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Additional records of the little sleeper shark, *Somniosus rostratus* (Elasmobranchii: Squaliformes: Somniosidae), in Mediterranean Sea

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Abstract

This study investigates the distribution and morphometrics of the little sleeper shark, *Somniosus rostratus* (Risso, 1827), in the Mediterranean Sea. Ten sharks caught as bycatch between 2009 and 2019 in the northern sectors of the Strait of Sicily, the south Tyrrhenian Sea, the northwestern Ionian Sea, and the south Adriatic Sea using drifting longlines, as well as five retrieved from the Tripoli (Libya) marketplace, were morphologically confirmed to represent *S. rostratus*. The sharks exhibited typical characteristics for this species and were all caught from deep waters, indicating a potential mesopelagic habit. The study also utilized literature reviews and global databases for a comprehensive mapping of *S. rostratus* distribution in the Mediterranean Sea, which revealed sporadic occurrences in the eastern Mediterranean and an absence in the north Adriatic Sea. Morphometric data provided insights into the reproductive characteristics of *S. rostratus*. The study highlights the ecological significance of the Strait of Sicily (Central Mediterranean Sea) for the species, indicating it as a likely spawning area, and underscores the impact of the interactions between sharks and pelagic drifting swordfish fisheries in the Mediterranean, which result in increased mortality rates for threatened shark and ray species. Prioritizing conservation measures for endangered elasmobranch populations is crucial for maintaining marine ecosystem balance and ensuring fishery resource sustainability.

Keywords

biodiversity, distribution, elasmobranch Mediterranean Sea, *Somniosus rostratus*

Introduction

The deep-water little sleeper shark, *Somniosus rostratus* (Risso, 1827), is a rare or apparently rare chondrichthyan (Garibaldi et al. 2012; Guallart et al. 2013), currently assessed at the global level as Least Concern by the IUCN Red List (Finucci et al. 2020).

The little sleeper shark is found at depths from 180 m to 2734 m, reaches a maximum total length of 1314 mm (Weigmann 2016), and apparently feeds mainly on cephalopods, but also benthic invertebrates and fishes (Golani 1986; Garibaldi et al. 2012; Guallart et al. 2013; Barría et al. 2015a; Capapé et al. 2020; Ebert and Dando 2022). The apparent rarity of this shark may be due to several reasons, including a naturally low population density (Garibaldi et al. 2012; Guallart et al. 2013), the inadequacy of the fishing gears deployed in catching this species, and the non-exploitation of deep bottom-dwelling habitats throughout its range.

The general distribution of *S. rostratus* includes the Eastern Atlantic, extending from areas off the United Kingdom and Ireland, to France, Portugal, the Madeira Islands, Canary Islands and Western Sahara, as well as the Western Central Atlantic, possibly from areas located off Cuba, up to the Mediterranean Sea (Compagno 1984; Yano et al. 2004; Ebert and Stehmann 2013; Ebert et al. 2013; Meléndez et al. 2017; Finucci et al. 2020; Ebert and Dando 2022). In the Mediterranean, *S. rostratus* is prevalent in the western sector, albeit not very abundant, and appears sporadically in the eastern sector; to date, it is absent in the north Adriatic and the Black Sea (Goren and Galil 2015; Serena et al. 2020; Damalas et al. 2022; Ebert and Dando 2022).

In this study, the capture of *S. rostratus* from the Strait of Sicily in the central Mediterranean, plus additional records from the Tyrrhenian, Ionian, Adriatic, and Libyan waters is described, and the distribution records of this species in the basin, recently reviewed by Capapé et al. (2020), is updated.

Material and methods

Three specimens of *Somniosus rostratus* were captured in the northern sectors of the Strait of Sicily, by a commercial fishing vessel as swordfish bycatch, two specimens (S1 and S2) on 13 September 2015 off Licata (Fig. 1: map ID 36; Fig. 2A), the third (S3) on 15 September 2015 off Gela (Fig. 1: Map ID 37; Fig. 2A) (Table 1). Mesopelagic drifting longlines (Kirby Sea; fishing hook No. 2) baited with mackerel and squids were used. Catches were carried out during the night. The fishermen declared that they had never landed those sharks before. Between August and September 2016, two additional specimens (S4 and S5) were fished by the same boat and with the same gear reported above, off Scoglitti (Fig. 1: map ID 38; Fig. 2B) (Table 1).

The specimens S1, S3, S4, and S5 were deposited at the Museo Civico di Storia Naturale, Comiso, Italy (MSNC) and S2 was deposited at the Wilderness Studi Ambientali, Palermo, Italy (WSA). At these institutions, selected morphometric measurements were taken to the nearest 1 mm using a digital caliper, following Compagno (1984); weight was determined to the nearest 0.1 g (Table 2). Females were dissected, the uterine contents examined and, in case of pregnancy, eggs and embryos were counted and measured. The following catalog numbers were assigned to the above five sharks: S1, MSNC 4885; S2, WSASr1; S3, MSNC 4886; S4, MSNC 4887; and S5, MSNC 4888.

Other records of *S. rostratus* collected through experimental fishing surveys are furthermore presented (Table 1):

- On 22 July 2009, in the northwestern Ionian Sea, a specimen (S6) (Fig. 1: map ID 27) (Fig. 3) was caught using a drifting longline set with 1100 hooks (soaking time 24 h 30 min), targeting swordfish (six swordfish were captured, with a total weight of 233 kg), along with a specimen of *Pteroplatytrygon violacea* (Bonaparte, 1832) (≈7 kg).
- On 21 and 22 July 2010, two specimens of *S. rostratus* (S7 and S8) were captured in the northwestern Ionian Sea (Fig. 1: map ID 30), using a drifting longline equipped with 1100 hooks (soaking time ≈ 14 h). The longline was targeting swordfish, resulting in the capture of 11 specimens weighing (in total) 395 kg and 8 specimens weighing 411 kg, respectively. Furthermore, on 21 July 2010, a specimen of *Zu cristatus* (Bonelli, 1819) (≈4 kg), along with four specimens of *Ruvettus pretiosus* Cocco, 1833 (total weight ≈ 44 kg), were unintentionally caught and subsequently discarded. On 22 July 2010, only three specimens of *R. pretiosus* (total weight ≈ 44 kg) were caught and discarded.
- On 14 July 2011, a specimen (S9) was captured in the southern Tyrrhenian Sea around the Aeolian Islands (Fig. 1: map ID 31), using a drifting longline (1100 hooks; soaking time 6 h 30 min) targeting swordfish (8 swordfish specimens weighing 167 kg) along with a specimen of *Z. cristatus* (≈4 kg).
- On 4 September 2019, in the southern Adriatic (Fig. 1: map ID 41), a specimen (S10) was caught using a drifting longline. The fishing operation occurred between 03:45 and 09:39 hours.
- In 2006, one of us (ADN) observed the presence of five specimens of *S. rostratus* (S11 to S15) in the Tripoli fish market. After interviewing the fishers, it was ascertained that the five specimens were caught with pelagic longlines, together with other sharks, off the central-western Libyan coast.

For S6–S9 only an approximate weight was obtained, while TL and weight were measured for S10; S6–S10 were discarded. No data were collected for S11–S15.

Table 1. Summary of *Somniosus rostratus* records in the Mediterranean (The majority of records cited after Capapé et al. 2020).

Marine region	Locality	Map ID	Year	Latitude (N), Longitude (E)	Depth [m]	Fishing gear	*N*	*W* [g]	TL [mm]	FL [mm]	Reference
Adriatic Sea	South sector	19									[1]
	Off Apulia	34	2012?		427–788	MEMO					[2] [3]
	South sector	41	2019	41°17′38.92″N, 17°43′31.09″E	1140	MD-LL	1♂	3121	890		**This study** (S10)
	South sector	42	2019	41°45′00.00″N, 17°22'00.12"E	1100	LL	4				Bueloni personal communication
Aegean Sea	North of Crete	10									[4] [5] [6] [7]
	North sector	18	1990–1992		100–500	BT					[8] [7]
Algerian Sea		9									[9]
	100 km off Algiers (Dellys, Cap Djenet, Bou Haroun, Cherchell)	28	2009–2015	36°55′N, 3°53′E			19				[10]
				36°43′N, 3°36′E							
				36°40′N, 4°40′E							
				36°37′N, 2°11′E							
Catalan Sea	Off Barcelona	16	1987	41°02′N, 3°04′E	1975	LL	1♂		680		[11]
	Off Barcelona	22	1994	40°42′N, 1°32′E	180	LL	1♂		650		[11]
	Off Barcelona	23	1999	41°01′N, 2°16′E	534	BT	1♀ pr.		1000		[12]
	Ibiza Channel	35	2013–2014		550–670	BT	20 (8♀ pr.)		874–1042		[13] [14]
Catalan Sea	Gulf of Lions	33	2011–2013		40–2200	BT	5		715–980		[15] [16]
Gulf of Lions	Off Nice	1	1826		Very deep		1♀		310		[17]
	Off Nice	1	1874				1♀ pr.				[18]
	Off Nice	1	1880?								[19]
	Off Nice	1	1880				1♂		705		[20]
	Off Nice	1	1900				1♂		282		[20]
	Off Nice	1	1882?				1♀		490		[20]
Ionian Sea	East of Sicily	4	1892				1				[21]
	East of Sicily, off Simeto River estuary	5	1893		1000		1♀ pr.				[21]
	Northwestern	15	1985–1988?		>200						[22]C
	Eastern sector	21									Questionable in [23]
	Northwestern sector	27	2009	37°48′42.01″N, 16°56'08.99"E		MD-LL	1♀	~5000			**This study** (S6)
	Northwestern sector	30	2010	38°45′15.01″N, 17°51′24.01″E		MD-LL	1	~8000			**This study** (S7)
	Northwestern sector	30	2010	38°53′32.39″N, 17°35′46.79″E		MD-LL	1	~6000			**This study** (S8)
Levantine Sea	Off Haifa	13	1985	32°58′44″N, 34°35′46″E	1330	LL	1♂		775		[24]
	Off Haifa	14	1985–1991	32°31′00″N, 34°02′00″E	1280–1500	LL	8 (2♀ pr.)				[25]
				33°02′00″N, 34°37′00″E							
	Off Israel coasts	17	1988–1999		734–1558	BT					[26]
	Syrian waters	24	2001	35°36′N, 35°39′E	450	LL	76		**1020** (largest)		[27] [28] [29] [30] [31]
	Off Fethiye	25	2008	36°25′00″N, 28°47′00″E	2500	LL	1♀		810		[32]
Libyan Sea	Libyan waters, west	12									[33] [34] [35] [36]
	Tripoli market	NM	2006				5				**This study,** ADN personal observation (S11-S15)
	Off South of Crete	26	2009	34°32′37.68″N, 25°46′30.00″E	1200	OT	1				[37]
Ligurian Sea		2							820		[38 39]
		2					1♀pr.				[40] [1]
		2									[41] [40] [42] [1]
		2	2010?		>1500	LL	25♂		>655		[43] [44]
		2	2010?		>1500	LL	30♀		Some ♀ > 800		[43] [44]
		2	2015								[45]
	Genova	6	1899				1♀		955		[20]
Ligurian Sea	Sestri Levante	7	1899				1♀		937		[20]
	Sestri Levante	7	1979	44°10′N, 9°25′E			1♀ pr.		822		[20]
	Bonassola	8	1909								[40]
	Ventimiglia	11					1♀		953		[20]

Table continues on next page.

Table 1. Continued.

Marine region	Locality	Map ID	Year	Latitude (N), Longitude (E)	Depth [m]	Fishing gear	*N*	*W* [g]	TL [mm]	FL [mm]	Reference
Strait of Gibraltar and Alboran Sea		39									[46]
Strait of Sicily	Malta Island	32	2011			LL	2♀		935 1036		[47]
	Malta Island	32	2015				1				[48]
	Malta Island	32	2016				1				[48]
	Off Licata	36	2015	36°45′59.93″N, 13°51′36.67″E	~700	MD-LL	2♀ pr.	6850 6650	992 985		**This study** (S1, S2)
	Off Gela	37	2015	36°42′12.00″N, 14°08′09.00″E	~700	MD-LL	1♀ pr.	7480	990		**This study** (S3)
	Off Scoglitti	38	2016	36°45′29.04″N, 14°05′03.40″E		MD-LL	1♀ 1♂	5950 1140	925 618		**This study** (S4, S5)
	Off Ras Jebel, northeastern Tunisian coast	40	2019	37°31′28″N, 10°17′10″E	120	BT			990		[49]
Tyrrhenian Sea	Off Palermo	3	1874				1♀		880		[50]
		20									
	Off Anzio	29	2010			LL	1♀		800		[51]
	Aeolian Islands	31	2011	38°43′31.20″N, 14°59′29.40″E		MD-LL	1	5000			**This study** (S9)
Western Mediterranean		NM	2009–2013	36–44°N, 2–5°E		LL	24			715–980	[52] [16]

LL = longline; BT = bottom trawl; MD-LL = meso-pelagic longlines; NM = not mapped; ? = questionable; pr. = pregnant; TL = total length; FL,= fork length; *W* = weight; OT = otter trawl, MEMO = Marine Environment Monitoring system; S1–S15 = specimens numbered as reported in the text and in Tables 2, 3. [1] Costa (1991); [2] Carluccio et al. (2019); [3] Carluccio et al. (2021); [4] Ananiadis (1961); [5] Economidis (1973); [6] Papaconstantinou (2014); [7] Papaconstantinou and Conides (2021); [8] Labropoulou and Papaconstantinou (2000); [9] Dieuzeide et al. (1953); [10] Kheddam et al. (2016); [11] Barrull and Mate (1995); [12] Barrull and Mate (2001); [13] Guallart et al. (2013); [14] Guallart and García-Salinas (2015); [15] Barría et al. (2015b); [16] Carpentieri et al. (2021); [17] Risso (1826); [18] Moreau (1881); [19] Giglioli (1880); [20] Cigala-Fulgosi and Gandolfi (1983); [21] Sicher (1898); [22] Capezzuto et al. (2010); [23] Papaconstantinou (1990); [24] Golani (1986); [25] Hornung et al. (1993); [26] Galil (2004); [27] Ali and Saad (2003); [28] Saad et al. (2004); [29] Saad et al. (2006); [30] Saad and Alkusairy (2022); [31] Damalas et al. (2022); [32] Irmak and Özden (2021); [33] Compagno (1984); [34] UNEP-MAP RAC/SPA (2005); [35] Séret et al. (2009); [36] Finucci et al. (2020); [37] Tecchio and Ramirez-Llodra (2018); [38] Canestrini (1864); [39] Canestrini (1872); [40] Tortonese (1956); [41] Tortonese (1952); [42] Tortonese (1968); [43] Garibaldi et al. (2012); [44] Garibaldi (2015); [45] Ferrando et al. (2019); [46] Báez et al. (2019); [47] Vella et al. (2013); [48] Vella et al. (2017); [49] Capapé et al. (2020); [50] Doderlein (1881); [51] Psomadakis et al. (2012); [52] De Loyola Fernández et al. (2017). Dr Elia Bueloni is affiliated with the Cooperativa Torpedo, Ravenna.

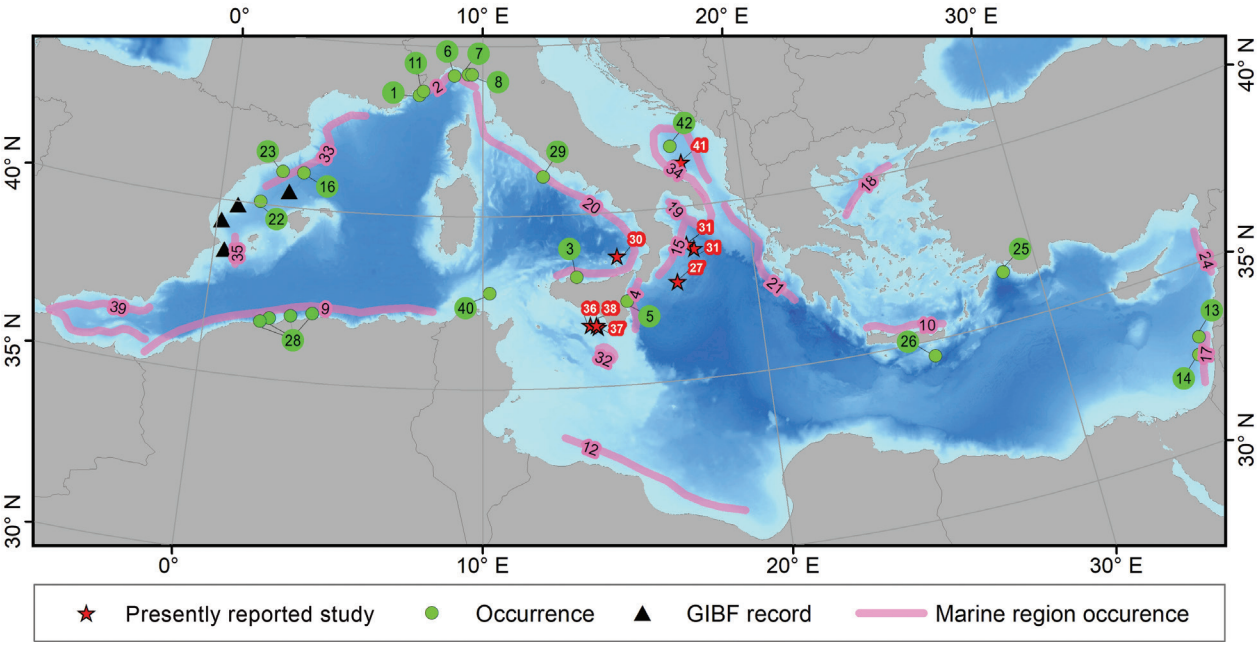

Figure 1. Geographical distribution of *Somniosus rostratus* based on the previous records and presently reported study within the Mediterranean Basin. The red star shows occurrence records for this study; the green circle represents occurrence records with geographic coordinates, from the literature; the pink represents occurrence records without geographic coordinates; and the black triangles are GBIF occurrence records (GIBF 2024). The numbers refer to the "Map ID" in the Table 1 to identify the reference of the record.

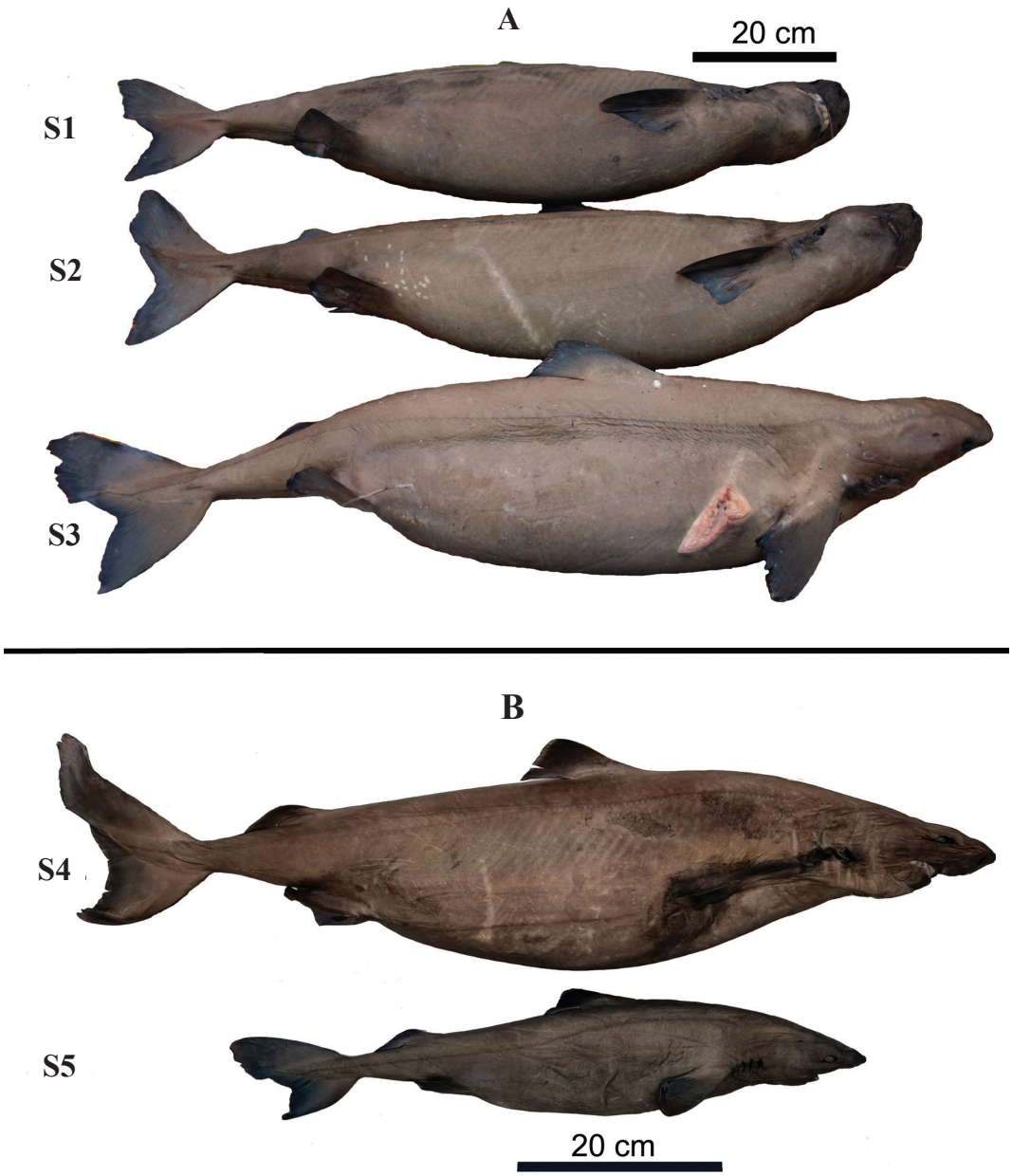

Figure 2. *Somniosus rostratus* from the Strait of Sicily. **A.** females S1 (MSNC 4885), S2 (WSASr1), and S3 (MSNC 4886) captured in 2015 (Fig. 1) Map ID 36 [S1–S2], 37 [S3]. **B**: female S4 (MSNC 4887), and male S5 (MSNC 4888) captured in 2016 (Fig. 1) Map ID 38 [S4–S5].

The geographical distribution of the little sleeper shark was mapped gathering all existing scientific literature concerning previous records of the species in the Mediterranean Sea (Table 1). In addition, any missing data was added using the Global Biodiversity Information Facility (GBIF 2024), excluding all non-georeferenced data. The map was created using Quantum GIS software (QGIS 2020), following the methodology outlined by Sardo et al. (2022).

The records of *S. rostratus* in the Mediterranean Sea provided by Capapé et al. (2020) have been updated, with the addition of information on shark capture and size, when available (Table 1).

Results

All of the fifteen sharks recorded in the presently reported study were identified as *Somniosus rostratus* following the keys and descriptions given by Cigala-Fulgosi and Gandolfi (1983), Compagno (1984), Serena (2005), Ebert et al. (2013), and Capapé et al. (2020) (Table 1).

The four specimens S1–S4 were females with a total length (TL) ranging from 925 mm to 992 mm (973 ± 32 mm) and a weight ranging from 5950 to 7480 g (6732 ± 630 g); the males S5 and S10 were 618 mm and 890 mm TL and 1140 g and 3121 in weight, respectively (Tables 1, 2) (Fig. 2).

Table 2. Selected biometric characters of specimens S1–S5 of *Somniosus rostratus* captured on the Strait of Sicily (specimens defined and illustrated in Fig. 2).

Character	Specimen reference number									
	S1		S2		S3		S4		S5	
Date of capture	13 Sep. 2015		13 Sep.2015		15 Sep. 2015		26 Aug. 2016		14 Sep. 2016	
Sex	♀		♀		♀		♀		♂	
Total weight (g)	6850		6650		7480		5950		1140	
Morphometric characters	mm	[% of TL]	mm	[% of TL]	mm	[% of TL]	mm	[% of TL]	mm	[% of TL]
Total length (TL)	992		985		990		925		618	91.3
Fork length	903	91.0	903	91.7	906	91.5	873	94.4	564	81.6
Precaudal length	812	81.9	806	81.8	805	81.3	772	83.5	504	35.9
Pre-first dorsal length	347	35.0	352	35.7	347	35.1	327	35.4	222	67.0
Pre-second dorsal length	678	68.3	650	66.0	684	69.1	647	69.9	414	20.1
Head length	203	20.5	202	20.5	194	19.6	183	19.8	124	1.6
Eye length	16	1.6	16	1.6	15	1.5	14	1.5	10	1.5
Eye height	13	1.3	13	1.3	12	1.2	11	1.2	9	17.3
Prebranchial length	147	14.8	138	14.0	135	13.6	146	15.8	107	20.7
Prepectoral length	205	20.7	204	20.7	197	19.9	188	20.3	128	61.2
Prepelvic length	609	61.4	612	62.1	626	63.2	594	64.2	378	7.8
Premouth length	63	6.4	65	6.6	65	6.6	55	5.9	48	6.0
Pectoral base	62	6.3	66	6.7	66	6.7	59	6.4	37	12.1
Pectoral anterior margin	123	12.4	122	12.4	113	11.4	118	12.8	75	5.3
Pectoral inner margin	35	3.5	43	4.4	43	4.3	46	5.0	33	9.1
Pectoral posterior margin	75	7.6	80	8.1	94	9.5	98	10.6	56	12.3
Pectoral height	94	9.5	97	9.8	96	9.7	118	12.8	76	8.9
First dorsal base	78	7.9	84	8.5	84	8.5	83	9.0	55	10.5
First dorsal anterior margin	106	10.7	105	10.7	113	11.4	112	12.1	65	6.1
First dorsal inner margin	49	4.9	59	6.0	55	5.6	53	5.7	38	6.6
First dorsal posterior margin	64	6.5	74	7.5	68	6.9	56	6.1	41	18.4
Dorsal margin of caudal	180	18.1	184	18.7	162	16.4	183	19.8	114	7.1
Lower postventral margin of caudal	83	8.4	80	8.1	80	8.1	88	9.5	44	14.4
Preventral margin of caudal	138	13.9	140	14.2	130	13.1	142	15.4	89	91.3

The brief description of the specimens is the following: short snout, pointed in its profile, rounded underside, dorsal fins without spines, equal-sized dorsal fins, anal fin absent, long ventral caudal lobe, first dorsal fin on back closer to pectorals than pelvic fins, short keels on base of caudal fin (Figs. 2, 3, 4A, 4B). Color: body brown, fins darker, snout black. The dental formula obtained from S3 was: 31–31 teeth in the upper jaw and 18–18 teeth in the lower jaw (Fig. 4C).

The selected morphometric measurements of S1–S5, expressed as % of TL (Table 2) as well as the dental formula obtained from S3, were included in the ranges retrieved from the literature (Cigala-Fulgosi and Gandolfi 1983; Golani 1986; Herman et al. 1989; Capapé et al. 2020; Hsu et al. 2020).

Females S1–S3 were pregnant. The number of embryos ranged from 9 to 14 and they were very small, from 2 to 50 mm in length (Table 3) (Fig. 5).

Table 3. Additional biometric characters of three females of *Somniosus rostratus* captured in the Strait of Sicily in 2015 (specimens defined and illustrated in Fig. 2).

Character	Specimen reference number		
	S1	S2	S3
Gonad weight [g]	422 R/788 L	596 R/470 L	416 R/813 L
Liver weight [g]	671	595	429
Intestine weight [g]	281	370	448
Number of embryos in oviducts	4 R/5 L		7 R/7 L
Length of embryos [mm]	2		40–50
Number of ova in oviducts		5 R/4 L	

R = right; L = left.

Discussion

The TL of three of the four females of *Somniosus rostratus* caught from the Strait of Sicily corresponded to the values expected for adult specimens (Barrull and Mate 2001; Guallart et al. 2013) and approached the maximum size observed in Mediterranean waters (Table 1) (Barría et al. 2015b; De Lojola Fernández et al. 2017).

The little sleeper shark is an ovoviviparous species, that gives birth to a litter of 8–17 young whose length ranges between 210 and 280 mm (Compagno 1984; Golani et al. 2006; Froese and Pauly 2022). After evisceration, different developmental stages of gonads in our females of similar size were observed and the low number of ova and embryos counted supported the hypothesis that the species is not very prolific (Capapé et al. 2020).

Somniosus rostratus is generally captured as bycatch by bottom trawlers and mesopelagic longlines at various depths, frequently in deep waters, and it is generally discarded (Séret et al. 2009; FAO 2016; Finucci et al. 2020; Carpentieri et al. 2021). Similarly, specimens in the presently reported study were incidentally caught in the relatively deep waters of the central Mediterranean Sea and of the south Adriatic Sea through drifting mesopelagic longlines used in swordfish fishery. Although generally described as a bathydemersal shark, the wide range of depths at which it has been captured in the Mediterranean (Table 3) and the remains of the mesopelagic cephalopod *Histioteuthis* sp. in its stomach could suggest a mesopelagic

Figure 3. *Somniosus rostratus* (female S6) captured in the northwestern Ionian Sea in 2009 (Fig. 1: map ID 27).

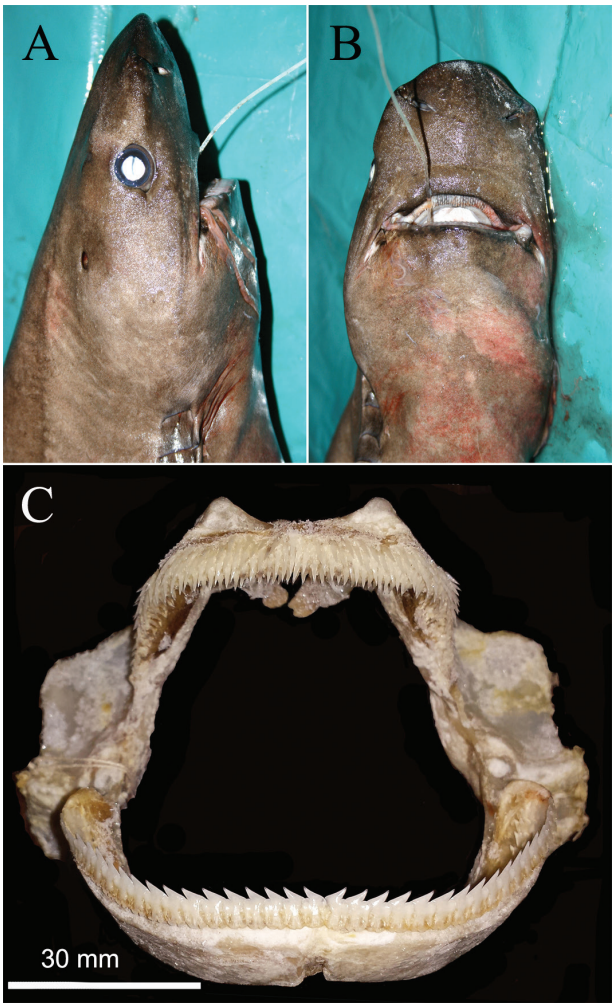

Figure 4. *Somniosus rostratus*. (**A**) Lateral view of head (specimen S2). (**B**) Ventral view of head (specimen S2). (**C**) Anterior view of dissected jaw with full dental armament (specimen S3).

habit for *S. rostratus*, able to actively move in the water column (Guallart et al. 2013; Guallart and García-Salinas 2015; Barría et al. 2015a). Generally, pregnant females are caught near the bottom (Guallart et al. 2013).

Some of the specimens reported in Table 1, as well as embryos, fetuses and/or anatomical parts of this species of shark caught in the basin are deposited in the collections of various Museums of Natural History; for example in Spain (Barrull et al. 1999; Barrull and Mate 2001), France (Yano et al. 2004; Chagnoux 2022), Czech Republic (Šanda and De Maddalena 2003), Italy (Doderlein 1878–1879; Tortonese 1938, 1956; Di Palma 1979; Sarà and Sarà 1990; Vanni 1992; Mizzan 1994; Mancusi et al. 2002; Carnevale et al. 2007), and the United Kingdom (Gray 1851; Ridewood 1921; Yano et al. 2004). Additionally, a number of Mediterranean basin findings are documented in GBIF (2024), covering areas off Valencia and Alicante, Spain, and the southern Adriatic Sea (Fig. 1).

As already observed (Irmak and Özden 2021; Ebert and Dando 2022), the density of records of *S. rostratus* appears highest in the western sector of the Mediterranean Sea, prevalently in the Ligurian and Catalan seas (Fig. 1; Table 3). Abundant bycatches were observed between the Balearic Islands and the Spanish coast (De Loyola Fernández et al. 2017) and off the Ligurian coast (Garibaldi et al. 2012, Garibaldi 2015), while nursery grounds were identified in the eastern and northeastern waters of Spain as well as in the Ligurian Sea (Capapé et al. 2020).

The occurrence of *S. rostratus* is known from the eastern sector of the basin (Goren and Galil 2015; Golani 2021; Damalas et al. 2022), but to date, it appears to be more sporadic in eastern areas than in the western sector (Fig. 1; Table 1). Until recently, the occurrence of *S. rostratus* in the Turkish waters required confirmation (Kabasakal 2019, 2020); the presence of the species was ascertained for the southwestern waters of the country by Irmak and Özden (2021) and *S. rostratus* was therefore added to the shark fauna of the Turkish waters (Kabasakal 2021). In the Aegean waters, the little sleeper shark was rarely observed (Papaconstantinou 2014) and it was not detected during the experimental bottom trawl surveys performed from 2005 to 2014 in the southern sectors of these waters (Peristeraki et al. 2017). In Syrian waters, *S. rostratus* has been reported as frequent by Ali (2018), but it has not been observed in recent surveys (Alkusairy and Saad 2018).

In the central Mediterranean and in the Adriatic Sea, which include the areas of interest of the presently reported note, *S. rostratus* has been found in the Strait of Sicily, the western Ionian, and the South Adriatic Sea (Table 1). Although based on literature (Compagno 1984; Séret et al. 2009; Finucci et al. 2020; Ebert and Dando 2022), the distribution range of *S. rostratus* also comprises the western

Figure 5. *Somniosus rostratus* embryo, approximately 50 mm in length, of the S3 caught in the Strait of Sicily in 2015 (MSNC 4886; Fig. 1: map ID 35; see Table 2).

Libyan waters, the species has not been listed in a recent inventory of the Chondrichthyes of Libyan coasts (Shakman et al. 2023); the occurrence in this region was confirmed by one of us (ADN) in 2006 after the observation of specimens at the fish market of Tripoli. In the Strait of Sicily, the little sleeper shark has been recorded for the first time in Maltese waters, in 2011 (Vella et al. 2013) and, more recently, in 2019, the species was detected for the first time in northeastern Tunisian waters (Capapé et al. 2020).

Additional reasons for the diverse distribution of *S. rostratus* in the various areas of the Mediterranean Sea might be the different degree of coverage of on-board observers on fishing vessels or of landing controls or even the different density or distribution of scientific surveys conducted in the various parts of the basin. Any of these factors is potentially able to bias our perception and knowledge of the geographical distribution of this species.

Although the occurrence of *S. rostratus* is generally known off Sicilian coasts (Tortonese 1956; Ragonese et al. 2013), the species was never reported in various experimental bottom trawl surveys performed in the Sicily Channel during the period 1994–2020 (Scacco et al. 2002; Relini et al. 2010; Ragonese et al. 2013; Geraci et al. 2017; Fernandez-Arcaya et al. 2019; Ragonese 2022; Farrugio and Soldo unpublished*). Consequently, the findings of *S. rostratus* documented here are of huge importance, not only because they determine the presence of this uncommon shark in the northern sectors of the Strait of Sicily, but also because they could indicate the presence of a likely spawning area for the species.

The whole Strait of Sicily is recognized as an Ecologically or Biologically Significant Area (EBSA) (Consoli et al. 2016; UNEP 2016; Di Lorenzo et al. 2018) and the presence of important nurseries and spawning areas for many fishery resources (Consoli et al. 2016), as well as for threatened and endangered species of elasmobranchs, heavily impacted by human pressures such as fishery activities, have been underlined numerous times (Zava et al. 2016, 2020, 2022; Colloca et al. 2019; Geraci et al. 2019; Scannella et al. 2020).

The interaction between sharks and pelagic or mesopelagic drifting swordfish fisheries, which unintentionally catch sharks and other species as bycatch, leading to detrimental impacts on shark populations, is another significant issue raised by this note. These interactions can result in increased mortality rates for sharks and rays, further exacerbating the decline of already threatened and endangered species, many of which are not properly assessed in the Mediterranean Sea, due to the insufficient availability of data. The International Commission for the Conservation of Atlantic Tunas (ICCAT) has the mandate to assess the pelagic species that might be impacted by the fisheries targeting tunas and billfish species and on-board observers have been imposed on a defined percentage of some fleets, but the available data is still insufficient for any reliable assessment of the shark species concerned in the Mediterranean Sea. Understanding the dynamics of this interaction and its ecological consequences is crucial for effective conservation and management efforts concerning this species. Conservation measures that prioritize the protection of endangered elasmobranch populations are crucial for maintaining the balance of marine ecosystems and for ensuring the sustainability of fishery resources.

Conclusions

The presently reported study provides valuable insights into the distribution and morphological characteristics of the deep-water little sleeper shark, S*omniosus rostratus*, in the Mediterranean Sea. It underscores the challenges associated with studying deep-water species, particularly

* Farrugio H, Soldo A (2014) Status and conservation of fisheries in the Sicily Channel/Tunisian Plateau. Draft internal report for the purposes of the Mediterranean Regional Workshop to Facilitate the Description of Ecologically or Biologically Significant Marine Areas. 7–11 April 2014, Malaga, Spain.

those with low-population densities or elusive behaviors, and sheds light on the potential reasons for the perceived rarity of *S. rostratus*.

The findings suggest a mesopelagic habit for the little sleeper shark, supported by the range of depths at which it has been captured and the presence of mesopelagic cephalopods in its stomach. Additionally, morphometric data offer insights into the reproductive characteristics of the species, emphasizing the ecological significance of the Strait of Sicily (central Mediterranean Sea) as a potential spawning area. Given the relevance of the Strait of Sicily as an Ecologically or Biologically Significant Area (EBSA), the study underscores the need for effective conservation measures in this region. It encourages further research and monitoring efforts to better understand and protect essential habitats for marine life.

The study reveals that S. *rostratus*, along with other elasmobranchs, is captured as bycatch in pelagic swordfish longline fisheries. The resulting interactions lead to increased mortality rates for vulnerable shark and ray species, highlighting the importance of considering the ecological consequences of bycatch interactions, especially for threatened and endangered elasmobranch populations. The International Commission for the Conservation of Atlantic Tunas (ICCAT) and other relevant bodies are urged to address data gaps and assess the impact of fisheries on the conservation status of deep-water shark species in the Mediterranean.

In conclusion, this research contributes valuable data on the distribution and characteristics of *S. rostratus* and underscores broader conservation challenges related to bycatch interactions. It emphasizes the need for proactive measures to ensure the sustainability of Mediterranean marine ecosystems. The study serves as a call to action for enhanced collaboration between scientific communities, fisheries management organizations, and conservation bodies to address the complexities surrounding the conservation of deep-water shark species in the region.

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