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On the occurrence of the sandbar shark, *Carcharhinus plumbeus* (Chondrichthyes: Carcharhinidae) off the Slovenian coast (northern Adriatic)

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The paper deals with a new record of the juvenile sandbar shark *Carcharhinus plumbeus* (Nardo, 1827) in the waters off Piran. This record confirms again the fact that the northern Adriatic Sea should be considered as a nursery area for this species. This fact, together with the general lack of knowledge on other shark species, show the need for systematic research of elasmobranch populations in the Slovenian part of the Gulf of Trieste.

Key words: Chondrichthyes, Carcharhinidae, *Carcharhinus plumbeus*, nursery area, status, Slovenian coast, northern Adriatic

INTRODUCTION

The sandbar shark, *Carcharhinus plumbeus* (Nardo, 1827) is a medium-size migratory shark (COMPAGNO, 1984). The species is reported on both sides of the Atlantic, in the Pacific and Indian Oceans where it is targeted (MCAULEY *et al.*, 2007). *C. plumbeus* is known throughout the Mediterranean Sea, although it completely disappeared from some regions such as the Mediterranean coast of France (CAPAPÉ, 1977; CAPAPÉ *et al.*, 2000). By contrast, it is rather abundant in southern regions, such as the Algerian coast (HEMIDA *et al.*, 2002) and the Tunisian coast (BRADAĪ *et al.*, 2002), where nursery areas were recently discovered in the southern Gulf of Gabès (BRADAĪ *et al.*, 2005; SAĪDI *et al.*, 2005). Recently, a nursery ground was reported from

Boncuk Bay (southeastern Aegean Sea, Turkey; KABASAKAL, per. comm.).

In the northern Adriatic Sea, records of sandbar sharks are rather rare and their details are sometimes contradictory. TORTONESE (1956) and BINI (1967) considered the species to be rather common in the Adriatic, while STOSSICH (1880), FABER (1883) and JARDAS (1985, 1996) reported the species as rather rare in the same area. Some relatively scarce data on the historical evidence of this species have been previously described by LIPEJ *et al.* (2000). Despite all mentioned sources, it should be concluded that there is a lack of well-documented records with basic data on specimens. Recent evidence of the presence of the sandbar shark in the Gulf of Trieste has been previously reported by COSTANTINI & AFFRONTE (2003). Their report dealt with the capture of

six neonate sandbar sharks in the northern Adriatic Sea measuring from 465 to 688 mm in total length. Two of them were captured in waters off Marano in the Gulf of Trieste. In a previous paper about sandbar shark occurrence in the Gulf of Trieste LIPEJ *et al.* (2000), are discussing about two specimens (Fig 1a,b) were entangled in nets in waters off Piran (Gulf of Trieste) on two different fishing dates during October 2000. Both were juveniles, measuring 710 and 815 mm in total length. The recent capture of a small free-swimming specimen suggests reconsideration of the occurrence of the species in the

area in order to assess its real status in the region, to establish elasmobranch monitoring and also to prepare a national plan for elasmobranch species in the same region.

MATERIAL AND METHODS

The sandbar shark (Fig. 1c-e) was captured in waters off Piran on 14 October 2007. The specimen was entangled in a trammel net. Body measurements of the sandbar shark were made with a hand meter to the nearest 0.5 cm and with a calliper to the nearest millimetre, following

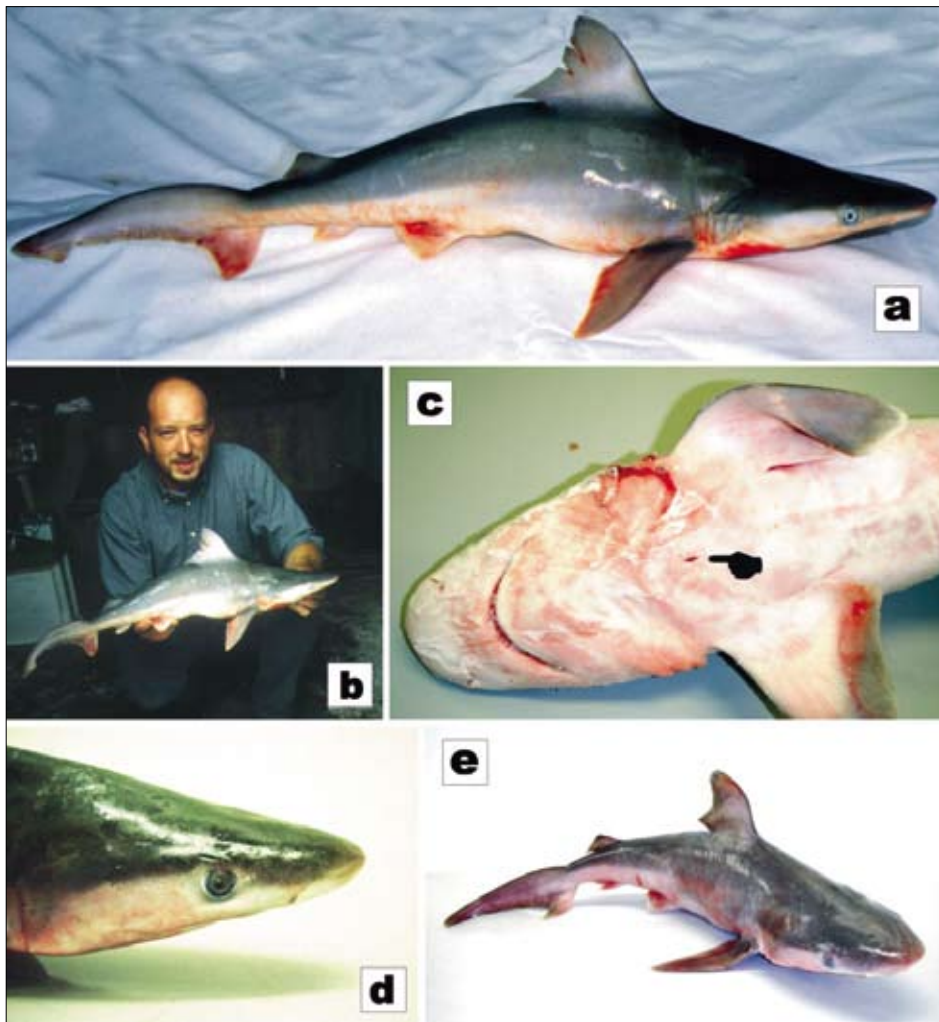


Fig.1. Previous (a, b) and recently captured specimens (c, d, e) of the sandbar sharks in Slovenian coastal waters. Legend: a, b – specimen, captured in October 2000, c – the ventral part of the specimen captured in 2007 with finger pointing to the unhealed umbilical scar, d – lateral view of the head, e – full view of the specimen

Table 1. Weights, measurements and percents of total length determined for sandbar shark *Carcharhinus plumbeus* (Nardo, 1827): specimen 1 caught off Piran (1), Slovenia (northern Adriatic Sea), specimens 2 and 3 from LIPEJ et al. (2000). All measurements are given in millimetres

Specimen	1		2		3	
Date	Oct 14, 2007		Oct 16, 2000		Oct 27, 2000	
Weight (g)	2340		2600		3600	
Measurements	mm	%TL	mm	%TL	mm	%TL
Total length	705	100	710	100	815	100
Fork length	559	79.3	575	81.0	660	81.0
Precaudal length	510	72.3	525	73.9	605	74.2
Pre-second dorsal length	440	62.4	450	63.4	510	62.6
Pre-first dorsal length	205	29.1	205	28.9	235	28.8
Head length	173	24.5	190	26.8	210	25.8
Prebranchial length	133	18.9	145	20.4	165	20.2
Preorbital length	65	9.2	55	7.7	75	9.2
Interdorsal space	168	23.8	165	23.2	175	21.5
Dorsal-caudal space	50	7.1	51	7.2	55	6.7
Prepectoral length	160	22.7	160	22.5	195	23.9
Prepelvic length	345	48.9	365	51.4	420	51.5
Pectoral-pelvic space	148	21.0	155	21.8	185	22.7
Pelvic-anal space	53	7.5	55	18.3	60	7.4
Pelvic-caudal space	130	18.4	130	18.3	142	17.4
Preanal length	425	60.3	455	64.1	-	-
Prenarial length	39	5.5	34	4.8	47	5.8
Preoral length	55	7.8	61	8.6	64	7.9
Eye length	10	1.4	9	1.3	12	1.5
Eye height	10	1.4	11	1.5	11	1.3
Intergill length	43	6.1	40	5.6	49	6.0
Pectoral anterior margin	123	17.4	120	16.9	133	16.3
Pectoral posterior margin	98	13.9	86	12.11	106	13.0
Pectoral base	45	6.4	46	6.5	55	6.7
Pectoral inner margin	40	5.7	33	4.6	45	5.5
Pectoral length	83	11.8	81	11.4	93	11.4
Pectoral height	95	13.5	88	12.4	106	13.0
First dorsal anterior margin	102	14.5	102	14.4	108	13.3
First dorsal posterior margin	86	12.2	83	11.7	98	12.0
First dorsal base	90	12.8	87	12.2	92	11.3
First dorsal length	125	17.7	116	16.4	123	15.1

Table 1. Cont'd.

First dorsal height	66	9.4	66	9.3	83	10.2
Second dorsal anterior margin	28	4.0	32	4.5	33	4.0
Second dorsal posterior margin	38	5.4	35	4.9	37	4.5
Second dorsal base	29	4.1	29	4.1	29	3.6
Second dorsal length	56	7.9	51	7.2	58	7.1
Second dorsal height	18	2.6	24	3.4	28	3.4
Pelvic anterior margin	37	5.2	36	5.1	47	5.8
Pelvic posterior margin	44	6.2	41	5.8	49	6.0
Pelvic base	34	4.8	29	4.1	29	3.6
Pelvic inner margin length	25	3.5	25	3.5	25	3.1
Pelvic length	60	8.5	54	7.6	65	8.0
Pelvic height	33	4.7	31	4.4	40	4.9
Anal anterior margin	45	6.4	40	5.6	51	6.2
Anal posterior margin	24	3.4	29	4.1	37	4.5
Anal base	31	4.4	29	4.1	34	4.2
Anal length	55	7.8	54	7.6	60	7.4
Anal height	22	3.1	26	3.7	33	4.0
Dorsal caudal margin	190	26.9	197	27.8	215	26.4
Preventral caudal margin	72	10.2	73	10.3	81	9.9
Lower postventral caudal margin	50	7.1	48	6.7	57	7.0
Caudal fork length	62	8.8	61	8.6	62	7.6
Upper postventral caudal margin	103	14.6	97	13.7	118	14.5
Caudal fork width	50	7.1	54	7.6	61	7.5
Terminal caudal margin	40	5.7	40	5.6	52	6.4
Terminal caudal lobe	47	6.7	47	6.6	55	6.7
Internarial space	42	6.0	45	6.3	47	5.8
Mouth width	67	9.5	71	10.0	77	9.4
Head height	96	13.6	100	14.1	104	12.7
Trunk height	112	15.9	120	16.9	143	17.5
Abdomen height	104	14.7	110	15.5	133	16.3
Tail height	77	10.9	76	10.7	77	9.4
Caudal peduncle height	27	3.8	30	4.2	31	3.8
Interorbital space	78	11.0	83	11.7	89	10.9
Head width	88	12.5	93	13.1	100	12.3
Trunk width	102	14.5	95	13.4	115	14.1
First dorsal inner margin	35	4.9	29	4.1	31	3.8
Second dorsal inner margin	27	3.8	22	3.1	29	3.6

COMPAGNO (1984), and was weighed to the nearest gram. The specimen is housed in the collection of the Marine Biology Station (National Institute of Biology) in Piran with catalogue number MBP-334. Measurements carried out on the specimen are presented in Table 1, together with available data collected from other two specimens captured in the area previously (see LIPEJ *et al.*, 2000).

RESULTS AND DISCUSSION

The sandbar shark exhibited an unhealed umbilical scar on the ventral surface and the claspers were shorter than the pelvic fin length, flexible and not yet calcified (Fig. 1c-e). Its total length was similar to size at birth previously reported in sandbar sharks from other areas (see Table 2). We consider it a neonatal specimen although its weight is much higher than the average free-swimming neonate weight for sharks in the Gulf of Gabès recorded by SAIDI *et al.*, (2005) which ranged between 400 and 1740 g and from the coast of Senegal, ranging between 920 and 1520 g (mean: 1077.17 mm \pm 133.28) according to DIATTA *et al.* (2008). The relationship between the total length (TL) and the weight of the nine neonatal or juvenile specimens reported to date in the northern Adriatic was $y = 8.5043x - 3566.8$ (Fig. 2).

The specimens, one of which being the subject of this study, as well as the other eight

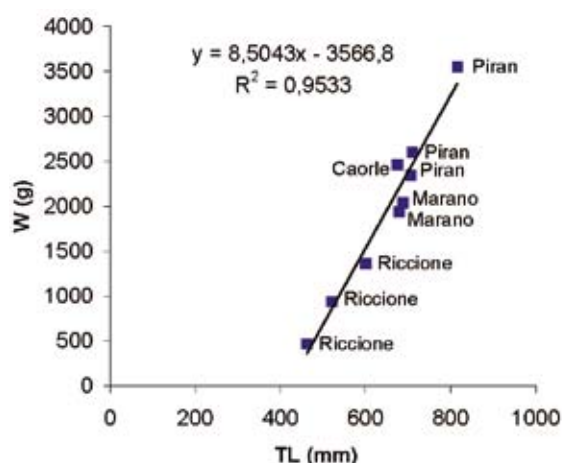


Fig. 2. The length-weight (TL-W) relationship for juvenile and neonatal sharks recorded in the northern Adriatic from various sources (specimen from this study, data from LIPEJ *et al.* (2000) and from COSTANTINI & AFFRONTE (2003))

specimens reported in papers of LIPEJ *et al.* (2000) (Figs. 1 a-b) and COSTANTINI & AFFRONTE (2003), were caught in the period from the end of August to the end of October. Obviously, the parturition takes place during the late summer and autumn period. KABASAKAL (pers. comm.) observed some neonates and pregnant females in the waters of Boncuk Bay (SE Aegean Sea, Turkey) during late spring and early summer. The parturition period is in good agreement with observations carried out in the Gulf of Gabès where many neonates with still unhealed

Table 2. Data on size at birth of sandbar sharks in different marine areas

Size at birth (mm)	Area	Authors
530-660	Northern Australia	STEVENS & MC LOUGHLIN (1991)
600-750	China Sea	TANIUCHI (1971)
600-750	South Africa	BASS <i>et al.</i> (1973)
400-500	South Africa	CLIFF <i>et al.</i> (1988)
# 510	Western Atlantic	SPRINGER (1960)
# 597	Western tropical Atlantic	AMORIM <i>et al.</i> (1998)
546-605	Eastern tropical Atlantic	CADENAT & BLACHE (1981)
> 440	Italian Seas	TORTONESE (1956)
450-650	Gulf of Gabès	SAIDI <i>et al.</i> (2005)
580-650	Coast of Senegal	DIATTA <i>et al.</i> (2008)
> 465	Northern Adriatic	This study

umbilical scars were captured between August and September (BRADAI *et al.*, 2005). Off the coast of Senegal, near-term females were captured between March and May suggesting that parturition probably occurred from March to June. The gestation period is estimated at twelve months. Females appear to reproduce every two years (DIATTA *et al.*, 2008).

LIPEJ *et al.* (2000) suggested three possible explanations for the lack of data on the sandbar shark distribution in the Adriatic. Firstly, the lack of data may be a consequence of misidentification and confusion due to the similarity with other shark species at first sight such as *Mustelus* spp, secondly, a lack of cooperation between ichthyologists and fishermen, or thirdly, a real rarity of such species. Seven years after the first capture of two juveniles in waters off Piran (LIPEJ *et al.*, 2000) we can discard the first two possibilities, at least for the studied area.

Since the northern Adriatic could be considered at present as a nursery ground for this species as a consequence of the records of neonates and juveniles exhibiting still unhealed umbilical scars, sandbar sharks inhabit the area at least seasonally. The record of a pregnant female carrying 9 living embryos additionally supports this fact (COSTANTINI & AFFRONTI, 2003). The fact that female sandbar sharks give birth in the Adriatic and Ionian Seas has also been reported by DE MADDALENA & BAENSCH (2005). In favour of the third hypothesis stand old reports such as those of STOSSICH (1880) and FABER (1883), both pointing to the fact that the sandbar shark is a very rare species in the Adriatic and that it was captured mainly in the regions off Trieste and Venice.

In many parts of the world, for example in the southwestern Atlantic, the sandbar shark has faced a population decline. The species is treated with a status of lower risk/near threatened species (MUSICK & FOWLER, 2000). Some other populations, like the northwest Atlantic population of the sandbar shark, are even evaluated as conservation dependant (lower risk/conservation dependent). The main problem of the sandbar shark is its "K-Selected" characteristics such as long gestation period, small litter size, late age at maturity and slow growth rate which makes it

more vulnerable to overexploitation by fishing (BARRULL & MATE, 2002; MCAULEY *et al.*, 2007). Based on data about this species in the northern Adriatic, and the Adriatic as a whole, we cannot assess the real status of this species in the area. However, strong arguments indicating that the northern Adriatic is a nursery ground for this species establishes it as one of the important areas in the species life cycle. This shows a great need for the establishment of elasmobranch monitoring in this area and also the preparation of a national action plan for elasmobranchs. This is even more important as *C. plumbeus* is not the only one present here. To date, 13 shark species of the 28 species found in the Adriatic Sea (LIPEJ *et al.*, 2004) have been recorded in the Slovenian part of the Gulf of Trieste. However, only three shark species including the spurdog *Squalus acanthias* Linnaeus, 1758, the smoothhound *Mustelus mustelus* (Linnaeus, 1758) and the blackspotted smoothhound *M. punctulatus* Risso, 1826 could be considered as common ones. Four shark species, such as the thresher shark *Alopias vulpinus* (Bonnaterre, 1788), the blue shark *Prionace glauca* (Linnaeus, 1758), the smallspotted catshark *Scyliorhinus canicula* (Linnaeus, 1758) and the nursehound *S. stellaris* (Linnaeus, 1758) occur occasionally in the studied area. Others are known only from relatively old records (see SOLDO & JARDAS, 2002; LIPEJ *et al.*, 2004). To this end, every single record of such species is important evidence of shark occurrence in the Slovenian part of the Gulf of Trieste. However, there is still a lack of knowledge about sharks presence in the area. Only comprehensive research on sharks inhabiting Slovenian coastal waters can provide proper guidelines for a national action plan for elasmobranchs.

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O pojavi psa tupana, *Carcharhinus plumbeus* (Chondrichthyes: Carcharhinidae) u slovenskim vodama (sjeverni Jadran)

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SAŽETAK

U ovom radu se iznosi podatak o novom nalazu juvenilnog primjerka psa tupana *Carcharhinus plumbeus* (Nardo, 1827) uhvaćenom u vodama Pirana. Ovaj nalaz potvrđuje činjenicu da se sjeverni Jadran može smatrati rastilištem ove vrste. S obzirom na pomanjkanje saznanja o drugim vrstama morskih pasa nužno je sustavno istražiti populaciju hrskavičnjača u slovenskom dijelu tršćanskog zaljeva.

Ključne riječi: Chondrichthyes, Carcharhinidae, *Carcharhinus plumbeus*, rastilište, status, slovenske vode, sjeverni Jadran