterranean Sea regional level (Pollard *et al.*, 2016). It is also included in Annex II of the Specially Protected Areas and Biological Diversity Protocol (UNEP/MAP-SPA/RAC, 2018) and according to the GFCM recommendation (no. 36/2012/3), *O. ferox* cannot be retained on board, transshipped, landed, transferred, stored, sold or displayed or offered for sale.

The occurrence of *O. ferox* in Turkish seas was a matter of dispute for a long time, due to the lack of stored specimens or photographic material for precise species identification (Kabasakal, 2021). Besides a couple of unverified historical records of the species (i.e., Geldiay, 1969; Fischer *et al.*, 1987; Mater & Meriç, 1996), only four *O. ferox* individuals were recorded from the Turkish coast until now (Fergusson *et al.*, 2008; Kabasakal & Bayrı, 2019; Kabasakal & Bilecenoğlu, 2020). In this paper, we present four additional *O. ferox* sightings from the Turkish Mediterranean coasts that would fill the knowledge gap to a great extent for this remarkably poorly known species.

## Materials and Methods

Data of the present article was collated from the following sources: (a) screening of old and contemporary

ichthyological books and shark-specific publications (i.e. Geldiay, 1969; Fischer *et al.*, 1987; Mater & Meriç, 1996), dealing with the fishes of the Aegean Sea and the eastern Mediterranean, to extract unverified historical records of the species from the study area; (b) screening of peer-reviewed articles (Fergusson *et al.*, 2008; Kabasakal & Bayrı, 2019; Kabasakal & Bilecenoğlu, 2020) to extract the evidence-based previous occurrences of *O. ferox* in Turkish seas; (c) screening of digital and published media reporting on the capture of large sharks in Turkish seas; and (d) citizen scientists' observations. The unverified historical records of *O. ferox* (data source (a)) were not included in Table 1, because of their nonevidence-based nature. Only the evidence-based contemporary records (data source (b)) and unpublished additional records (data sources (c) and (d)) were presented in Table 1, in agreement with the protocol proposed by Kovačić *et al.* (2020). Whenever possible the following data was collated for examined specimens: total length (TL), total weight (TW), sex, date and locality of capture, type of fishing gear, post-landing remarks such as the locality where the captured *O. ferox* shipped to be displayed, auctioned and/or sold as a whole or cut into pieces. Regarding the nature of fishery-dependent opportunistic research (Jessup, 2003), information on the size and weight of the captured small-tooth sand tiger sharks were either extracted from the fishing logs or obtained after an interview with the fisherman, or collated following the data mining of digital or published media, in which the relevant data has always been provided by the fishers. Species identification follows Compagno (2001) and Ebert *et al.* (2021), and taxonomic nomenclature follows Froese & Pauly (2023). Photographs



**Figure 1.** Map showing approximate capture localities of *Odontaspis ferox* along the Turkish coast. The numbers correspond to relevant specimens given in Table 1.

**Table 1.** Summary of evidence-based occurrences of *Odontaspis ferox* along the Turkish coasts in chronological order. Specimen numbers are the same as the numbers shown on the map in Figure 1. N/A: Not available

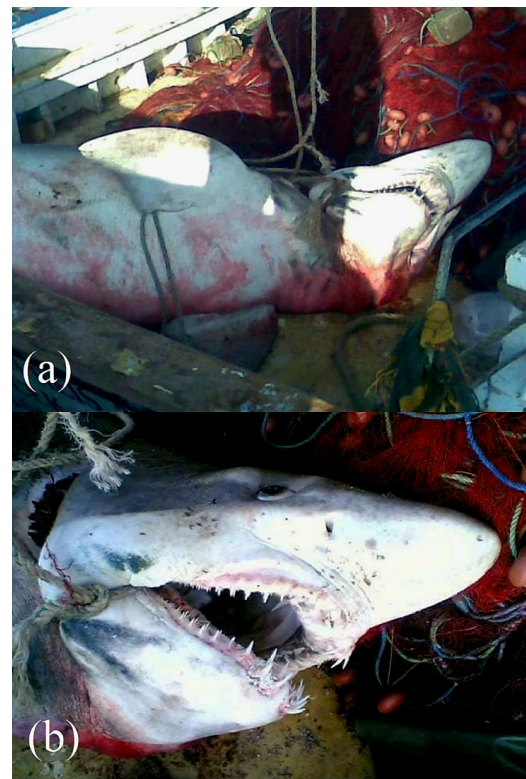
No	Year	Location	Size (cm)	Sex	Depth	Remarks	Reference
1	2002	Fethiye Bay	200	N/A	N/A	Captured in demersal trawl fishery	Fergusson <i>et al.</i> (2008)
2	2004	Urla, İzmir Bay	190	F	30	Captured in artisanal fishery, type of the fishing gear is unknown	Fergusson <i>et al.</i> (2008)
3	2009	Antalya Bay	ca. 400	N/A	N/A	Type of fishing gear is unknown; the specimen was cut to pieces and sold	Present study
4	2013	Fethiye Bay	ca. 120	F	N/A	Type of fishing gear is unknown; shipped to İstanbul Fishmarket and auctioned	Present study
5	2019	Antalya Bay	ca. 400	F	100 to 120	Captured in demersal trawl fishery	Kabasakal & Bayrı (2019)
6	2019	Taşucu, Mersin	ca. 400	F	N/A	Captured in demersal trawl fishery and sold	Kabasakal & Bilecenoğlu (2020)
7	2021	Bozyazı, Mersin	ca. 350	F	N/A	Captured in demersal trawl fishery and sold	Present study
8	2022	Fethiye Bay	272	M	N/A	Type of fishing gear is unknown; the specimen cut to pieces and sold; jaws are preserved in the personal collection of Mr. Erdi Bayrı	Present study

of the additional records of *O. ferox* were stored in the personal archive of the corresponding author and available upon request for further inspection. Capture localities of *O. ferox* in Turkish marine waters are plotted on the map (Fig. 1) and details of relevant data are presented in Table 1.

## Results

### *Description of examined specimens (Figs. 2-5)*

Small-tooth sand tiger sharks are large, bulky odontaspids with a long bulbously conical snout, and mouth long and extending behind eyes (Figs. 2-3); tooth rows numerous and teeth moderately large with a prominent narrow cusp with two pairs of lateral cusplets (Figs. 2-5); upper anterior teeth separated from lateral teeth by 2 to 4 rows of small intermediate teeth (Fig. 5); first dorsal fin closer to pectoral-fin bases than pelvic-fin bases (Figs. 3-4); first dorsal fin noticeably larger than second dorsal fin and anal fin (Fig. 4); anal fin with strongly concave posterior margin (Fig. 3); caudal fin asymmetrical but with a strong ventral lobe (Fig. 3); color medium grey or grey-brown above, usually lighter below, sometimes with darker spots scattered on the body (Figs. 2-5). Observed descriptive characters coincide with those presented in Compagno (2001) and Ebert *et al.* (2021), thus the examined specimens (n=4) were described as *O. ferox*.



**Figure 2.** Specimen of *Odontaspis ferox* captured off Antalya in the summer of 2009 (record no 3 in Table 1). (a) ventral view of the specimen; and (b) ventro-lateral view of the head showing the long mouth extending behind the eyes.

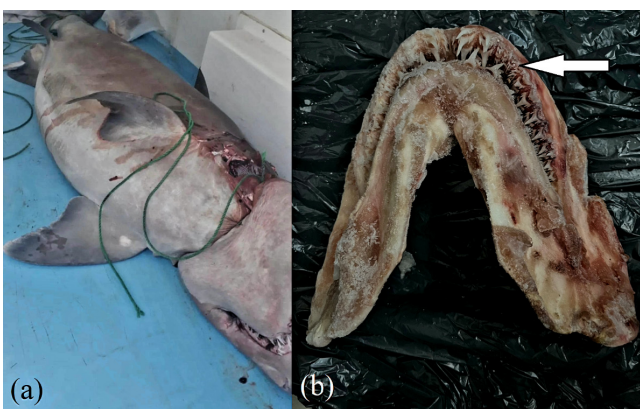




**Figure 3.** Specimen of *Odontaspis ferox* captured off Fethiye coast in 2013 (record no 4 in Table 1). Arrow denotes the strongly concave posterior margin of the anal fin.



**Figure 4.** Specimen of *Odontaspis ferox* captured off Bozyazı on 4th of November 2021 (record no 7 in Table 1). (a) lateral lines denote that the first dorsal fin is closer to pectorals than pelvic fins; also on this panel, it is seen that the first dorsal fin is larger than the second one; and (b) arrow denotes the rows of small intermediate teeth separating upper anterior teeth.



**Figure 5.** Specimen of *Odontaspis ferox* captured off Fethiye coast on 13th of July 2022 (record no 8 in Table 1). (a) ventrolateral view of the specimen; and (b) arrow denotes the rows of small intermediate teeth separating upper anterior teeth.

### Additional records

Available data collated from the sources, which are mentioned in the materials and methods section, revealed four additional records of *O. ferox* from the Turkish Mediterranean waters. In the summer of 2009, a specimen of *O. ferox* was captured off Antalya in commercial fisheries and sold to a hotel or a restaurant to attract customers' attention (Fig. 2). In 2013, a juvenile small-tooth sand tiger shark was captured in commercial fisheries off the Fethiye coast and shipped to the İstanbul wholesale fish market for auction (Fig. 3). On 4 November 2021, a specimen of *O. ferox* was captured in a demersal trawl fishery off the Bozyazı coast, upon landing cut to pieces and sold to a restaurant (Fig. 4). Recently, on 13 July 2022 a small-tooth sand tiger shark was captured off the Fethiye coast, which was also cut to pieces and sold (Fig. 5).

### Discussion

Sharks are among the most threatened marine taxa in the Mediterranean Sea, evidently declining more severely in abundance when compared to other parts of the world (Cavanagh & Gibson, 2007; Bargnesi *et al.*, 2020). Since conservation and management actions are strongly dependent on a sound knowledge of local diversity, historical and contemporary records of especially rare and threatened shark species are of great importance (Tavares *et al.*, 2019), as in the present case of small-tooth sand tiger shark.

The presence of *O. ferox* along the Aegean and Mediterranean coasts of Türkiye was first mentioned by Geldiay (1969), but this research was not associated either by a stored specimen, or photographic and morphological evidence, hindering its confirmation from the region. Two additional studies also presented information on its occurrence from Türkiye (Fischer *et al.*, 1987; Mater & Meriç, 1996), again without any evidence that may help with the verification of the relevant records. The occurrence of *O. ferox* in Türkiye was thus a matter of dispute for a long time until the capture of two individuals from İzmir and Fethiye Bay was presented by Fergusson *et al.* (2008). Since no further observations were available from the region in the following decade, the species was considered to be possibly extinct from Turkish coasts in the IUCN regional red list (Pollard *et al.*, 2016). In a recent study, Kabasakal & Bayrı (2019) reported a specimen of *O. ferox* (TL 400 cm) caught by a bottom trawler off Antalya Bay, not only substantiating its presence in Türkiye but also proving that the species is not extinct yet.

Following the comprehensive list of Fergusson *et al.* (2008) comprising 14 captured *O. ferox* individuals from the Mediterranean Sea between 1964 and 2008, a total of 10 further evidence-based records were published at disjunct localities including Rhodes Island (Corsini-Foka, 2009), Andros Island (Damalas & Megalofonou, 2012), Malta (Vella *et al.*, 2017), Cyprus (Akboru *et al.*, 2019; Giovos *et al.*, 2021), Tunisia (Ben Amor *et al.*, 2020), Türkiye (Kabasakal & Bayrı, 2019; Kabasakal & Bilecenoğlu, 2020), eastern Aegean Sea (Moutopoulos *et al.*, 2022), and Albania (Soldo *et al.*, 2022), corresponding to a total of 24 records given during the last 60 years. This geographical pattern clearly reveals the widespread but patchy distribution of the species throughout the Mediterranean Sea with remarkably low density. Due to the sporadic and irregular nature of records of small-tooth sand tiger sharks from Turkish waters, we therefore consider its status of occurrence as rare, which is supported by the conclusions outlined in the most recent studies from adjacent waters, emphasizing the rarity of *O. ferox* (Damalas & Megalofonou, 2012; Akboru *et al.*, 2019; Serena *et al.*, 2020; Giovos *et al.*, 2022; Moutopoulos *et al.*, 2022).

Collated information from the field surveys and literature search also provided some basic information on the life history of *O. ferox* occurring in the eastern Mediterranean Sea (Table 1). The size of the small-tooth sand tiger sharks mentioned in the present study varies between approximately 120 and 400 cm, and the depth of captures ranged between 30 and 120 m. Considering the types of known fishing gears (n=8), it is seen that published or examined specimens of *O. ferox* have been captured mainly in different types of demersal fishery (Table 1). Therefore, we can suggest that a wide size range of *O. ferox* is threatened by the fishing pressure of demersal fisheries along the Turkish Mediterranean coast operated along a wide depth range of the continental shelf. Regarding the size at birth (>105 cm) of small-tooth sand tiger sharks (Ebert & Stehmann, 2013), the size of one specimen (Sp. no 4, approximately 120 cm; Table 1) coincides with the juvenile phase of the life span of *O. ferox*; however, for the moment, it is not possible to suggest whether the parturition of small-tooth sand tiger shark occurs in Turkish Aegean or Mediterranean waters, solely based on the previous occurrence of a single juvenile, and further investigation and evidence-based data is required to clarify this question.

## Conclusion

Contrary to previous arguments that *O. ferox* is possibly extinct in Turkish seas (Pollard *et al.* 2019), the presence of the species has been verified by several contemporary

records, of which the most recent incidental capture of this species in the mentioned region was in 2022 (Specimen no 8 in Table 1). Due to patchy occurrence and scarcity of records, the status of occurrence of *O. ferox* in Turkish seas was evaluated as “rare”, which is a resident species along the Turkish Mediterranean coasts. The increasing use of smartphones and social media posts showing the large elasmobranchs opened a window of opportunities to allow shark researchers to warn about the captures of uncommon sharks in remote localities. In recent years, the collaboration with citizen scientists and screening of internet media yielded several new records of sharks from Turkish waters, accompanied with a broadened understanding of the distribution ranges of rare large sharks (Kabasakal & Bilecenoğlu, 2020). Thus, in addition to traditional survey methods, this new approach, use of citizen scientists and local ecological knowledge, may allow us achieving unreported record(s), which eventually may increase our knowledge on the bioecology of the species. Since *O. ferox* is already included in Annex II of the SPA/BD Protocol covered by Recommendations GFCM/36/2012/3 and GFCM/42/2018/2, it should be rapidly included to the list of species banned for fishing through the official fishery legislation published by Ministry of Agriculture and Forestry, owing to the current threat of targeted captures and landings in commercial fisheries.

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**Conflict of Interest:** The authors have no conflict of interest to declare.

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