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CAPTURES OF LARGE SHARK SPECIES FROM THE NORTHEASTERN TUNISIAN COAST (CENTRAL MEDITERRANEAN SEA)

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ABSTRACT

*The paper examines three large predatory sharks captured in the north-eastern Tunisian coast and the central Mediterranean Sea. These three species are bluntnose sixgill shark *Hexanchus griseus* (Bonnaterre, 1788), smalltooth sand tiger shark *Odontaspis ferox* (Risso, 1810), and great white shark *Carcharodon carcharias* (Linnaeus, 1758). The distribution of the three species is detailed and their ecological role commented.*

Key words: Chondrichthyes, *Hexanchus griseus*, *Odontaspis ferox*, *Carcharodon carcharias*, distribution, Tunisian coast

CATTURE DI GRANDI SPECIE DI SQUALI LUNGO LA COSTA TUNISINA NORD-ORIENTALE (MEDITERRANEO CENTRALE)

SINTESI

*L'articolo esamina tre grandi squali predatori catturati lungo la costa nord-orientale della Tunisia e nel Mediterraneo centrale. Si tratta dello squalo capopiatto *Hexanchus griseus* (Bonnaterre, 1788), del cagnaccio *Odontaspis ferox* (Risso, 1810) e del grande squalo bianco *Carcharodon carcharias* (Linnaeus, 1758). Gli autori presentano nel dettaglio la distribuzione delle tre specie e commentano il loro ruolo ecologico.*

Parole chiave: Chondrichthyes, *Hexanchus griseus*, *Odontaspis ferox*, *Carcharodon carcharias*, distribuzione, costa tunisina

INTRODUCTION

The northern Tunisian coast constitutes a transition path for fish species between the western and eastern Mediterranean Basins, and mainly for large predatory sharks (Quignard & Capapé, 1971; Capapé, 1989). This opinion has been corroborated by recent reports of captures occurring in this same area (Rafrafi-Nouira et al., 2015, 2019; Ben Amor et al., 2016; 2019; Capapé et al., 2018).

Investigations regularly conducted concomitantly in Tunisian waters in the wake of local assistance of experienced fishermen have allowed the collection of a shoal of bluntnose sixgill shark *Hexanchus griseus* (Bonnaterre, 1788), a specimen of the rare smalltooth sand tiger *Odontaspis ferox* (Risso, 1810), and a great white shark *Carcharodon carcharias* (Linnaeus, 1758). This paper provides information and data about the capture of the three species, occurring during commercial surveys off the northern Tunisian coast, and some comments about the status of these species in the capture areas, and inside and outside the Mediterranean Sea.

MATERIAL AND METHODS

Each species is separately presented, including data of fishing gear, capture site, depth, nature of bottom and, when possible, associated fauna (Fig. 1). The specimens were rapidly cut into slices and sold soon after landing and it was generally difficult to get for each specimen its size, total length (TL) and total body weight. Photographs were taken to confirm the authenticity of these captures.

RESULTS

Bluntnose sixgill shark *Hexanchus griseus* (Bonnaterre, 1788)

This species is distributed worldwide, from the Pacific to the Indian Ocean, and off both sides of the Atlantic Ocean (Cook & Compagno, 2005). It is known throughout the Mediterranean Sea, in both eastern and western basins, and commonly collected in certain areas (Capapé et al., 2003, 2004; Kabasakal, 2006, 2013; Basusta & Basusta, 2015).

Catches of *Hexanchus griseus* were previously cited in northern Tunisian areas at the level of Eskerkis Bank (Capapé, 1989; Rafrafi-Nouira et al., 2015) and southwards, mainly in the Gulf of Gabès (Bradaï et al., 2002). Additionally, single specimens of *H. griseus* were sporadically captured by trawl targeting European pilchard *Sardina pilchardus* (Walbaum, 1792), approximately at a depth of 200 m, in the Gulf of Tunis. On 10 June 2019, a shoal of 21 *H. griseus* was landed at the fishing port of Kélibia, located in the north of the

Cape Bon Peninsula, northeastern Tunisia, by bottom longline targeting groupers. The captures occurred in the Strait of Sicily between Marettimo Island, close to the northwestern Sicilian coast, and the northeastern Tunisian coast, at a depth of 700-1000 m approximately (Ben Amor et al., 2019).

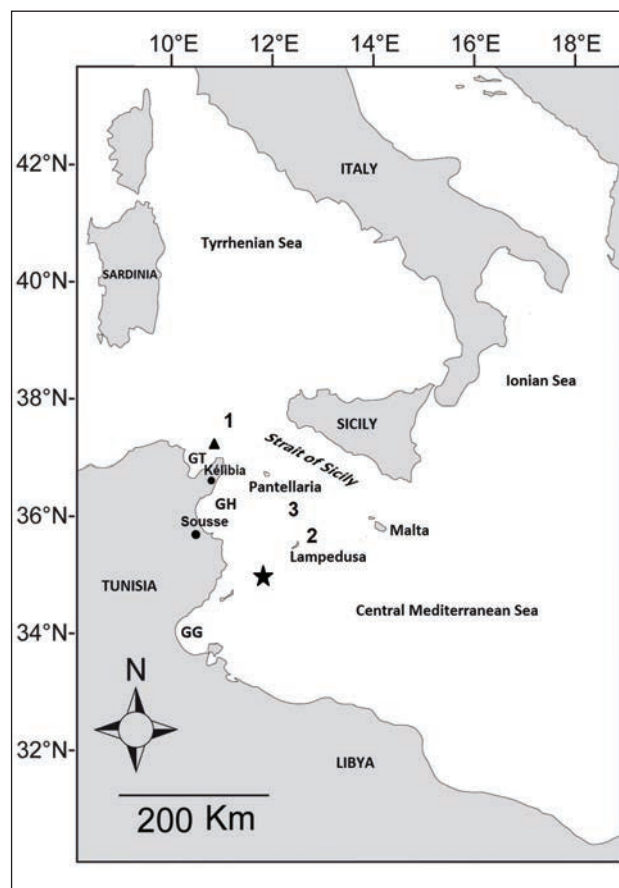


Fig. 1: Map of the central Mediterranean Sea, indicating capture sites of the three large sharks presented in this paper. *Hexanchus griseus*: 1. Capture from Ben Amor et al. (2019). 2. Capture occurring on 9 April 2020. 3. Capture occurring on 24 April 2020. *Odontaspis ferox*: black triangle, around Zembra Island from Capapé (1975). 2. Together with *Hexanchus griseus*. Black star, capture site of *Carcharodon carcharias*. GT = Gulf of Tunis. GH = Gulf of Hammamet. GG = Gulf of Gabès. Sl. 1: Zemljevid obravnavanega območja z označeno lokaliteto, kjer so bili ujeti primerki treh velikih morskih psov. *Hexanchus griseus*: 1. Podatki po Ben Amor s sod. (2019). 2. Ulov z dne 9 aprila 2020. 3. Ulov z dne 24 aprila 2020. *Odontaspis ferox*: črni trikotnik, okoli otoka Zembra, po Capapé (1975). 2. Skupaj s primerkom vrste *Hexanchus griseus*. Črna zvezdica označuje lokaliteto ulova vrste *Carcharodon carcharias*. GT = Tuniški zaliv. GH = Zaliv Hammamet. GG = Zaliv Gabès.



Fig. 2: Shoal of *Hexanchus griseus* landed at the fishing site of Kélibia.

Sl. 2: Jata morskih psov šesteroškrjarjev, ujetih na lokaliteti Kélibia.

One year later, on 9 April 2020, a second shoal of 12 *H. griseus* was collected between the east coast of Linosa, an islet close to Lampedusa, and the western coast of Malta Island, at 35° 43' 20" N and 13° 9' 43" E (see Fig. 1). The specimens were caught by bottom longlines, at depths between 400 and 1100 m on rocky bottom, together with a specimen of smalltooth sand tiger shark *Odontaspis ferox* (Risso, 1810), a specimen of unidentified torpedo, several *Squalus blainvillei* (Risso, 1826), and a specimen of dusky grouper *Epinephelus marginatus* (Lowe, 1834). All captured specimens were landed at the fishing port of Kélibia, where they were examined and photographed (Fig. 2). The total weight of this shoal reached 55 tons.

Additionally, on 24 April 2020, other 2 specimens of *H. griseus* were captured off Pantelleria Island, at 36° 28' 20" N and 12° 31' 30" E. They were caught by bottom longlines, at a depth of 1100 m, on rocky bottom. They were not measured for length, but weighed 350 kg and 400 kg, respectively.

Finally, on 2 May 2020, 13 specimens of *H. griseus*, 2 females and 11 males, were captured 13 miles south-east of Pantelleria Island, at 36° 28' 20" N and 12° 29' 51" E. They were caught by bottom longlines, at a depth of 800 m on rocky bottom, together with specimens of *E. marginatus*. Their total body weight reached



Fig. 3: Fully yolked eggs removed from a female of *Hexanchus griseus*: 1. Each egg was covered by a fine diaphanous membrane. 2. All eggs were enveloped together in one single membranous capsule.

Sl. 3: Z rumenjacom bogato jajce, odstranjeno iz samice vrste *Hexanchus griseus*: 1. Vsako jajce je prekrito s fino presevno membrano. 2. Vsa jajca so skupaj združena v eni membranski kapsuli.

54 tons. Both females measured 3.5 m in total length and weighed 700 kg in total body weight, and carried 120 and 118 fully yolked eggs ready to be ovulated, respectively. Each egg was covered by a fine diaphanous membrane, and together they were enveloped in a single membranous capsule (Fig. 3).

All specimens of *H. griseus* were identified *in situ* or from photographs provided by Kélibia port authority, through the combination of some characteristics, such as: body stout, head broad, snout short and blunt, six gill slits, a single dorsal fin above fin base, upper jaw with 4 rows of front teeth, lower jaw with 6 rows of lower blade-like, comb-shaped teeth on each side, dorsal surface dark brown, belly beige. This description is in total accordance with Boeseman (1984), Compagno (1984), Quéro et al. (2003), and Ebert & Stehmann (2013).

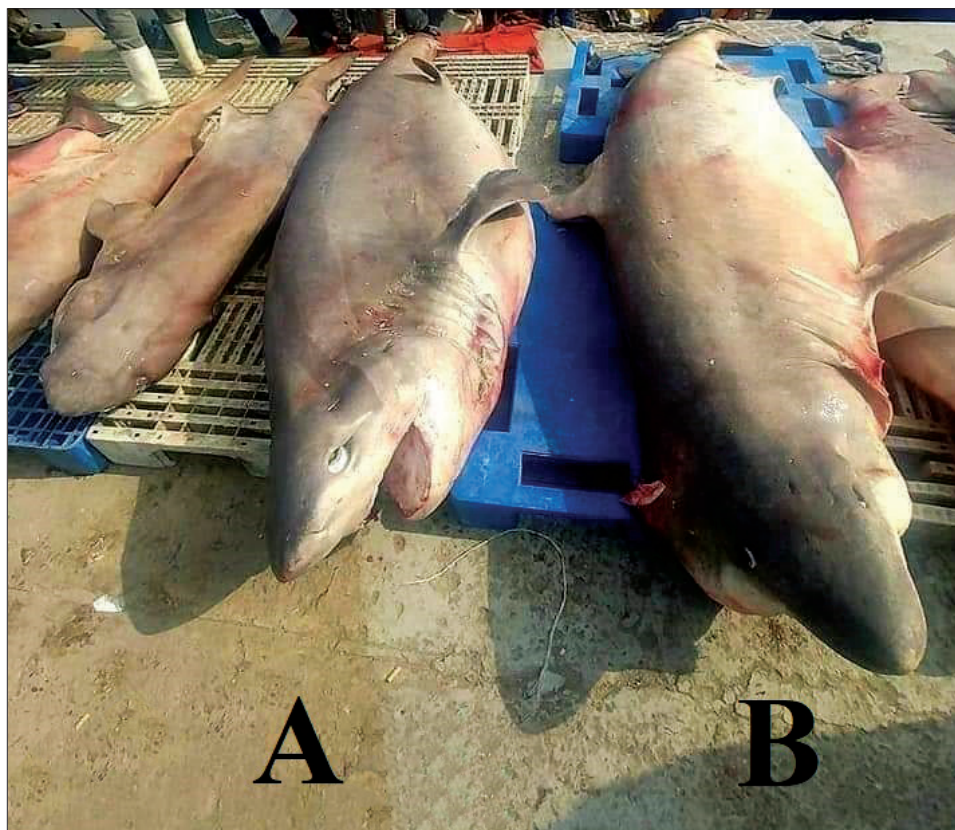


Fig. 4: A. *Hexanchus griseus*. B. *Odontaspis ferox*. landed at the fishing site of Kélibia.
Sl. 4: A. *Hexanchus griseus*. B. *Odontaspis ferox*, iz ribiške lokalitete Kélibia.

Smalltooth sand tiger shark *Odontaspis ferox* (Risso, 1810)

This shark was captured together with a shoal of *H. griseus* in similar conditions (see above). It was identified by the combination of the following main morphological characters: a bulky body with a long conical snout; eye small more than 4 times in snout, without nictitating eyelids; mouth long, extending behind the eyes (Fig. 4); teeth moderately large, each with a prominent narrow cusp and two or more pairs of lateral cusplets (Fig. 5); second dorsal fin origin above or slightly behind anal fin origin; anal fin and second dorsal fin smaller than first dorsal fin, caudal fin asymmetrical, with a strong lower lobe. Colour medium grey, sometimes with darker reddish spots scattered along the body, pelvic and anal fins very dark grey, lower edge of caudal fin almost black. These morphological characters are in total agreement with Compagno (1984), and Ebert & Stehmann (2013).

The smalltooth sand tiger shark, *Odontaspis ferox*, has a cosmopolitan distribution in warm temperate and tropical waters, and although essentially demersal, it has also been captured pelagically in mid-ocean (Compagno, 1984). The species often occurs inshore

at steeply shelving coastal and insular locations, and in the Southern Hemisphere, most *O. ferox* were caught by trawl on the continental slope down to 880 m (Fergusson et al., 2008).

Due to its wide distribution, the species has been reported in oceans and seas throughout the world (Ebert & Stehmann, 2013). It is sporadically captured off the western Atlantic coast from North America (Sheehan, 1998) to Brazil (Menni et al., 1995). Off the eastern Atlantic coast, *O. ferox* is recorded off France (Quéro et al., 2003), Portugal (Carneiro et al., 2014) and southward of the Strait of Gibraltar from Morocco, without information about the capture site according to Collignon & Aloncle (1972), to Mauritania (Ebert & Stehmann, 2013). It is recorded in waters surrounding islands such as the Azores (Barcelos et al., 2018), Madeira (Maul, 1955), the Canaries (Barría et al., 2018) and Cape Verde (Wirtz et al., 2013).

The first Mediterranean record of *O. ferox* occurred off Nice, southern France (Risso, 1810), subsequently, it was also reported by Bougis (1959) and Granier (1964); conversely, Capapé (1977) and Capapé et al. (2000) did not find the species in the area. Barrull & Mate (2002) considered the species as present off the Spanish coast. Tortonese (1956)

noted the capture of a large female, 370 cm TL, from the Gulf of Genoa, southwards, two other specimens were reported by Vanni (1992), while Vacchi & Serena (1997) and Sperone *et al.* (2012) reported captures from the Sicily Strait. Soldo & Jardas (2000) added that *O. ferox* is sporadically caught in the Adriatic Sea. Eastwards, *O. ferox* is present in the Aegean Sea (Ondrias, 1971), furtherly Kabasakal & Bayri (2019) summarized several captures of specimens that occurred in Turkish waters, while Akbora *et al.* (2019) reported other captures from Cyprus Island. Additionally, *O. ferox* is also recorded in the Levant Basin (Mouneimne, 1977; Golani, 2005; Bariche & Fricke, 2020).

Off the Maghreb shore, Dieuzeide *et al.* (1953) noted the occurrence of the species in the Algerian coast, which was furtherly confirmed (Hemida, pers. com., in Barrull & Mate, 2002). Capapé (1975) reported the capture of a female measuring 247 cm TL and weighing 70 kg, off Zembra Island, located in the Gulf of Tunis, northeastern Tunisia. The present capture (Fig. 5) constitutes a new record for the central Mediterranean Sea, where Schembri *et al.* (2003) noted that specimens may be collected annually in small numbers around Malta Islands; among them adult females of up to ca 360 cm TL were captured during years 1998 and 1999 in the area.

Great white shark *Carcharodon carcharias* (Linnaeus, 1758)

This large shark has worldwide distribution, especially in temperate waters, and its occurrence is well documented throughout the Mediterranean Sea, especially in the Strait of Sicily, where several juvenile and adult specimens were recorded (Quéro, 1984; Fergusson 1996, 2002; Saïdi *et al.*, 2005; Maliet *et al.*, 2013). *C. carcharias* is known off the Tunisian coast, like other large and dangerous elasmobranch species (Capapé *et al.*, 1975), and it appears that more than 60 reliable captures of the species should be taken into consideration from Tunisian waters (Zaouali *et al.*, 2020).

On 28 April 2020, a specimen was caught by drift longline baited with clupeid and scombrid species. The capture occurred off Sousse, a city located in eastern Tunisia, at 35° 01' 01" N and 12° 11' 11" E, at a depth of 30-50 m, on soft bottom. The specimen was a female measuring 232 cm TL and weighing 90 kg. It was identified based on the combination of main morphological characters, such as: body very large, fusiform, snout rather blunt, flattened above, origin of first dorsal fin slightly posterior to inner corner of pectoral fin, a single keel on caudal base, teeth triangular, coarsely serrate, blade-like; colour greyish-brown or blue above, belly white (Fig. 6).



Fig. 5: Head and mouth of *Odontaspis ferox* showing the teeth (black arrow).

Sl. 5: Glava in usta vrste *Odontaspis ferox* z zobmi (črna puščica).

DISCUSSION

The captures of large sharks reported in the present paper indicate that these species are not totally extinct in the Mediterranean and some viable populations continue to develop and reproduce in this sea. Such is for instance the case for *H. griseus* and *C. carcharias*.

Conversely, such pattern is not evident for *O. ferox*, but it cannot be totally ruled out seeing that some specimens were recently captured in the eastern Mediterranean (Kabasakal & Bayri, 2019; Akbora *et al.*, 2019; Bariche & Fricke, 2020).

About the specimens caught from Malta Islands, Schembri *et al.* (2003) noted that such discoveries suggest that adult females reach annually selected sites, possibly for reproduction, which makes *O. ferox* especially vulnerable during aggregations when they fall prey to overfishing and spearfishing more easily. The recent captures of *O. ferox* from both central and eastern Mediterranean suggest that the species is not totally extinct in this sea. However, the presence of a viable population in some areas is yet uncertain, partially due to the lack of information about all traits of its reproductive biology.

These two new captures of shoals of *Hexanchus griseus* from the Tunisian coast confirm once again that the species is not facing a drastic decline despite its *K*-selective traits (Ebert, 1986; Capapé *et al.*,

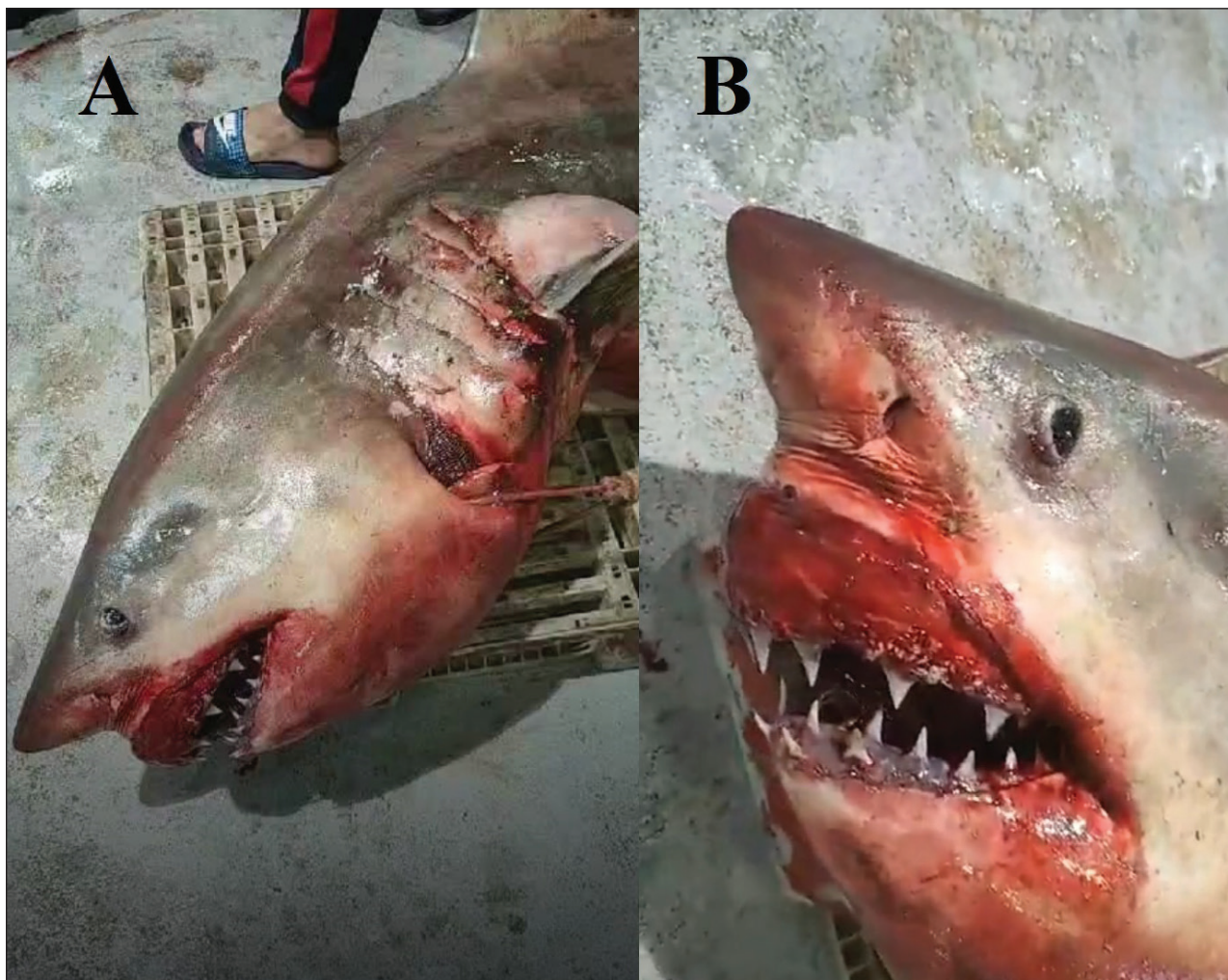


Fig. 6: *Carcharodon carcharias* landed at the fishing site of Sousse. **A. Head. B. Snout showing teeth.**
Sl. 6: *Carcharodon carcharias* iz ribiške lokalitete Sousse. **A. Glava. B. Gobec z zobmi.**

2004). Also, there have been several records reported throughout the Mediterranean during several decades, suggesting that a viable population of *H. griseus* is at present probably established in this sea. The captures of the two shoals probably occurred during the shark's reproductive period as indicated by the presence of large males and females, probably adults. Such hypothesis is confirmed by the fact that three females carried fully yolked oocytes. The record of first such specimen was provided by Ounifi-Ben Amor *et al.* (2017), and two are described in the present paper. The numbers of these oocytes, 85, 118 and 120 revealed higher levels of ovarian fecundity than is generally recorded in viviparous sharks. *H. griseus* could be classified as a relatively prolific elasmobranch species and such phenomenon explains its abundance in some areas, Tunisian and Turkish waters as best instances. Each oocyte is protected by a fine membrane, and all oocytes are enveloped together

in an external membrane. This prevented them from being scattered while handled by fishermen, which unfortunately, can happen, too (see Ounifi-Ben Amor *et al.*, 2017).

Such abundance could be correlated to food sources and feeding aggregation, or, like in the present cases, to sharks apparently schooling to revisit sites with good environmental conditions and availability of food and in search of favourable nursery grounds where females could lay and protect their brood. Such patterns cannot be totally ruled out.

The flesh of *H. griseus* is not appreciated for consumption by Tunisian people, it is probably ichthyosarcotoxic due to its richness in oil and rather dangerous to health (see Capapé *et al.*, 1975). The shark was not targeted by fishermen, but due to the fact that the country is facing economic difficulties, these captures are considered an opportunity by fishermen and consequently the sharks are not released

back into the sea, which may contribute to a possible depletion of stocks. A strong monitoring of the species should therefore be conducted to avoid a drastic decline of the species in the area.

Boldrocchi *et al.* (2017) noted that between 476 and 2015, 628 reliable records of *C. carcharias* were reported in the Mediterranean Sea, and informed us (Boldrocchi, 2020, *in letteris*) that no other record occurred in this sea since 2015. The two records of *C. carcharias* reported by Rafrafi *et al.* (2015, 2019) from the northeastern Tunisian coast and the present record are probably the last ones known to date locally and in this sea. Such records mean that Tunisian waters are a hotspot for conservation and reproduction of this species. The specimen caught off Sousse is probably a juvenile specimen (see Compagno, 1984) and confirms the hypothesis that Tunisian waters could be a nursery ground for the species. Despite a number of white sharks caught in Tunisian waters and their relative abundance, their role in the conservation

and reproduction of the species were completely dismissed by Moro *et al.* (2019), which is a rather incomprehensible and inadmissible opinion.

Following Ferretti *et al.* (2008) it appears, according to the evidence available, that large predatory sharks in the Mediterranean Sea are generally declining in abundance, diversity and range. Conversely, the data herein presented indicate that may not be the case in certain Mediterranean areas.

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ULOVI VELIKIH MORSKIH PSOVA OB SEVEROVZHODNI TUNIZIJSKI OBALI (OSREDNJE SREDOZEMSKO MORJE)

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POVZETEK

Avtorji poročajo o treh vrstah velikih morskih psov, ujetih ob severovzhodni tunizijski obali. Gre za primerke morskega psa šesteroškrgarja *Hexanchus griseus* (Bonnaterre, 1788), morskega bika *Odontaspis ferox* (Risso, 1810), in belega morskega volka *Carcharodon carcharias* (Linnaeus, 1758). Razpravljajo o razširjenosti vrst in njihovi ekološki vlogi.

Cljučne besede: Chondrichthyes, *Hexanchus griseus*, *Odontaspis ferox*, *Carcharodon carcharias*, razširjenost, tunizijska obala

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