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OCCURRENCE OF DEEP-SEA SQUALIFORM SHARKS, *ECHINORHINUS BRUCUS* (ECHINORHINIDAE) AND *CENTROPHORUS UYATO* (CENTROPHORIDAE), IN MARMARA SHELF WATERS

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ABSTRACT

On 2 October 2019, a female little gulper shark, *Centrophorus uyato*, was captured at a depth of 150 m in the central Sea of Marmara. The species had been last documented in the region in 1991 and the capture of the present specimen occurred more than 30 years after the species' first occurrence in this area. On 21 August 2021, a shoal of bramble sharks ($n=17$), *Echinorhinus brucus*, were captured in the same station at a depth of 150 m. Large deep-sea sharks, such as *E. brucus*, should not be exclusively considered as solitary sharks, since the species has also been sighted in shoals; however, the aggregation recorded in the area requires further investigation to assist with future management plans for this species. The occurrence of these rare deep-sea sharks in the Sea of Marmara should be monitored carefully to ensure their existence in this marine environment.

Key words: sharks, deep-sea, occurrence, continental shelf, anoxic conditions

PRESENZA DI SQUALI SQUALIFORMI, *ECHINORHINUS BRUCUS* (ECHINORHINIDAE) E *CENTROPHORUS UYATO* (CENTROPHORIDAE), NELLE ACQUE DELLA PIATTAFORMA DI MARMARA

SINTESI

Il 2 ottobre 2019 è stata catturata una femmina di centroforo boccanera, *Centrophorus uyato*, a 150 m di profondità nel Mar di Marmara centrale. La specie era stata documentata per l'ultima volta nella regione nel 1991 e la cattura di questo esemplare è avvenuta più di 30 anni dopo la prima segnalazione della specie in quest'area. Il 21 agosto 2021, un banco di ronchi ($n=17$), *Echinorhinus brucus*, è stato catturato nella stessa stazione a una profondità di 150 m. I grandi squali di profondità, come *E. brucus*, non dovrebbero essere considerati esclusivamente come squali solitari, dal momento che la specie è stata avvistata anche in banchi; tuttavia, l'aggregazione registrata nell'area richiede ulteriori indagini per contribuire ai futuri piani di gestione di questa specie. La presenza di questi rari squali di profondità nel Mar di Marmara dovrebbe essere monitorata con attenzione per garantire la loro esistenza in questo ambiente marino.

Parole chiave: squali, acque profonde, presenza, piattaforma continentale, condizioni anossiche

INTRODUCTION

Deep-sea chondrichthyans have been defined as sharks, rays and chimaeras whose predominant distribution or most of their lifecycle is restricted to depths from about 200 m to over 2000 m (Ebert, 2013; Cotton & Grubbs, 2015). Of the global chondrichthyan fauna (1,207 species), 575 species are considered to be deep-sea (47.6% of global total; Cotton & Grubbs, 2015), with the order of Squaliformes being the most species-rich group among these (Ebert, 2013, 2015). To date, a total of 88 chondrichthyan species have been recorded in the Mediterranean Sea, including 48 shark species, 38 batoid species, and 2 chimaeras (Serena et al., 2020). According to a recent overview of the deep-sea fauna of the eastern Mediterranean Sea (Damalas et al., 2022), the number of chondrichthyan species occurring at >200 m depth is 22 in the eastern Ionian Sea, 12 in the southern Aegean Sea, 11 in the Libyan Sea and 7 in the northern Aegean Sea. From a chronological perspective, Sion et al. (2004) identified 7 species occurring between 600 and 4,000 m during a DESEAS survey carried out in three areas of the Mediterranean Sea (the Balearic Sea - GSA 5, and western and eastern Ionian Sea - GSAs 19 and 20, respectively). During a MEDITS survey covering an extensive marine area (GSAs 1, 5, 6, 7, 8, 9, 10, 11, 16, 17, 18, 19, 20, 22, 23 and 25), Follesa et al. (2019) recorded 14 species of deep-sea sharks occurring in the area, with 2 of them occupying depths between 10 and 800 m, and the remaining 12, including *Centrophorus* cf. *granulosus* (Bloch and Schneider, 1801) (which is no longer a valid species) and *C. uyato*, occupying depths between 200 and 800 m. In a recent study, Carluccio et al. (2021) observed 6 shark species by means of a MEMO baited lander in central Mediterranean between 300 and 1,110 m in depth.

One of the primary obstacles in deep-sea chondrichthyan research is the difficulty of observing, sampling, or collecting data (Cotton & Grubbs, 2015). Since deep-sea research requires a significant amount of logistic support and funding, the deep-sea chondrichthyans in the Sea of Marmara were, in the past, neglected in systematic research in favour of commercially valuable teleosts. For many years, the main source of knowledge on the deep-sea chondrichthyans of the region has been opportunistic sampling, carried out during general ichthyological demersal surveys or deep-sea imaging surveys for geological purposes (Benli et al., 1993; Meriç, 1995; Kabasakal et al., 2005; Kabasakal & Dalyan, 2011; Kabasakal & Bilecenoğlu, 2014; Kabasakal, 2009a, 2009b, 2017). In a recent review of the deep-sea shark populations of the Sea of Marmara, Kabasakal (2022) stated that

bathydemersal species accounted for approximately 43% (6 species) of the sharks in the region. Since every piece of data can provide a valuable contribution to describing the life history of the deep-sea shark species of the Sea of Marmara, researchers are now more involved in sampling and examining rare and previously neglected species. In the present article, we provide new evidence of the presence of *Echinorhinus brucus* (Bonnaterre, 1788) in Marmara shelf waters based on a recent incidental capture of a shoal of bramble sharks in research surveys. We also discuss the reasons that may have led to the capture of a shoal of *E. brucus*, which normally occurs as a sporadic species. Furthermore, we report the occurrence of *Centrophorus uyato* (Rafinesque, 1810) more than 30 years after its first appearance in the Sea of Marmara.

MATERIAL AND METHODS

Study area

Beşiktepe et al. (1994) define the Sea of Marmara (Fig. 1) as a small basin between the continents of Europe and Asia, with a surface area of 11,500 km² and a maximum depth of 1,390 m. The Sea of Marmara is connected to the Mediterranean Sea and the Black Sea through the Dardanelles and the Bosphorus Strait, respectively. A distinguishing feature of the Sea of Marmara is the constant oxygen deficiency below the halocline, which is more pronounced in the eastern Marmara basin (Ünlüata & Özsoy, 1988; Beşiktepe et al., 1994). Recent surveys have demonstrated that in deep trenches anoxic conditions may soon occur (Mantikçi et al., 2022; Salihoğlu et al., 2022).

Sampling methodology

Specimens of *E. brucus* and *C. uyato* were collected during two demersal fishery surveys in autumn 2019 and summer 2021, performed as sub-studies of an extensive governmental project entitled “Integrated Marine Pollution Monitoring 2017-2019 and 2020-2022 Programme in Turkish Seas”. Demersal sampling was carried out by means of a MEDITS-designed otter-trawl, which has a 24 m width at the front opening and a cod-end mesh size of 14 mm (knot-to-knot). Hauling was performed over suitable bottoms at a towing speed of 3 miles/hour for 30 minutes. Field surveys were carried out on board of a stern-trawling research vessel *R/V Yunus-S* of Istanbul University.

The water parameters (salinity, temperature, pH, conductivity and oxygen) were recorded by a CTD (SeaBird SBE 19+). Environmental parameters at station MD18, where the examined specimens of

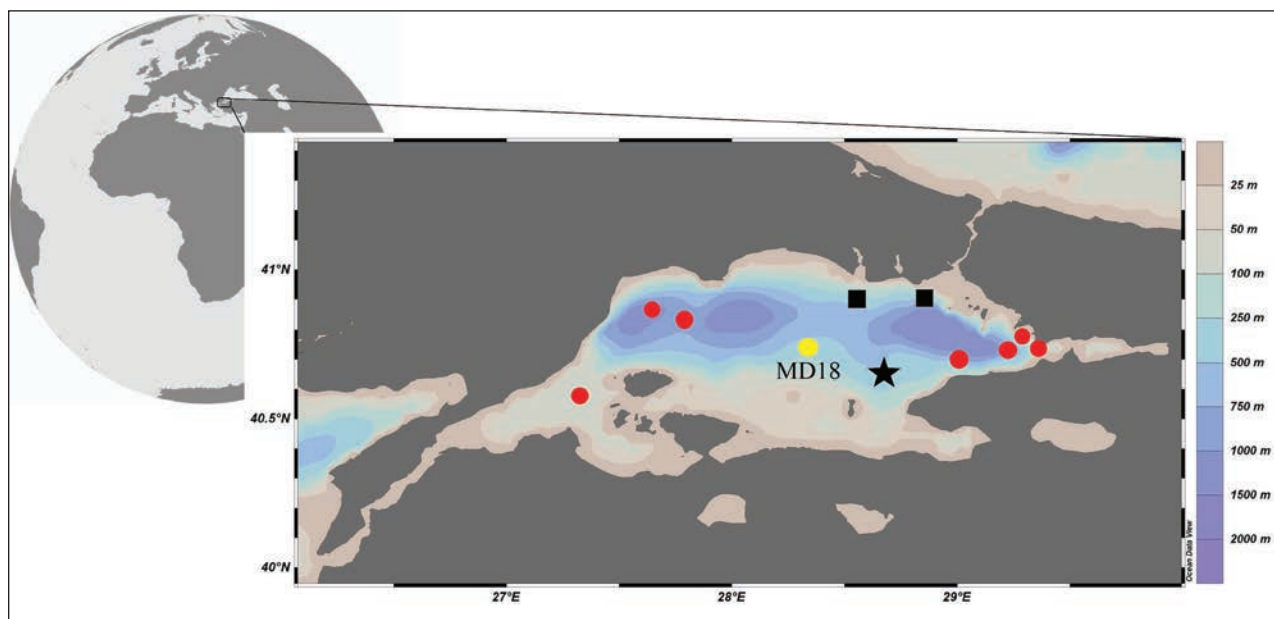


Fig. 1: Sampling localities of earlier and more recent specimens of *Centrophorus uyato* and *Echinorhinus brucus* captured in the Sea of Marmara. (■) indicates earlier capture sites for *C. uyato*, one specimen per site (Meriç, 1995); (★) indicates the capture sites for the *C. granulosus* reported in Benli et al. (1993); the red circles present capture sites for the *E. brucus* reported in Kabasakal et al. (2005), Kabasakal & Dalyan (2011), Kabasakal & Bilecenoğlu (2014), Kabasakal (2017), Kabasakal et al. (2023), one specimen per site; the yellow circle indicates the capture sites for specimens of *C. uyato* and *E. brucus* collected in the present study.

Sl. 1: Lokalizacije, na katerih so bili ugotovljeni predhodni in recentni primeri pojavljanja primerkov vrst *Centrophorus uyato* in *Echinorhinus brucus*, ujetih v Marmarskem morju. Črn pravokotnik (■) prikazuje prejšnje podatke o ulovu primerkov vrste *C. uyato*, en primerik na lokaliteto (Meriç, 1995); zvezdica (★) označuje lokaliteto ulova primerkov vrste *C. granulosus*, nanašajoč se na vir Benli et al. (1993); rdeči krogi označujejo lokaliteto ulova primerkov vrste *E. brucus*, nanašajoč se na vire Kabasakal et al. (2005), Kabasakal & Dalyan (2011), Kabasakal & Bilecenoğlu (2014), Kabasakal (2017), Kabasakal et al. (2023), en primerik na lokaliteto; rumeni krog kaže lokaliteto ulova primerkov vrst *C. uyato* in *E. brucus*, obravnavnih v pričujoči raziskavi

E. brucus and *C. uyato* were collected, are presented in Fig. 2. The starting and ending coordinates of bottom-trawl hauling at MD18 station were as follows: starting plot, 40°42'18" N-28°20'20" E; ending plot, 40°42'78" N-28°18'44" E. Following the capture of *E. brucus* specimens, only their total weight was recorded for biomass estimations. Due to the absence of a suitably sized water tank on board for keeping the sharks in good conditions during morphometric measurements etc., the shoal of bramble sharks were immediately returned to the sea alive. Nevertheless, the total length (TL) of the single specimen of *C. uyato* was measured. Total length (TL) is the distance between the tip of the snout and tip of the upper caudal lobe, where the upper caudal lobe is in depressed position (Compagno, 1984). All of the specimens were photographed fresh. Species identification followed Veríssimo et al. (2014), Barone et al. (2022) and White et al. (2022), while taxonomic nomenclature and the IUCN Red List status followed Serena et

al. (2020). The specimen of *C. uyato* was stored at the Faculty of Aquatic Sciences, Istanbul University, without a registration number.

RESULTS AND DISCUSSION

On 2 October 2019, a female little gulper shark (Fig. 3), *Centrophorus uyato*, was captured at a depth of 150 m at bottom-trawl station MD18 located in the central Sea of Marmara. The examined gulper shark measured 82 cm in total length (TL), the remaining descriptive characteristic were as follows: a typical squaliform species, with spines in front of two dorsal fins and a moderately long pectoral-fin free rear tip; anal fin absent; first dorsal fin slightly greater in height than second dorsal fin; caudal fin with a strongly notched posterior margin; coloration brownish-grey dorsally and lighter in the same colour ventrally; wide blackish-dark bands on posterior margins of dorsal fins; pectoral, pelvic and caudal fins with conspicuous white margins.

The described specimen coincided with the descriptions of *C. uyato* in Veríssimo et al. (2014), Barone et al. (2022) and White et al. (2022).

On 21 August 2021, a shoal of bramble sharks ($n = 17$; Fig. 3, 4), *E. brucus*, were captured at the same station (MD18) at a depth of 150 m. The total mass of the bramble sharks was 445 kg. The descriptive characteristics of the examined bramble sharks were as follows: a large, short nosed and flat-headed squaliform species, with two spineless dorsal fins, first dorsal fin originating behind pelvic fin origin; enlarged, tack-like, conspicuous denticles scattered over body and fins; dorsal surface light to medium grey, with fin edges blackish. The described specimens coincided with the descriptions of *E. brucus* in Ebert and Stehmann (2013) and Barrone et al. (2022). Environmental parameters at station MD18 (the depth of measurement was 122 m) were as follows: salinity 38.80‰; temperature 15.31°C; and dissolved oxygen 1.39 mg/L (Fig. 2).

The first accounts of the occurrence of *E. brucus* were provided by Ninni (1923) and Deveciyan (1926), both referring to the species as *Echinorhinus spinosus*. Moreover, in a recent checklist of Turkish Marine Fishes, Bilecenoğlu et al. (2014) mentioned an occurrence of *E. brucus* in the Sea of Marmara based on Ninni (1923). The main doubt about the reliability of information given by Ninni (1923) and Deveciyan (1926) arises from the fact that neither author gave any information on the locality of capture of the bramble sharks they examined. Since both authors' observations on *E. brucus* were based on specimens landed at the Istanbul wholesale fish market during early 1920s, it is uncertain whether these were indeed captured in the Sea of Marmara or elsewhere in Turkish waters. Furthermore, the species was not mentioned in the noteworthy ichthyological inventory of the Sea of Marmara issued in the 1940s (Rhasis Erazı, 1942). Therefore, the information on the early Marmara records of *E. brucus* appear to be contradictory.

In the early 2000s, *E. brucus* was considered extinct in eastern Mediterranean waters (Hemida & Capapé, 2002); however, during an underwater imaging survey of the North Anatolian Fault Zone, in October 2002, a bramble shark was imaged by means of a remotely operated vehicle deployed in Tekirdağ Trench (northwestern Sea of Marmara), at a depth of 1214 m (Kabasakal et al., 2005). Following that record, other bramble sharks were incidentally captured in several regions of the Sea of Marmara. Kabasakal and Dalyan (2011) reported the capture of 3 specimens. Kabasakal and Bilecenoğlu (2014) reported the capture of a single specimen and that

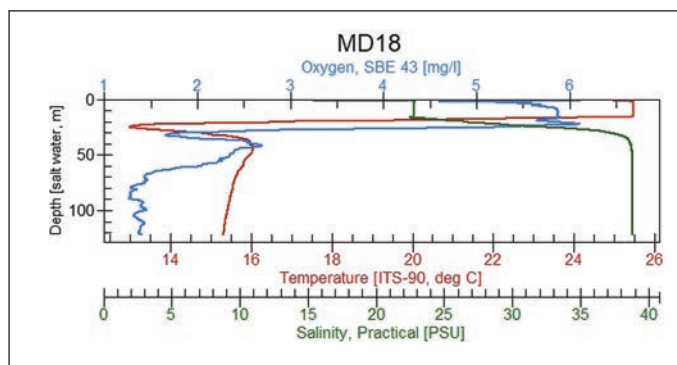


Fig. 2. Oceanographic parameters at station MD18, measured at the beginning of bottom trawling.

Sl. 2: Oceanografski parametri na postaji MD18, merjeni na začetku vleke s pridneno vlečno mrežo.

record was followed by a relatively recent capture of a female bramble shark in the shelf waters of southwestern Sea of Marmara (Kabasakal, 2017). Basic data of the bramble sharks captured in the Sea of Marmara are summarized in Table 1.

Records of *Centrophorus* sp. in the Sea of Marmara are sparser and dating back to 1989 (Table 1). In autumn 1992, during a cruise of *R/V K. Piri Reis* in the region, 5 specimens of *C. granulosus* were collected (total weight 11 kg) at a depth of 400 m (capture site 40°36'5" N - 28°36'3" E) (Benli et al., 1993). Later, *C. granulosus* was also captured in trammel nets deployed in depths between 120 and 350 m on the northern continental slope of the Sea of Marmara (Meriç, 1995). However, recent studies by Veríssimo et al. (2014), Bellodi et al. (2022) and White et al. (2022) demonstrate that only one species (*C. uyato*) is currently present in the Mediterranean Sea. The occurrence of *C. uyato* in the northern slope of the Sea of Marmara was also reported by Meriç (1995), following the captures of a female (44.2 cm TL) on 19 May 1989, at a depth of 150 m, and a male (45.3 cm TL) on 11 August 1991, at a depth of 270 m.

As seen in Table 1, there are several previous reports of both *C. granulosus* and *C. uyato* from the Sea of Marmara. Furthermore, in the ichthyological checklist of Turkish Marine Fishes, Bilecenoğlu et al. (2014) included *C. granulosus* and *C. uyato* among the fishes of the Sea of Marmara; however, the mentioned records in the checklist refer to Benli et al. (1993; for *C. granulosus*) and Meriç (1995; for *C. uyato*). Since *C. granulosus* is no longer a valid species, the recent revisions (Veríssimo et al. 2014; Bellodi et al., 2022; White et al., 2022) cite only one species of the *Centrophorus* genus to be currently present in the Mediterranean Sea, namely, *C. uyato*. Following the example of Kousteni et al.



Fig. 3. Specimens of *Centrophorus uyato* (A) and *Echinorhinus brucus* (B and C) captured at station MD18 among a shoal of horse mackerel, *Trachurus trachurus*.

Sl. 3: Primerki vrst *Centrophorus uyato* (A) in *Echinorhinus brucus* (B in C), ujeti skupaj z jato šnjurov *Trachurus trachurus* na postaji MD18.

(2021), who genetically confirmed the presence of the little gulper shark in Cypriot waters, it would be necessary to conduct a further investigation based on the morphological measurements of the deposited specimens that are believed to have been captured in the Sea of Marmara and were identified as *C. granulosus* by Benli et al. (1993) and Meriç (1995), to confirm the presence of *C. uyato* in the region. *C. uyato* was last documented in the Sea of Marmara in 1991 and the present specimen was captured more than 30 years after the first occurrence of the species in this area.

The most recent identification of the demersal fish fauna of the Sea of Marmara was made in monthly sampling campaigns during bottom-trawl surveys conducted between March 2017 and December 2018 at 34 stations, during which Daban et al. (2021) collected 12 species of cartilaginous fishes, but no specimen of either *C. uyato* or *E. brucus*. Although the numerosity of the cartilaginous fish species

increased with depth, only *Hexanchus griseus* and *Oxynotus centrina* were obtained of the bathidemersal shark species (Daban et al., 2021). According to Serena (2005), *C. uyato* is an occasional species in the Mediterranean Sea, captured as bycatch in deep bottom trawling and longlining. The occurrence of *Centrophorus* sp. in bottom longline fishery was also reported by Megalofonou and Chatzistryrou (2006), based on specimens caught off the island of Crete in depths between 350–480 m and identified as *C. granulosus* in the published article. Lteif et al. (2017) reported the capture of 38 specimens of *C. uyato* at depths ranging from 115 to 600 m between May 2013 and February 2014 (3.8 specimens per month) in Lebanese waters. Based on the data gathered in the 25 years of MEDITS surveys, Follesa et al. (2019) reported the occurrence of *C. cf. granulosus* in several GSAs (1, 8, 9, 11, 16, 18, 19, 20 and 22) of the Mediterranean, while *C. uyato* was only reported from GSA 1. Recently, the morphometrics of a little gulper

Tab. 1: Fishing data of *Centrophorus granulosus*, *C. uyato* and *Echinorhinus brucus* sighted or captured in the Sea of Marmara since 1989. *Benli *et al.* (1993) reported the TL of only one specimen.

Tab. 1: Podatki o primerkih vrst *Centrophorus granulosus*, *C. uyato* in *Echinorhinus brucus* opaženih ali ujetih v Marmarskem morju od leta 1989. *Benli *et al.* (1993) omenja telesno dolžino (TL) le enega primerka.

No	TL (cm)	W (kg)	Sex	Date of capture or sighting	Depth of capture or sighting (m)	Type of gear	Reference
<i>Centrophorus granulosus</i>							
1-5	62.6*	1.4	?	Autumn 1992	400	Bottom-trawl	Benli <i>et al.</i> (1993)
6	?	?	?	Before 1991	120-350	Trammel-net	Meriç (1995)
<i>Centrophorus uyato</i>							
1	44.2	?	♀	19 May 1989	150	Trammel-net	Meriç (1995)
2	45.3	?	♂	11 August 1991	270	Trammel-net	Meriç (1995)
3	82	?	♀	2 October 2019	150	Bottom-trawl	Present study
<i>Echinorhinus brucus</i>							
1	?	?	?	October 2002	1214	ROV	Kabasakal <i>et al.</i> (2005)
2	170	45	♀	9 December 2005	600-700	Bottom-trawl	Kabasakal & Dalyan (2011)
3	225	140	♀	20 November 2008	100	Gill-net	Kabasakal & Dalyan (2011)
4	250	175	♀	28 December 2009	150	Gill-net	Kabasakal & Dalyan (2011)
5	220	300	♀	19 May 2010	300	Gill-net	Kabasakal & Bilecenoğlu (2014)
6	160	100	♀	24 January 2017	45	Gill-net	Kabasakal (2017)
7	ca. 200	?	?	18 March 2022	<100	Beam-trawl	Kabasakal <i>et al.</i> (2023)
8-24	?	?	?	21 August 2021	150	Bottom-trawl	Present study

shark incidentally hooked in commercial longlines at a depth of 140 m in the Gulf of Antalya (northeastern Mediterranean Sea) has been reported (Kabasakal *et al.*, 2022). Compared to other parts of the Mediterranean (Megalofoinou & Chatzisprou, 2006; Lteif *et al.*, 2017; Follesa *et al.*, 2019), in Turkey, *C. uyato* has apparently been caught in shallower waters in recent years. It can be suggested that the increasing deoxygenation of the deep waters of the region has been driving *C. uyato* to shallower regions, where it becomes bycatch. Moreover, the fact that before the end of the 1990s, when aerobic conditions prevailed in deep waters (Kocataş *et al.*, 1993), captures of *Centrophorus* species in the Sea of Marmara had always been reported from waters deeper than 200 m (Benli *et al.*, 1993; Meriç, 1995), also supports this suggestion. Previous records of bramble sharks from the Sea of Marmara were either of incidental captures or sightings of solitary specimens (Kabasakal *et al.*, 2005; Kabasakal & Dalyan, 2011; Kabasakal & Bilecenoğlu, 2014; Kabasakal, 2017), while the individuals of *E. brucus* examined herein were for the first time captured as a shoal. According to Ebert and Stehmann (2013), *E. brucus* is an uncommon

to rare shark in most of its distributional range and generally occurs as sporadic bycatch of other fisheries. Deep-sea sharks are known to aggregate in small to large schools, and it has been hypothesised that these sharks (e.g., *Squalus* spp., *Etmopterus* spp., *Proscymnodon* spp.) may hunt in packs to subdue larger prey (Ebert, 2013). However, De Maddalena and Zuffa (2003) as well as Javadzadeh *et al.* (2011) stated that the bramble shark is a rare deep-water shark that has only been recorded sporadically and as a rule solitarily at widely dispersed locations throughout the world.

In the same bottom-trawl hauling more than 700 kg of horse mackerel, *Trachurus trachurus*, was captured together with the shoal of *E. brucus*, suggesting the bramble sharks may have been captured while pursuing easy prey. Another assumption about this unusual capture of a shoal of *E. brucus* is that it occurred in consequence to the deoxygenation of the bathyal bottom of the Sea of Marmara (Mantıkçı *et al.*, 2022). At station MD18, where the shoal of bramble sharks was captured, the dissolved oxygen of the bottom water was 1.39 mg/L, which is already lower than the hypoxia

limit (<2 mg/L; Fig. 2). The MD18 station is in the vicinity of Çınarcık Trench, the deepest point (1390 m) of the Sea of Marmara, where anoxia is about to develop (Mantikçı et al., 2022). In recent years, no captures of *E. brucus* have occurred in deep bathyal zones and deep-sea trenches, and most bramble sharks (n=21; 87.5%) have been captured in shelf waters (<200 m depth). The prevailing deoxygenation in the deep waters of the region (Mantikçı et al., 2022; Kabasakal et al., 2023) may have also led to the capture of the present shoal. Generally, deep-sea sharks are not highly migratory, except for the vertical migrations of gravid females at the end of gestation when they approach the shore to give birth (Hemida & Capapé, 2002). Although aggregation of large deep-sea sharks, such as bluntnose sixgill shark, *Hexanchus griseus*, is an unusual phenomenon (Ben Amor et al., 2019), there are some large deep-sea shark species, such as *E. brucus*, that cannot be considered as exclusively solitary; this should be taken into consideration, in addition to the shark's seasonality, when developing and implementing management plans in the future. During extensive MEDITS surveys in the last 25 years, *E. brucus* has not been captured in any of the GSAs. Due to the alarming paucity of Mediterranean records and the restricted distribution of this species (Hemida & Capape, 2002; De Maddalena & Zuffa, 2003; Sion et al., 2004; Kabasakal & Bilecenoglu, 2014; Follesa et al., 2019; Damalas et al., 2022) is the population inhabiting the Sea of Marmara all the more important for the survival of the species in the entire Mediterranean Sea. The 2020 IUCN Red List of Threatened Species assessed *C. uyato* and *E. brucus* as endangered (Finucci et al., 2020a, b), and to date neither of these two sharks has been included in the list of protected species in Turkish seas. Finally, the paucity of information about *E. brucus* in the Mediterranean Sea is making these species even more vulnerable and threatened, which is why the population of bramble shark inhabiting the Sea of Marmara requires even more attention than other sharks.

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Fig. 4. A bramble shark, *Echinorhinus brucus*, being released by the fisherman. The arrows indicate bramble sharks swimming among a shoal of horse mackerel, *Trachurus trachurus*.

Sl. 4: Bodičastega morskega psa (*Echinorhinus brucus*) je ribič izpustil na svobodo. Puščica označuje bodičaste morske pse, ki plavajo okoli jate navadnih šnjurov (*Trachurus trachurus*).

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POJAVLJANJE DVEH GLOBOKOMORSKIH MORSKIH PSOV *ECHINORHINUS BRUCUS* (ECHINORHINIDAE) IN *CENTROPHORUS UYATO* (CENTROPHORIDAE), V VODAH MARMARKEGA ŠELFA

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POVZETEK

Drugega oktobra 2019 so na globini 150 m v osrednjem delu Marmarskega morja ujeli manjši primerek globokomorskega trneža (*Centrophorus uyato*). Zadnji dokumentiran pojav te vrste v regiji izvira iz leta 1991, ulov pričujočega primerka se je torej pojavil trideset let po prvem zapisu o pojavljanju te vrste v regiji. Enaindvajsetega avgusta 2021 so na isti vzorčevalni postaji na globini 150 m ujeli jato 17 primerkov bodičastih morskih psov (*Echinorhinus brucus*). Kaže, da se veliki globokomorski psi kot npr. *E. brucus*, ne pojavljajo posamič, ampak tudi v jatah. Da bi prispevali k prihodnjim načrtom upravljanja za to vrsto, bo potrebno še naprej spremljati njeno populacijo, da bi preverili združevanje primerkov v jate v raziskani regiji. Potreben je natančen monitoring primerkov tega redkega globokomorskega psa v Marmarskem morju, da bi zagotovili njegov obstoj v morskem okolju.

Ključne besede: morski psi, globokomorsko okolje, pojavljanje, kontinentalni šelf, anoksične razmere

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