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SHORT COMMUNICATION

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First documented record of neonate angular roughshark *Oxynotus centrina* from the eastern Adriatic Sea

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Abstract: Many biological aspects of deep-water sharks are poorly known due to their rarity and difficulties in conducting detailed research on them. The angular roughshark (*Oxynotus centrina*) is a rare species, critically endangered in the Mediterranean Sea, of which records are scarce across this region. Here we present a record of a female neonate *O. centrina* from the south-eastern Adriatic Sea, caught by a Montenegrin commercial trawler. Scientific observers were present on-board and collected the specimen, which was subsequently analysed in the laboratory. The specimen was 225 mm long (TL), weighed 59.6 g and had an unhealed umbilical scar. To date, records of this species in the Adriatic Sea have comprised of both adult and older juvenile individuals, but no records of neonates were found in the published literature. In this work, the basic biological observations of the specimen are reported.

Keywords: newborn; elasmobranchs; chondrichthyes; Montenegro; shark

Sažetak: PRVI NALAZ NOVOROĐENE JEDINKE MORSKOG PSA PRASCA OXYNOTUS CENTRINA U ISTOČNOM JADRANSKOM MORU**.** Mnogi biološki aspekti dubokomorskih morskih pasa slabo su poznati zbog rijetkih nalaza te nedostatka detaljnijih istraživanja. Morski pas prasac (*Oxynotus centrina*) je rijetka i kritično ugrožena vrsta u Sredozemnom moru, a nalazi ove vrste na tom području su oskudni. U ovom radu se prikazuje nalaz novorođene ženke *O. centrina* iz jugoistočnog područja Jadranskog mora, uhvaćene od strane crnogorskog komercijalnog ribarskog broda. Jedinka je prikupljena od strane znanstvenih promatrača koji su bili na brodu u trenutku ulova, te je naknadno analizirana u laboratoriju. Jedinka je bila duga 225 mm (TL), težila je 59,6 g i imala je vidljiv nezarasli pupčani ožiljak. Dosadašnji nalazi ove vrste u Jadranskom moru uključivali su samo odrasle i starije juvenilne jedinke, dok nalazi novorođenih jedinki do sada nisu dokumentirani. U ovom radu su prikazana osnovna biološka zapažanja o analiziranoj jedinci.

***Ključne riječi*:** neonatalna jedinka; elasmobranchii; hrskavičnjaće; Crna Gora; morski pas

INTRODUCTION

Deep-sea sharks account for more than half (approximately 56%, 278 species) of modern sharks and approximately 45% of all deep-water cartilaginous fish today (536 species) (Kyne and Simpfendorfer, 2007; Dulvy *et al*., 2021). According to Kyne and Simpfendorfer (2007) and Ebert (2013), all shark species whose distribution is restricted to waters deeper than 200 m or which spend a significant part of their life cycle at depths greater than 200 m, are defined as "deep-sea sharks". The angular roughshark, *Oxynotus centrina* (Linnaeus, 1758) (Squaliformes: Oxynotidae), is a member of this poorly known group of sharks.

Oxynotus centrina is a bizarre-looking deep-water shark species, occurring throughout the Mediterranean and along the eastern Atlantic coasts, southward as far as South Africa and northward as far as Norway (Serena, 2005; Ebert and Dando, 2020; Otero and Mytilineou, 2022). Knowledge about the different biological aspects of this benthic shark is scarce due to the rarity of its records in the Mediterranean. Sporadic occurrences of adults and pregnant females have been reported from several parts of the Mediterranean Sea (e.g. Dragičević *et al*., 2009; Başusta *et al*., 2015; Yığın *et al*., 2016). In a recent study, Kabasakal and Özbek (2022) reported on the length-weight relationship of *O. centrina* based on specimens collected from different sub-regions of the Mediterranean Sea. It mainly feeds on polychaetes and sipunculids, but also on other marine groups as such teleosts and crustaceans (Capapé, 2008). However, it is suggested that this species has much narrower feeding niche, as other studies have shown it feeds particularly on elasmobranch eggs (Barrull and Mate, 2001; Guallart *et al*., 2015). This argument for a highly specialized feeding niche is further supported by the high $\delta^{15}N$ values found in *O. centrina* specimens, which are similar to those found in top predators (Gul *et al*., 2022). It is an ovoviviparous species, producing 7 to 23 pups annually after a gestation period of 3 to 12 months (Ebert and Dando, 2020). Finally, it is considered critically endangered (CR) in the Mediterranean Sea (Soldo and Guallart, 2016), with a suspected population decline of 80% or even more (Ebert and Dando, 2020).

Several records identified in the Adriatic Sea (Cugini and De Maddalena, 2003; Dragičević *et al*., 2009;

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Gajić *et al*., 2021) have considered individuals which were either adults or older juveniles. In a recent work, Soldo & Lipej (2022) mention a record of small pups of *O. centrina* in the Brač channel (in Croatia), however, with no specific data provided. Here we report the first occurrence of a neonate *O. centrina* from the eastern Adriatic continental shelf.

MATERIALS AND METHODS

On 28th April 2022, a single female specimen of angular roughshark was caught by a bottom trawl on the continental shelf in the territorial waters of Montenegro. The trawl net was hauled at the depth of between 90 and 100 metres (N 42.270569, E 18.641214; approximate midpoint of the trawling haul). Scientific staff of the Institute of Marine Biology (Kotor, Montenegro) boarded a commercial vessel in order to carry out the regular monitoring programme of commercial fisheries (DCF-DCRF).

The specimen was already dead when it was discovered among the other caught species at least half an hour after the net was retrieved, during the sorting of the catch by crew members and the Institute's staff. It was brought to the Institute of Marine Biology in Kotor and examined in the Laboratory for Ichthyology and Marine Fisheries.

The species was determined following Serena (2005) and Ebert and Dando (2020) by observation of: the large D-shaped spiracles; the compressed, triangular body shape; the high, sail-like dorsal fins, with spines, where the first dorsal spine was inclined forwards.

Morphometric measures were taken to the nearest millimetre, while total weight (TW), eviscerated weight (EW) and liver weight (LW) were measured to the nearest gramme following Dragičević *et al*. (2009). The hepatosomatic index (HSI) was calculated as HSI = 100 LW / EW.

RESULTS AND DISCUSSION

The total length (TL) of the neonate specimen was 225 mm and it weighed 59.6 g (Fig. 1). The umbilical scar from yolk sac was clearly observed and was unhealed, indicating only a short time since parturition (Fig. 2). To the best of the authors' knowledge, the smallest individual recorded to date from the Adriatic Sea was 300 mm in total length and weighed 430 g (in Gajić *et al*., 2021). However, Cugini and De Maddalena (2003) recorded a pregnant female in the Adriatic Sea and suggested that this species is among the rarest sharks in the surveyed area. Megalofonou and Damalas (2004) suggest that parturition likely takes place during the end of spring, which is in line with the record presented here. The angular roughshark is a poorly known deep-water species and many of its biological and ecological characteristics are still insufficiently studied. Its parturition in the Mediterranean is observed in the area of the coast of Languedoc in France, where eight neonates were recorded, ranging from 210 to 240 mm in TL and weighted between 66 and 73 grams (Capapé *et al*., 1999), which mostly corresponds to the data in this study. Further, a neonate specimen (225 mm TL) was previously reported from Bozcaada Island (in the north-eastern Aegean Sea) (Eryilmaz, 2003). Moreover, reports of similar-size neonates were also provided by Kabasakal (2010), Mulas *et al*. (2021) and Gul *et al*. (2022). Their occurrence appears to be rare in the entire

Fig. 1. The neonate *O. centrina* caught within Montenegrin territorial sea.

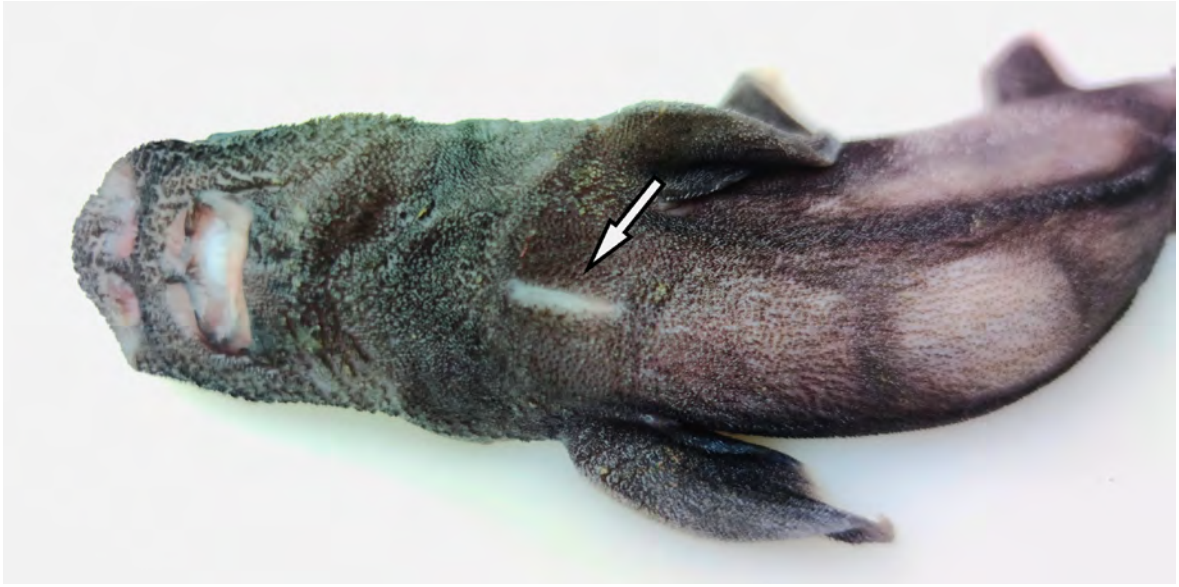

Fig. 2. Unhealed umbilical scar in the neonate specimen from Montenegro, marked by an arrow.

Mediterranean basin, with a very small number of published records. Additionally, a slightly older juvenile of *O. centrina* was incidentally caught in Saros Bay (in the north-eastern Aegean Sea), it was 290 mm in TL and 260 g in TW (Kabasakal and Özbek, 2022).

The morphometric measurements are shown in Table 1. The liver weight was 12.84 g (21.54 % of the TW). The calculated hepatosomatic index had a value of HSI = 30.64, which falls in the range described for females (Capapé *et al*., 1999; Dragičević *et al*., 2009). The stomach of this individual was empty, without any visible content. An empty stomach is commonly observed in both adult and juvenile individuals of this species, but the possible reason for this is still not clear (Kousteni and Megalofonou, 2016). According to Guallart *et al*. (2015), it is also possible that the presence of vitellus in the stomach contents of *O. centrina* could have been overlooked in previous studies, potentially being considered either digested remains or amorphous unidentifiable material, which was also reported by Gul *et al*. (2022).

Dragičević *et al*. (2009) suggest that *O. centrina* probably reproduces in alternate years, which, together with its apparent rarity and small litter size (Serena, 2005; Ebert and Dando, 2020), contributes to its high vulnerability. Kabasakal (2015) and Kousteni and Megalofonou (2016) and references therein show that records of *O. centrina* are still very rare and scarce, even over recent decades, when the trawling effort has been at very high level across the entire Mediterranean basin and has included the whole depth range of the species. According to Kabasakal (2015), in the eastern Mediterranean region, bottom trawling accounted for the majority (72%) of the reported captures of *O. centrina*. It is well known that it does not have any economic value and therefore it is not landed, which could be a possible reason for the rarity of species records. The recent research by Gajić *et al*. (2021) provides several

Table 1. Morphometric measurements of the recorded angular roughshark neonate.

Measurement	mm	% of TL
Total length	225	100
Fork length	219	97
Head length	48	21
Interdorsal space	37	16
Precaudal length	163	72
Prefirst dorsal fin length	55	24
Presecond dorsal fin length	126	56
Prepectoral fin length	52	23
Pectoral fin anterior margin	35	16
First dorsal anterior margin	52	23
First dorsal height	39	17
First dorsal base	31	14
Second dorsal anterior margin	38	17
Second dorsal height	30	13
Second dorsal posterior margin	21	9
Second dorsal base	20	9
Pelvic anterior margin	23	10
Pelvic height	18	8
Pelvic posterior margin length	12	5
Pelvic base	13	6
Dorsal caudal margin	61	27
Terminal caudal margin	16	7
Preventral caudal margin	53	24
Caudal peduncle length	10	4
Head height	25	11
Trunk height	27	12
Abdomen height	33	15
Eye length	11	5

records from the eastern Adriatic, suggesting that the species could be less rare than is commonly thought. Such an increase in the number of records might be a result of the more intense usage of citizen science in recent years, as half of the records provided in Gajić *et al*. (2021) come either from direct reports from fishers or from social networks.

On the other hand, studies that indicate a very narrow feeding niche, characterized by the consumption of elasmobranch eggs (Guallart *et al*., 2015; Mulas *et al*., 2021) could also explain the rarity of this species. If the validity of this diet can be proved by further studies, it could help explain species rarity, as such a narrow niche is unlikely to support a larger number of individuals in the ecosystem, due to the relatively limited availability of food resources. In this case, the species rarity could be conditioned by its own ecology.

CONCLUSIONS

The monitoring of elasmobranch by-catch and collecting data on their individual catches and observations is very important, in order to expand the current knowledge of these threatened vertebrates, particularly in the cases of rare species. Neonates and juveniles represent important lifecycle forms in elasmobranch conservation, whose occurrences can lead to the identification of critical habitats as are nursery areas. Such cases have already been seen in the Adriatic Sea, for example in the case of the sandbar shark *Carcharhinus plumbeus* (Nardo, 1827) (Lipej *et al*. 2008; Jambura *et al*., 2021). Hence, in order to gain more insight into the way of life of the rare *O. centrina* and contribute to its conservation, more monitoring and research efforts are highly needed.

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REFERENCES

Barrull, J., Mate, I. 2001. First confirmed record of angular roughshark *Oxynotus centrina* (Linnaeus, 1758) predation on shark egg case of small-spotted catshark *Scyliorhinus canicula* (Linnaeus, 1758) in Mediterranean waters. Annales, Series Historia Naturalis, 11(23), 23-28.

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. Journal of Black Sea/Mediterranean Environment, 21(1), 92-95.

Capapé, C. 2008. Diet of the angular rough shark *Oxynotus centrina* (Chondrichthyes: Oxynotidae) off the Languedocian coast (southern France, north-western Mediterranean). Vie et Milieu, 58(1), 57-62.

Capapé, C., Seck, A.A., Quignard, J.P. 1999. Observations on the reproductive biology of the angular rough shark, *Oxynotus centrina* (Oxynotidae). Cybium, 23(3), 259-271.

Cugini, G., De Maddalena, A. 2003. Sharks captured off Pescara (Italy, western Adriatic Sea). Annales, Series Historia Naturalis, 13(2), 201-208.

Dragičević, B., Dulčić, J., Capapé, C. 2009. Capture of a rare shark, *Oxynotus centrina* (Chondrichthyes: Oxynotidae) in the eastern Adriatic Sea. Journal of Applied Ichthyology, 25(s1), 56-59. https://doi.org/10.1111/j.1439-0426.2009.01265.x

Dulvy N.K., Pacoureau, N., Rigby, C.L., Pollom, R.A., Jabado, R.W., Ebert, D.A., Finucci, B. *et al*. 2021. Overfishing drives over one third of all sharks and rays toward a global extinction crisis. Current Biology, 31(21), 4773-4787.e8. https://doi.org/10.1016/j.cub.2021.08.062

Ebert, D.A. 2013. Deep–sea Cartilaginous Fishes of the Indian Ocean. Volume 1. Sharks. Food and Agriculture Organization (FAO) Species Catalogue for Fishery Purposes, 256 pp.

Ebert, D.A., Dando, M. 2020. Field guide to sharks, rays & chimaeras of Europe and the Mediterranean. Princeton University Press, 383 pp. https://doi.org/10.1111/jfb.14695.

Eryilmaz, L. 2003. A study on the fishes of Bozcaada Island (north Aegean Sea). Turkish Journal of Marine Sciences, 9(2), 121-137.

Gajić, A.A., Lelo, S., Joksimović, A., Pešić, A., Tomanić, J., Beširović, H., Dragičević, B. 2021. Contemporary records of the rare and critically endangered angular rough shark, *Oxynotus centrina* (Linnaeus, 1758), from the eastern Adriatic Sea. Journal of Fish Biology, 100(1), 329-334. https://doi.org/10.1111/jfb.14932

Guallart, J., García−Salinas, P., Ahuir−Baraja, A.E., Guimerans, M., Ellis, J.R., Roche, M. 2015. Angular roughshark *Oxynotus centrina* (Squaliformes: Oxynotidae) in captivity feeding exclusively on elasmobranch eggs: an overlooked feeding niche or a matter of individual taste? Journal of Fish Biology, 87(4), 1072-1079. https://doi.org/10.1111/jfb.12761

Gul, G., Yokeş, M.B., Demirel, N. 2022. The occurrence and feeding of a critically endangered shark species, *Oxynotus centrina* in the Sea of Marmara. Journal of Fish Biology, 101(3), 728-735. https://doi.org/10.1111/jfb.15119

Jambura, P.L., Ćetković, I., Kriwet, J., Türtscher, J. 2021. Using historical and citizen science data to improve knowledge about the occurrence of the elusive sandbar shark *Carcharhinus plumbeus* (Chondrichthyes–Carcharhinidae) in the Adriatic Sea. Mediterranean Marine Science, 22(1), 169. https://doi.org/10.12681/mms.24624

Kabasakal, H. 2010. Historical and contemporary records of the angular rough shark *Oxynotus centrina* (Chondrichthyes; Oxynotidae) in Turkish waters. Mediterranean Marine Science, 11(2), 361-368. https://doi.org/10.12681/mms.84

Kabasakal, H. 2015. Occurrence of the angular rough shark, *Oxynotus centrina* (Chondrichthyes; Oxynotidae) in the eastern Mediterranean. Annales, Series Historia Naturalis, 25(1), 1-10.

Kabasakal, H., Özbek, E.Ö. 2022. Length-weight relation of the angular rough shark, *Oxynotus centrina* (Linnaeus, 1758) in the Mediterranean Sea. Natural and Engineering Sciences, 7(2), 97-107. https://doi.org/10.28978/nesciences.1159204

Kousteni, V., Megalofonou, P. 2016. Observations on the biological traits of the rare shark *Oxynotus centrina* (Chondrichthyes: Oxynotidae) in the Hellenic Seas. Journal of Fish Biology, 89(3), 1880-1888. https://doi.org/10.1111/jfb.13077

Kyne, P.M., Simpendorfer, C.A. 2007. A collation and summarization of available data on deepwater chondrichthyans: biodiversity, life history and fisheries. International Union for Conservation of Nature, Species Survival Commission, Shark Specialist Group, 137 pp.

Lipej, L., Mavrič, B., Dobrajc, Ž., Capapé, C. 2008. On the occurrence of the sandbar shark, *Carcharhinus plumbeus* (Chondrichthyes: Carcharhinidae) off the Slovenian coast (northern Adriatic). Acta Adriatica, 49(2), 137-145.

Megalofonou, P., Damalas, D. 2004. Morphological and biological characteristics of a gravid angular rough shark (*Oxynotus centrina*) and its embryos from the Eastern Mediterranean Sea. Cybium, 28(2), 105-110. https://doi.org/10.26028/cybium/2004-282-003

Mulas, A., Bellodi, A., Carbonara, P., Cau, A., Marongiu, M.F., Pesci, P., Porcu, C. *et al*. 2021. Bio-ecological features update on eleven rare cartilaginous fish in the Central-Western Mediterranean Sea as a contribution for their conservation. Life, 11(9), 871. https://doi.org/10.3390/life11090871

Otero, M., Mytilineou, C. 2022. Deep-sea atlas of the eastern Mediterranean Sea. IUCN-HCMR DeepEastMed Project. International Union for Conservation of Nature, VII+371 pp.

Serena, F. 2005. Field identification guide to the sharks and rays of the Mediterranean and Black Sea. Food and Agriculture Organization (FAO), 97 pp.

Soldo, A., Guallart, J. 2016. *Oxynotus centrina* (errata version published in 2016). The IUCN Red List of Threatened Species 2016: e.T63141A97834254. https://www.iucnredlist.org/species/63141/97834254. Accessed on 06th of May 2022.

Soldo, A., Lipej, L. 2022. An annotated checklist and the conservation status of chondrichthyans in the Adriatic. Fishes, 7(5), 245. https://doi.org/10.3390/fishes7050245

Yığın, C.Ç., İşmen, A., Önal, U. 2016. Occurrence of a rare shark, *Oxynotus centrina* (Chondrichthyes: Oxynotidae), from Saros Bay, North Aegean Sea. Journal of the Black Sea/Mediterranean Environment, 22(1), 103-109.