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Occurrence of bluntnose sixgill shark, *Hexanchus griseus* (Bonnaterre, 1788) in the Gulf of Trieste (northern Adriatic) with particular reference to historical and contemporary records in the Adriatic Sea

Lovrenc LIPEJ[1*], Domen TRKOV[1], Borut MAVRIČ[1], Tomaso FORTIBUONI[2,3], Nicola BETTOSO[4], Daša DONŠA[5] and Danijel IVAJNŠIČ[5]

[1]*Marine Biology Station, National Institute of Biology, Fornače 41, 6330 Piran, Slovenia*

[2]*Istituto Superiore per le Protezione e la Ricerca Ambientale (ISPRA), Via Ca' Fornacetta 9, 40064 Ozzano dell'Emilia, Bologna, Italy*

[3]*Istituto Nazionale di Oceanografia e Geofisica Sperimentale (OGS), Borgo Grotta Gigante, 42/c, 34010 Sgonico, Trieste, Italy*

[4]*Agenzia Regionale per la Protezione dell´Ambiente del Friuli Venezia Giulia, Via A. La Marmora, 13, 34139, Trieste, Italy*

[5]*Faculty for Natural Sciences and Mathematics and Faculty of Arts, University of Maribor, Koroška 160, 2000 Maribor, Slovenia*

**Corresponding author, e-mail: lovrenc.lipej@nib.si*

A specimen of a sixgill bluntnose shark, Hexanchus griseus *(Bonnaterre, 1788), was caught 1.5 NM north of Cape Ronek (Izola, Slovenia) in a fishing net for large-sized flatfish (such as turbot) on 28 January 2018. Three other older cases of catch of sixgill bluntnose sharks were recorded in Slovenia and the Gulf of Trieste. Among these, the finding of the specimen in the Lagoon of Marano and Grado is unusual although there are reported cases of sixgill bluntnose sharks in rivers. An analysis of the available data on the bluntnose sixgill shark in the Adriatic Sea, obtained from different published papers, social media and other sources, was done to understand whether the occurrence of* H. griseus *in the northern Adriatic differs from other parts. A generalised linear model (GLM) approach revealed that larger specimens are more frequently sighted across the Adriatic Sea, while in the Northern Adriatic part, significantly smaller specimens (juveniles) were recorded in comparison to the Central and Southern parts. It seems that the bluntnose sixgill shark is not in conjunction with a common large shark decreasing trend across the whole Mediterranean Sea.*

Key words: Chondrichthyes, *Hexanchus griseus*, Slovenia, occurrence, Adriatic Sea

INTRODUCTION

The bluntnose six-gill shark, *Hexanchus griseus* (Bonnaterre, 1788), is a widespread heavy-bodied shark species, occurring in temperate and tropical waters of the Atlantic, Pacific and Indian oceans (COMPAGNO, 1984). It is a large deep-water dwelling shark, typically occurring below 100 m depth but ranging from surface to 2500 m. During the day, the sixgill shark is found close to the bottom, while during the night, it is known to perform vertical movements towards the surface (ANDREWS *et al*., 2009). This shark is a long-lived species, and exhibits delayed sexual maturity (CAPAPÉ *et al.,* 2004).

The bluntnose sixgill shark was recorded in the entire Mediterranean Sea (for example BARRULL & MATE, 2000, 2002; CAPAPÉ *et al*., 2003; KABASAKAL, 2006, 2013) and also in the Adriatic (KIRINČIĆ & LEPETIĆ, 1955; ŠOLJAN, 1975; JARDAS, 1984, 1996; BARRULL & MATE, 2000, 2002; SCARAVELLI & AFFRONTE, 2002; SOLDO & JARDAS, 2002; CAPAPÉ *et al*., 2003; CUGINI & DE MADDALENA, 2003; LIPEJ *et al*., 2004; DULČIĆ & KOVAČIĆ, 2020). Juvenile specimens are often found in shallower waters (EBERT, 1994). Recently, its congener *Hexanchus nakamurai* was also reported for the Mediterranean Sea (DAMALAS & MEGALOFONOU, 2012), and it was recorded recently in the Adriatic Sea (BAKIU *et al.,* 2018).

Males reach their sexual maturity when they measure from 309 to 330 cm in total length and females at total length between 350 and 420 cm (EBERT *et al*., 2013). The neonate sharks measure approximately 60 to 70 cm in total length, whilst their maximum total length may reach at least 480 cm (GRIFFING *et al*., 2019). The bluntnose sixgill shark is an opportunistic nocturnal predator feeding on various prey items such as teleosts, other sharks and rays, cephalopods, crustaceans, and on the carcasses of marine mammals (EBERT, 1994). Although bluntnose sixgill shark lives in deeper areas, it is to some extent exploited by fisheries. According to KABASAKAL (2006), fisheries represent a major threat, while pollution, habitat loss, degradation, and others are considered less important. BARRULL & MATE (2002) considered longline catches as an important prey source for sixgill sharks, also confirmed by CELONA *et al*. (2005), who proposed that sixgill sharks feed on hooked prey in longlines such as swordfish during night excursions to the surface. According to GERACI *et al*. (2017), large-sized sixgill sharks were commonly found at the fish markets in some sites in Sicily and sold in the eighties, but now are generally discarded at sea.

In the Red book of Croatian marine fish, JARDAS *et al.* (2008) assessed the bluntnose sixgill shark as a vulnerable species, while the IUCN Red List of Threatened Species in the Mediterranean region (IUCN, 2022) and at the global level (FINUCCI *et al.,* 2020) assessed the species as near treatened (NT) with the trend of decline.

In the Adriatic Sea, the species was reported mainly from its middle and southern part (JARDAS, 1984), while in the northern Adriatic Sea, it was considered as rare (LIPEJ *et al.,* 2004) or occasional (ZAVODNIK & KOVAČIĆ, 2000). Early naturalists' (FORTIBUONI *et al.*, 2010) also described the species as historically rare or very rare in the Adriatic Sea, being more abundant during summer. The maximum reported length in historical records was 300 cm (FORTIBUONI *et al.*, 2017). CAPAPÉ *et al.* (2003) suggested that the records of bluntnose sixgill sharks in the Adriatic Sea (and in the eastern Mediterranean Sea) are less numerous than in the western part. They offered three explanations: in the eastern Mediterranean Sea, the species was probably less abundant, the waters were less exploited and/or information is reported to a lesser extent.

Since there is an overall lack of information about *H. griseus* in the northernmost part of the Adriatic Sea, the purpose of this contribution was to present the available data of the bluntnose sixgill shark in waters off Slovenia and in the wider Gulf of Trieste. Particular interest was given to the occurrence of bluntnose sixgill sharks in the Adriatic Sea to obtain the pattern of presence of this demersal shark according to available data.

MATERIAL AND METHODS

A specimen of bluntnose sixgill shark was caught 1.5 Nm northward Cape Ronek (Izola, Slovenia) in a fishing net for large-sized flatfish

Fig. 1. Broadnose sixgill shark specimen from Izola, entangled in a fishing net on 28 January 2018.

on 28 January 2018 1 (Fig. 1). It was captured on a muddy bottom at a depth of about 20 m. The specimen was identified with the aid of ichthyological keys for determination, such as TORTONESE (1956), BINI (1967) and COMPAGNO (1984). The specimen was photographed, measured (total length to the nearest cm) and weighed (total body weight to the nearest kg) by the fisherman. The jaws of the specimen are housed at the Marine Biology Station in Piran (Slovenia). The body surface and the branchial region of the shark were carefully examined for the presence of ectoparasites. Other records in the area under investigation (waters off Slovenia and the

Fig. 2. A 310 cm bluntnose sixgill shark specimen from Izola, entangled in a fishing net on 23 November 1972 in Izola (a and b). Another specimen, 250 cm total length, was captured in the Marano and Grado Lagoon in 2011 (c and d). The close–up photo shows the comb-shaped cuspid teeth (b and d), typical for the species.

Gulf of Trieste) were also presented based on personal observations or obtained through the interviews with fishermen (Fig. 2).

To assess the incidence of the bluntnose shark in different parts of the Adriatic Sea, we collected data from different sources. The data used in this paper was gathered from published works dealing with shark occurrence in the Adriatic Sea with particular reference to the occurrence of the bluntnose sixgill shark such as FABER (1883), BRUSINA (1888), LIPEJ *et al.* (2004). Other suitable data were obtained by checking:

a) data that were obtained from local fishermen, but only in the case of photographic evidence,
b) information that appeared in media such as national, regional and local newspapers and TV channels in Adriatic countries,
c) information published in Shark Year Magazine (Notes on Sharks recently recorded from the Mediterranean and European Region),
d) data obtained through systematic online searches on the web by using scientific and vernacular names of bluntnose sharks in different languages of countries bordering the Adriatic Sea.

The following data were collected when possible: total size, weight, locality, type of record (captured, sighting, stranded) and depth of capture. Only results accompanied with photographic or film (videos) evidence were taken into consideration. Altogether 87 documented records of the bluntnose sixgill shark were obtained from the above-mentioned sources. Records with uncertain documented sources were not taken into consideration.

To analyse the occurrence of sixgill sharks in different parts of the Adriatic Sea, we divided it following GAČIĆ *et al.* (2001) into three geographic areas: The Northern, Central and Southern Adriatic. The northern part is very shallow and does not exceed a depth of 100 m. In the Central Adriatic, a maximum depth of 280 m can be found in the Jabuka Pit, whereas it reaches a maximum depth of 1,233 m in the south (BLAKE & TOPALOVIĆ, 1996).

All sharks of which the total length was measured or estimated were categorised in different size classes: from 101–150 cm, 151–200 cm, 201–250 cm, 251–300 cm, 301–350 cm, 351–400 cm, 401–450 cm, 451–500 cm and larger than 500 cm. A generalised linear model (GLM) approach was calibrated in the R statistical environment (R CORE TEAM, 2020) to identify possible spatio-temporal size patterns in the occurrence of the bluntnose sixgill shark in the Adriatic Sea. A subsample (n = 61) of the database had to be used in this step because of missing shark size information in many records. The GLM model effect plot of predictor variables (time, area [Northern Adriatic, Central Adriatic, Southern Adriatic]) was designed by applying the Rcmd package (FOX & BOUCHET-VALAT, 2020).

RESULTS

The shark was identified as a bluntnose sixgill shark due to the diagnostic features of a single dorsal fin, typical comb-shaped teeth in the lower jaw and the number of gill slits. The specimen measured 217 cm in total length and weighed 52 kg (Table 1). It was a juvenile

Fig. 3. Demoleus heptatus, ectoparasite found on the skin of the specimen of bluntnose sixgill shark from Izola

Table 1. Morphometric data of the specimen entangled in a fishing net on 28 January 2018 in Izola (Slovenia).

	parameter		
		mm	% TL
1	Total length	2170	100.00
2	Fork length	1670	77.00
3	Precaudal length	1544	71.17
4	Pre-first dorsal length	1213	55.92
5	Head length	432	19.90
6	Prebranchial length	310	14.29
7	Preorbital length	88	4.06
8	Prepectoral length	447	20.62
9	Prepelvic length	1011	46.57
10	Preanal length	1336	61.57
11	Prenarial length	42.19	1.94
12	Preoral length	105	4.84
13	Eye length	54.95	2.53
14	Eye height	31.05	1.43
15	Pectoral anterior margin	240	11.06
16	Pectoral posterior margin	175	8.06
17	Pectoral base	147	6.77
18	Pectoral inner margin	83.58	3.85
19	Pectoral length	225	10.37
20	Pectoral height	175	8.06
21	First dorsal anterior margin	137	6.31
22	First dorsal posterior margin	98	4.52
23	First dorsal base	131	6.04
24	First dorsal length	173	7.97
25	First dorsal height	88	4.06
26	Pelvic anterior margin	89	4.10
27	Pelvic posterior margin	185	8.53
28	Pelvic base	195	8.99
29	Pelvic inner margin length	30.81	1.42
30	Pelvic length	220	10.14
31	Pelvic height	72	3.32
32	Anal anterior margin	94	4.33
33	Anal posterior margin	124	5.71
34	Anal base	128	5.90
35	Anal length	169	7.79
36	Anal height	70	3.23
37	Dorsal caudal margin	615	28.34
38	Preventral caudal margin	143	6.59
39	Lower postventral caudal margin	55.15	2.54
40	Caudal fork length	136.43	6.29
41	Upper postventral caudal margin	385	17.74
42	Caudal fork width	180	8.29
43	Terminal caudal margin	102	4.70
44	Terminal caudal lobe	127	5.85
45	Internarial space	107.08	4.93
46	Mouth width	275	12.67
47	Interorbital space	194	8.94
48	Nasal length	26.4	1.22
49	Subterminal caudal fin width	45.57	2.10
50	Subterminal caudal margin	66.45	3.06

female. No food remains were found in the stomach, and the specimen seemed to be malnourished. According to the sex and size, the specimen was assessed as an immature female. A parasitic copepod (Fig. 3) found on the skin of the chin was identified as a female of *Demoleus heptapus* (Otto, 1821) (Pandaridae, Copepoda Poecilostomatoida). The record represented the first report on the presence of this ectoparasite in the Adriatic Sea and one among rare cases in the whole Mediterranean region (LIPEJ & TRKOV, 2018).

Some bluntnose sixgill sharks findings were discovered in Slovenian waters and the broader area of the Gulf of Trieste, which were not yet reported in scientific literature. On 23 November 1972, a bluntnose sixgill shark was captured in the St. Simon Bay near Izola. It measured 310 cm in total length (Figs. 2a & 2b). Unfortunately, there is neither data on weight nor other morphometric parameters available. Another specimen, measuring only 150 cm in total length, was found stranded or probably discarded by fishermen at Cape Viližan in Izola in September 1978 and inspected by one of the authors (LL). A third specimen was recorded in the Grado and Marano Lagoon in April 2011 (Figs. 2c & 2d). The shark entered the lagoon

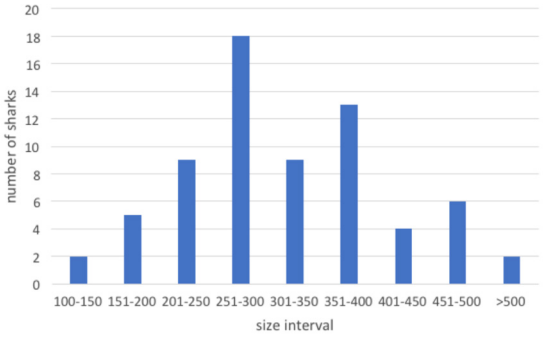

Fig. 4. The size (total length) classes of bluntnose sixgill sharks in the Adriatic Sea based on historical and recent records (n = 61).

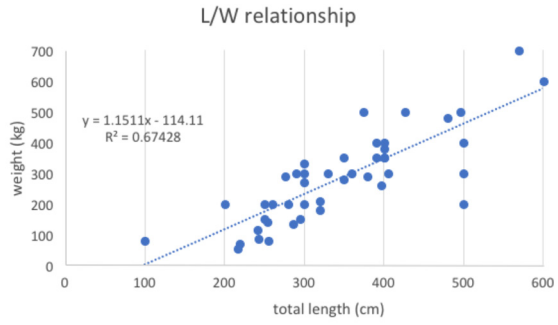

Fig. 5. The L/W relationship from data (n = 44) obtained from published records and social media.

area and was entangled in a fishing net. It measured 250 cm in total length. All bluntnose sixgill sharks up to date recorded in the Gulf of Trieste were small-sized.

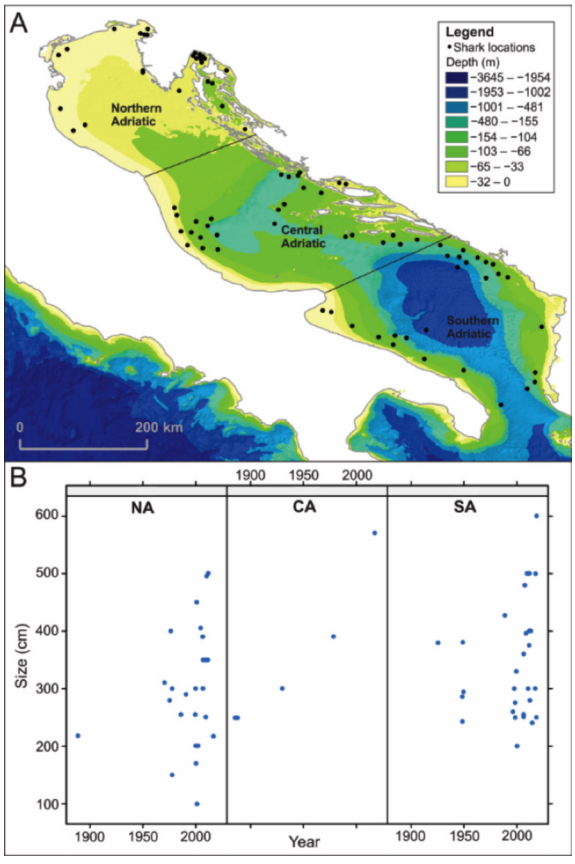

Fig. 6. Geographic areas of the Adriatic Sea with bathymetric data (gathered at https://download.gebco.net/; 18.10.2021) and approximate bluntnose sixgill shark locations (A) together with the corresponding spatio-temporal bluntnose sixgill shark size distribution based on subsampled data (n = 61) (B). Legend: Legend: NA – northern Adriatic, CA . central Adriatic and SA – southern Adriatic.

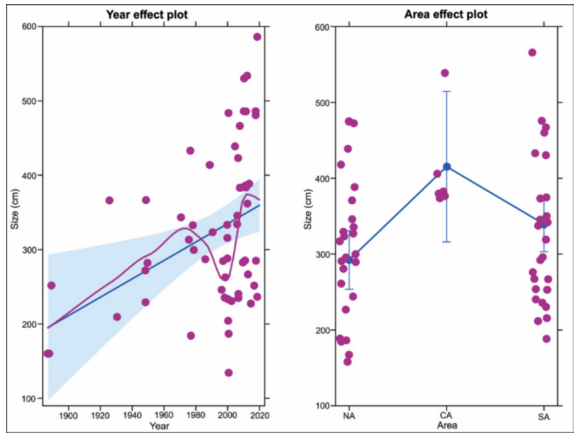

Fig. 7. The GLM model effect plots with predictors Year (left) and geographic area (right). Legend: NA – northern Adriatic, CA – central Adriatic and SA – southern Adriatic.

The length-frequency distribution of the specimens considered in this study shows two peaks (Fig. 4). The largest belonged to the size category 251–300 cm, followed by 351–400 cm. The majority of the observed bluntnose sixgill sharks in the Adriatic Sea reached a size between 251 and 400 cm. The length/weight (LW) relationship of the species (1:1.17) indicated a significant linear behaviour by reaching a determination coefficient of 0.67 ($p < \alpha$; $\alpha = 0.05$) (Fig. 5). The smallest recorded sixgill shark in the Adriatic Sea between 1880 and 2021 reached 52 kg (217 cm) and the largest approximately 700 kg (570 cm).

The distribution map (Fig. 6a) and the corresponding time-size-geographic area conditioning plot (Fig. 6b), based on subsampled data (n = 61), additionally proved that the bluntnose

Table 2. GLM model summary.

Call:
glm(formula = size ~ (Year - 1) + geographic_area, family = gaussian(identity), data = sixgill_shark)

Deviance Residuals:

Min	1Q	Median	3Q	Max
-203.92	-72.82	-1.57	53.36	226.49

Coefficients:	Estimate	Std. Error	t value	Pr(>|t|)	
Year	1.234	0.448	2.755	0.007	**
NA	-2167.712	894.455	-2.424	0.019	*
CA	-2044.566	871.106	-2.347	0.022	*
SA	-2120.338	895.917	-2.367	0.021	*

Null deviance: 7130147 on 61 degrees of freedom
Residual deviance: 549708 on 57 degrees of freedom
AIC: 738.59

sixgill shark is occurring in all parts of the Adriatic Sea. More precisely, records of occurrence were concentrated in the last two decades. By analysing the shark's spatio-temporal size pattern, we can conclude that ever-larger specimens are more frequently sighted throughout the whole studied area (year estimate > 0; $p < 0.05$) (Table 2, Fig. 7). In the last decades, in the Northern Adriatic part significantly smaller specimens were reported (Table 2, Fig. 7) than in the Central and Southern Adriatic parts. However, the GLM model residuals indicated that the Central Adriatic Sea group should be cautioned due to the lower number of recorded sharks (Fig. 7).

DISCUSSION

Although landings of the bluntnose sixgill shark are not very scarce, their morphometric parameters are only rarely measured and published, since only in limited number of cases researchers have the possibility to perform biometric measurements. The specimen was caught in January, in the winter period. Such an event is not unusual; MADIRACA (2016), who performed a study on sixgill sharks on Maltese islands, pointed out that most studied sharks were caught in the first quarter of the year. A parasitic copepod, *Demoleus heptapus,* found on the studied specimen from Izola, represented the first report on the presence of this ectoparasite in the Adriatic Sea and one among rare cases in the whole Mediterranean region (LIPEJ & TRKOV, 2018).

Only a few records of the bluntnose sixgill shark were previously reported in the northernmost part of the Adriatic Sea. TORTONESE (1956) mentioned a case of a female bluntnose sixgill shark caught near Trieste, which measured 359 cm in total length. Taking into consideration the case mentioned by TORTONESE (1956), LIPEJ (1999) included the bluntnose sixgill shark as an expected species in the checklist of sharks in the Key for the determination of vertebrates in Slovenia (KRYŠTUFEK & JANŽEKOVIČ, 1999). The specimen from Izola caught in 1972 thus represents the first documented case of *H. griseus* in Slovenia. Three recorded sixgill sharks found in Slovenia, and the one recorded in nearby areas of the Marano Lagoon were juveniles. It is known that juveniles of *H. griseus* inhabit shallower water than adults, and they move to greater depths as they grow (EBERT, 1994), while adults are generally found below 90 m (GILHEN & COAD, 1989). Neonates and juveniles may stray close to the coast and occur in bays and ports (EBERT, 2002). Young bluntnose sixgills sharks prey mainly on cephalopods and teleosts, while larger specimens prefer to feed on a wide range of pelagic and benthic vertebrates (including sharks) and cephalopods in much deeper waters (*sensu* EBERT, 1986). Since adult *H. griseus* are

Table 3. Records of the bluntnose sixgill shark in the Adriatic Sea based on published records in scientific literature, local newspapers, web site sources and museum specimens. Legend: NA – northern Adriatic, CA – central Adriatic and SA – southern Adriatic, Alb – Albania, Cro – Croatia, Ita – Italy, Mtg – Montenegro and SLO – Slovenia, nd – no data available.

No	Year	Date	Locus port & harbour/locus of stranding	number n	state	area	sex	length cm	weight kg	source
1	1872	feb 1872	Rimini	1	Ita	NA	♀	-	-	Lipej et al., 2004
2	1876	15.03.1876	Rimini-Ravenna	1	Ita	NA	-	-	-	Vanni (1992)
3	1880	winter 1880	Split	1	Cro	CA	-	-	-	Faber (1883)
4	1880	winter 1880	Split	1	Cro	CA	-	-	-	Faber (1883)
5	1887	1887	Krapan, Šibenik	1	Cro	CA	-	250	-	Brusina (1888)
6	1890	30. 10. 1890	Rijeka	1	Cro	NA	-	219	68	http://www.lokalpatrioti-rijeka.com/forum/viewtopic.php?p=78480
7	1899	3.1.1899	Venice	1	Ita	NA	-	-	-	Vanni (1992)
8	1904	3.12.1904	Novalja, Pag	1	Cro	NA	-	-	-	muzejski dnevnik Zadar
9	1912	26.03.1905	Bakar	1	Cro	NA	-	-	-	Lokalpatrioti Rijeka • Početna (lokalpatrioti-rijeka.com)
10	1927	5.12.1927	Dubrovnik	1	Cro	SA	-	380	-	Priroda
11	1929	9.01.1929	Dubrovnik	1	Cro	SA	-	-	-	Priroda
12	1932	17.09.1932	Okrug	1	Cro	CA	-	300	200	Priroda
13	1935	1935	Kvarner	1	Cro	NA	-	-	-	Barrull & Mate (2000)
14	1950	2.06.1950	south of Dubrovnik	1	Cro	SA	♂	243	86	Kirinčić & Lepetić (1955)
15	1950	19.08.1950	south of Dubrovnik	1	Cro	SA	♀	380	290	Kirinčić & Lepetić (1955)
16	1950	12.09.1950	south of Dubrovnik	1	Cro	SA	♂	286	135	Kirinčić & Lepetić (1955)
17	1951	16.08.1951	south of Dubrovnik	1	Cro	SA	♂	295	150	Kirinčić & Lepetić (1955)
18	1972	23.11.1972	Simonov zaliv, Izola	1	Slo	NA	-	310	-	this study
19	1977	23.12.1977	Bakarac	1	Cro	NA	-	280	200	Novi list
20	1978	okt.78	Izola	1	Slo	NA	-	150	-	this study
21	1978	25.10.1978	Žurkovo	1	Cro	NA	-	400	400	PMR-04394 Prirosdoslovni muzej Rijeka

22	1979	26.02.1979	Opatija	1	Cro	NA	-	300	300	Novi list
23	1980	May 1980	Blitvenica, Jabuka pit	1	Cro	CA	-	390	400	Jardas, 1996
24	1985	13.05.1985	Blitvenica, Jabuka pit	1	Cro	SA	-	-	-	Pallaoro & Jardas (1996)
25	1987	12.03.1987	Sv. Andrija	1	Cro	NA	-	255	-	Pallaoro & Jardas (1996)
26	1989	3.01.1989	Venice	1	Ita	NA	♀	-	-	Mizzan (1994)
27	1990	10.09.1990	Bay of Tivat	1	Mtg	SA	♀	427	500	Glasnik prirodnjačkog muzeja Beograd
28	1992	27.04.1992	Opatija	1	Cro	NA	-	290	300	Glas Istre
29	1998	18.09.1998	Svetac (sv. Andrija)	1	Cro	SA	♀	260	200	Petrov (2003)
30	1999	21.09.1999	Glavat	1	Cro	SA	♀	300	270	Petrov (2003)
31	2000	17.04.2000	Sušac	1	Cro	SA	♀	250	200	Petrov (2003)
32	2000	1.11.2000	Kopište, Lastovo	1	Cro	SA	♂	276	290	Petrov (2003)
33	2001	23.05.2001	Rt Gruj, Mljet	1	Cro	SA	♂	330	300	Petrov (2003)
34	2002	16.04.2002	Sv. Andrija	1	Cro	SA	♀	200	200	Petrov (2003)
35	2001	2001	Bisceglie (Puglia)	6	Ita	SA		nd	nd	http://web.tiscali.it/seastories2/avvist2001.html
36	2001	7.09.2001	Cesenatico	1	Ita	NA	-	255	80	12 milj od obale pred Cesenatico
37	2001	29.12.2001	Opatija	1	Cro	NA	-	300	-	Scaravelli & Affronte (2001)
38	2002	22.01.2002	Pescara	1	Ita	NA	♂	-	-	Cugini & De Maddalena, 2003
39	2002	22.01.2002	Pescara	1	Ita	NA	♂	-	-	Cugini & De Maddalena, 2003
40	2002	28.08.2002	Pescara	1	Ita	NA	-	100	80	Cugini & De Maddalena, 2003
41	2002	25.09.2002	Pescara	1	Ita	NA	-	170	-	Cugini & De Maddalena, 2003
42	2002	10.10.2002	Pescara	1	Ita	NA	♀	cca 450	-	Cugini & De Maddalena, 2003
43	2002	19.11.2002	Pescara	1	Ita	NA	-	200	-	Cugini & De Maddalena, 2003
44	2003	23.01.2003	Pescara	1	Ita	NA	-	200	-	Cugini & De Maddalena, 2003
45	2003	25.02.2003	Pescara	1	Ita	NA	-	200	-	Cugini & De Maddalena, 2003
46	2006	23.06.2006	San Benedetto del Tronto	1	Ita	NA	-	405	300	https://www.lavalledelmetauro.it/contenuti/funghi-flora-fauna/scheda/10265.html

47	2008	29.01.2008	Mljet	1	Cro	SA		250	150	https://www.24sata.hr/news/avantura-na-mljetu-ulovili-morskog-psa-od-25-metra-47476
48	2008	4.07.2008	Budva	1	Mtg	SA	-	254	140	Pobjeda, 5.7.2008
49	2008	8.10.2008	Riječki zaljev	1	Cro	NA	-	390	350	https://www.pixsell.hr/agency/pxl-standard-news/rijeka-rijeci-ribari-ulovili-morskog-psa-volonju-gallery-3840/
50	2008	16.10.2008	Chieti (Abruzzo)	1	Ita	SA	♀	360	300	La piazza, 25.ott.2008
51	2008	may 2008	Ortona	1	Ita	NA	-	300	-	La piazza, 25.ott.2008
52	2009	20.07.2009	Rtina	1	Cro	NA	-	350	280	https://www.24sata.hr/news/morskog-psa-od-35-metara-ulovio-ispod-paskog-mosta-127010
53	2009	25.09.2009	Lastovo	1	Cro	SA	-	480	480	24sata.hr
54	2010	10.03.2010	Prevlaka	1	Cro	SA	-	397	261	https://www.24sata.hr/news/morskoga-psa-glavonju-su-morali-izvuci-automobilom-163176
55	2011	apr.11	laguna di Marano	1	Ita	NA	-	250	-	this study
56	2011	26.09.2011	Luka Krnica, Istra	1	Cro	NA	-	350	np	https://ilpiccolo.gelocal.it/trieste/cronaca/2011/09/26/news/filmato-casper-lo-squalo-che-vive-nel-relitto-1.836908
57	2012	22.04.2012	Rijeka	1	Cro	NA	-	496	500	Novi list
58	2012	5.05.2012	Albania	1	Alb	SA	-	500	-	http://sharkyear.com/2012/notable-recent-shark-records-from-the-mediterranean-and-european-region.html
59	2012	10.05.2012	Jabuka	1	Cro	SA	-	300	330	https://www.rtl.hr/vijesti/kod-jabuke-ulovili-grdosiju-od-330-kilograma-7f223eee-b9f2-11ec-ac20-0242ac130025
60	2012	28.5.-1.6.2012	Bari pit	1	Ita	SA	-	-	-	d'Onghia et al., 2015
61	2012	24.10.2012	Brindisi	1	Ita	SA	-	-	200	http://sharkyear.com/2013/notes-on-sharks-recently-recorded-from-the-mediterranean-and-european-region.html
62	2012	4.11.2012	Sazan, Vlore	1	Alb	SA	-	-	400	http://sharkyear.com/2013/notes-on-sharks-recently-recorded-from-the-mediterranean-and-european-region.html
63	2012	5.11.2012	Mola	1	Ita	SA	-	-	120	Bello pers. Comm.
64	2013	10.01.2013	Mamula, Boka kotorska	1	Mtg	SA	♀	375	500	http://www.radiodux.me/naslovnica/2905-morski-pas-uhvaena-u-boki-baen-u-more
65	2013	2.02.2013	Mola	1	Ita	SA	-	small	-	Shark Year Magazine
66	2013	29.01.2013	Sazan	1	Alb	SA	-	400	350	Shark Year Magazine
67	2013	2.07.2013	Plavnik	1	Cro	NA	-	350	-	https://www.24sata.hr/news/oci-u-oci-s-psinom-srce-mi-je-udaralo-gledao-sam-u-neman-321885

68	2013	28.07.2013	Galipolli	1	Ita	SA	-	-	-	https://www.lecceprima.it/speciale/foto-giorno/pesce-vacca-pescato-a-gallipoli.html
69	2013	20.08.2013	Torre Canne	1	Ita	SA	-	400	380	http://www.osservatoriooggi.it/notizie/attualita/5545-pescatori-squalo
70	2013	28.08.2013	Monopoli	1	Ita	SA	-	500	300	https://www.faxonline.it/monopoli/attualita/9054-catturato-uno-squalo-elefante-di-tre-quintali
71	2013	14.11.2013	San Benedetto del Tronto	1	Ita	NA	-	500	400	https://www.rivieraoggi.it/2013/11/15/175201/squalo-di-5-metri-pescato-al-largo-di-san-benedetto/
72	2014	7.06.2014	Manfredonia	1	Ita	SA	-	400	350	https://www.foggiatoday.it/social/segnalazioni/squalo-vacca-pescato-manfredonia.html
73	2014	22.08.2014	Rafailovići	1	Mtg	SA	-	280	-	https://mondo.ba/Info/Region/a503277/Crna-Gora-Uhvatili-morskog-psa-od-tri-metra.html
74	2016-18		Buljarica	1	Mtg	SA	-	241	115	Ćetković, 2018
75	2017	19.jun.17	Galipolli	1	Ita	SA	-	-	700	https://www.puglia.com/squalo-7-quintali-pescato-gallipoli-bufera-sul-web/
76	2018	28.jan.18	Izola	1	Slo	NA	♀	217	52	this study
77	2019	1.03.2019	Castro, Lecce	1	Ita	SA	-	300	-	Shark Year Magazine
78	2019	22.10.2019	Durres	1	Alb	SA	-	-	500	Gazeta Shqiptare
79	2019	27.11.2019	Galipolli	1	Ita	SA	-	500	2 q	https://www.piazzasalento.it/pesca-straordinaria-a-gallipoli-catturato-uno-squalo-capopiatto-da-due-quintali-145391
80	2019	8.12.2019	Rogoznica	1	Cro	CA	-	570	700	morski hr - jadranski web portal
81	2020	28.04.2020	Manfredonia	1	Ita	SA	-	250		https://www.pugliareporter.com/2020/04/28/puglia-squalo-predatore-di-origine-preistorica-pescato-a-largo-di-manfredonia-liberato-subito-video/
82	2020	7.10.2020	Mola	1	Ita	SA	-	-	200	https://m.facebook.com/molalibera/posts/2735532833380059?comment_id=2735726690027340
83	2020	18.12.2020	Sazan	1	Alb	SA	-	600	600	https://www.youtube.com/watch?v=g17L-eyot3k
84	2021	9.02.2021	vzhodni Krk	1	Cro	NA	-	-	-	https://radiosarajevo.ba/vijesti/regija/kod-krka-ulovili-ajkulu-pa-je-bacili-jer-se-tesko-reze-strucnjaci-to-je-zasticena-vrsta/406213
85	na	-	Trieste	1	Ita	NA	♀	359	-	Tortonese, 1956
86	na	-	Adriatic Sea	1	-	-	♂		-	Ginnasio di stato Scippione Maffei, Verona
87	< 1888		Krapan, Šibenik	1	Cro	CA	-	250	-	Brusina, 1888

known to be cannibalistic, it is possible that juveniles of *H. griseus* approach coastal areas also to avoid predation and competition with adults (CAREY & CLARK, 1995). The finding of the specimen in the lagoon of Marano and Grado could be considered rather unusual; however, there is a case of bluntnose sixgill shark reported in rivers in Tasmania (BARNETT *et al.,* 2010).

CAPAPÉ *et al*. (2003) mentioned 114 records of bluntnose sixgill sharks in the Mediterranean Sea by considering historical and recent data. Only six reports were mentioned for the Adriatic in their report. Here we present additional 81 cases of evidence of *H. griseus* in the Adriatic, not included in the work of CAPAPÉ *et al*. (2003). The number of records increased, especially during the last twenty years (Fig. 6b), probably related to citizen science's expanding involvement in sharing information. In addition, the growing utilisation of internet services and social media increased the accessibility of many available records such as photographs and movies (*sensu* KABASAKAL, 2010). The highest number of records was obtained in southern Adriatic, followed by the surprisingly high number of records in the Northern Adriatic Sea (n = 41). The number of records differs from the opinion of JARDAS *et al.* (2008), who stated that the species is restricted to the southern Adriatic Sea and that only in rare cases single specimens may be recorded in other areas. ZAVODNIK & KOVAČIĆ (2000) reported bluntnose sixgill sharks only occasionally recorded in the Rijeka Bay (northern Adriatic).

The analysis of the presence of the bluntnose sixgill shark in the Adriatic Sea showed that the reported sharks were primarily present in its southern part, which is much deeper than other areas. However, there are many records also in the middle and northern Adriatic Sea. Bluntnose sixgill shark measured from 100 to more than 500 cm in total length (Fig. 4 and 6b). Two size peaks are recognisable, one related to sharks in the size class from 251 to 300 cm and the second one in the size class from 351 to 400 cm in total length. The GLM approach confirmed, by considering time as a covariate, that bluntnose sixgill sharks, reported in the northern Adriatic Sea, were significantly smaller compared to the Central and Southern parts; they can be considered juveniles.

In recent years, when we are witnessing a drastic decrease of large (and other) shark species across the whole Mediterranean Sea, it seems that the bluntnose sixgill shark does not follow this trend tightly. As a deep water species, perhaps it is less vulnerable to fishing activities. At the same time, more and more cases are known when fishermen release the sharks back into the water (BULIĆ, 2022).

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Pojava volonje *Hexanchus griseus* (Bonnaterre, 1788.) u Tršćanskom zaljevu (sjeverni Jadran) s posebnim osvrtom na povijesne i nove zapise u Jadranskom moru

Lovrenc LIPEJ, Domen TRKOV, Borut MAVRIČ, Tomaso FORTIBUONI, Nicola BETTOSO, Daša DONŠA i Danijel IVAJNŠIČ

Kontakt e-pošta: lovrenc.lipej@nib.si

SAŽETAK

Primjerak volonje *Hexanchus griseus* (Bonnaterre, 1788), ulovljen je 28. siječnja 2018. 1,5 NM sjeverno od rta Ronek (Izola, Slovenija) u mrežu za lov na velike plosnate ribe (kao što su plosnatice). Još dva prethodna slučaja ulova volonje zabilježena su u Sloveniji i Tršćanskom zaljevu. Među njima, neobičan je pronalazak primjerka u lagunama Marano i Grado, iako postoje prijavljeni ulovi volonje u rijekama. Učinjena je analiza dostupnih podataka o volonji u Jadranskom moru, dobivenih iz različitih objavljenih radova, društvenih mreža i drugih izvora, kako bi se ustanovilo razlikuje li se pojava *H. griseusa* u sjevernom Jadranu od ostalih dijelova. Pristup generaliziranog linearnog modela (GLM) otkrio je da se veći primjerci češće viđaju diljem Jadranskog mora, dok su u sjevernom dijelu Jadrana zabilježeni znatno manji primjerci (mladi) u odnosu na srednji i južni dio. Čini se da volonja nije povezan s uobičajenim trendom smanjenja broja velikih morskih pasa u cijelom Sredozemnom moru.

Ključne riječi: Chondrichthyes; *Hexanchus griseus*; Slovenija; pojava vrste; Jadransko more